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VETERINARY OBSTETRICS

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A TEXT-BOOK

OF

VETERINARY OBSTETRICS:

INCLUDING THE DISEASES AND ACCIDENTS INCIDENTAL TO PREGNANCY, PARTURITION, AND EARLY AGE IN THE DOMESTICATED ANIMALS.

With Two Hundred and Twenty-six Illustrations.

BY

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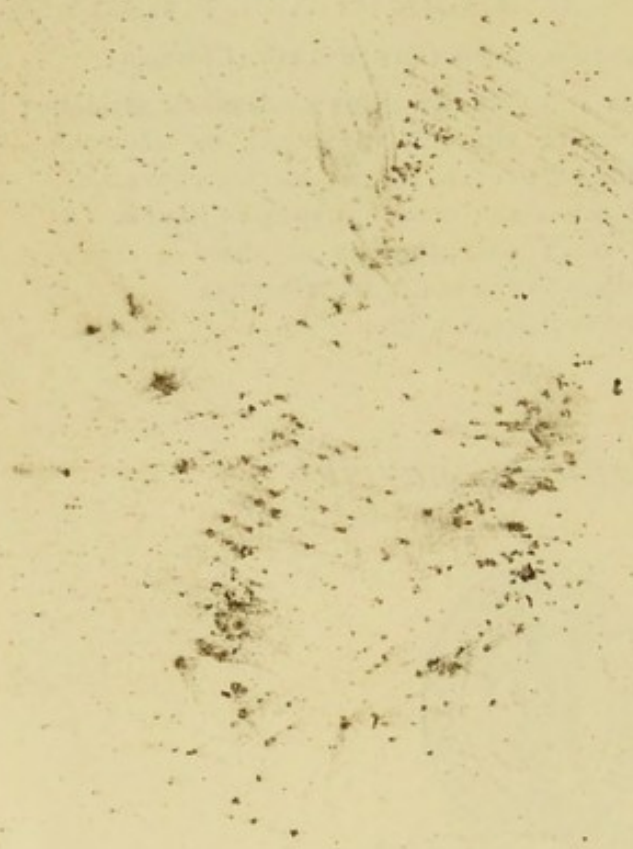

PREFATORY NOTE TO THE SECOND EDITION.

In preparing a second edition of this work, it has been subjected to some alteration and considerable revision, in order to make it more correct and, while introducing much new matter, to keep it within reasonable dimensions. The illustrative cases given in the first edition have been almost entirely omitted, and for several reasons, the chief of which was that to retain them and add others that have since been reported would greatly increase the bulk of the volume, while perhaps contributing little to its usefulness.

It is scarcely necessary to state that everything has been done to make this edition as complete and acceptable as its predecessor; the best authorities on the different subjects included in the work have been consulted and utilised in bringing the information up to date, and more woodcuts have been added; so that the book might continue to be considered as at least equal to the best of those which have appeared on this important branch of veterinary science.

GEORGE FLEMING.

Higher Leigh, Combe Martin, North Devon,
November, 1895.

PREFACE TO THE FIRST EDITION.

WHEN we consider the vast and yearly increasing amount of animal wealth we possess, the great skill, attention, and expense bestowed on the perfecting of the most important of the domesticated creatures, which are daily becoming more essential factors in our progressive civilization, it is somewhat remarkable, and rather discreditable, though not altogether inexplicable, that nothing in the way of a work devoted to the parturition of animals, and to the diseases and accidents incidental to that period, has yet appeared in the English language. For very many years the Anglo-Saxon race has devoted itself most assiduously and praiseworthily, and with the greatest measure of success, to the multiplication and full development of those qualities which more particularly enhance the value and utility of these animals. This has entailed unwearied efforts, the closest and shrewdest observation, and all the judgment and practical and scientific knowledge which generations of men could afford.

It might therefore be considered that everything relating to the reproduction and rearing of these creatures must, from a materialistic point of view alone, be of great moment not only to breeders and stock-raisers, but to the entire community. Great loss may be, and far too often is, quickly sustained among animals during the pregnant or parturient period, and this loss may not only prove very serious to individuals, but make itself gravely felt by the general public. A treatise which might aid, to however small an extent, in pointing out how these losses may be averted or remedied, must surely, then, prove a welcome boon to those who are engaged in breeding and raising animals, as well as to all who are interested—and few are not—in their multiplication and welfare. At the commencement of this century a book was published, entitled, "A Practical Treatise on the Parturition of the Cow, or the Extraction of the Calf; and also on the Diseases of Neat Cattle in General." The author was Edward Skellet, "Professor of that part of the Veterinary Art"; but that and other parts of this art were certainly in a very crude, meagre, and elementary condition in the days when Skellet ventured to touch upon them; and yet his book may be said to be the only attempt which has been made in this direction in England. Papers on Obstetricy—some of them of much value—have appeared from time to time in professional journals; but while in other countries many treatises have been produced, no one in this country has undertaken the task of supplying what has, for very many years, been an urgent want—a text-book of Obstetricy worthy of modern Veterinary Science. The necessity for such a guide has been felt more particularly by the Veterinary practitioner at the commencement of his career; for only too frequently he has had to rely entirely upon his own resources, and to painfully acquire, at the expense of his employers, that

knowledge of the subject which was either very imperfectly or not at all taught at the Veterinary Schools, and could not be found elsewhere. To deliver one of the larger domesticated animals in a case of difficult parturition requires special knowledge and aptitudes; and even those practitioners who are fortunate in possessing these will be the first to confess that to attempt delivery in many cases is really a work of the Danaides.

To the members of the Veterinary profession, therefore, no apology can be necessary in offering for their acceptance the present book. Every endeavour has been made to make it a standard work, representative of the most advanced views relating to this department of Veterinary Medicine. Animated by the desire to present my colleagues in English-speaking countries with a text-book at least equal to the best of the many which have been published on the Continent—a list of which is appended—every likely source of information has been made available, and no labour or pains have been spared to render my onerous and very difficult task as complete and as useful as possible. A glance at the references and illustrative cases will testify to the correctness of this statement.

It has often been a matter for regret by the accoucheur of women, that the parturient period of animals was one upon which they could obtain but little, if any, information; and its relations and importance with regard to this and the puerperal period in the human species has frequently been insisted upon. I trust that this cause for regret may be at least partially removed, and that the text-book may prove of some service to those medical men who are anxiously striving to advance human obstetricy, and a knowledge of those pathological processes around which there is still doubt and uncertainty.

My best thanks are due to Professor Saint-Cyr, of the Lyons Veterinary School, for allowing me to use many of the drawings which illustrate his excellent treatise on the same subject, and to which I have often referred with much advantage. I am also greatly indebted to Mr. W. A. Cartwright, of Whitchurch, Salop, for his kindness in looking over the proof-sheets containing the more practical portion of the subject; his long experience and skilful practice, combined with careful reading and study, rendered his assistance particularly valuable in this respect.

In this first attempt to deal with a very serious task, omissions and defects will doubtless be discovered. But in the circumstances in which I was placed they were unavoidable, and perhaps, after all, they will not interfere with the utility of the work. Now that certain principles in animal obstetrics have been laid down, and a commencement has been made to establish the practice of the Veterinary Obstetrist on a sound scientific basis, it is to be hoped that rapid progress will be made in rendering it more perfect. Humanity is perhaps as deeply concerned in this direction as in many others, and it must always be an important object with the Veterinary Surgeon to spare animals pain, and to abridge their sufferings as much as possible.

GEORGE FLEMING,
Second Life Guards.

REGENT'S PARK BARRACKS,
November, 1877.

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Saint-Cyr. Traité d'Obstétrique Vétérinaire. Paris, 1875.

Saint-Cyr and Violet. Second Edition of the above. Paris, 1888.

Germany.

Jörg. Anleitung zu einer Rationellen Geburtshülfe der Landwirthschaftlichen Thiere. Leipsic, 1818. This is almost a complete reproduction of the English work by Skellet, at least so far as the Plates are concerned.

Binz. Theoretisch-praktische Geburtshülfe für die Haussaugethiere. Freiburg, 1830.

Günther. Handbuch der Praktischen Veterinärgeburtshülfe, nebst einem Anhange über die Wahl der Zuchtpferde. Hanover, 1830.

Thomas. Kenntnisse, Erfahrungen und Hulfsleistungen bei den Geburten der Pferde. Glogau, 1832.

Seyflert. Die Geburtshülfe bei den Kühen, 1838.

Ziller. Kurzgefastzter, jedoch möglichst gründlicher Unterricht über die Geburtshülfe der Gröszeren Landwirthschaftlichen Hausthiere. Schleusingen, 1838.

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Fleming. Text-book of Veterinary Obstetrics: including the Diseases and Accidents incidental to Pregnancy, Parturition, and Early Age in the Domesticated Animals. First edition, London, 1878; second edition, 1896.

TABLE OF ILLUSTRATIONS.

FIG.			PAGE
1.	Pelvis of the Mare	*Baumeister and Rueff*	3
2.	Pelvis of the Cow	*Ibid.*	6
3.	Pelvis of the Sheep	*Ibid.*	7
4.	Lateral Ligaments of the Sacrum and Pelvis	*Leyh*	8
5.	Ligaments of the Lumbar Vertebræ, Sacrum and Pelvis, seen from below	*Ibid.*	10
6.	Longitudinal Section of a Mare's Pelvis	*Saint-Cyr*	13
7.	Diagram of the Mare's Pelvic Axis	*Ibid.*	14
8.	Inlet of the Pelvis of the Mare : Wide Pelvis	*Ibid.*	15
9.	Inlet of the Pelvis of the Mare : Narrow Pelvis	*Ibid.*	16
10.	Longitudinal Section of the Cow's Pelvis	*Ibid.*	17
11.	Inlet of the Cow's Pelvis : Narrow Pelvis	*Ibid.*	18
12.	Inlet of the Cow's Pelvis : Wide Pelvis	*Ibid.*	18
13.	Bones of Pelvis of Mare	*Ibid.*	20
14.	Bones of Pelvis of Horse	*Ibid.*	20
15.	Median Section of the Pelvis of the Horse	*Franck*	22
16.	Median Section of the Pelvis of the Mare	*Ibid.*	22
17.	The Generative Organs of the Mare *in situ*	*Saint-Cyr*	28
18.	Section of Udder of Cow	*Franck*	34
19.	Lobule of Mammæ	*Virchow*	35
20.	Section of the Cow's Teat	*Guibourt*	35
21.	Generative Organs of the Mare : isolated	*Chauveau*	37
22.	Nerves of Mare's Uterus	*Franck*	42
23.	Utricular Gland of a Pregnant Goat	*Ibid.*	43
24.	Utricular Gland of a Pregnant Cow	*Ibid.*	43
25.	Horizontal Section of Uterine Glands	*Ibid.*	44
26.	Uterus, Oviducts, and Ovaria of the Sheep	*Owen*	45
27.	Ovary opened vertically	*Saint-Cyr*	50
28.	Portion of the Ovary of a Pig	*Ibid.*	50
29.	Graafian Vesicle in Mare's Ovary	*Franck*	50
30.	Ovulum of the Mare	*Ibid.*	50
31.	Formation of the Ovisac in the Bitch's Ovary	*Bischoff*	52
32.	Graafian Vesicle and Ovum	*Barry*	53
33.	Escape of Ovum from Ovisac	*Thomson*	53
34.	Successive Stages in Formation of Corpus Luteum in Graafian Follicle of Sow	*Pouchet*	54
35.	Impregnating Tube	*Lyford*	67

FIG.			PAGE
36.	Section of Impregnating Tube	*Ibid.*	67
37.	Dilator of the Cervix	*Ibid.*	67
38.	Ovum from Oviduct of Rabbit	*Bischoff*	69
39.	A more advanced Ovum	*Ibid.*	69
40.	Ovum from Uterine half of Oviduct	*Ibid.*	70
41.	Ovum from Uterine end of Oviduct	*Ibid.*	70
42.	Blastoderm and Primitive Trace	*Saint-Cyr*	71
43.	Ovum Twenty to Twenty-five Days Old	*Ibid.*	73
44.	Ovum about a Month Old	*Ibid.*	74
45.	Chorion of Mare at Mid-term	*Colin*	75
46.	Fœtal Membranes of the Cow at Mid-term	*Ibid.*	76
47.	Fœtal Membranes of the Goat at Full Time	*Ibid.*	77
48.	Fœtus and Fœtal Membranes of Cat	*Buffon*	78
49.	Fœtus of Mare and its Envelopes	*Chauveau*	79
50.	Plan of Fœtal Envelopes in Mare	*Saint-Cyr*	82
51.	Portion of Chorion with Placentulæ : Cow	*Gurlt*	87
52.	Accessory Placentulæ in a Cow's Uterus	*Franck*	88
53.	Accessory Placentulæ on the Cow's Uterus	*Ibid.*	88
54.	Fœtal Portion of Placenta Prævia	*Ibid.*	89
55.	Maternal and Fœtal Cotyledons of the Cow	*Colin*	90
56.	Cotyledon of a Cow's Uterus	*Pettigrew*	91
57.	Fœtal Circulation in a Transition State	*Saint-Cyr*	104
58.	Fœtal Circulation : Advanced Period	*Colin*	106
59.	Male Fœtus of the Mare	*Franck*	111
60.	Genito-urinary Organs of a Fœtal Sheep	*Müller*	112
61.	Female Organs of a Fœtal Deer	*Ibid.*	114
62.	Female Fœtus of the Cow	*Franck*	114
63.	Genital Organs of a Hermaphrodite Goat	*Leuckart*	115
64.	Vertical Section through a Portion of the Uterine Cotyledon of a Cow	*Franck*	129
65.	The Gravid Uterus of a Multiparous and Uniparous Animal	*Thomson*	133
66.	Twin Pregnancy : Cow	*Saint-Cyr*	165
67.	A Mole	*Zundel*	178
68.	Hydatid Cyst or Mole : Human	*Boivin*	179
69.	Cow in the Act of Parturition : Standing Position	*Original*	236
70.	Mare in the Act of Parturition : Recumbent Position	*Baumeister*	237
71.	Normal Position of the Fœtus in the Mare at Parturition : First Stage	*Franck*	240
72.	Normal Position of the Fœtus in the Mare at Parturition : Second Stage	*Ibid.*	241
73.	Normal Position of the Fœtus in the Mare : Third Stage	*Saint-Cyr*	243
74.	Diameters of the Pelvis	*Saint-Cyr*	244
75.	Lumbo-sacral Position	*Ibid.*	245
76.	Right Cephalo-ilial Position in the Dorso-lumbar Presentation	*Franck*	246

FIG.			PAGE
77.	Cephalo-sacral Position in the Dorso-lumbar Presentation	*Saint-Cyr*	247
78.	Cephalo-sacral Position in the Dorso-lumbar Presentation	*Ibid.*	248
79.	Left Cephalo-ilial Position in the Sterno-abdominal Presentation	*Franck*	248
80.	Mammary Gland during Lactation	*Virchow*	272
81.	Completely Deformed Pelvis : Mare	*Saint-Cyr*	290
82.	Pelvic Exostosis	*Ibid.*	291
83.	Fracture of the Pelvis	*Ibid.*	292
84.	Uterine Hernia : Mare	*Ibid.*	298
85.	Uterine Hernia : Cow	*Zundel*	299
86.	Incomplete Torsion of the Uterus	*Ibid.*	313
87.	Multiple Torsion of the Uterus	*Gurlt*	314
88.	Diagram of Uterine Torsion	*Saint-Cyr*	322
89.	Left Uterine Torsion	*Gurlt*	323
90.	Right Uterine Torsion	*Ibid.*	323
91.	Right Uterine Torsion : Manipulation	*Saint-Cyr*	324
92.	Left Uterine Torsion : Manipulation	*Ibid.*	324
93.	Left Uterine Torsion *in situ*	*Rossignol*	327
94.	Darreau's Retroversor	*Darreau*	333
95.	Barnes' Uterine Dilator	*Original*	359
96.	Skull of a Hydrocephalic Calf	*Saint-Cyr*	382
97.	Skull of a Hydrocephalic Calf	*Rueff—Baumeister*	383
98.	Skull of a Hydrocephalic Foal	*Saint-Cyr*	383
99.	Calf affected with Hydrocephalus	*Rueff—Baumeister*	384
100.	Extraordinary Development of the Cranium of a Hydrocephalic Calf	*Original*	385
101.	Anasarcous Fœtal Calf	*Franck*	388
102.	Anasarcous Fœtal Calf	*Ibid.*	388
103.	Deformed Head and Neck of a Foal	*Ibid.*	392
104.	Ectromelian Monstrosity : Horse	*Zundel*	402
105.	Ectromelian Monstrosity : Goat	*Rueff—Baumeister*	402
106.	Symelian Monstrosity : Pig	*Ibid.*	403
107.	Celosomian Monstrosity : Calf	*Ibid.*	403
108.	Ectopia Cordis	*Hering*	404
109.	Pseudencephalian Monstrosity	*Ibid.*	404
110.	Cyclopean Monstrosity : Ram	*Ibid.*	405
111.	Cyclopean Monstrosity : Ass	*Gurlt*	405
112.	Acephalian Monstrosity	*Ibid.*	406
113.	Schistocephalus Fissislabrus	*Rueff—Baumeister*	406
114.	Camylorrhacchis Contorta	*Ibid.*	407
115.	Monomphalian Monstrosity	*Ibid.*	408
116.	Skull of Syncephalian Monstrosity	*Franck*	408
117.	Monocephalian Monstrosity	*Rueff—Baumeister*	409
118.	Sysomian Monstrosity	*Rueff-Baumeister*	409
119.	Monosomian Monstrosity : Calf	*Original*	410
120.	Polymelian Monstrosity : Calf	*Rueff—Baumeister*	410
121.	Double Parasitic Monstrosity : Cow	*Zundel*	411

FIG.			PAGE
122.	Sysomian Monstrosity	*Saint-Cyr*	417
123.	Celosomian Monstrosity: Lamb	*Youatt*	419
124.	Twin Fœtuses in Different Presentations	*Saint-Cyr*	423
125.	Anterior Presentation: Deviation of the Hind-limbs in the Pelvis	*Ibid.*	430
126.	Anterior Presentation: Hind-limb Deviation	*Franck*	431
127.	Anterior Presentation: Fore-limb crossed over the Neck	*Saint-Cyr*	435
128.	Anterior Presentation: Fore-limbs flexed at the Knees	*Ibid.*	437
129.	Anterior Presentation: Extending the Fore-limb	*Franck*	438
130.	Anterior Presentation: One Fore-limb completely retained	*Saint-Cyr*	440
131.	Anterior Presentation: Both Fore-limbs completely retained	*Ibid.*	441
132.	Anterior Presentation: Downward Deviation of the Head	*Ibid.*	444
133.	Anterior Presentation: Extreme Downward Deviation of the Head	*Ibid.*	446
134.	Anterior Presentation: Lateral Deviation of the Head towards the Shoulder	*Ibid.*	449
135.	Anterior Presentation: Lateral Deviation of the Head towards the Abdomen	*Ibid.*	450
136.	Anterior Presentation: Deviation of the Head Upwards and Backwards	*Ibid.*	454
137.	Anterior Presentation: Deviation of the Head Upwards and Laterally	*Ibid.*	454
138.	Lumbo-Sacral Position	*Ibid.*	456
139.	Hock Presentation: Calf	*Franck*	462
140.	Diagrams of the Hind-limbs in Hock Presentation	*Ibid.*	462
141.	Hock Presentation: Hock Corded	*Saint-Cyr*	466
142.	Thigh and Croup Presentation	*Ibid.*	467
143.	Thigh and Croup Presentation: Thigh Corded	*Ibid.*	469
144.	Thigh and Croup Presentation: Body Corded	*Franck*	470
145.	Transverse Presentation: Right Cephalo-ilial Position—Side View	*Saint-Cyr*	474
146.	Transverse Presentation: Right Cephalo-ilial Position—Upper View	*Franck*	474
147.	Transverse Presentation: Vertical or Cephalo-sacral Position	*Saint-Cyr*	477
148.	Sterno-abdominal Presentation, Head and Feet Engaged: Foal	*Franck*	479
149.	Sterno-abdominal Presentation, Head Retained: Calf	*Saint-Cyr*	480

FIG.			PAGE
150.	Solid Repeller, with a Removable Spike.	*Original*	489
151.	Simple-jointed Repeller	*Ibid.*	489
152.	Jointed Repeller: Open	*Rainard*	489
153.	Jointed Repeller: Closed	*Ibid.*	489
154.	Traction Cord and Band, and the Manner of Applying them	*Baumeister*	500
155.	Schaack's Traction Cord	*Saint-Cyr*	500
156.	Binz's Simple Head-collar	*Baumeister*	502
157.	Rueff's Head-collar, No. 1	*Rueff*	502
158.	Rueff's Head-Collar, No. 2	*Ibid.*	502
159.	Binz's Forceps-band	*Baumeister—Rueff*	503
160.	Schaack's Forceps-halter	*Saint-Cyr*	504
161.	Manner of Placing Schaack's Halter	*Ibid.*	504
162.	Schaack's Halter Placed on a Calf's Head	*Ibid.*	505
163.	Halter with a Single Traction Cord	*Detroye*	506
164.	Halter with Two Traction Cords	*Ibid.*	506
165.	Defays' Wire-extractor with the Torsion Rods		507
166.	Defays' Wire Extractor Applied		508
167.	Breulet's Tube and Noose		508
168.	Breulet's Noose Fixed on the Fœtus		508
169.	Cartwright's Porte-cord		509
170.	Darreau's Porte-cord		509
171.	Günther's Curved Porte-cord and Blunt Crotchet		509
172.	Darreau's Curved Porte-cord		509
173.	Darreau's Repeller		510
174.	Binz's Porte-cord		511
175.	Short Blunt Crotchet		511
176.	Blunt Finger Crotchet		511
177.	Short Sharp Crotchet, with Broad or Flanged Point		512
178.	Short Sharp Crotchet, with Round Point		512
179.	Long Blunt Crotchet		513
180.	Long Pointed Crotchet		513
181.	Long Pointed Crotchet, Darreau's Pattern		513
182.	Long Pointed Crotchet, Darreau's Pattern		513
183.	Schaack's Crotchet		516
184.	Simple Short Crotchet-forceps		518
185.	Long Simple Crotchet-forceps		518
186.	Günther's Long Crotchet-forceps		519
187.	Jointed Crotchet-forceps		519
188.	Nelson's Blunt Crotchet-forceps		519
189.	Nelson's Serrated Crotchet-forceps		519
190.	Tallich's Short Bent Crotchet-forceps		520
191.	André's Crotchet-forceps		520
192.	Bitch Forceps		522
193.	Weber's Forceps		522
194.	Defays' Forceps		522

FIG.			PAGE
195.	Diagram of the Pelvic Axis	*Saint-Cyr*	524
196.	Obstetric Pulleys	*Ibid.*	528
197.	Baron's Obstetric Machine	*Ibid.*	530
198.	Straight Embryotom	*Original*	535
199.	Curved Embryotom		535
200.	Gunther's Embryotom : Improved Pattern		536
201.	Colin's Scalpel Embryotom		536
202.	Unsworth's Spring Embryotom		536
203.	Günther's Long-handled Embryotom		537
204.	Cartwright's Subcutaneous Spatula		537
205.	Carsten Harm's Spatula		537
206.	Ungefrohrn's Spatula		538
207.	Cartwright's Bone-chisel		538
208.	Cartwright's Bone-saw		538
209.	Swedish Chain-saw		538
210.	Pad Pessary	*Saint-Cyr*	588
211.	Ring Pessary	*Ibid.*	589
212.	Cup and Ball Pessary	*Ibid.*	589
213.	Zundel's Labial Sutures	*Zundel*	593
214.	The Loop of Delwart's Truss	*Franck*	593
215.	Delwart's Truss Applied	*Saint-Cyr*	594
216.	Renault's Truss	*Ibid.*	595
217.	Leather Truss	*Franck*	596
218.	Lund's Truss Iron		597
219.	Lund's Truss Applied	*Saint-Cyr*	598
220.	Parturient Apoplexy : Cow	*Armatage*	638
221.	Teat-syphon	*Original*	691
222.	Ring Teat-syphon		691
223.	Lüthi's Perforating Sound		699
224.	Armatage's Truss Applied for Umbilical Hernia	*Armatage*	708
225.	Umbilical Clam	*Ibid.*	712
226.	Armatage's Iron Umbilical Clam	*Ibid.*	712

TABLE OF CONTENTS.

PAGE

PREFATORY NOTE TO SECOND EDITION - - - - iii
PREFACE TO FIRST EDITION - - - - - v
LIST OF WORKS ON VETERINARY OBSTETRICS - - - vii
INTRODUCTION - - - - - - xxxi

PART FIRST.

EUTOKIA, OR TOKOLOGY.

BOOK I.—OBSTETRICAL ANATOMY - - - 1
CHAPTER I.—THE PELVIS - - - - 1
SECTION I.—BONES OF THE PELVIS - - - 2
1. Os Innominatum - - - - 2
Ilium - - - - - 3
Ischium - - - - - 4
Pubis - - - - - 4
2. Sacrum - - - - - 5
3. Coccyx - - - - - 6
Differences in the Bones of the Pelvis of other Animals than the Mare - - - - - 6
Cow - - - - - - 6
Sheep and Goat - - - - - 7
Bitch and Cat - - - - - 7
Pig - - - - - - 8
SECTION II.—ARTICULATIONS OF THE PELVIS - - 8
1. Sacro-lumbar Articulation - - - 8
2, 3. Sacro-iliac Articulations - - - 9
4. Ischio-pubic Symphysis - - - - 9
5. Sacro-coccygeal Articulations - - - 9
Differences in the Pelvic Articulations of other Animals than the Mare - - - - - 10
Cow - - - - - - 10
Sheep and Goat - - - - - 11
Bitch and Cat - - - - - 11
Sacro-sciatic Ligament - - - - 11
SECTION III.—THE PELVIS AND ITS CAVITY - - 12
Mare - - - - - - 12
External Surface - - - - 12
Internal Surface - - - - 13

PAGE

Anterior Opening or Inlet - - - 14
Posterior Opening or Outlet - - - 16
Differences in other Animals than the Mare - - 17
Cow - - - - - - 17
Sheep and Goat - - - - - 19
Pig - - - - - - 19
Bitch and Cat - - - - - 19
Differences in the Pelvis according to Sex - - 19
SECTION IV.—CAPACITY OF THE PELVIS, OR PELVIMETRY - 21

CHAPTER II.—FEMALE GENERATIVE ORGANS - 27
SECTION I.—EXTERNAL ORGANS OF GENERATION - - 27
The Vulva - - - - - 27
Differences in other Animals than the Mare - - 30
Cow - - - - - - 30
Sheep - - - - - - 31
Pig - - - - - - 31
Bitch and Cat - - - - - 31
SECTION II.—THE MAMMÆ - - - - 32
Differences in other Animals than the Mare - - 34
Cow - - - - - - 34
Sheep and Goat - - - - - 35
Pig - - - - - - 36
Bitch - - - - - - 36

CHAPTER III.—INTERNAL ORGANS OF GENERATION 36
SECTION I.—THE VAGINA - - - - 36
Differences in other Animals than the Mare - - 38
Cow, Sheep, and Goat - - - - 38
Pig - - - - - - 38
Bitch and Cat - - - - - 39
SECTION II.—THE UTERUS - - - - 39
Differences in other Animals than the Mare - - 42
Cow - - - - - - 42
Sheep and Goat - - - - - 46
Pig - - - - - - 46
Bitch and Cat - - - - - 46
Development - - - - - 46
SECTION III.—FALLOPIAN TUBES, OR OVIDUCTS - - 47
Differences in other Animals than the Mare - - 48
Cow, Sheep, and Goat - - - - 48
Pig - - - - - - 48
Bitch - - - - - - 48
SECTION IV.—THE OVARIES - - - - 48
Differences in other Animals than the Mare - - 51
Cow, Sheep, and Goat - - - - 51
Pig - - - - - - 51
Bitch and Cat - - - - - 51
Development - - - - - 51

PAGE

BOOK II.—OBSTETRICAL PHYSIOLOGY - - 55
REPRODUCTION - - - - 55

CHAPTER I.—GENERATION - - - - 57
SECTION I.—PUBERTY - - - - 57
SECTION II.—ŒSTRUM OR MENSTRUATION - - 59
SECTION III.—MATURATION OF THE GRAAFIAN VESICLES - 63

CHAPTER II.—FECUNDATION - - - 64

CHAPTER III.—STERILITY - - - - 65

CHAPTER IV.—CHANGES IN THE OVUM - - 68
SECTION I.—DEVELOPMENT OF THE EMBRYO - - 71
SECTION II.—APPENDAGES OF THE FŒTUS - - 75
Chorion - - - - - - 75
Differences in other Animals than the Mare - - 77
Ruminants - - - - - 77
Pig - - - - - - 78
Bitch and Cat - - - - - 78
Amnion - - - - - - 79
Liquor Amnii - - - - - 80
Differences in other Animals than the Mare - - 81
Ruminants - - - - - 81
Pig - - - - - - 81
Bitch and Cat - - - - - 81
Allantois - - - - - - 81
Differences in other Animals than the Mare - - 84
Ruminants - - - - - 84
Pig - - - - - - 84
Bitch and Cat - - - - - 84
Umbilical Vesicle - - - - - 84
Differences in other Animals than the Mare - - 85
Ruminants and Pig - - - - 85
The Placenta - - - - - 85
Differences in other Animals than the Mare - - 86
Cow - - - - - - 86
Sheep and Goat - - - - - 92
Pig - - - - - - 92
Bitch and Cat - - - - - 92
Functions - - - - - - 93
Umbilical Cord - - - - - 93
Differences in other Animals than the Mare - - 94
Ruminants - - - - - 94
Pig - - - - - - 95
Bitch and Cat - - - - - 95
SECTION III.—DEVELOPMENT OF THE FŒTUS - - 96
The Nervous System - - - - 97
The Organs of Sense - - - - 98
The Skin and its Appendages - - - - 100
The Locomotory Apparatus - - - - 101

PAGE

The Circulatory System - - - - 104
The Respiratory Apparatus - - - - 107
The Digestive Apparatus - - - - 108
The Genito-urinary Organs - - - - 110

SECTION IV.—PERIODS OF DEVELOPMENT - - 115

SECTION V.—PHYSIOLOGICAL PHENOMENA IN THE FŒTUS - 118
Nervous Functions - - - - - 119
Absorption - - - - - 120
Nutrition - - - - - - 121
Circulation - - - - - 122
Secretion - - - - - - 124

SECTION VI.—WEIGHT AND DIMENSIONS OF THE FŒTUS AT BIRTH - - - - - 125

CHAPTER V.—PREGNANCY - - - - 127

SECTION I. — MODIFICATIONS IN THE UTERUS DURING PREGNANCY - - - - - 128
Volume - - - - - - 128
Structure - - - - - 128
Sensibility - - - - - 131
Form - - - - - - 132
Situation - - - - - 134
Direction - - - - - 134
Influence on and Alterations in the Position of Neighbouring Organs - - - - - 135

SECTION II.—POSITION OF THE FŒTUS IN THE UTERUS - 137

SECTION III.—SIGNS OF PREGNANCY - - - 138
Rational Signs - - - - - 138
Material Signs - - - - - 140
Sensible Signs - - - - - 143

SECTION IV.—DURATION OF PREGNANCY - - 148
Mare - - - - - - 149
Cow - - - - - - 151
Sheep and Goat - - - - - 152
Pig - - - - - - 153
Bitch - - - - - - 153
Cat - - - - - - 153

SECTION V. — UNIPAROUS, GEMELLIPAROUS, AND MULTIPAROUS PREGNANCY - - - - 153
Mare - - - - - - 154
Cow - - - - - - 155
Sheep - - - - - - 158
Goat - - - - - - 160
Free-Martins - - - - - 161
Diagnosis of Multiple Pregnancy - - - 163
Position of the Fœtuses in Multiple Pregnancy - - 164

CHAPTER VI.—HYGIENE OF PREGNANT ANIMALS - 166

PAGE

BOOK III.—PATHOLOGY OF PREGNANCY - - 169

CHAPTER I.—ANOMALIES IN PREGNANCY - - 169

SECTION I.—SUPERFŒTATION - - - - 169

SECTION II.—EXTRA-UTERINE PREGNANCY - - 173

Symptoms, Course, and Terminations - - - 176

Diagnosis and Treatment - - - - 177

SECTION III.—SPURIOUS OR PSEUDO-PREGNANCY - - 178

Moles - - - - - - 178

Uterine Cysts - - - - - 180

Hydrops Uteri or Hydrometra - - - 180

CHAPTER II.—DISEASES INCIDENTAL TO PREGNANCY - - - - - - 181

SECTION I.—INFLUENCE OF PREGNANCY ON ORDINARY DISEASES - - - - - 181

SECTION II.—DISEASES INCIDENTAL TO PREGNANCY - 182

Pica - - - - - - 183

Rickets and Osteomalacia - - - - 183

Constipation - - - - - 184

Vomiting - - - - - - 184

Colic - - - - - - 184

Œdema - - - - - - 184

Hydramnios or Hydrops Amnii - - - 185

Symptoms - - - - - 185

Diagnosis - - - - - 185

Results - - - - - - 186

Etiology - - - - - 186

Treatment - - - - - 186

Paraplegia - - - - - 187

Treatment - - - - - 188

Cramp - - - - - - 188

Eclampsia - - - - - - 189

Cerebral Congestion - - - - 189

Hysteria - - - - - - 189

Amaurosis - - - - - 190

Cough - - - - - - 190

Albuminuria - - - - - 190

Mammitis - - - - - 190

Red Colostrum - - - - - 190

CHAPTER III.—ACCIDENTS OF PREGNANCY - - 191

Ante-partum Prolapsus of the Vagina - - - 191

Treatment - - - - - 192

Hernia of the Uterus (Hysterocele) - - - 193

Ante-partum Rupture of the Uterus - - - 194

Causes - - - - - - 196

Symptoms - - - - - 196

Treatment - - - - - 196

Metrorrhagia - - - - - 197

PAGE

Abnormal Retention of the Fœtus - - - 198
Symptoms and Terminations - - - 199
Causes - - - - - - 202
Treatment - - - - - 202
Abortion - - - - - - 204
Sporadic Abortion - - - - 205
Causes - - - - - 205
Symptoms - - - - - 209
Results - - - - - 211
Pathological Anatomy - - - - 211
Diagnosis - - - - - 212
Treatment - - - - - 214
Epizoötic, Enzoötic, or Infectious Abortion - - 216
Causes - - - - - 217
Symptoms - - - - - 222
Pathological Anatomy - - - - 223
Treatment - - - - - 224

BOOK IV.—NORMAL PARTURITION - - - 227

CHAPTER I.—PHYSIOLOGY OF PARTURITION - 227
Section I.—Causes of Parturition - - - 228
Section II.—The Expelling Powers - - - 229
Section III.—Signs and Course of Parturition - 232

CHAPTER II.—PRESENTATIONS OF THE FŒTUS AND MECHANISM OF PARTURITION - - - 239
Section I.—Presentations - - - - 241
Section II.—Positions - - - - 242
Section III.—Mechanism of Parturition - - 250
Mare - - - - - - 251
Cow - - - - - - 254
Other Animals - - - - - 255

CHAPTER III.—NECESSARY AID IN NORMAL PARTURITION - - - - - 255
Section I.—Attention to the Mother - - 256
Section II.—Attention to the Offspring - - 265

CHAPTER IV.—SEQUELÆ OF PARTURITION - - 268
Section I.—Functional Modifications - - 268
Section II.—Organic Modifications - - - 275

PART SECOND.

DYSTOKIA.

General Considerations - - - - - 279

BOOK I.—MATERNAL DYSTOKIA - - - 289

CHAPTER I.—DYSTOKIA BY PELVIC CONSTRICTION 289
Complete Deformity of the Pelvis - - - 290
Exostoses - - - - - - 291

PAGE

Fractures - - - - - - 291
Tumours in the Pelvic Cavity - - - 293
Indications for Surgical Treatment - - - 294

CHAPTER II.—DYSTOKIA BY DISPLACEMENT OR CHANGED RELATIONS OF THE UTERUS - 297

Hernia of the Uterus—Hysterocele - - - 297
Origin and Symptoms in Uniparous Animals - - 298
Origin and Symptoms in Multiparous Animals - - 300
Pathological Anatomy - - - - 300
Diagnosis - - - - - 301
Indications - - - - - 303
Deviation of the Uterus - - - - 306
Diagnosis - - - - - 307
Complications - - - - - 308
Indications - - - - - 308
Torsion of the Uterus: Contorsio Uteri - - 309
History - - - - - 309
Nature and Frequency - - - - 312
Etiology - - - - - 316
Symptoms - - - - - 318
Diagnosis - - - - - 321
Prognosis - - - - - 326
Pathological Anatomy - - - - 326
Treatment - - - - - 328
Torsion of the Uterus in the Mare - - - 340
Causes - - - - - - 341
Symptoms - - - - - 341
Prognosis and Treatment - - - - 342
Torsion of the Uterus in other Animals - - 343

CHAPTER III.—DYSTOKIA FROM MORBID ALTERATIONS IN THE GENERATIVE ORGANS - - 344

1. Utero-vaginal Tumours - - - - 344
Diagnosis - - - - - 346
Treatment - - - - - 346
Cancerous, Carcinomatous, or Sarcomatous Tumours - 347
Condylomatous, Papillomatous, and Lipomatous Tumours - - - - - 348
Fibroid and Myomatous Tumours - - - 348
Thrombi or Hæmatomata - - - 349
Serous Cysts - - - - - 350
Hernia of the Bladder into the Vagina: Vaginal Cystocele - - - - - 351
Treatment - - - - - 352
Tumours in the Vicinity of the Genital Organs - 353

2. Rigidity of the Cervix Uteri - - - 354
Symptoms - - - - - 354
Diagnosis - - - - - 356

PAGE

Prognosis - - - - - 356
Treatment - - - - - 356
3. Induration of the Cervix Uteri - - - 361
Symptoms - - - - - 362
Diagnosis - - - - - 363
Prognosis - - - - - 363
Pathological Anatomy - - - - 364
Treatment - - - - - 364
4. Complete Obliteration of the Os Uteri - - 365
Causes - - - - - 365
Symptoms - - - - - 366
Results - - - - - 366
Diagnosis - - - - - 366
Treatment - - - - - 366

CHAPTER IV. — OTHER CAUSES OF MATERNAL DYSTOKIA - - - - - 367

1. Anomalies in the Placenta - - - 367
Schirrous Chorion - - - - 367
2. Morbid Adhesion between the Fœtus and Uterus - 368
3. Stricture or Occlusion of the Uterus by External Bands or Membranes - - - - - 369
4. Persistent Hymen - - - - - 369
Treatment - - - - - 370
5. Vaginal and Vulvar Constriction, or Atresia - - 370
Treatment - - - - - 371

BOOK II.—FŒTAL DYSTOKIA - - - 372

GROUP I.—OBSTACLES INDEPENDENT OF PRESENTATIONS AND POSITIONS - - - - 372

CHAPTER I.—VARIOUS CAUSES - - - 373

The Umbilical Cord as an Obstacle - - - 373
Diagnosis - - - - - 374
Indications - - - - - 374
Excess in Volume of the Fœtus - - - 374
Causes - - - - - - 375
Diagnosis - - - - - 377
Prognosis - - - - - 378
Indications - - - - - 379
Excess in Growth of Hair - - - - 379
Anomalies in, and Diseases of, the Fœtal Membranes - 380
Indications - - - - - 381
Abnormal Quantity of Placental Fluid - - - 381

CHAPTER II.—DISEASES OF THE FŒTUS - - 381

Hydrocephalus - - - - - 381
Pathological Anatomy - - - - 382
Diagnosis - - - - - 386
Indications - - - - - 386
Ascites, Anasarca, and Hydrothorax - - - 387

PAGE

Cause - - - - - 389
Diagnosis - - - - - 390
Indications - - - - - 390
Emphysema - - - - - 391
Indications - - - - - 391
Polysarcia - - - - - 391
Indications - - - - 392
Contractions - - - - - 392
Indications - - - - - 393
Tumours - - - - - 394
Indications - - - - - 394
Death - - - - - - 394

CHAPTER III.—MONSTROSITIES - - - 394
Classification - - - - - 395

CLASS I.—SIMPLE MONSTROSITIES - - - 396
Order I.—Simple Monstrosities through Absence of Parts - - - - - 396
Order II.—Simple Monstrosities through Smallness of Parts - - - - - 396
Order III.—Simple Monstrosities through Abnormal Division of the Body - - - - 397
Order IV.—Simple Monstrosities through Absence of the Natural Division of Parts - - - 397
Order V.—Simple Monstrosities through Fusion or Coalition of Organs - - - - 397
Order VI.—Simple Monstrosities through Abnormal Position and Form of Parts - - - 397
Order VII.—Simple Monstrosities through Excess in Formation - - - - - 398
Order VIII.—Hermaphrodites - - - 398

CLASS II.—TREBLE AND DOUBLE MONSTROSITIES - - 398
Order I.—Trigeminal Monstrosities - - - 398
Order II.—Monsters with Two Heads - - 399
Order III.—Double-headed Monstrosities, with the Trunk Wholly or Partially Double - - - 399
Order IV.—Monstrosities with a Single Head, but the Trunk or Limbs more or less Completely Double - 399
Order V.—Monstrosities with a Single Head and Trunk, and more than Four Limbs - - - 400
Order VI.—Monstrosities with the Head, Trunk, and Limbs more or less Completely Double - - 400
Origin of Monstrosities, and the Laws of Teratology - 411
Frequency of Monstrosities - - - 415
Distorted Monstrosities - - - - 416
Cyclopean Monstrosity - - - - 416
Pseudencephalian Monstrosity - - - 416
Double-headed Monstrosities - - - 417
Celosomian Monstrosities - - - 418
Diagnosis - - - - - 418

PAGE

Prognosis - - - - - 419
Extraction - - - - - 419
Double and Triple Monstrosities - - - 420
Diagnosis - - - - - 420
Extraction - - - - - 421

CHAPTER IV.—DYSTOKIA FROM MULTIPARITY - 421
Diagnosis - - - - - 423
Extraction - - - - - 424

GROUP II.—DYSTOKIA FROM MALPRESENTATION OR MALPOSITION OF THE FŒTUS - - - 425

CHAPTER I.—DYSTOKIA DEPENDING ON THE ANTERIOR PRESENTATION - - - 426

A.—Normal Anterior Presentation - - - 427

Section I.—Dystokia from Abnormal Positions - 427
Dorso-pubic Position - - - - 427
Dorso-supra-Cotyloidean Positions - - - 428

Section II.—Dystokia due to the Hind-limbs - 428
Extended Hind-limbs retained by their Stifles - - 428
Hind-limbs flexed under the Body pass with it into the Genital Canal - - - - 429

B.—Abnormal Anterior Presentation - - - 433

Section I.—Dystokia due to the Fore-limbs - - 433
One or Both Fore-limbs crossed over the Neck - - 434
Fore-limbs incompletely extended - - - 435
One or Both Fore-limbs flexed at the Knees - - 436
One or Both Fore-limbs completely retained - - 440

Section II.—Dystokia due to the Head - - 443
Downward Deviation - - - - 444
Head bent under the Body - - - - 446
Lateral Deviation to the Right or Left - - 448
Deviation Upward and Backward - - - 453

Section III.—Dystokia due to the Head and Fore or Hind Limbs - - - - - 455
Head retained, and with it One or Both of the Fore-limbs - - - - - 455
Head or One of the Fore-legs retained, and One or Both of the Hind-legs in the Genital Canal - - 455

CHAPTER II.—DYSTOKIA IN THE POSTERIOR PRESENTATION - - - - - 456

A.—Normal Posterior Presentation - - - 457

Section I.—Dystokia from Abnormal Positions - 457
Lumbo-pubic Position - - - - 457
Lumbo-supra-Cotyloidean Positions - - - 459

Section II.—Dystokia due to the Head or Fore-limbs - 459
Head and Contracted Neck - - - - 459
Fore-limbs - - - - - 460

PAGE

B.—Abnormal Posterior Presentations - - 460
Hock Presentation - - - - 462
Thigh and Croup Presentation - - - 467

CHAPTER III.—DYSTOKIA FROM TRANSVERSE PRESENTATIONS - - - - - 472

Section I.—Dystokia from the Dorso-lumbar Presentation - - - - - - 473
Cephalo-ilial Positions - - - - 473
Cephalo-sacral Position - - - - 477

Section II. — Dystokia from the Sterno-abdominal Presentation - - - - - 478
Cephalo-ilial Positions - - - - 478
Cephalo-sacral Position - - - - 478

BOOK III.—OBSTETRICAL OPERATIONS - - 483

CHAPTER I. — PRELIMINARY PRECAUTIONS AND OPERATIONS - - - - - 484

CHAPTER II.—RECTIFICATION OF PRESENTATIONS AND POSITIONS - - - - - 487
Retropulsion - - - - - 487
Rotation - - - - - 491
Version - - - - - - 491
Extension and Flexion - - - - 493

CHAPTER III.—MECHANICAL MEANS FOR THE EXTRACTION OF THE FŒTUS - - - 498

Section I.—Cords and Bands - - - 499
Halter, Head-cord, or Head-collar - - - 501

Section II.—Pass- or Porte-Cords - - - 509
Section III.—Crotchets or Hooks - - - 511
Section IV.—Crotchet-Forceps and Forceps - - 517

CHAPTER IV. — THE EMPLOYMENT OF FORCE IN DYSTOKIA - - - - - 523

Section I.—Direction of Traction - - - 524
Section II.—Degree of Traction - - - 524
Section III. — Means for developing the Necessary Force - - - - - - 528
Section IV.—Comparison between Manual and Mechanical Force - - - - - 531

CHAPTER V.—EMBRYOTOMY - - - - 532
Embryotomy Instruments - - - - 534
Preliminary Arrangements for Embryotomy - - 540
Craniotomy or Cephalotomy - - - 540
Puncture of the Cranium - - - - 541
Craniotomy - - - - - 542
Decapitation and Decollation - - - 542
Amputation of the Limbs - - - - 544
Amputation of the Fore-limbs - - - 545

PAGE

Amputation of the Hind-limbs - - - 547
Detruncation or Division of the Body of the Fœtus - 548
Evisceration - - - - - 549
Thoracic Evisceration - - - - 550
Abdominal Evisceration - - - - 550

CHAPTER VI.—VAGINAL HYSTEROTOMY - - 551

CHAPTER VII.—GASTRO-HYSTEROTOMY OR CÆSARIAN SECTION - - - - - 554
Indications - - - - 556
Operation - - - - 557

CHAPTER VIII.—SYMPHYSIOTOMY - - - 561

CHAPTER IX.—ARTIFICIAL PREMATURE BIRTH - 561

CHAPTER X.—SUPPLEMENTARY OBSERVATIONS REGARDING MOTHER AND PROGENY - - 562

BOOK IV.—ACCIDENTS AFTER PARTURITION - 564

CHAPTER I.—RETENTION OF THE FŒTAL ENVELOPES - - - - - - 564
Symptoms and Terminations - - 565
Causes - - - - - 566
Treatment - - - - 567

CHAPTER II.—POST PARTUM HÆMORRHAGE - 574
Symptoms - - - - 575
Treatment - - - - 576

CHAPTER III.—INVERSION OF THE UTERUS - - 576
Symptoms - - - - 577
Complications - - - - 579
Prognosis - - - - 580
Causes - - - - - 581
Treatment - - - - 583
Amputation of the Uterus.—Metrotomy - 600

CHAPTER IV.—INVERSION OF THE VAGINA - - 603
Symptoms - - - - 605
Prognosis - - - - 605
Treatment - - - - 606

CHAPTER V.—INVERSION OF THE BLADDER - 608

CHAPTER VI.—TRAUMATIC LESIONS OF THE GENITAL AND NEIGHBOURING ORGANS - 609

I.—Laceration and Rupture of the Uterus - - 609
Treatment - - - - - 612
Rupture of the Uterus after Parturition - - 613
II.—Laceration and Rupture of the Vagina - - 613
Complications of Ruptured Vagina - - 616
III.—Thrombus of the Vagina and Vulva - - 619
IV.—Relaxation of the Pelvic Symphysis - - 619

PAGE

V.—Rupture of the Bladder - - - 620
VI.—Rupture of the Intestines - - - 620
VII.—Rupture of the Diaphragm - - - 620
VIII.—Rupture of the Abdominal Muscles - - 620
IX.—Rupture of the Sacro-sciatic Ligament - 621
X.—Rupture of the Heart - - - 621

BOOK V.—PATHOLOGY OF PARTURITION - - 622

CHAPTER I.—VAGINITIS - - - - 622

CHAPTER II.—LEUCORRHŒA - - - 624

CHAPTER III.—METRITIS, METRO-PERITONITIS, AND PARTURIENT FEVER - - - - 625

Symptoms - - - - 625
Terminations - - - - 626
Pathological Anatomy - - - 628
Causes - - - - - 631
Prognosis - - - - 634
Prophylaxis - - - - 634
Treatment - - - - 634

CHAPTER IV.—PARTURIENT OR PUERPERAL APOPLEXY.—PARTURIENT COLLAPSE - - 636

Symptoms - - - - 637
Duration, Terminations, and Complications - 640
Prognosis - - - - 642
Causes - - - - - 643
Pathological Anatomy - - - 646
Nature - - - - - 647
Diagnosis - - - - 653
Prophylaxis - - - - 653
Curative Treatment - - - 654

CHAPTER V.—POST PARTUM PARALYSIS - - 659

Symptoms - - - - 659
Diagnosis - - - - 660
Pathology - - - - 660
Prognosis - - - - 660
Treatment - - - - 661

CHAPTER VI.—ECLAMPSIA - - - - 661

Symptoms - - - - 662
Etiology and Pathology - - - 665
Diagnosis - - - - 667
Prognosis - - - - 667
Treatment - - - - 667

CHAPTER VII.—EPILEPSIA UTERINA.—MANIA PUERPERALIS - - - - - - 668

Symptoms - - - - 668
Cause - - - - - 669
Treatment - - - - 669

PAGE

CHAPTER VIII.—PARTURIENT LAMINITIS - - 670
Symptoms - - - - 670
Causes - - - - - 671
Treatment - - - - 672

CHAPTER IX.—MAMMITIS OR MASTITIS - - 673
Pathological Congestion of the Mammæ - - 674
Causes - - - - - 674
Symptoms - - - - - 674
Treatment - - - - - 676
Inflammation of the Mammæ - - - 676
Symptoms - - - - - 677
Course and Terminations - - - 680
Pathological Anatomy - - - 685
Causes - - - - - 686
Complications - - - - - 690
Prognosis - - - - - 690
Treatment - - - - - 690

CHAPTER X.—AGALACTIA - - - - 696

CHAPTER XI.—INJURIES TO THE TEATS - - 697
Fissures - - - - - 697
Causes - - - - - 697
Symptoms - - - - - 697
Treatment - - - - - 698
Obliteration of the Galactophorus Sinus - - 698
Symptoms - - - - - 698
Treatment - - - - - 699
Fistula of the Teat - - - - 700

BOOK VI.—DISEASES AND ABNORMALITIES OF THE YOUNG ANIMAL - - - - 701

CHAPTER I.—ASPHYXIA OF THE NEW-BORN ANIMAL 701

CHAPTER II.—UMBILICAL HÆMORRHAGE - - 702
Treatment - - - - 702

CHAPTER III.—PERSISTENCE OF THE URACHUS - 703
Treatment - - - - 703

CHAPTER IV.—UMBILICAL HERNIA - - - 704
Causes - - - - - 705
Pathological Anatomy - - - 705
Symptoms - - - - 706
Prognosis - - - - 706
Diagnosis - - - - 707
Treatment - - - - 707

CHAPTER V.—ŒDEMA OF THE UMBILICUS - - 713
Treatment - - - - 714

CHAPTER VI.—INFLAMMATION OF THE UMBILICAL CORD - - - - - - 714
Symptoms - - - - 714

PAGE

Pathological Anatomy - - - 715
Causes - - - - - 715
Treatment - - - - 717

CHAPTER VII.—ARTHRITIS - - - - 718
Causes - - - - - 719
Symptoms - - - - 722
Prognosis - - - - 724
Pathological Anatomy - - - 724
Treatment - - - - 727

CHAPTER VIII.—INDIGESTION - - - 729
Causes - - - - - 729
Symptoms - - - - 729
Treatment - - - - 730

CHAPTER IX.—GASTRO-INTESTINAL CATARRH - 730
Symptoms - - - - 731
Etiology - - - - 731
Pathological Anatomy - - - 732
Prognosis - - - - 732
Treatment - - - - 732

CHAPTER X.—DYSENTERY OF YOUNG ANIMALS - 733
Symptoms - - - - 733
Pathological Anatomy - - - 735
Etiology - - - - - 736
Diagnosis - - - - 737
Prognosis - - - - 737
Treatment - - - - 737

CHAPTER XI.—RETENTION OF MECONIUM.—CONSTIPATION - - - - - - 739
Causes - - - - - 739
Symptoms - - - - 739
Treatment - - - - 739

CHAPTER XII.—ECLAMPSIA OF YOUNG ANIMALS - 740
Symptoms - - - - 740
Treatment - - - - 741

CHAPTER XIII.—TETANUS AGNORUM - - 741
Symptoms - - - - 741
Etiology - - - - - 741
Pathology - - - - 741
Prognosis - - - - 741
Treatment - - - - 742

CHAPTER XIV.—CYANOSIS - - - - 742

CHAPTER XV.—SKIN DRYNESS OF THE NEW-BORN ANIMAL - - - - - - 743

CHAPTER XVI.—IMPERFORATE ANUS - - 743
Symptoms - - - - 743
Treatment - - - - 744

PAGE

CHAPTER XVII.—IMPERFORATE VULVA AND VAGINA 745

CHAPTER XVIII.—IMPERFORATE PREPUCE - - 746

CHAPTER XIX.—OCCLUSION OF THE EYELIDS - 746

CHAPTER XX.—OCCLUSION OF THE AUDITORY CANAL 747

CHAPTER XXI.—TONGUE-TIE - - - 747

CHAPTER XXII.—CLEFT PALATE - - - 748

ADDENDUM.—Infectious Abortion - - - 749

INDEX - - - - - - 751

A

TEXT-BOOK OF VETERINARY OBSTETRICS.

INTRODUCTION.

The generation and development of animated creatures is correctly described as an "eminently physiological act," and one which is ordinarily carried out, from beginning to end, as a perfectly natural process, and without any extraneous interference being required for its accomplishment. But, speaking now with regard to the higher orders of viviparous animals, this happy termination of a most important series of phenomena is not always observed; and not infrequently various causes—internal as well as external—may operate unfavourably in a number of ways, and more or less imperil the perfect development or existence of the young creature, or compromise the health or life of the mother. More especially is this danger likely to occur when the period arrives for the expulsion of the fœtus from the abdomen of its parent.

With the domesticated animals, when these obstacles to development or birth intervene, in order to remove or overcome them, and assist or supplement the natural efforts, recourse must be had to artificial means, and the resources of science and art are accordingly invoked.

The term "parturition" (from *parturio*, to bring forth) is applied to the act by which the product of conception, when it has reached a certain stage of development, is expelled from the body of the mother; and this act is that which is usually considered to be the most critical in the existence of the young creature, and to most frequently demand attention in such valuable animals as the Mare, Cow, Sheep, Bitch, etc.

The parturition of the domesticated animals, and the abnormal conditions which may precede or follow that event, come within the province of Veterinary Science, and form that division of it named "Obstetricy," which has aptly been designated the "Science of Midwifery" when applied to this division of human surgery. Though it is that which has

been selected as the title of this work, and though it is also that which is most frequently employed in technical speech by the Veterinarian, yet it is not so correctly applied with respect to animals as it is to mankind; inasmuch as, according to one derivation, it implies to "stand before" (from *obstare*, to stand before), whereas, in aiding in the birth of animals, the operator generally stands behind the creature which is in difficulty; though if the derivation from *obstare*, which also means to "oppose," "hinder progress," "offer obstruction," be accepted, then the term is quite justifiable and expressive. The term "accouchement," so often used when speaking of the birth of a human being, is not always appropriate when employed with reference to this event in animal life, as the larger domesticated creatures are more frequently delivered of their young in a standing than a recumbent position.

Instead of Obstetricy, the terms "Tokology" (τοκος, a birth, from τίκτειν, to bring forth, and λόγος, a discourse), "Tokognosia," "Tokarexeologia," and "Tokarexis"—the practice of Tokology—have been introduced; but they are not sufficiently familiar to warrant their adoption at present, and we have therefore deemed it advisable to retain the better-known word.

The term "Obstetrics" is not, as has been already shown, limited to the act of parturition—certainly one of the most important, and yet difficult, of all the animal functions; for it includes not only rules which should be followed in order to remove or remedy the material obstacles or accidents which may hinder the accomplishment of that act, but likewise embraces everything connected with the health and preservation of the female parent and the young creature while they are in the closest relations with each other before parturition, as well as for some time after their disjunction.

It therefore essentially comprehends a mechanical portion, which consists in devising means for surmounting obstacles that may impede the birth of the young animal; and, scarcely less important, a thorough knowledge of those complex functions and conditions connected with conception, generation, and the parturient state.

The Veterinarian, then, to be a successful obstetrician, must possess special and varied information of a highly scientific kind in the domain of anatomy, physiology, hygiene, pathology, surgery, etc., and to this must be added the benefits to be derived from experience; for, as has been well remarked by Saint-Cyr, in proportion as his intervention is salutary and beneficial when it is intelligent and opportune, so may it be fatal and disastrous when it is irrational, or even inopportune. His knowledge of the subjects above named must be grouped in a certain

order, so as to form a doctrinal code, and to constitute a perfect science, having its object, its rules, and its means completely defined.

The science of Veterinary Obstetrics, then, demands a perfect acquaintance with the anatomy and physiology of the generative organs and the region in which they are situated in the different animals. The study of the organs concerned in generation is essential to acquiring a knowledge of their several functions, and it is only through understanding these functions that we can appreciate the normal or abnormal course they may pursue, and be prepared to interfere successfully when required. And a correct notion of the formation, structure, magnitude, and other features of the region containing these organs—and which has been named the *pelvic cavity*—is absolutely necessary if we wish to understand the act of parturition in the several animals, and be able to render useful service when delivery of the young creature is hindered by mechanical obstacles. A knowledge of the physiology of these organs and the phenomena pertaining to generation—the formation of the fœtus, its development and external conformation, and its connections with the parent, with gestation and the modifications it produces in the organism—as well as the anomalies, accidents, and diseases which may occur during this period, is required, in addition to an acquaintance with that of the final act which we have named "parturition."

The four chief functions of the generative system may be enumerated as follows: *menstruation* or *œstrum*, *conception*, *gestation*, and *parturition*, all of which are intimately related to and dependent upon each other—a failure or defect in one disturbing their relationship, and leading to sterility or irregularity in reproduction. Deviations or anomalies in form or structure of the individual organs upon which these functions rely for their proper performance, will also tend to interfere more or less with their accomplishment.

Everything connected with this portion of the subject, which terminates with *natural* or *spontaneous parturition*, has been included under the head of EUTOKIA (from εὖ, well, and τοχος, birth).

The difficulties attending parturition, whether they depend upon the mother or the fœtus, or upon both, with the means for overcoming them, and the accidents which may complicate difficult parturition, come under the general designation of DYSTOKIA (from δὺς, difficult, and τοχος, birth).

This arrangement of the various subjects is necessary in a comprehensive treatise on Obstetrics, and it is the one which will be followed in this manual.

The maladies to which the parent is most exposed after parturition,

and their medical or surgical treatment, as well as the condition of the young animal after birth and up to the time of weaning, also form a portion of the veterinary obstetrist's study.

Such is the plan of the work: and I have only now to state that the animals more particularly referred to are of the Horse, Ox, Dog, Pig, Sheep, and Goat species; the other creatures which man has domesticated—such as the Elephant, Camel, Rabbit, and Cat—coming but rarely within the observation of the veterinary practitioner.

It may be remarked that pregnancy and parturition in the domesticated animals differ in several important features from these processes in the human species—the differences being mainly due to the dissimilarity in their respective attitudes: the quadrupedal position of the former, and the horizontal direction of the trunk, giving rise to peculiarities which are not observed in our own species, whose vertical and bipedal characteristics entail wide contrasts in this respect.

In addition to the knowledge which has been mentioned as necessary for the successful prosecution of Veterinary Obstetricy, other qualifications must be looked upon as essential. The practitioner must be possessed of great tact in manipulation, a certain amount of mechanical skill, much patience, and readiness in device; and in addition, for the larger animals, address, a fair amount of physical strength, and the advantage which long arms and fingers confer.

We need not allude to the immense importance of this branch of Veterinary Science from an economical point of view. The ever increasing value of nearly all the domesticated animals, and the necessity for their multiplication to supply the demands and meet the requirements of a widely-extending and rapidly-progressive civilization, render everything connected with their reproduction of great moment and concern; while to assist creatures in the pangs of protracted or impotent labour, and to prevent or abbreviate suffering—in all probability to preserve their life—previous to, during, or subsequent to the occurrence of this physiological act, is no less a duty than it should be a source of satisfaction to the Veterinarian.

PART FIRST.

EUTOKIA, OR TOKOLOGY.

THOSE divisions of ANATOMY, PHYSIOLOGY, and PATHOLOGY which are directly related to the processes of *generation*, *gestation* or *pregnancy*, and *parturition*, as well as that act itself, belong to the section of Obstetrics to which the designation of EUTOKIA (εὖ, *well* or *favourable*, and τόκος, *birth*), or TOKOLOGY, has been given. We shall discuss each of these subjects in the order in which they now stand, commencing with the *anatomy of the pelvis*, and of the *external and internal organs of generation.*

BOOK I.

OBSTETRICAL ANATOMY.

THE female organs chiefly concerned in generation and parturition are either entirely passive, or more or less active; according as they are composed of hard or bony, or soft parts. The *pelvis* constitutes the first, while the second are composed of the organs and structures contained within it, or more or less directly attached to it. The pelvis also forms the passage which the fœtus has to pass through in order to reach the external world in the act of parturition.

The soft organs are the *vulva*, *vagina*, *uterus*, *ovaries*, and *mammæ*: the latter furnish the young creature with its proper nourishment immediately after birth. Of these soft organs, some are *external*, and others are *internal*; the first are the vulva and mammæ, and the second are the vagina, uterus, and ovaries. The vagina and the greater portion of the unimpregnated uterus are contained in the cavity of the pelvis; and the ovaries, as well as the uterus during pregnancy, are lodged in the abdomen.

Our study will commence with an examination of the pelvis in the various domesticated animals, beginning with a description of the bones of which it is composed; then its ligaments; and, lastly, this osseous framework, which is of much importance, will be considered as a whole, and from an obstetrical point of view.

Afterwards the external and internal organs of generation will be described, and their differences noted in the various species.

The Equine species will be taken as the type, and the differences in the other species compared with it.

CHAPTER I.

The Pelvis.

THE pelvis is the large, symmetrical, more or less horizontal, or horizontally conoidal cavity or canal which continues the abdomen posteriorly, and with which it communicates in front. It is formed of bony and ligamentous walls, and contains, sustains, and protects a portion of the

genito-urinary apparatus, as well as the terminal portion of the alimentary canal. It is situated towards the end of the spine, and is supported by the posterior extremities, with which it is connected by joints and muscles. For the hind limbs, as well as for some of the powerful muscles of the trunk, the pelvis constitutes a most important fulcrum or fixed point in various movements. It is one of the two mechanical elements concerned in the act of parturition, and its form varies more or less in different species; though its direction is always rectilinear in the domesticated animals, and not incurvated as in woman.

SECTION I.—BONES OF THE PELVIS.

The pelvis is composed of three principal bones—the two *coxæ* or *ossa innominata*, and the *sacrum;* and to a certain extent of the *coccygeal* or tail bones. At an early period of life these bones can be subdivided, but after a certain time they become consolidated. Each coxal bone, for instance, is at an early stage of intra-uterine existence composed of cartilage only; subsequently three centres of ossification appear, and these extend until at birth they have coalesced to form three bones, which are united by cartilage. In addition to these centres, two complementary nuclei are present, one of which constitutes what is termed the *anterior iliac crest* or *spine* and the *ilio-pectineal line* or *ridge*, and the other the *ischiatic tuberosity*. After birth, the three chief portions of the coxæ are completely ossified, and meet in the acetabulum—where they are closely joined—and at the pubic symphysis, where the coxa of one side meets its fellow of the other. In youth, the different parts of each coxa are very thick, the spongy tissue being abundant, and the compact tissue scanty; as the animal advances in age, the former diminishes and the latter increases in density and thickness, the two layers closely approaching each other.

1. *Os Innominatum.*

The *coxa* or *os innominatum* is a pair bone, there being one on each side; it belongs to the trunk, through its concurrence in the formation of the pelvis, and also to the posterior limb, of which it constitutes the first ray or *haunch.*

It is a flat bone, widely expanded at either extremity, rather constricted in the middle portion, and curved or twisted in two different directions, its anterior part forming an obtuse angle with the posterior; so that while its external surface is inferior in the hinder portion, the anterior looks outwards, or even upwards, in front. At its middle portion it offers a wide and deep articular depression surrounded by a high rim—the *cotyloid cavity* or *acetabulum*—in which the corresponding articular head of the femur is lodged and moves. Above this cavity is a marked, roughened thin ridge—the *supra-cotyloid crest* or *ischiatic spine*, into which the sacro-sciatic ligament is fixed.

Below the cotyloid cavity, and inclining inwards, is a large circular or oval aperture, which is occupied by the obturator muscles, and is named the *foramen ovale* or *sub-pubic opening* or *foramen.*

The two coxæ are united inferiorly in the median line, and posteriorly by an articulation or solid suture—the *symphysis pubis* or *ischio-pubic symphysis*, and form by this junction a kind of V-shaped figure, the widest portion of which is in front, and renders the lateral diameter of the pelvis more extensive before than behind. Above, they articulate with the sacrum.

Each coxa, as has been stated, is composed of three portions which unite at the acetabulum ; and although consolidated into one piece, yet they are separately described as if distinct. The names of these divisions are *ilium*, *ischium*, and *pubis*.

ILIUM.—The *ilium*, *hip*, or *haunch bone* (*os ilium*), gives its name to the region it occupies. It is the largest of the three bones, as well as being that which is most elevated. In shape it is irregularly triangular and flat, and is directed obliquely downwards, inwards, and backwards; it has two faces, three borders, and three angles. Its *external* or *superior face*, or *dorsum*, is marked by some muscular imprints, and is curved in its widest part to form a concave space—the *external iliac fossa*, which lodges the gluteal muscles. The *internal* or *inferior* face, or *venter*, offers a smooth external portion—the *iliac surface*, into which is implanted the iliac psoas or iliacus muscle; and an internal roughened,

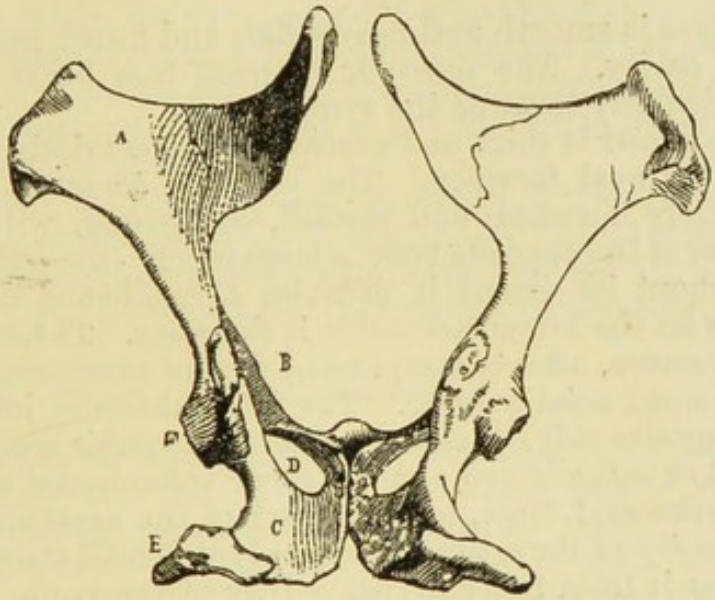

Fig. 1.

PELVIS OF THE MARE.

A, Ilium ; B, Pubis ; C, Ischium ; D, Foramen Ovale ; E, Tuberosity of the Ischium ; F, Cotyloid Cavity.

ear-shaped, irregularly diarthrodial surface, most apparent from behind —the *auricular facet*, for articulation with the sacrum.

The *anterior border*, or *crest of the ilium*, is slightly concave, and bears a rugged lip for muscular insertion. The *external border* is thick and roughened, and grooved for the passage of bloodvessels; inferiorly it has three nutrient foramina. The *internal border* is thin and concave, especially in its posterior part, where it constitutes the *great sciatic notch;* it affords attachment to the sacro-sciatic ligament. The *spine* or *ridge* of the same name partly belongs to it.

The *external angle*, *antero-superior spinous process*, or *point of the hip*, is a wide, thick, and flattened portion, bearing four tuberosities affording attachments to muscles. The *internal* or *antero-internal angle* or *supero-posterior spinous process*, is a rough tuberosity curving upwards and backwards to form an angle with the corresponding portion of the opposite ilium—the *summit of the croup*. The *inferior*, *posterior* or *cotyloid angle* (concurring in the formation of the acetabulum), is very large

and prismatic in shape. Posteriorly, it offers a concave articular surface (acetabular), and above this cavity is the *supra-cotyloid ridge* or *crista ilii*—an elongated eminence passing backwards, sharp at its summit, smooth internally, and roughened externally, which is continuous anteriorly with the inner border of the bone, divides its iliac and articular surfaces, becomes lost on the anterior margin of the pubis, and laterally limits the anterior circumference or border of the pelvic cavity —the *linea ilio-pectinea.*

The ilium is therefore united to, or in contact with, the sacrum superiorly, and inferiorly and posteriorly with the two bones next to be described.

Ischium.—The *ischium* (*os sedentarum* of man) is next in size to the ilium, and the most posterior of the three bones. In form it is flat and irregularly quadrilateral; and is composed of a thick solid portion—the *body*, and a narrow part—the *neck.* It has *two faces*, *four borders*, and *four angles.*

The *upper face* is smooth and nearly flat, and forms part of the floor of the pelvic cavity. The *lower* or *external* face bears some rugged imprints, particularly towards the symphysis.

The *anterior border* is thick and concave, and posteriorly circumscribes the obturator or oval foramen. The *posterior border* is straight and directed obliquely forward and inward, composing, with the corresponding border of the opposite bone, a large notch—the *pubic* or *ischiatic arch.* Throughout its extent it exhibits a roughened depressed lip, which projects on the lower face—this is the *spine.* The *external border* is thick and concave, affords attachment to the sacro-sciatic ligament, and forms the small sciatic notch. The *internal border* joins its homologue of the opposite side, to complete the *ischio-pubic symphysis.*

The *external* or *cotyloid angle* is the most voluminous, and shows an excavated diarthrodial facet, forming part of the acetabulum, and the posterior extremity of the crista ilii, limited by a small transverse fissure which separates it from the external border of the bone. The *antero-internal angle* joins the posterior angle of the pubis. The postero-external angle is the most important from an obstetrical point of view, as it constitutes what is commonly named the point of the hip; with the corresponding bone of the opposite side, it forms the ischiatic tuberosity (*tuber ischii*)—a thick, up-curved prismatic mass which is continued by a prominent ridge elongated from before to behind, the thin margin of which is curved outwards and downwards. The distance between the external tuberosities of the two ischii gives the width of the ischial arch, and allows an estimate to be formed of the transverse diameter of the posterior opening of the pelvis. The postero-internal angle constitutes, with that of the other ischium, the summit of the triangular notch or space named the 'ischial,' or 'pubic arch' in some species.

Pubis.—The *pubis* (*pecten* or *share-bone*) is the smaller of the three, and is situated between the ilium and ischium. It is irregularly triangular, and is described as having *two faces*, *three borders*, and *three angles.*

The *upper face* is concave and smooth, and concurs in forming the floor of the pelvis. In the pelvis of many Mares it has a more or less marked depression, apparently produced at the expense of the anterior portion of the bone, which is thin; while in the Horse it is generally much thicker at this part, and instead of a depression the surface may be plain or even convex. The *lower face* is rough, and traversed on its

whole length by a wide groove which reaches the bottom of the acetabulum, and lodges the pubio-femoral ligament and a very large vein.

The *anterior border* is thin and uneven, and is curved like the arc of a circle; it concurs in forming the anterior circumference of the pelvis. The *posterior border* is thick and concave, and in front circumscribes the *oval*, *sub-pubic*, or *obturator foramen*. It is channelled, near the acetabulum, by a fissure that passes obliquely downwards and inwards. The *internal border* joins that of the opposite pubic bone in the middle line, to form the anterior portion of the ischio-pubic or pelvic symphysis.

The *external* or *cotyloid angle* is the thickest, and constitutes the largest portion of the roughened depressed surface at the bottom of the acetabulum. The *internal angle* is united to the corresponding angle of the opposite bone. The *posterior angle* is fused at an early period with the antero-internal angle of the ischium, to form the inner boundary of the obturator foramen.

The pubis does not alter much in form with age, but retains its convex shape, while the part around the acetabulum is of considerable thickness: a circumstance which tends to diminish the pelvic cavity to a notable degree. During life, the pubic bones gradually lose their spongy tissue, and to such an extent that in old age it has almost disappeared, and the parts are translucid.

It may also be well to note that the compact tissue is most abundant in the vicinity of the acetabulum, that cavity being the point where the impulsive efforts communicated to the body by the posterior limbs are concentrated; at this part, also, ossification commences.

2. *Sacrum.*

The *sacrum* (*os basilare* of man) may be said to terminate the vertebral spine posteriorly, and results from the fusion of five vertebræ into a single, voluminous, pyramidal or triangular mass. It encloses the pelvic cavity above, and articulates in front with the last lumbar vertebra, behind with the first coccygeal or tail-bone, and laterally with the ossa innominata. It has an *upper* and a *lower face*, *two lateral borders*, a *base* or *anterior extremity*, *summit* or *posterior extremity*, and *central canal*.

The *upper face* shows the *supra-spinous processes* or *supra-sacral spine* (though the processes only meet at their base). On each side of this spine is a channel in which are four openings—the *supra-sacral foramina*, which communicate with others on the inferior face. The *lower face* is smooth, and slightly concave from before to behind; this is the roof of the pelvic cavity, and shows traces of its being composed of five bones, as well as offers four foramina for the passage of the sub-sacral nerves.

The *two lateral borders* are thick and concave, and posteriorly show a rugged lip. In front is an irregular oblique surface for articulation with the ossa innominata; this is divided into two portions, the lower of which, slightly uneven and diarthrodial, is the *auricular surface;* the upper is for the insertion of the sacro-sciatic ligament.

The *base*, or *anterior extremity*, is articulated by a slightly oval and convex surface with the last lumbar vertebra, and forms with the spine a salient angle looking down towards the abdominal cavity, named the *sacro-vertebral angle*. Laterally, it is united to the two coxæ, between which it is fixed like a horizontal wedge. In front it shows the opening of the spinal canal.

The *summit* or *posterior extremity* likewise offers the opening of the spinal canal, and a surface for articulation with the first tail-bone. The *central canal* is a continuation of that in the other vertebræ, for the passage of the spinal cord. In this bone, however, instead of being circular it is triangular, and diminishes in width posteriorly.

The position of the sacrum is more or less inclined downwards from before to behind, according to the breed of the Mare.

3. *Coccyx.*

The *coccygeal* or tail bones are a series of small, cylindrical, or irregularly prismatic pieces, from fifteen to eighteen in number, behind the

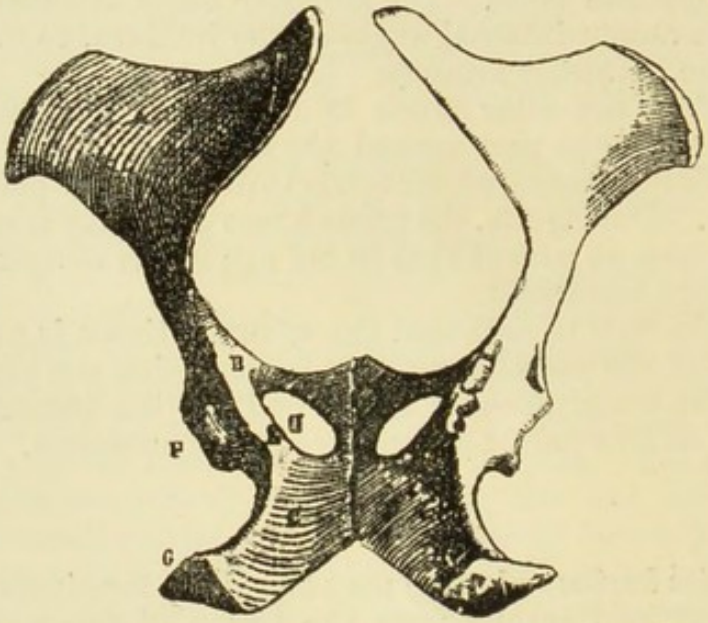

Fig. 2.

PELVIS OF THE COW.

A, Ilium ; B, Pubis ; C, Ischium ; D, Foramen Ovale ; E, Sciatic Spine ; F, Cotyloid Cavity ; G, Tuberosity of the Ischium.

sacrum, the first three of which may be said to belong to the pelvis. They form the base of the tail.

DIFFERENCES IN THE BONES OF THE PELVIS OF OTHER ANIMALS.

In all the domesticated animals the coxæ are nearly horizontal, and the ilium has a vertical direction.

Cow.

In the pelvis of the Cow, the space between the coxæ is no greater before than behind ; they are not so solid or voluminous, comparatively, as in the Mare. This is more particularly the case with the *ilium*, the iliac concavity of which is not so wide. It is more vertical than in the Mare. The *ischium*, though thinner than in the Mare, has a much wider surface, and is more curved from before to behind and from side to side ; while the ischiatic spine, or supra-cotyloid crest, is very prominent and thin. Three tuberosities are observed on the postero-external angle.

The *pubis* is wide and thin; it has no channel on its inferior face, and the upper face is very concave. The foramen ovale is large, and its margin thin. The symphysis is ossified earlier than in the Mare.

The *sacrum* is longer, and more curved and voluminous than that of the Mare. The lateral borders are sharp and directed downwards. It is composed of the same number of vertebræ as in the Horse. The articular surfaces for union with the coxæ approach the vertical direction.

The *coccygeal bones* are stronger and more tuberous; they are from sixteen to twenty in number.

The pelvis of the Cow is therefore less developed than that of the Mare, though it has more extensive bony walls; it is also lighter and less voluminous. We shall see that it likewise differs in its form and direction, and that this has a notable influence in the mechanism of parturition.

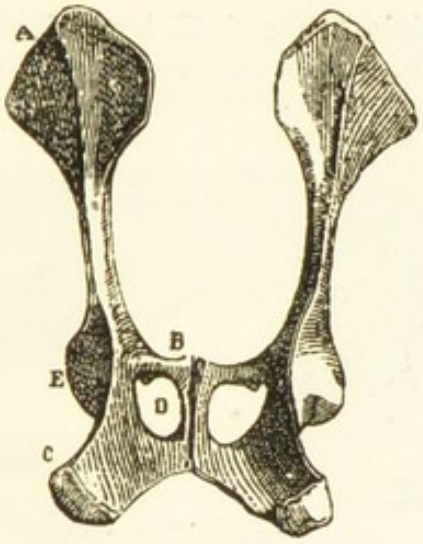

Fig. 3.

PELVIS OF THE SHEEP.

A, Ilium; B, Pubis; C, Ischium; D, Foramen Ovale; E, Cotyloid Cavity.

Sheep and Goat.

In the Sheep and Goat, the bones of the pelvis greatly resemble those of the Cow. The *ischium*, instead of being curved in a longitudinal direction, however, is nearly rectilinear, and the external iliac fossa is divided into two portions by a small longitudinal crest. The pelvis, on the whole, is more horizontal and longer than in the Cow.

Bitch and Cat.

In the Bitch and Cat, the lateral diameter of the pelvis is greater before than behind; the *ilium* is almost vertical, and its external face is much depressed. The space which forms the pubic arch only occupies the inner moiety of the posterior border of the *ischium*, which is very broad; between the arch and the ischial tuberosity is a roughened lip, which is directed downwards. The *sacrum* is somewhat quadrangular; it is composed of three bones, which are consolidated at an early age, and the lateral surfaces for articulation with the ilium are turned outwards and almost vertical. There are only three vertebral

foramina. The coccygeal bones are strong and tuberous, and the first five or six are as perfect as the true vertebral bones.

Pig.

The pelvis of the Pig resembles that of the Sheep. The crest of the *ilium* is convex, and there is no external protuberance on the symphysis pubis. The *pubis* is narrow; and the *ischium*, instead of a crest, has a tuberous prominence. The *sacrum* is formed by four vertebræ, which do not become fully consolidated for a long time, and it is sometimes difficult to discover where the sacrum ends and the coccyx begins. The spinous processes are absent; and the neural arch being deficient on each side, the spinal canal is open above. There is nothing particular to note in the *coccygeal* bones.

SECTION II.—ARTICULATIONS OF THE PELVIS.

The bones of the pelvis are united by articulations and ligaments, as well as fibrous bands, which are complementary. A knowledge of these is of some importance to the obstetrist. The articulations are

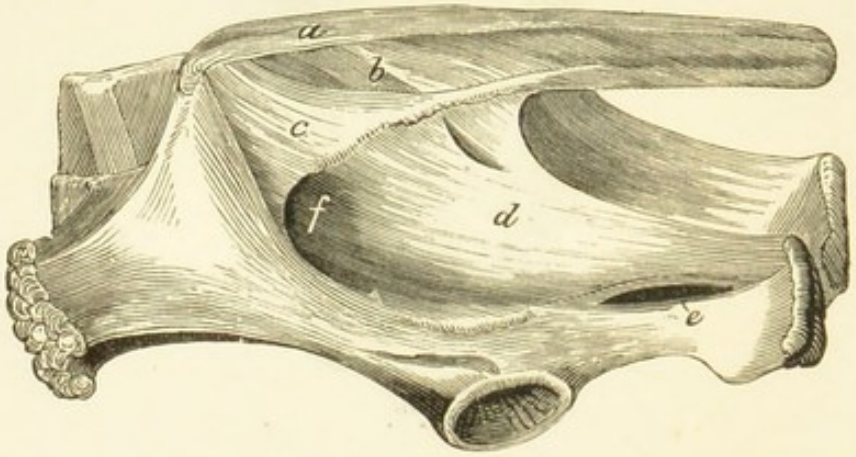

Fig. 4.

LATERAL LIGAMENTS OF THE SACRUM AND PELVIS.

a, Superior Sacro-iliac Ligament; *b*, Sacral Ligament; *c*, Lateral Sacro-iliac Ligament; *d*, Sacro-sciatic Ligament; *e*, Small Sciatic Notch; *f*, Great Sciatic Notch.

five in number: (1) the *sacro-lumbar*, (2, 3) the two *sacro-iliac*, (4) the *ischio-pubic symphysis*, and (5) the *sacro-coccygeal* articulations. The *ilio-sacral* and *sacro-sciatic* ligaments complete the subject of this section.

1. *Sacro-lumbar Articulation.*

The *sacro-lumbar articulation* is formed between the anterior face or base of the sacrum, and the last lumbar vertebra; the union takes place by five articular surfaces and thick fibro-cartilages, and numerous strong ligaments bind the two bones closely and very firmly together, so as to allow only a very restricted amount of movement between them. It would appear that these bones, though so limited in their movements on each other, yet are never anchylosed in old age nor yet by accident, even if all the other vertebræ in this region should happen to be consolidated.

This arrangement is particularly remarkable in the Mare, on which it confers great strength and solidity. It is not present in the Cow; consequently, that animal is liable to a kind of incomplete luxation, which may at times become an obstacle in parturition.

We have already alluded to the salient angle formed by the union of the last lumbar vertebra with the sacrum (*sacro-vertebral angle*), and which looks downward into the abdominal cavity.[1]

2, 3. *Sacro-iliac Articulations.*

The *sacro-iliac articulation* of each side establishes the union of the posterior limbs with the spine, and is formed by the sacrum and ossa ilii; it belongs to the arthrodial class of joints. The two surfaces which come into apposition have been already described, and it only now remains to point out that the sacrum is fixed between the antero-superior extremities of the ossa ilii like a horizontal wedge or the keystone of an arch inverted; the transverse diameter is greater below than above—the pressure it has to resist being from below. The oblong roughened surfaces on the sacrum and ilium have a layer of cartilage between them to diminish shock and facilitate movement, which is further promoted by each articulation being provided with a synovial membrane, though the amount of synovia secreted is very trifling. The union of the bones at this part is strengthened by three powerful ligaments: the *sacro-iliac*—superior and inferior, and the *sacro-iliac proper*. There is also the *sacro-sciatic* or *sacro-ischiatic* to be noticed hereafter. Though the movements of this articulation are very limited, but still useful in locomotion and parturition, yet it rarely, if ever, becomes consolidated. The diarthrodial union between the bones appears to be chiefly, if not exclusively, intended to obviate the fractures which must occur had they been united in a more solid manner; while the two articulations being the centre towards which all the impulsive efforts of the posterior extremities converge, a great degree of mobility would not be compatible with their solidity.

4. *Ischio-pubic Symphysis.*

The *symphysis pubis*, as it is sometimes termed, is the amphiarthrosis formed by the union, inferiorly, of the two ossa pubis and ischia. The articulation is consolidated by means of a layer of fibro-cartilage between the margin of these bones, which becomes ossified more or less completely and rapidly according to species; and by a layer of white ligamentous fibres—short and compact—which pass across above and below, the latter being the strongest. The movements of this articulation are very limited, and depend solely upon the elasticity of the interosseous cartilage; they are abolished when ossification occurs. This happens in the majority of horses before adult age; though sometimes the posterior portion is cartilaginous after this period.

5. *Sacro-coccygeal Articulations.*

These resemble those of the vertebræ in general, there being a thick disc of fibro-cartilage placed between each tail-bone, the first of which

[1] This angle is much more marked in woman, and is named the *promontory*; it is immediately at the entrance to the pelvis, and for these reasons it is frequently a cause of difficult parturition in her; while, from its less development and distance from the pelvis, it offers no obstacle in animals.

is joined to the posterior extremity of the sacrum. Their solidity is further assured by a common fibrous sheath which completely envelops them, but without interfering with their mobility. This mobility greatly favours parturition; but it must be noted that not infrequently the first coccygeal bone is completely ossified with the sacrum, and as this necessarily limits the elevation of the tail, it diminishes the supero-inferior diameter of the posterior opening of the pelvis, and may in this way prove an obstacle to the expulsion of the fœtus.

Differences in the Pelvic Articulations of other Animals.

In all the domesticated animals other than the Equine species, the sacrum is joined to the last lumbar vertebra by *three* diarthrodial surfaces only—the *head* of the body and two *transverse processes;* these latter on the vertebræ are not in immediate contact with the base of the

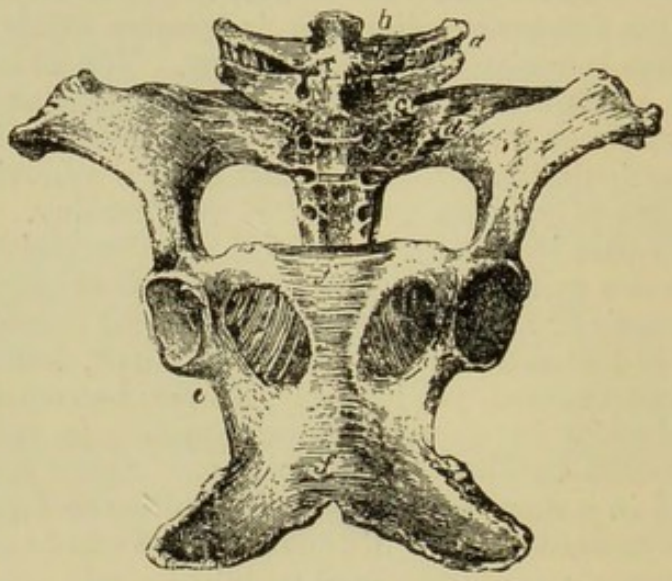

Fig. 5.

Ligaments of the Lumbar Vertebræ, Sacrum and Pelvis, seen from below.

a, Intertransverse Ligament of the Lumbar Vertebræ; *b*, Capsular Ligament of the Spinous Process of the Fifth and Sixth Lumbar Vertebræ; *c*, Capsular Ligament of the Sacrum; *d*, Inferior Sacro-iliac Ligament; *e*, Obturator Ligament; *f*, Transverse Ligament of the Ischio-pubic Symphysis.

sacrum, an interosseous ligament uniting them. Therefore it is that, in the *Cow* more particularly, there is greater mobility in the sacro-lumbar articulation, and the possibility of a greater increase in the supero-inferior diameter of the pelvis when it is subjected to such eccentric pressure as the passage of the fœtus would produce.

Cow.

In the Cow the *ischio-pubic symphysis* is considerably longer than in the Mare, not rectilinear, and much curved downwards in the middle; across this concavity on the floor of the pelvis, the fœtus passes during parturition. In the Cow ossification of the symphysis is less complete, and does not take place until much later than in the Mare, though it may in some instances be found entirely accomplished in old animals. Ossification, according to Saint-Cyr, commences in the Cow at the ischial arch, and proceeds forwards; while in the Mare it begins at the

pubis and extends backwards. The same authority remarks that this symphysis in the Cow has often a salient crest projecting into the pelvic cavity, which, if it does not offer a very considerable obstacle to the passage of the fœtus, may nevertheless greatly fatigue the obstetrist when his hand is engaged between it and the young creature, during the straining of the mother.

Sheep and Goat.

In these animals the *ischio-pubic symphysis* is rectilinear; the interposed cartilage is not ossified until very late in life, and almost never in those which have had many young. The same remarks are applicable to this symphysis in the Pig.

Bitch and Cat.

The symphysis in the Bitch and Cat scarcely ever ossifies; so that these animals, when advanced in age, still have a notable degree of mobility in this region, and the diameter of the pelvic cavity may be proportionately increased.

Sacro-sciatic Ligament.

The *sacro-sciatic ligament* (Fig. 4, *d*) transforms the pelvic cavity into a complete canal, by filling up the space on the side of the pelvis, between the sacrum and coxæ. It is a wide membranous expansion, composed of white fibrous tissue—the fibres crossing each other in different directions, and serves rather to enclose this portion of the pelvic space than to maintain the solidity of the sacro-iliac articulation. It is irregularly quadrilateral, its *superior border* being rectilinear, and attached along the rough crest on the side of the sacrum, as well as to the first two or three coccygeal bones. Its *anterior border* is irregular, and not well defined, but it is inserted above into the base of the sacrum, and below into the inner border of the ilium, circumscribing in its middle the opening which has been named the great ischiatic notch, through which the gluteal vessels and nerves, as well as the sciatic nerves, pass, and to the compression of which against the bones of the pelvis during pregnancy may be due cramp of the posterior limbs, or even more or less persistent paralysis; the *inferior border* is attached to the spine of the ischium, as well as to the ischiatic tuberosity, and between these insertions, and immediately behind the cotyloid cavity, it forms the small ischiatic notch, the opening through which the obturator internus muscle passes; while the *posterior border*, not well limited, completes the posterior circumference of the pelvic cavity, and divides into two layers, between which lies the semimembranosus muscle, and above it is mixed up with the enveloping sheath of the tail muscles and bones.

The *inner face* of this wide ligament is covered by peritoneum to the extent of one-third in front; and behind it is in direct relation with various organs contained in the pelvic cavity, by means of an abundant loose connective tissue. Its *external face* is traversed by the sciatic nerves and covered by muscles.

There are no notable differences in this ligament in the various species of animals we are dealing with.

SECTION III.—THE PELVIS AND ITS CAVITY.

Having now studied the individual portions which compose the pelvis, as well as the manner in which they are united, it remains to consider this region in its entirety, and with regard to its general conformation, dimensions, axes, and other important features. This study is of much moment from an obstetrical point of view, and for the full comprehension of the mechanism of parturition.

The *cavity of the pelvis* is the space between the inlet and outlet. In the human female it lodges nearly the whole of the uterus, and in the early days of pregnancy the fœtus also. This is not the case with the domesticated animals, owing to their different attitude, until the act of parturition carries the progeny there.[1] With its two openings, the pelvic cavity is capable of more or less increase in capacity in every direction, through relaxation of the pubic and sacro-iliac articulations and sacro-sciatic ligaments. The yielding of the latter is very noticeable in the larger animals immediately before parturition, as well as the elevation of the coccyx by the body of the fœtus in its passage outwards. It is also a fact of daily observation that the pelvis permanently widens in animals which have had young frequently; this accounts for the peculiar rocking gait they exhibit in progression, which, in some of the domesticated creatures at least, is no doubt due to persistent relaxation in the articulations above mentioned.

It may be again observed that the anterior margin of the floor of this cavity is nearly straight, and its posterior border is deeply cut into by the ischial arch, while the floor itself often offers some diversities. For instance, it may be convex in front and concave behind, or *vice versâ*, the concavity being separated from the convexity by a transverse ridge, which may also be represented by a series of small conical eminences; or the floor may be a smooth plane sloping upwards from before to behind, with a kind of raised border surrounding the anterior contour of the obturator foramen.

We will first notice the pelvis of the Mare, and proceed to compare it with the other domesticated animals.

Mare.

Considered in a general manner, the pelvis of the Mare represents a slightly cone-shaped bony cavity at the posterior part of the trunk, completing or continuing the abdominal cavity; the base of this conical space, intersected obliquely downwards and backwards, is anterior: its axis forms, with that of the abdomen, a very wide angle, the sinus of which is inferior. The summit or narrowest part of the cavity is posterior. With regard to conformation, it offers, for convenience of description, an *external* and *internal surface*, and *two openings*.

External Surface.—This surface may be considered as consisting of *four regions, planes, or faces*. The *superior region* or *croup* is the narrowest, and is slightly oblique downwards and backwards, the degree of obliquity varying not only in different breeds, but also in different animals of the same breed and species. In the Mare it is

[1] Girard thought that, in the Bitch, one of the young in the body of the uterus might occupy this space; but Rainard could not verify this: all his examinations of pregnant animals which had died before bringing forth their young proved the body of the uterus to be quite empty.

indicated by the droop or slope of the croup, which is generally greater than that of the Cow. It is more conspicuous in common than in well-bred horses, in which the croup is almost horizontal, and the tail nearly on a level with its highest point. The width of this region also varies not only with the height and volume of the animal's body, but also according to breed—the draught or coarse-bred Horse having a wider croup than the thorough-bred one. This region is constricted from before to behind, and shows, on the middle line, the spinous processes of the sacrum and the first coccygeal vertebræ; and on each side the channels into which open the four sacral foramina.

The *inferior region* is nearly horizontal, and is slightly convex. Formed by the pubic and ischial bones, it offers in the middle the symphysis pubis, on each side the subpubic channels and the obturator foramen, and outwardly the cotyloid cavities through which the pelvis rests on the posterior limbs.

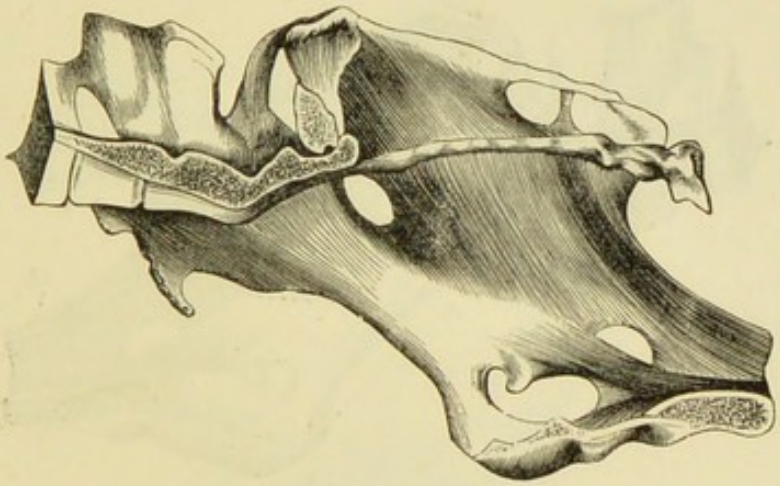

Fig. 6.

Longitudinal Section of a Mare's Pelvis.

The lateral regions are more extensive than the others; they are inclined downwards and inwards, and are wider before than behind. On each are observed the crest of the ilium and the two anterior iliac spines, the external iliac fossa, the great sciatic notch, the spine of the ischium, the small sciatic notch, and the tuberosity of the ischium.

The *internal surface* (Fig. 6), as has been already mentioned, is formed partly of bony and partly of ligamentous walls, and circumscribes the pelvic cavity, which is a continuation of that of the abdomen, and with which it communicates by a wide osseous circle—the *anterior opening* or *inlet* of the pelvis. A transverse section of this canal shows that it is oval-shaped, the largest portion being towards the pubis, and the narrowest towards the sacrum.

The internal surface is more regular than the external, but it cannot be divided into two portions like the human pelvis, the inner aspect of the ilia not being excavated to form an anterior cavity. It may, however, be considered as having *four concave planes*, an *anterior opening* or *inlet*, and a *posterior opening* or *outlet*.

The *superior*, *sacral*, or *rectal plane*, or *roof of the pelvis* is formed by the lower face of the sacrum, and is in contact with the rectum,

subsacral vessels, and sympathetic nerves. It is slightly concave longitudinally.

The *inferior plane*, or *floor of the pelvis*, is constituted by the upper surface of the pubic bones and ischia. It is rectilinear from before to behind, and concave from side to side. The symphysis pubis occupies the median line; it is salient, and varies in length according to the size of the animal, being usually about six or seven inches. In front, at the pubis, is a depression more or less marked, in which the previously-emptied bladder can be lodged during the passage of the fœtus. On each side is the obturator foramen, which is partly closed by the internal obturator muscles, and through which the obturator vessels and nerves make their exit.

The two *lateral planes* are formed by the inner surface and spine of the ischia, and in great part by the sacro-sciatic ligaments; the sciatic notches belong to them, and they are traversed from before to behind

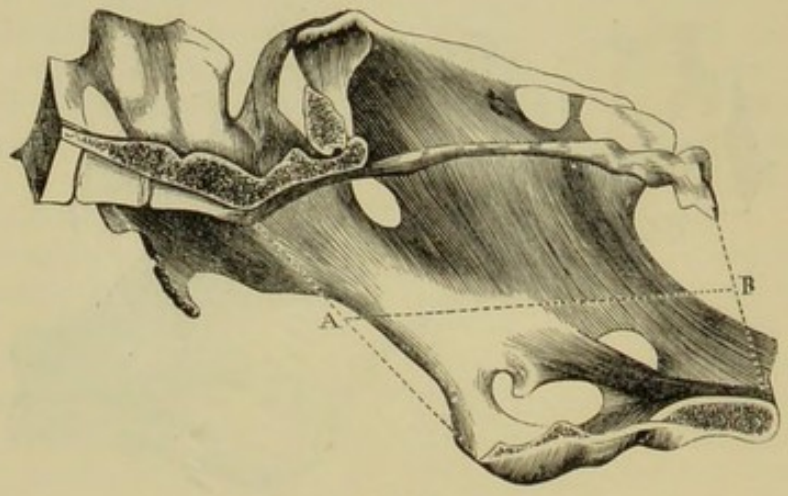

Fig. 7.

Diagram of the Mare's Pelvic Axis.

A, Inlet; B, Outlet.

by the obturator vessels and nerves, and pierced by the gluteal and ischio-muscular vessels and nerves, the internal pudic and the great and small sciatic nerves. As has been stated, it is the compression of these nerves by the uterus and its contents which causes the cramps pregnant animals experience towards the termination of gestation. The lateral planes are readily dilatable during parturition.

Anterior Opening or Inlet (Figs. 7, 8, 9).—This opening, which is continuous with the abdominal cavity, and may also be designated the *brim*, *anterior circumference*, or *abdominal opening of the pelvis*, is nearly circular, or slightly oval, the widest part corresponding to the symphysis pubis. It is a little obliquely inclined downwards and backwards, and is limited above by the anterior border of the sacrum and its articulations with the lumbar vertebra and ilia; below, by the anterior border of the pubic bones; and on each side, by the ileo-pectineal crest and a portion of the inner aspect of the ilia. Owing to this circumference being entirely bony, and also to the solidity of the articulations between the different bones, the inlet of the pelvis cannot be dilated to any appreciable degree under the most violent efforts, even supposing the

sacro-iliac and ischio-pubic ligaments to become softened and relaxed before pregnancy—a change which must be indeed rare in the Mare.

It is by the *inlet* that the fœtus enters the pelvic cavity, and a knowledge of its dimensions is therefore of much moment to the obstetrist. These dimensions are ascertained by taking the diameter of the opening at several points, but two diameters are generally recognised: a *supero-inferior* and a *transverse*. The *supero-inferior*, or *sacro-pubic diameter* (Figs. 8, 9, *a*, *b*), rather oblique, is the width between the sacro-vertebral angle and the symphysis pubis. This is generally the largest diameter, though exceptions are met with now and again; it is the diameter which should receive the widest part of the fœtus when it enters the pelvis. It varies with the size of the Mare, but is usually between eight and ten inches. The *transverse* or *bis-iliac diameter* is measured from one ileo-pectineal crest to another, and is generally less than the supero-inferior, though sometimes it may be equal, or even greater. It is from seven to nine inches.

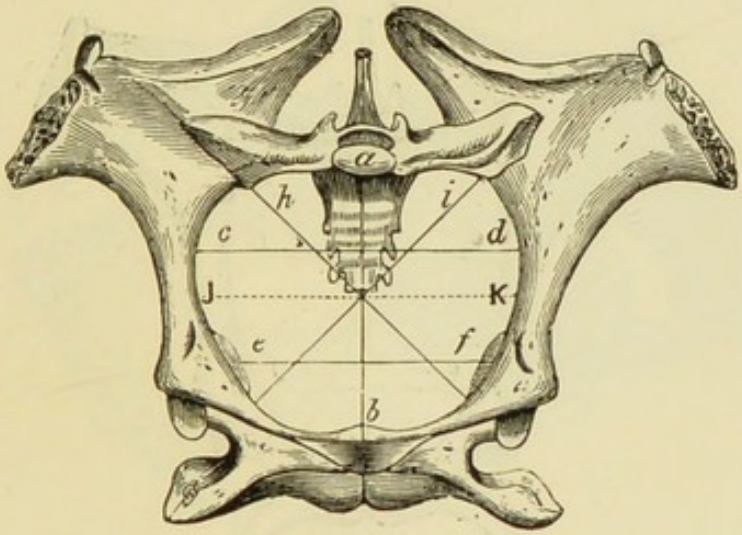

Fig. 8.

Inlet of the Pelvis of the Mare: Wide Pelvis.

a b, Supero-inferior, or Sacro-pubic Diameter; *c d*, Superior Bis-iliac Diameter; *e f*, Inferior Bis-iliac Diameter; *e i*, *f h*, Oblique, Ilio-sacral, or Sacro-iliac Diameters; J K, Middle Diameter.

It may be observed that Franck gives two oblique transverse diameters, and Saint-Cyr, in the new edition of his work, follows him, though the two do not agree in their measurements. I do not see much advantage to be gained from the adoption of these oblique diameters, which render the measurements more complicated, especially in view of the fact that the pelvis varies in form—the transverse diameter not unfrequently exceeding that of the vertical; but, following Saint-Cyr's example, I give them here, as in some respects they may be useful:

In this measurement there are two *transverse*, or *bis-iliac diameters*, a *superior* and an *inferior*. The *superior* (Figs. 8, 9, *c*, *d*) is about the upper third of the pelvic cavity, and corresponds to the shoulder and hip joints of the fœtus when it is in the *dorso-* and *lumbo-sacral* positions —the most frequent; while the *inferior* (*e*, *f*) is drawn at the lower fourth of the cavity, corresponding to the elbow and stifle joints of the fœtus. The upper diameter is sometimes less than the sacro-pubic (as in Fig. 9); but more frequently it is equal, or even superior to it. The

inferior bis-iliac diameter sometimes slightly exceeds the sacro-pubic, but generally it is less. The *oblique, ilio-sacral,* or *sacro-iliac diameters* (Figs. 8, 9, *e i, f h*), pass from the articulations, the names of which they bear, through the middle of the inlet, to the ilio-pectineal crest on the opposite side—just about the centre of the cotyloid cavity. Their length is between that of the sacro-pubic and superior bis-iliac diameters, and they are only important to note when the inlet approaches a circular outline (Figs. 8, 12), as then the fœtus may pass through the cavity with its dorso-sternal diameter corresponding to one of them; while in more oval pelves it rotates slightly in its progress, its larger axis corresponding more or less with that of the inlet—that is, to the dotted lines in Figs. 9, 11.

Posterior Opening or Outlet (Fig. 7, b).—This is also sometimes named the *perineal circumference,* or *recto-urethral opening;* it includes in its contour the rectum and vagina, and is related to the vulva and

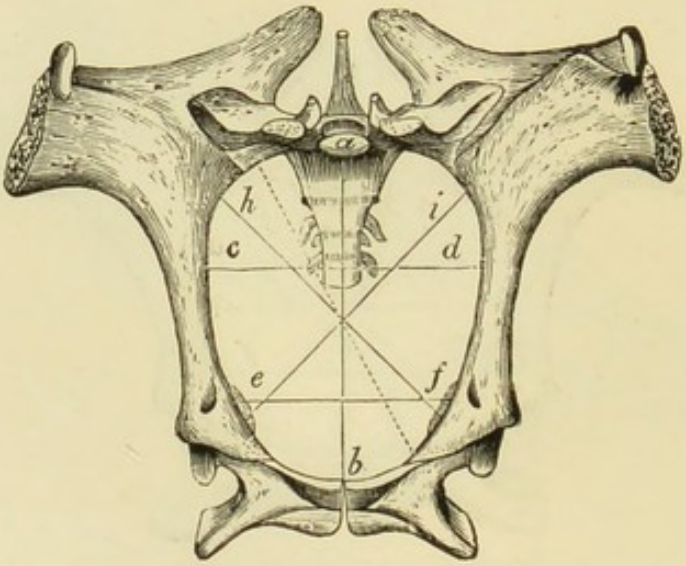

Fig. 9.

Inlet of the Pelvis of the Mare: Narrow Pelvis.

a b, Supero-inferior, or Sacro-pubic Diameter; *c d*, Superior Bis-iliac Diameter; *e f*, Inferior Bis-iliac Diameter; *e i, f h*, Oblique, Ilio-sacral, or Sacro-iliac Diameters.

anus, which are external to it. Owing to the horizontal direction of the Mare's pelvis, this outlet is limited above by the apex of the sacrum and the base of the coccyx; below, by the ischial arch, formed by the junction of the two ischia; and, laterally, by the upper surface of the ischia and posterior border of the sacro-sciatic ligaments. The opening is oval.

The *diameters* are ordinarily much less than those of the inlet—perhaps to the extent of one-fifth; but this circumstance has rarely any influence in parturition, as the opening is very dilatable, owing to the relaxation that takes place in the sacro-sciatic ligaments during the later months of pregnancy, and the great mobility of the sacrum and coccyx, which allows the supero-inferior diameter to be increased considerably.

It may be noted that the pelvis of the female Ass differs but little from that of the Mare, so far as shape is concerned, its inlet being generally oval from above to below, the sacro-pubic diameter slightly exceeding the transverse in measurement.

Differences in other Animals.

Cow.

In the Cow the pelvis (Fig. 10) is longer than in the Mare, and less vertical; the ischio-pubic symphysis is also longer, and, instead of being straight, is very curved, so that the floor of the pelvis is concave in every direction. The ischial arch is more deeply cut at the symphysis, and the posterior borders of the ischia join at an acute angle or V-shape, the opening being supero-posterior. The external border of these bones is higher, and the sciatic spine or supra-cotyloid crest is thinner and more elevated. So that, altogether, the bony parietes of the Cow's pelvis are more extensive, comparatively speaking, than the Mare's. The sacral surface is more concave, and the sacro-sciatic ligaments longer, though narrower.

The pelvic cavity (Figs. 11, 12) of the Cow is also less wide, when compared with its height. The diameters of the *inlet*—which is more

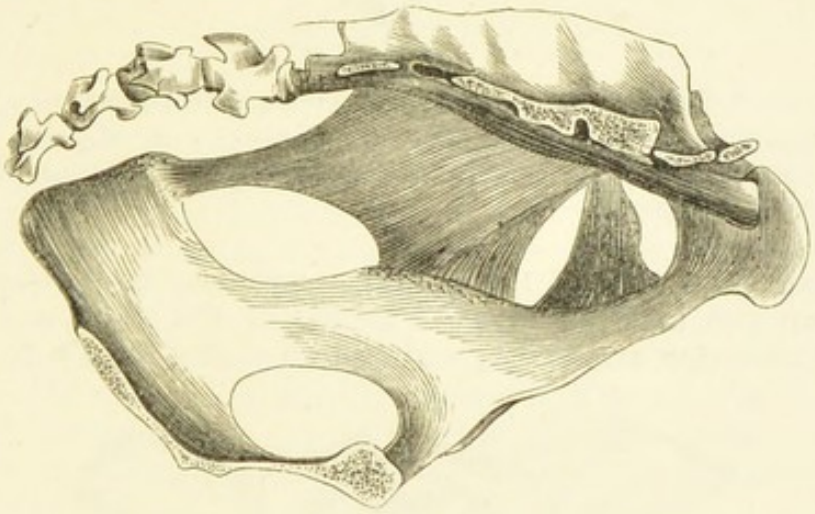

Fig. 10.

Longitudinal Section of the Cow's Pelvis.

oblique than in the Mare—are very unequal; the difference between the sacro-pubic and the transverse, according to Saint-Cyr, being one-third (nine and six inches); while it is narrower at its lower part, and not so markedly oval as in the Mare. Its sides are also nearly parallel for some distance, so that its sacro-pubic diameter is greater than its transverse; the difference varying, according to Saint-Cyr's measurements, in favour of the first from 3 centimetres (Fig. 12) to 10·4 centimetres (Fig. 11).

The dimensions of the *outlet* are not so reduced as in the Mare; they are more equal, and are about those of the transverse diameter of the inlet. It therefore results that the pelvis of the Cow is more cylindrical and less conical than that of the Mare; but this feature does not render parturition any easier, for though the outlet is a little larger than in the latter animal, yet this advantage is counterbalanced by the length of the pelvic cavity, the greater extent of its bony walls, and the very marked curvature of the symphysis. So it is that, while it rarely happens that the Foal experiences any difficulty in passing through the cavity, once it has fairly cleared the inlet, in the Cow parturition takes

longer, and it is not at all infrequent for the Calf to become fixed in the pelvis, there to remain unless removed by artificial means.

It is also to be noted that the floor of the pelvic cavity is on a much

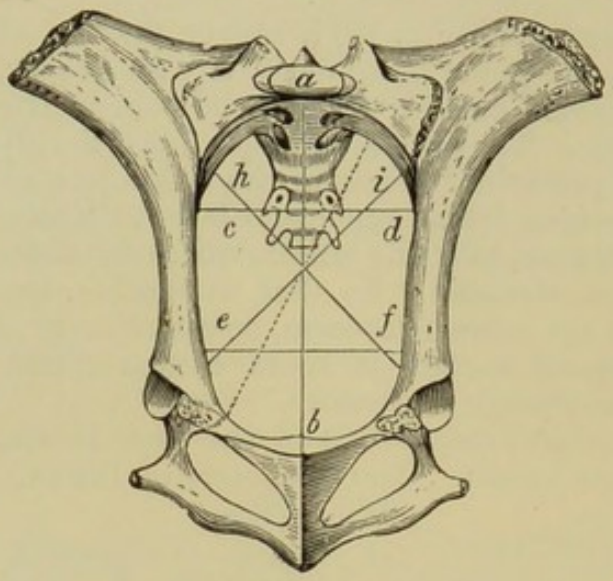

Fig. 11.

INLET OF THE COW'S PELVIS: NARROW PELVIS.

a b, Supero-inferior, or Sacro-pubic Diameter; *c d*, Superior Bis-iliac Diameter; *e f*, Inferior Bis-iliac Diameter; *e i*, *f h*, Oblique, Ilio-sacral, or Sacro-iliac Diameters.

higher level than that of the abdomen; consequently, the abdominal muscles are not inserted into the margin of the pubis, as in Solipeds, but more posterior and lower, and have a strong tendon fixed into the

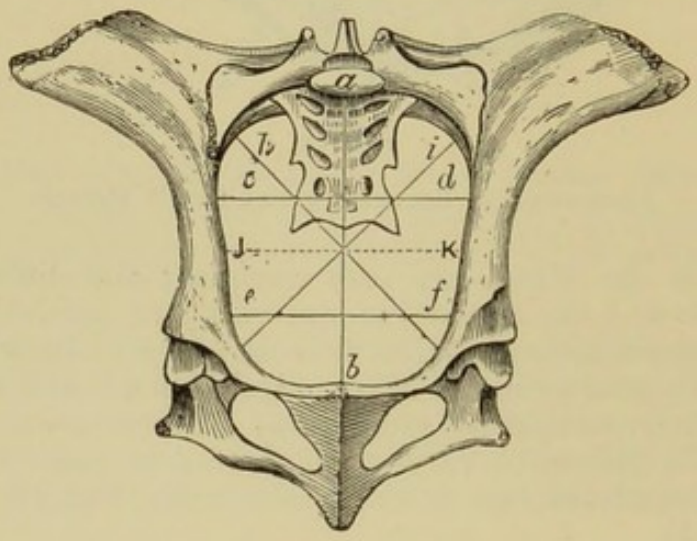

Fig. 12.

INLET OF THE COW'S PELVIS: WIDE PELVIS.

a b, Supero-inferior, or Sacro-pubic Diameter; *c d*, Superior Bis-iliac Diameter; *e f*, Inferior Bis-iliac Diameter; *e i*, *f h*, Oblique, Ilio-sacral, or Sacro-iliac Diameters; J K, Middle Diameter.

pubic symphysis—the *transverse ligament* of Goubaux. Therefore it is that a kind of steep step has to be ascended by the Calf before it can enter the pelvic cavity, and this explains why it often remains fixed against this upper level at the inlet.

Sheep and Goat.

With these animals the pelvis does not differ to any notable extent—except, of course, in size—from that of the Cow. The *symphysis* is nearly rectilinear in its direction, and its ossification occurs at a very much later period than in the Cow or Mare; this allows the diameters of the pelvic cavity to be increased during parturition, and accounts for the rarity of difficult births in the Sheep and Goat.

Pig.

The general conformation of the pelvis in the Pig is not unlike that of Ruminants, except that the *sacro-vertebral angle*, or 'promontory of the sacrum,' is more salient, the canal longer, the *plane* of its *anterior circumference* more oblique, and the direction of the *ischio-pubic symphysis* perfectly rectilinear. The *pelvic cavity* is very large in proportion to the size of the young at birth; therefore it is that accidents are very rare during the act of parturition.

Bitch and Cat.

In these creatures the *sacro-vertebral angle* is still more marked than in the Pig, and diminishes the inlet of the pelvis to a notable extent; the direction of the symphysis is rectilinear, and the general outline of the pelvic cavity is nearly cylindrical, though the inlet is larger below than above. The *ischium*, immediately above the obturator foramen, is wide and shallow, and rises abruptly to almost a right angle; this is the narrowest part of the canal, and here it is that the passage of the fœtus is obstructed in small females which have been impregnated by large dogs. It must be remarked, however, that the late, and often incomplete, ossification of the symphysis allows a certain amount of dilatation of the canal, and renders the passage of a comparatively large fœtus possible.

Differences in the Pelvis according to Sex.

There is a considerable difference in the size and conformation of the *male* and *female pelvis* in the domesticated animals, as might be expected from the sexual functions being so diverse in the two creatures, the female pelvis being larger in every sense, but more particularly in its transverse diameter. These differences have only been carefully studied in the Equine species, but they exist in a somewhat similar degree in the pelvis of other species.

In the Mare, in addition to the pelvis being wider than that of the Horse, the inlet is much larger, the ilio-pectineal crests are further apart, and the distance between the lower face of the sacrum and the anterior border of the pubis is much greater, the ilia and pubis being broader and more concave. On the upper surface of the Mare's pelvis, the sacro-sciatic notches are very deep; the inner border of the ilium forms a very concave line, and the ischiatic spines are widely separated. The floor of the pelvis is wide, and the bones composing it have a tendency to assume the same horizontal direction. In the Horse, the ischiatic border does not describe a regular curve; it is composed of two nearly straight portions, which unite where the neck of the ilium begins. The supra-cotyloid crests are not much separated, and are

turned outwards, and the two portions of the floor of the canal are directed very obliquely downwards and inwards. In the Mare the ischial arch is wider than in the Horse, and forms a regular curve in

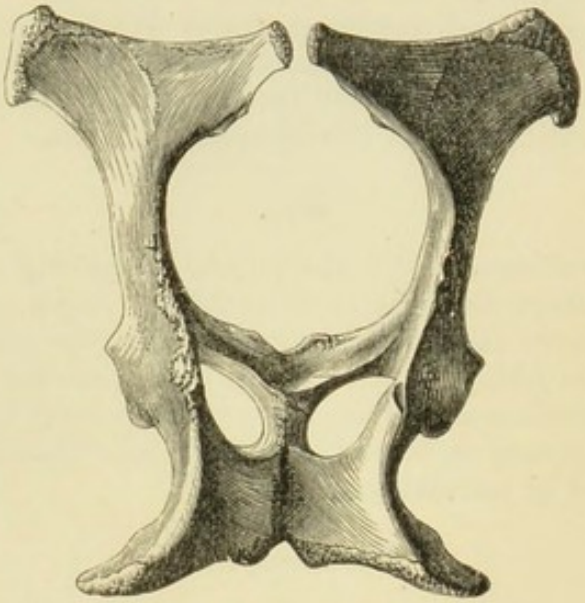

Fig. 13.

Bones of Pelvis of Mare.

joining the tuber ischii; while in the Horse these tuberosities are not nearly so wide apart, and the ischial arch forms a somewhat acute angle, the margin of which is nearly straight. The obturator foramina

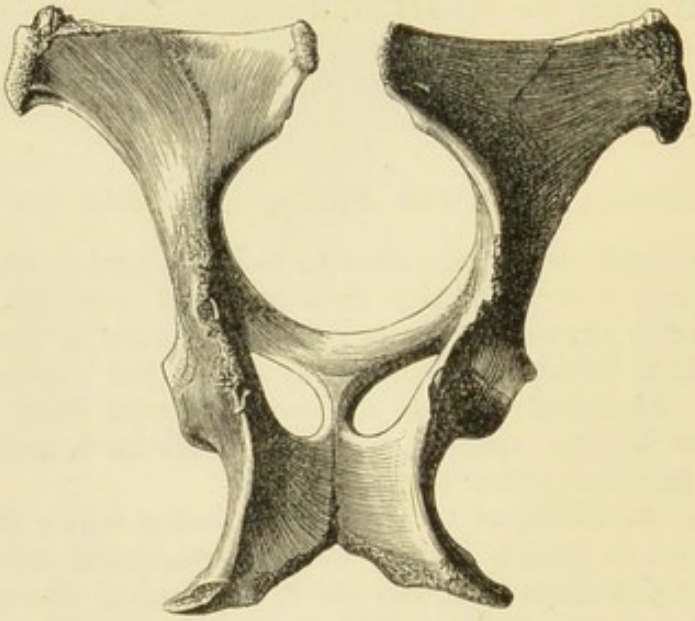

Fig. 14.

Bones of Pelvis of Horse.

are also large and almost circular in the Mare, while they are small and oval in the Horse; the ischio-pubic symphysis is farther from the cotyloid cavities in the former than in the latter.

The sacrum is also broader and longer in the Mare, and in the

majority of animals it is more concave from before to behind. The first coccygeal vertebræ are larger and more flexible, and carried at a greater elevation than in the Horse.

This difference of conformation in the pelvis of the Mare is adapted to the passage of the fœtus through the canal, and it causes the animal to appear lower in the forehand than the Horse, in which the croup is not so high. It is rare to find a Mare which has the croup so square as the Stallion, the hind quarter of which is almost equal in depth, breadth, and length.

The width of the pelvis of the Mare, as before observed, produces a rocking motion during progression, and this is all the more marked as the animal has been frequently bred from; for the same reason the speed is not so great, and it has been remarked that Mares which have had several foals are not well adapted for the circus.

The differences in the pelvis of the Mare and the Horse are sometimes noticeable at birth; but they are generally most apparent when the adult period has been reached, and the body has acquired its definitive form. In both sexes, the supero-inferior diameter of the inlet is greater than the transverse in early life.

Some idea of the difference in the dimensions of the pelvic cavity in the Mare and Horse, may be obtained from the following measurements of two animals about the same in size:

	Vertical Diameters.		Horizontal Diameters.	
	Between the Sacrum and Pubis.	Between the Sacrum and Ischium.	Between the Pectineal Ridges.	Between the Ischial Spines.
Mare	9 inches.	$6\frac{9}{10}$ inches.	$9\frac{1}{4}$ inches.	$7\frac{1}{2}$ inches.
Horse	8 „	$6\frac{3}{10}$ „	8 „	$6\frac{1}{2}$ „

The differences in the pelvis in the two sexes are, perhaps, not so marked in the smaller domesticated animals until the female has brought forth young several times.

SECTION IV.—CAPACITY OF THE PELVIS, OR PELVIMETRY.

We have already casually alluded to the capacity of the pelvic cavity in the larger domesticated animals, and to its diameters; and it will be inferred that these must vary with the different sizes existing in the Mare, Cow, Pig, and Bitch; though in others which are generally of uniform volume —as the Sheep, Goat, Ass, and Cat—the pelvis does not offer much diversity. In this respect the latter species resemble mankind, in the female of which a difference in size does not make much difference in pelvic dimensions—half an inch probably covering the variations. But in the Mare or Cow, if we compare a small with a large animal, this difference in diameters may extend to nearly two or three inches.

The subject of *pelvimetry* is very important to the *accoucheur* of the human species, as the female pelvis is particularly liable to be deformed or defective in its proportions. It is not nearly of so much moment to the veterinary obstetrist, as the head of young animals generally experiences no difficulty in passing through the pelvic cavity, except

sometimes in the Carnivora or in cases of hydrocephalus; and also because the less value of animal life leads the operator, when in difficulties, to sacrifice the fœtus rather than endanger the existence or value of the mother.

It is, nevertheless, useful to know the diameters of the pelvis of different animals, in order not only to fully understand the mechanism of parturition, but also with regard to the indications they may furnish in many cases of dystokia.

We have shown that the pelvic canal in the large and small Herbivora is somewhat of an oval shape, the narrowest part being above, and the widest below; and that in the Carnivora it is somewhat cylindrical. This difference in outline is conformable with the shape of the fœtal thorax, which in the former is deeper than it is wide, particularly at the period of birth. During parturition, the fœtus of Herbivorous animals is so placed, generally, that the withers and shoulders are towards the roof or superior plane of the pelvis; while the sternum and

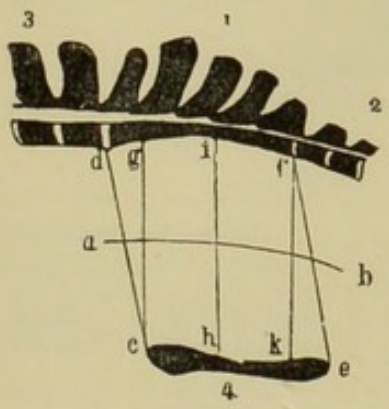

Fig. 15.

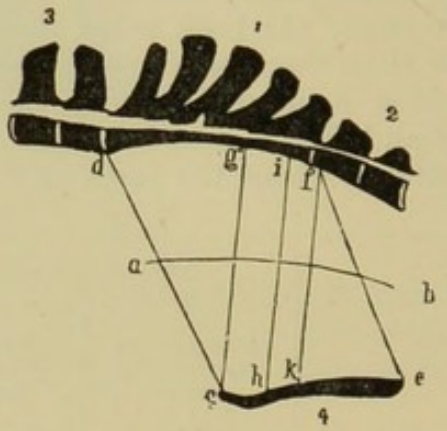

Fig. 16.

MEDIAN SECTION OF THE PELVIS OF THE HORSE (Fig. 15) AND MARE (Fig. 16).

1, Sacrum; 2, Two first Coccygeal Vertebræ; 3, Two last Lumbar Vertebræ; 4, Ischio-pubic Symphysis; *a b*, Axis of the Pelvic Cavity; *c d*, Supero-inferior Diameter of the Inlet; *e f*, Supero-inferior Diameter of the Outlet; *c g*, Vertical Diameter of the Inlet; *i h*, Vertical Diameter of the Mid-pelvis; *k f*, Vertical Diameter of the Outlet.

anterior limbs, which form a larger mass, rest on the floor or inferior plane. The passage of the thorax of the fœtus in these animals is, apart from other causes, the chief difficulty in parturition. In the human female, it is the head of the fœtus. The thorax of the Carnivorous fœtus is not nearly so deep, comparatively; it is therefore better adapted to pass through the nearly circular canal.

The term *diameter*, in obstetrics, is employed to designate the distance between certain points in the pelvic cavity, and by which, practically, we may compare the capacity of that space with the volume of the largest part of the fœtus that has to pass through it.

In the human species four diameters are usually given for the inlet and outlet of the pelvis, and some veterinarians also furnish these measurements. They are: (1) a *vertical* or *sacro-pubic*, from the sacro-lumbar articulation to the ischio-pubic symphysis; (2) a *transverse*, passing between the most concave portion of the ilia; and (3, 4) two oblique, from the ilio-pectineal line of one side to the sacro-lumbar articulation of the other.

Chauveau, in his measurements of the Horse's pelvis, gives these four measurements for the *inlet* (mean vertical, 8¼ inches; transverse, 8½ inches; oblique, 8½ inches); but for the *outlet* only the vertical and transverse (mean vertical, 6½ inches; transverse, 7 inches). Rainard, for the *inlet*, gives three diameters; (1) a *supero-inferior*, from the sacro-lumbar articulation to the anterior border of the ischio-pubic symphysis; (2) a *transverse*, from the inner surface of the cotyloid angle on one side to the same point on the opposite side; (3) a *vertical*, from the middle of the sacrum to the ischio-pubic symphysis in the larger animals, and to the sacro-coccygeal articulation in the smaller. But for the *outlet* he has only two diameters: (1) a *vertical*, from the posterior part of the ischio-pubic symphysis perpendicularly to the sacrum or its prolongation, the coccyx; (2) a *transverse*, from one ischial tuberosity to the other.

The most important diameter is certainly that between the middle of the sacrum and the ischio-pubic symphysis in the larger animals, and the sacro-coccygeal articulation and ischio-pubic symphysis in the smaller creatures. For it must be remembered that the pelvis of the domesticated animals offers a very inclined plane, and if, placing it in the position of the human pelvis, we draw a horizontal line from the symphysis towards the spine, it will be found that this line does not touch the sacro-lumbar articulation, but the middle of the sacrum in the large, and the sacro-coccygeal articulation in the smaller animals. This point is the narrowest through which the fœtus has to pass, and in which it will meet most resistance; for while the top of its shoulder is towards the sacrum, its chest is resting on the pubis. So that it may be said that this is really the first solid resistance to be overcome in parturition.

Considering the variations in size in some species, it is not possible to give general measurements for all; but we may follow the example of Rainard, and give average diameters for different-sized animals. These are tabulated as follows; the last column, headed 'Symphysis,' gives the length of the floor of the pelvis.

Species.	Height.	OPENINGS.				Symphysis.
		Inlet.		Outlet.		
		Diameters.	Measures.	Diameters.	Measures.	
Horse	15 hands	Supero-inferior Vertical Transverse	$9\frac{1}{2}$ in. $9\frac{1}{4}$ in. $9\frac{1}{4}$ to $9\frac{1}{2}$ in.	Vertical Transverse	$6\frac{7}{10}$ in. $7\frac{1}{2}$ in.	9 to $9\frac{1}{2}$ in.
	14 hands	Supero-inferior Vertical Transverse	$9\frac{1}{4}$ to $9\frac{1}{2}$ in. $8\frac{7}{10}$ in. $8\frac{7}{10}$ to 9 in.	Vertical Transverse	6 to $6\frac{1}{2}$ in. $6\frac{7}{10}$ to 7 in.	$8\frac{7}{10}$ in.
	12 hands	Supero-inferior Vertical Transverse	$8\frac{3}{10}$ to $8\frac{7}{10}$ in. $7\frac{9}{10}$ in. $7\frac{1}{2}$ to $7\frac{9}{10}$ in.	Vertical Transverse	$4\frac{3}{10}$ to $4\frac{7}{10}$ in. $5\frac{1}{10}$ to $5\frac{1}{2}$ in.	$7\frac{1}{10}$ to $7\frac{1}{2}$ in.
Ass	Medium size	Supero-inferior Vertical Transverse	$7\frac{9}{10}$ in. $5\frac{9}{10}$ in. $4\frac{7}{10}$ in.	Vertical Transverse	$4\frac{7}{10}$ in. $3\frac{9}{10}$ in.	$3\frac{9}{10}$ in.
Cow	Medium size	Supero-inferior Vertical Transverse	$8\frac{7}{10}$ in. $7\frac{9}{10}$ in. $7\frac{1}{10}$ in.	Vertical Transverse	$7\frac{9}{10}$ in. $7\frac{1}{2}$ in.	$4\frac{7}{10}$ in.
Sheep	Ordinary size	Supero-inferior Vertical Transverse	$4\frac{7}{10}$ in. $2\frac{4}{10}$ in. $3\frac{1}{10}$ in.	Vertical Transverse	$3\frac{1}{2}$ in. (varies) $2\frac{4}{10}$ in.	2 in.
Goat	Medium size	Supero-inferior Vertical Transverse	$4\frac{3}{4}$ in. $2\frac{3}{4}$ in. $3\frac{1}{2}$ in.	Vertical Transverse	$2\frac{3}{4}$ in. $2\frac{3}{4}$ in.	$2\frac{3}{4}$ in.
Pig	$27\frac{1}{2}$ in. Length from snout to tail, $54\frac{3}{4}$ in.	Supero-inferior Vertical Transverse	4 in. $3\frac{2}{10}$ in. $3\frac{2}{10}$ in.	Vertical Transverse	$2\frac{4}{10}$ in. 4 in.	4 in.
Dog	Large	Supero-inferior Vertical Transverse	$2\frac{1}{8}$ in. 2 in. 2 in.	Vertical Transverse	$2\frac{1}{8}$ in. 2 in.	2 in.
	Small	Supero-inferior Vertical Transverse	2 in. $1\frac{6}{10}$ in. $1\frac{2}{10}$ to $1\frac{6}{10}$ in.	Vertical Transverse	2 in. $1\frac{6}{10}$ in.	$1\frac{2}{10}$ in.
Cat	Ordinary size	Supero-inferior Vertical Transverse	$2\frac{1}{8}$ in. 2 in. $1\frac{2}{10}$ in.	Vertical Transverse	$2\frac{1}{8}$ in. $1\frac{6}{10}$ in.	$1\frac{6}{10}$ in.

Some veterinarians, however, as already stated, who have made this subject an almost special study, only specify two diameters—the *supero-inferior* or *sacro-pubic*, and the *transverse* or *bis-iliac*. The following are the measurements furnished by four of these authorities:

MARE.

Diameters.	Baumeister and Rueff.	Carsten-Harms.	Arloing.	Saint-Cyr.	Remarks.
INLET.	Inches.	Inches.	Inches.	Inches.	
Supero-inferior Diameter	9 to 10	$9\frac{1}{2}$	9	$8\frac{3}{4}$*	*The average of 28 measurements of Mares varying from $13\frac{1}{2}$ to 16·1 hands in height.
Transverse Diameter	11 to $12\frac{1}{2}$	$9\frac{1}{5}$	$9\frac{1}{5}$	$8\frac{1}{10}$†	†The average of 25 measurements as above.
OUTLET.					
Supero-inferior Diameter	9 to 10	$7\frac{1}{2}$	7		
Transverse Diameter	9	$6\frac{1}{2}$	$7\frac{1}{2}$		

COW.

Diameters.	Baumeister and Reuff.	Carsten-Harms.	Arloing.	Saint-Cyr.	Remarks.
INLET.	Inches.	Inches.	Inches.	Inches.	
Supero-inferior Diameter	9 to $9\frac{1}{2}$	$8\frac{1}{6}$	—	$10\frac{1}{2}$*	*The average of 5 measurements of Cows of different sizes and breeds.
Transverse Diameter	$6\frac{3}{4}$ to $7\frac{3}{4}$	7	—	$7\frac{1}{4}$†	†Ibid.
OUTLET.					
Supero-inferior Diameter	9				
Transverse Diameter	9	$6\frac{1}{2}$			

It will be seen from these measurements that no great practical utility can be derived from pelvimetry, so far as averages are concerned; as the diameters of the pelvis must vary with the size and other peculiarities in an animal's conformation; so that we may have considerable differences. In the Mare alone, Saint-Cyr found a difference in the supero-inferior diameter of $2\frac{1}{5}$ inches, and in the transverse diameter of $2\frac{1}{2}$ inches.

With the view of determining the capacity of the pelvis of the living animal at a given time, *external pelvimetry* has been resorted to. This consists in ascertaining the distance between the angles of the haunch on each side, that between the two ischial tuberosities, and that between the coxo-femoral articulation and the highest part of the croup. To find out the first, a piece of wood is placed vertically against each haunch, and the space between them is measured; for the second, a tape measures the distance between the ischial tuberosities; and for the third, a piece of wood is placed horizontally across the summit of the croup, while another is laid in the same direction along the trochanter and the ischial tuberosity, the vertical distance between the two pieces giving the measurement. Taking into consideration the shape of the pelvis, it has been calculated that the transverse diameter of the outlet should be nearly equal to one-fourth of the distance between the haunches, added to that between the ischial tuberosities; while the supero-inferior diameter of the outlet is supposed to be equal to three-fourths of the vertical distance separating the coxo-femoral articulation from the summit of the croup. These measurements only give the supposed diameters of the outlet; but Arloing, who has devoted much

attention to pelvimetry in animals, points out the means whereby the diameters of the inlet may be attained.[1]

This method is, however, so complicated and unsatisfactory, that it requires further elaboration before it can be recognised as useful and reliable.

Saint-Cyr has endeavoured, in a somewhat similar manner, to arrive at some criterion as to the diameters of the inlet of the pelvis—which is, after all, the most important in parturition—in the living animal. For the *sacro-pubic* diameter, he has taken for guide the *height of the Mare*, supposing that the two should be nearly always constant in their relations; and to fix this relation, the diameter was measured in twenty-eight animals of various sizes. Taking the average of these twenty-eight measurements, and dividing it by the average of the heights, the quotient obtained gave the *co-efficient*, by which it was necessary to multiply the height of any Mare to find the sacro-pubic diameter of its pelvis. For the *transverse* or *bis-iliac diameter*, the width of the croup measured between the external angles of the ilia (taken by a tape), or between the coxo-femoral articulations (taken by a large pair of compasses), was adopted. But it was soon discovered that one and the same co-efficient would not serve for all cases; as in common-bred lymphatic horses, the bones are large, the soft textures abundant, and the pelvic cavity less than would be surmised from the width of the croup; while in those which are well-bred, the bones are smaller and denser, the soft tissues more condensed, and the pelvic space large, comparatively speaking. So that the co-efficient had to be less in the latter than the former.

The results of Saint-Cyr's measurements and calculations are fairly reliable, and the external measurements do not differ very widely in their indications from those furnished by actual measurement of the pelvic cavity.

This method, however, even when accepted as perfectly reliable, only furnishes us with the dimensions of the well-formed normal pelvis; it gives no information with regard to internal deformities, for the estimation of which it is necessary to have recourse to 'direct exploration,' either through the vagina or rectum, by which we may not only discover the character, but also, approximately, the extent of the deformity. "Internal pelvimetry" may also be resorted to in this way; and in practice, after a little experience, it will be found sufficiently simple and trustworthy to be of much service. This internal measurement of the pelvic cavity cannot be satisfactorily made by means of compasses or other instruments in the living animal, as in woman; but the hand may be successfully employed in ascertaining the different diameters by spans—as the thumb from the index to the middle finger, and even widely spread to the little finger; the distance between these being previously known, we may readily ascertain with sufficient accuracy the diametrical capacity of the pelvis.

The *axis of the pelvis* is the term given to an imaginary line drawn through the pelvic canal from before to behind, at an equal distance from the circumference. In the human pelvis there are *two* axes—those of the upper and lower outlet, and a knowledge of them is of much importance in midwifery; they form an obtuse angle with each other, and, when combined with the inclination of the pelvis, we observe that the direction the human fœtus must take is somewhat tortuous or

[1] The calculations and measurements are given in Saint-Cyr's "Traité d'Obstétrique Vétérinaire," second edition, p. 26.

curved. In animals there is only one axis, and that is almost rectilinear, the sacro-vertebral angle or "promontory" being comparatively little developed, and the sacrum passing almost in a direct line from the vertebral column. This rectilinear direction of the pelvic axis is greatly to the advantage of animals during parturition; so that the *axis* of this canal requires but little notice from the veterinary obstetrist, except when the passage is very constricted.

CHAPTER II.

Female Generative Organs.

The *genital organs* of the female are much more complicated than those of the male, because of the far greater share they take in the process of generation. They are usually described, according to their situation, as *external* and *internal;* or from their function—as *copulative* and *formative.*

Proceeding from the exterior to the interior, these organs may be enumerated as follows: the *vulva* and *mammæ* or *mammary glands*, the *vagina, uterus, Fallopian tubes*, and *ovaries.* We will describe these in the above-mentioned order, taking the Mare again as the type, and indicating the differences in the other domesticated animals.

SECTION I.—EXTERNAL ORGANS OF GENERATION.

The Vulva.

The external orifice of the generative organs, the *vulva*, appears as a vertically elongated slit, situated beneath the anus, between the perineum and ischial arch and the posterior margin of the two hind quarters. It presents two thick *lips* or *labia*, and *two commissures*, externally; and internally it forms a cavity which is continuous with that of the vagina, and extends beyond the *meatus urinarius.* The limit between the vulva and vagina is not perceptible in the adult, but is always conspicuous in the fœtus.

The *lips* (*labiæ vulvæ*) are usually in contact, and they, with the opening which separates them (*rimæ vulvæ*), vary in size according to age and condition. They are slightly prominent and thick, being composed of firm, flexible, and elastic tissue, which is covered with a fine, smooth, unctuous skin destitute of hair, but rich in pigment in the majority of animals. Internally, they are covered by mucous membrane, a continuation of that lining the vagina, and which is constantly lubricated by a greasy mucus possessing a special odour, according to the species of animal; on the free border of the vulva this membrane and the skin meet.[1]

At the junction of the labia above and below are the *commissures*, due to this junction. The *superior commissure* is situated close to the anus, from which it is only separated by a narrow space—the *perinæum.* It is very angular, and corresponds to the *fourchette* in woman. The *inferior commissure* is obtuse, rounded and more voluminous; it lodges

[1] The two lips correspond to the *labia majora* of woman; there are no *labia minora* in animals.

the *clitoris*, and is situated immediately above the *raphé*. The *cavity* of the vulva sometimes contains the *hymen*, which separates it from the vagina at a certain period of life; it also contains the *meatus urinarius* and its *valve*, as well as the clitoris.

The *structure* of the vulva consists of the *mucous membrane* lining its interior, and which is covered by pavement epithelium; an erectile structure connected with it, named the *vaginal bulb*; two *constrictor muscles*; two *muscular ligaments*, *fasciæ*, etc. The *mucous membrane* is continuous with that of the vagina and bladder; it is usually of a pink or rosy tint, but at the period of œstrum it has a bright-red hue. Near the margin of the labia it frequently shows black pigmentary patches, which give it a marbled appearance. It is provided with

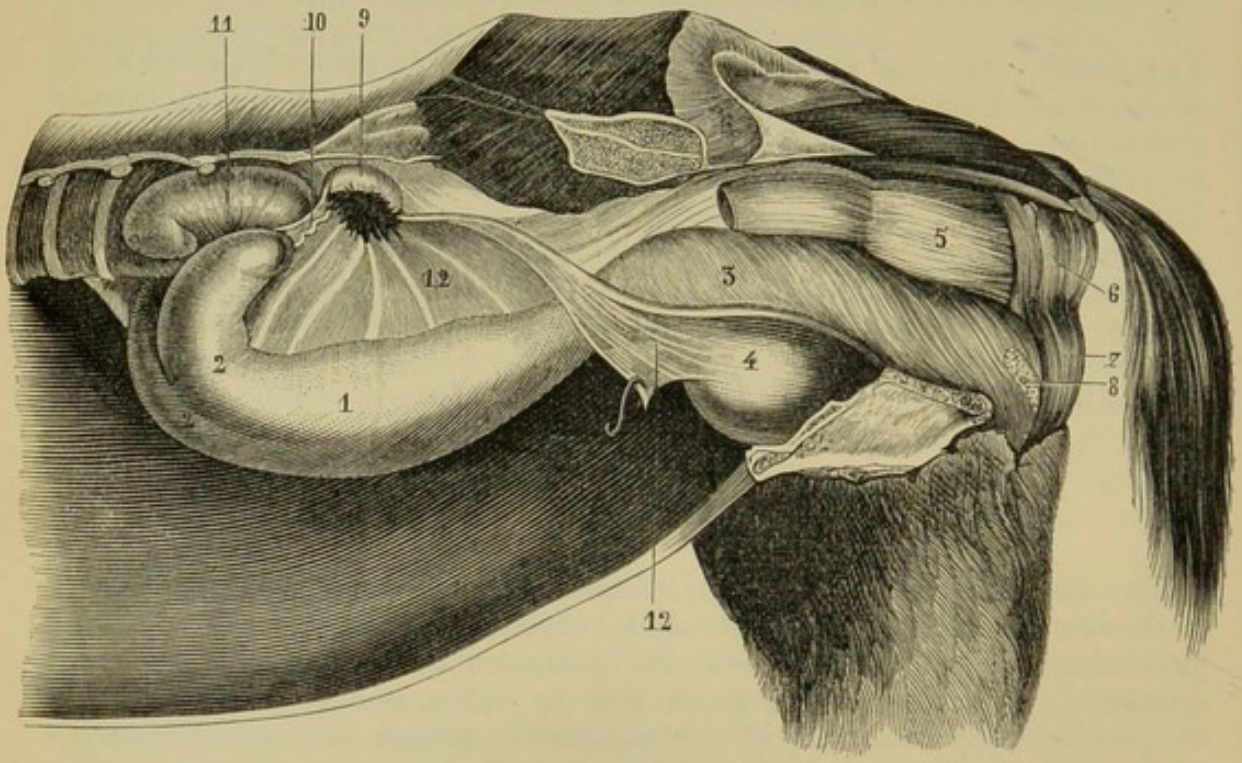

Fig. 17.

THE GENERATIVE ORGANS OF THE MARE *in situ*.

1, Body of the Uterus; 2, 2, Cornua of the Uterus; 3, Vagina; 4, Bladder; 5, Rectum; 6, Sphincter of the Anus; 7, Constrictor Muscle of the Vulva; 8, Bulb of the Vagina; 9, Ovary and Fimbriated Body; 10, Fallopian Tube; 11, Kidney; 12, 12, Broad Ligament.

numerous mucous follicles and sebaceous glands; the latter are chiefly found near the free border, and particularly around the clitoris and the space between it and the inferior commissure, where they aggregate to form several small sinuses. This membrane is also furnished with great numbers of papillæ. The *vaginal bulb* is wholly composed of erectile tissue with wide spaces, which constitutes the *plexus retiformis*. This tissue passes from the base of the clitoris to the sides of the vulva, where it terminates in a round, salient, or ring-like lobe. Covered by the posterior constrictor of the vulva, this bulb communicates inferiorly with the cavernous veins, and the afflux of blood into its meshes diminishes the capacity of the vulva, thereby concurring to render the coaptation of the copulatory organs more complete during coition.

The *muscles* of the vulva are constrictors—an anterior and posterior —and are voluntary. The *anterior constrictor* is analogous to Wilson's muscle in the male, and is formed of arciform fibres which surround the sides and lower part of the vagina at its commencement, its extremities being continued by means of aponeurotic fasciculi as far as the sides of the rectum, where they disappear. Posteriorly, this muscle is confounded with the next to be described. The *posterior constrictor* (*constrictor cunni*) is analogous to the constrictor of the vagina, and forms a real sphincter; it is comprised within the substance of the lips of the vulva. Superiorly, its fibres are mixed with those of the anal sphincter, and are attached to the sacrum by means of the suspensory ligaments. Inferiorly, the most forward are fixed to the base of the clitoris, and the middle are prolonged to both sides of the thighs, where they are inserted into the skin. Inwardly, this muscle is in relation with the vaginal bulb and the mucous membrane of the vulva. Its external face is separated from the skin of the lips by a very vascular cellulo-fibrous tissue, which is capable of contracting, and in the midst of which are observed some isolated red muscular fasciculi—given off from the principal muscle.

The *posterior constrictor* of the vulva is very powerful, and in acting during copulation contracts the vagina and compresses the penis; by reason of its attachment to the clitoris, when it acts it erects that organ. In Mares which are rutting, the movements of the clitoris are frequent, and it then projects outwards; this is particularly observed after micturition, and in this case the fibres of the constrictor attached to the clitoris elevate the latter by acting on its base, those fibres which are inserted into the skin of the thighs depressing the inferior commissure of the vulva, which exposes that very sensitive erectile body lodged in this space.

The *muscular ligaments* of the vulva in reality correspond to the *ligamentum suspensorium* of the penis in the male; they arise from the lower face of the sacrum, and descend as flat bands until they untie beneath the rectum, when they pass in several fasciculi into the lips of this part, and mix with the fibres of the posterior constrictor. They are composed of non-striated fibres. The *skin*, as already mentioned, is very fine and thin, black in the great majority of Mares, has scarcely any hair, and is very unctuous, odorous, and elastic. The bulk of the vulva is made up of subcutaneous *fascia*, to which the skin closely adheres; as well as adipose and connective tissue, and bloodvessels and nerves.

The *clitoris* is an exact, but miniature, counterpart of the corpus cavernosum of the male penis. From two to three inches in length, this body commences by two roots attached to the ischial arch, and which are covered by a rudimentary ischio-cavernous muscle. After being fixed to the ischial symphysis, by means of a suspensory ligament similar to that of the male, it passes backward and projects into the vulvar cavity, towards the inferior commissure, in which it is lodged. Its free extremity is enveloped in a mucous cap—the *preputium*, which is plicated in different directions; and towards the centre of the tubercle is a follicular cavity containing sebaceous matter, and which represents that in the extremity of the male penis. In every respect the clitoris resembles that organ, having a fibrous framework, erectile tissue, cavernous vessels or "plexus retiformis," and a pair of muscles—the *erectores clitoridis*. This organ is more especially the seat of venereal

excitation during coition. It is present in all the domestic female animals, and is frequently erected while they are in "heat," as well as in the act of copulation. It is abundantly supplied with nerves, which endow it with most acute sensibility, and the mucous membrane enveloping it is usually dark coloured or marbled, though in white Mares it may be colourless.

The *meatus urinarius* is the orifice of the urethra, which is a very short canal in the female. This canal passes immediately beneath the anterior sphincter muscle of the vulva, and after a brief course (about two inches) in the textures composing the floor of the vagina, opens into the vulvar cavity at from four to six inches from its exterior. This opening, which is on the floor of the cavity, is covered by a wide duplicature of the lining membrane that acts as, and is designated, the *valve* of the meatus or vagina (*valvula vaginæ*); its free border is turned backwards, and it would thus appear to direct the urine towards the external opening of the vulva, and prevent its reflux into the vagina. Rainard states that this valve is more extensive as the vagina is narrow, and consequently as the female is young; it has been compared to the hymen of woman. Brugnone was of opinion that it was attached to the upper surface of the vagina by a small cord, and that it was the rupture of this by the forced entrance of the penis which caused the slight flow of blood from the vulva observed in Mares put to the horse for the first time. This is no doubt the *hymen* to which he refers—a membrane found generally in the Filly, though not often in the Mare, but which, when present, separates the vulvar from the vaginal cavity. This membrane forms a circular partition, fixed by its circumference to the vulvo-vaginal walls along with the valve of the meatus, and is perforated by one or more openings, which are sometimes very small.

The existence of the hymen in animals has been denied, but that it is present sometimes, though rarely, there can be no doubt, and, as in woman, when imperforate it leads to retention of secretions. Not infrequently old brood Mares show in this situation pediculated appendices, which are the *débris* of this mucous septum.

The urethral orifice of the Mare is wider than that of the Horse, and will readily admit a large catheter. In passing that instrument, it is well to remember that the urethral canal curves forward and downward, and that the valve must be raised either with the point of the instrument or the finger before the passage can be entered.

In ordinary circumstances the vulva is retracted, and with Mares which have foaled several times the labia usually exhibit as many wrinkles or folds as parturition has been frequent.

During œstrum, but especially towards the termination of pregnancy, the labia become tumified and soft, the inferior commissure descends, the vulvar opening is enlarged, and from it is discharged a quantity of tenacious stringy mucus.

Differences in the Vulva of other Animals.

Cow.

In the Cow the lips of the vulva are larger, softer, and thicker than in the Mare, and the inferior commissure, angular and prolonged into a curved peak, is furnished with a tuft of hair. The *meatus urinarius* is disposed as in the Mare; but in the interior of the urethral canal, fixed to its

lower aspect, is a valve whose free margin is directed backwards; this valve surmounts a *cul-de-sac* about the third of an inch. This valve of the canal must be remembered in passing the catheter into the bladder. About an inch within the entrance of the vulva, and imbedded within the substance of its lips, are the *vulvo-vaginal glands* (*glandula vaginæ, S. Duverneyi, S. Bartholini*)—large almond-shaped bodies whose widest extremity is directed upwards, and the narrow end, situated near the clitoro-sciatic muscle, is prolonged into their excretory canals. These are conglomerate glands, whose excretory ducts unite to form a kind of sinus that at last opens into the vulva, about the third of an inch from the labia. The *clitoris* is longer, and more tortuous and slender than in the Mare, and contains a dense fibrous nucleus of a spiral shape. The *vaginal bulb* is much more extensive than in the Mare, and is continued to the clitoris, where it is covered by a thick muscle, which descends from the extremity of the sacrum, and terminates on the clitoris. The same changes occur in the vulva of the Cow as in the Mare during œstrum, and towards the termination of pregnancy; the mucous secretion of the vagina is more abundant in the Cow, however, and persists longer.

Sheep.

In the Sheep which has not copulated, a filamentary band, stretching across the constriction between the uro-genital canal and the vagina, represents the *hymen*. The *Malpighian canals* open into that passage near the constriction, and the crura of the clitoris are enfolded by erector muscles; while the clitoris itself protrudes immediately within the peak of the vulva.

Pig.

In the Pig, the *urethra* opens between two longitudinal ridges; but the surface of these and other similar prominences in the uro-genital passage is interrupted by numerous fine, wavy, oblique furrows. There is no vaginal valve, as in the other animals. The *clitoris* is comparatively small, and the inferior commissure of the vulva is still more acute and pointed than in the Cow and Ruminants in general. Towards the *meatus* are numerous fine points—the openings of glands analogous to the prostates; and on the sides of that orifice are two small fossæ surrounded by a raised border.

Bitch and Cat.

In the Bitch the *vulva* is triangular, and the *inferior commissure* acute. The *clitoris* is a small tubercle, and the *urethra* opens between a little transverse fold and the triangular flattened clitoris; beyond this is a second transverse crescentic fold, with its concavity opposite that of the preceding. In the Cat, a small cartilage or bone exists in the *clitoris;* this is not found in any other of the domesticated animals.

The PERINÆUM is the name given to the space between the superior commissure of the vulva and the lower margin of the anus. Its length varies in different species, and in different-sized animals of the same species; but it is shorter in creatures which have produced young than in those which have not. It is composed of various tissues—externally is the smooth, fine, and very elastic skin, with the vertical prominent line passing down its middle—the "raphé;" beneath this are connective

and adipose tissue, and fascia, with various muscles, bloodvessels, and nerves.

The internal limits of the *vulva* are defined by the constriction or *bulb*, which forms a marked prominence in early life, but tends to disappear in relaxed folds after the animal has brought forth young several times. The dimensions of this aperture are rather adapted for the passage of the fœtus than the penis; though its narrowness is sometimes an obstacle to delivery in a primipara. The limbs, body, or head of the fœtus are at times arrested at the superior or perineal commissure, which they so distend as to threaten laceration of that part. In emaciated animals, and particularly Mares, the vulva is deeply retracted above the ischia, and consequently disposes them to be injured in this region during coitus, by the accidental introduction of the male organ into the anus—the mechanical action of which damages, and may even rupture, the rectum. Rainard alludes to several occurrences of this kind, which terminated in the death of the Mares.

SECTION II.—THE MAMMÆ.

The *mammæ*, or *udders*, may be said to be appendices to the external organs of generation. They are the glands destined to secrete the fluid —milk—which is to nourish the young animal for some time after birth. In early life they are rudimentary, but become developed with age, and attain their full dimensions when the female is capable of reproduction; and especially at the full period of gestation, when their function is about to be carried on actively. After parturition their largest development is reached, and when the young creature has completed its term of sucking, they lose their activity and diminish considerably in size. In the Mare they are two in number, placed beside each other in the inguinal region, about nine inches in front of the vulva, where they take the place of the scrotum in the male. Externally, they appear as two hemispherical masses separated by a shallow furrow; each has in its centre, on each side of the mesian line, a conical, slightly flattened prolongation named the *teat* or *nipple*, which is perforated by several orifices from which the milk escapes, and by which the young creature obtains that fluid by suction. The two glands are retained in their position by the fine thin skin covering them, and which, destitute of hair at the extremity of the teats, though elsewhere provided with a soft short down, is smooth, pliable, and unctuous from the presence of sebiparous follicles. At the base of the teat are a number of small tubercles, which correspond to the areola of the nipple in woman; these are the glands.

The mammæ are also attached to the abdominal tunic by means of several wide, short, but elastic bands, which bear some analogy to the suspensory ligaments of the prepuce in the male.

In STRUCTURE each udder offers an *envelope of yellow elastic fibrous tissue*, *glandular tissue*, the *sinuses* or *galactophorous reservoirs*, and the *lactiferous ducts*, with *excretory canals* or *milk ducts*.

The *elastic envelope*, joined at the mesian line with that of the opposite udder, is strengthened by wide bands detached from the *tunica abdominalis;* it furnishes from its internal face numerous prolongations which, crossing each other in the mass of the gland, form septa or partitions that divide it into distinct lobes and lobules, which are in this way

somewhat independent of each other; so that one or more may be diseased or deranged in function, without the others being involved. Externally, this envelope is closely adherent to the skin, through the medium of a thin but dense layer of connective tissue.

The *glandular tissue* offers the same arrangement as other conglomerate glands, and is composed of *acini* or cæcal vesicles clustered, like grapes on their stalk, around the *tubuli lactiferi*, or ultimate terminations of the excretory ducts. These, commencing by *cul-de-sac* extremities, open into one another to form dilatations (*ampullæ*), and finally converge into a number of principal canals, which end in the galactophorous sinuses (*sinus lactei*). The acini of the lobules, as well as the ducts, are lined by polyhedral epithelium; this becomes spherical and infiltrated with fat during lactation.

The *galactophorous sinuses* or *reservoirs* are situated slightly above the base of the teat, and are generally two in number—one in front, the other behind; though there are sometimes three, and even four. They nearly always communicate with each other, and are prolonged into the teat by a corresponding number of terminal and independent excretory canals, whose orifices are always very narrow, and are seen at the free extremity of that body, which is obtuse and rounded. Collectively, these excretory canals are much wider at the base of the teat than at the extremity; the orifices are usually behind each other, and are about a line apart; and the canals and orifices are lined by a fine membrane which is continuous with the skin, the latter being closely adherent at this part.

The length of the *teats* varies with use; the elastic or dartoid tissues surrounding them, composed of non-striated circular and longitudinal fibres, renders them capable of a kind of erection, under the influence of stimuli. The extremity of the teat is well provided with this tissue, which acts as a sphincter, and prevents the passive flow of the milk.

Connective tissue, bloodvessels, nerves, and absorbents complete the organization of the mammæ. The *arteries* are given off from the external pudic; the *veins* are of two orders—deep, which follow the arteries, and superficial. The nerves are derived from the renal or mesenteric plexus.

As before mentioned, the mammæ undergo remarkable modifications at the age of puberty and the termination of gestation; and these changes have reference not only to their volume and secretion, but also to their minute structure. In the young or virgin Mare, they are hard, and can scarcely be perceived; and their dimensions are not much increased in those which have had only one or two foals, though the teats are usually larger than before; but when they have borne several foals, the mammæ continue somewhat enlarged and pendulous. When gestation is not going on, the glandular *cul-de-sacs* are contracted and wasted-looking; the lining membrane is shrivelled on itself, and covered with only a polygonal epithelium. At the termination of gestation, however, the mammæ assume the functions of the uterus to a certain extent; the vesicles become enlarged, and new ones are developed; the epithelium presents a spherical shape, is charged with fat granules, and fills the acini; the entire gland has become progressively, but greatly increased in size, and instead of being soft to the touch it now feels firm. Shortly before parturition the secretion of milk commences, and soon after that event the glandular cavities become fully distended, and

assume their maximum dimensions, which are maintained, with slight variations, during the entire period of lactation. When this period is terminated, the secretion gradually ceases, and the gland again assumes its quiescent condition, and nearly its ordinary size.[1]

Differences in other Animals.

Cow.

In the Cow the mammæ are also inguinal as in the Mare, and each lateral mass, although enveloped in a single fibrous capsule, is made up of two quite distinct glands—or "quarters," as they are commonly termed—and which can be seen, or felt as limited by a slight depression. Each gland has its corresponding teat, much more developed than that of the Mare; so that this animal really possesses four mammæ and four teats. The glands are compacted into a roundish mass, which is more

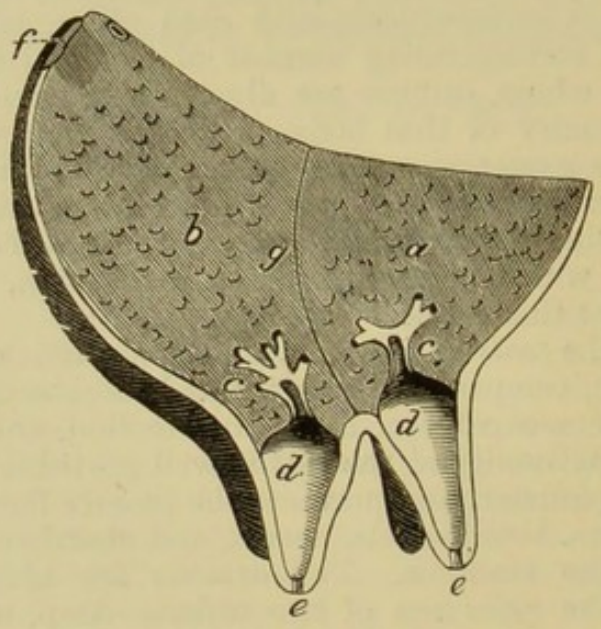

Fig. 18.

Section of Udder of Cow.

a, Anterior Quarter; *b*, Posterior Quarter; *g*, Septum between the Quarters; *c*, *c*, Section of the Lactiferous Ducts; *d*, *d*, Lactiferous Sinus or Milk Cistern; *e*, *e*, Orifice of the Teat; *f*, Large Lymph Gland in the Posterior Quarter.

or less pendulous when they are in active function; in the centre of each, and at the base of the teat, there is a single large galactophorous sinus, which is the general confluent of all the lactiferous ducts, and opens externally through the teat by a single excretory canal. This canal is widest at its commencement, and narrow at its termination at the end of the teat. The walls of the latter are very thick, elastic, and retractile. Not infrequently there are found behind the four teats one or two rudimentary teats, which are generally imperforate; though in very rare instances they have been observed to be perforate and to yield milk.

[1] In the male Horse we find rudimentary teats, which are concealed within the prominent annular fold of integument towards the extremity of the prepuce. They are not always present, however; though they are so in the Ass, which has them largely developed.

The teats of the Cow are generally from two and a half to three and a half inches in length, and, as has been said, this length varies according as the animal has reared a large or small number of calves. The two anterior are generally the longest, and the corresponding quarters furnish more milk than the others. The dartoid tissue around the free extremity of the teat, acting as a sphincter, prevents the passive escape of the milk from the orifices of the excretory ducts; for if a small cannula, scarcely larger than one of these ducts, be inserted slightly beyond the orifice, the secretion immediately flows. And when the end of a teat has been wounded, or when the elastic tissue of this part has been divided in the performance of some operation, there is no longer any obstacle to the emission of the milk.

The arteries that supply the mammæ of the Cow with blood are derived from the external pudic. The branch of each side, on reaching the lateral glands, divides into two principal trunks, one of which goes to a corresponding quarter; that which is destined for the posterior

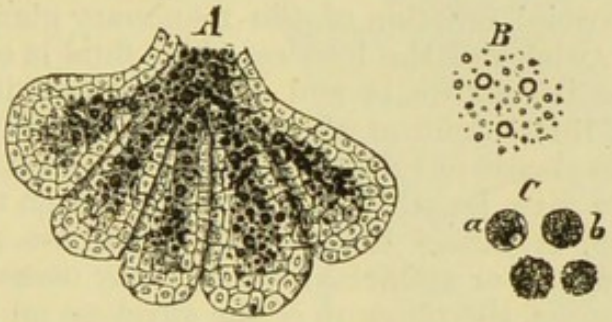

Fig. 19.

A, Lobule of the Mammæ filled with Milk; B, Milk Globules; C, Colostrum: *a*, Cell with a Visible Nucleus; *b*, Cells from which the Nucleus has disappeared.

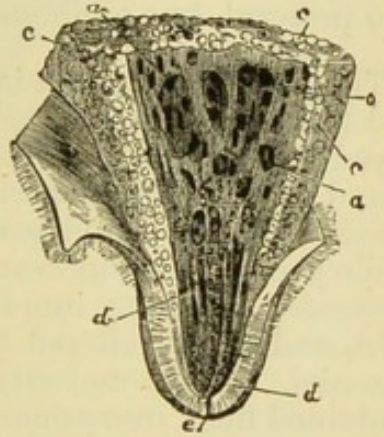

Fig. 20.

Section of the Cow's Teat.

a, *a*, Principal Lactiferous Ducts; *b*, Lactiferous Sinus; *c*, *c*, Acini; *d*, Elastic or Dartoid Tissue of the Teat; *e*, Orifice of the Teat.

gland bends at a right angle backwards, the branch for the anterior quarter—the largest—descending perpendicularly, to become subdivided into numerous ramuscles and terminal twigs. The veins and nerves are derived as in the Mare.

In the Cow, the secretion of milk can be excited and maintained by regular "milking," the only suspension occurring before the birth of another calf.

Sheep and Goat.

In the Sheep and Goat there are only two mammæ, as in the Mare and Ass, though they are formed on the same plan as in the Cow. They are also inguinal, somewhat hemispherical and voluminous, particularly in the Goat, and each is provided with a single conical, well-detached teat. The latter animal has sometimes, in addition, two posterior rudimentary teats, and the galactophorous sinus of each ordinary teat is very large, the walls of the teat being thin; it is capable of containing, in some instances, nearly three ounces of milk.

Pig.

In the Pig the mammæ are ten or twelve in number, disposed by pairs in two parallel rows extending from the inguinal region to beneath the thorax, and distinguished as *inguinal*, *abdominal*, and *thoracic* mammæ. They have not, as in the larger animals, any sinuses, the lactiferous canals of each teat joining directly to form a variable number of excretory ducts, which open at the free extremity of the teat by from five to ten orifices. The limits of each gland are denoted, externally, by a slight vertical depression, and a trifling convexity corresponding to the teat.

The mammæ of this animal are scarcely perceptible while they are not active; but during lactation they form two series of well-developed eminences, divided on the middle line by a wide and deep furrow.

Bitch.

In the Bitch there are eight to ten mammæ, arranged as in the Pig. When the latter number is present they are disposed on each side as two pectoral, two abdominal, and one inguinal.

The secretion of milk is a special function of the mammary glands, and takes place in the cæcal vesicles of the lobules. The fluid is conveyed from these into the lactiferous ducts and sinuses, where it is stored until a certain period: this retention after a time distends the glands very much, and puts the elastic envelope greatly on the stretch; while the teat also increases in size, length, and firmness. When this distension becomes inordinate, it causes the animal uneasiness and pain, and if not relieved by natural or artificial means it may occasion mischief. In the majority of cases, the pressure of the envelope on the contained fluid overcomes the resistance of the sphincter at the end of the teat, and relief is afforded in this way.

CHAPTER III.

Internal Organs of Generation.

The *internal* or *formative* organs of generation are contained within the pelvis and abdomen, and comprise the *vagina* (which some writers include with the external organs), *uterus*, *Fallopian tubes*, and *ovaries*.

SECTION I.—THE VAGINA.

The Vagina is a musculo-membranous canal of variable dimensions, with thin walls; it extends almost horizontally within the pelvic cavity, from the vulva posteriorly to the uterus anteriorly, the cervix or neck of which it embraces in a kind of semicircular *cul-de-sac*. The rectum lies above it, and the bladder below; on each side are the ureters and the walls of the pelvis, and posteriorly it is surrounded by adipose and loose connective tissue. When distended it is cylindrical in form, but usually its sides are in contact. Its length is variable, of course, but in a full-sized Mare it is about a foot long. It is maintained in position anteriorly by folds of peritoneum, which attach it to the rectum above and to the bladder beneath, the attachment to the rectum being accomplished through the medium of the loose connective tissue referred to. But this tissue, which also unites it to the bladder, is here close and

firm, and this fact may serve to explain why the rectum is so rarely involved in displacements of the uterus, while the bladder is always

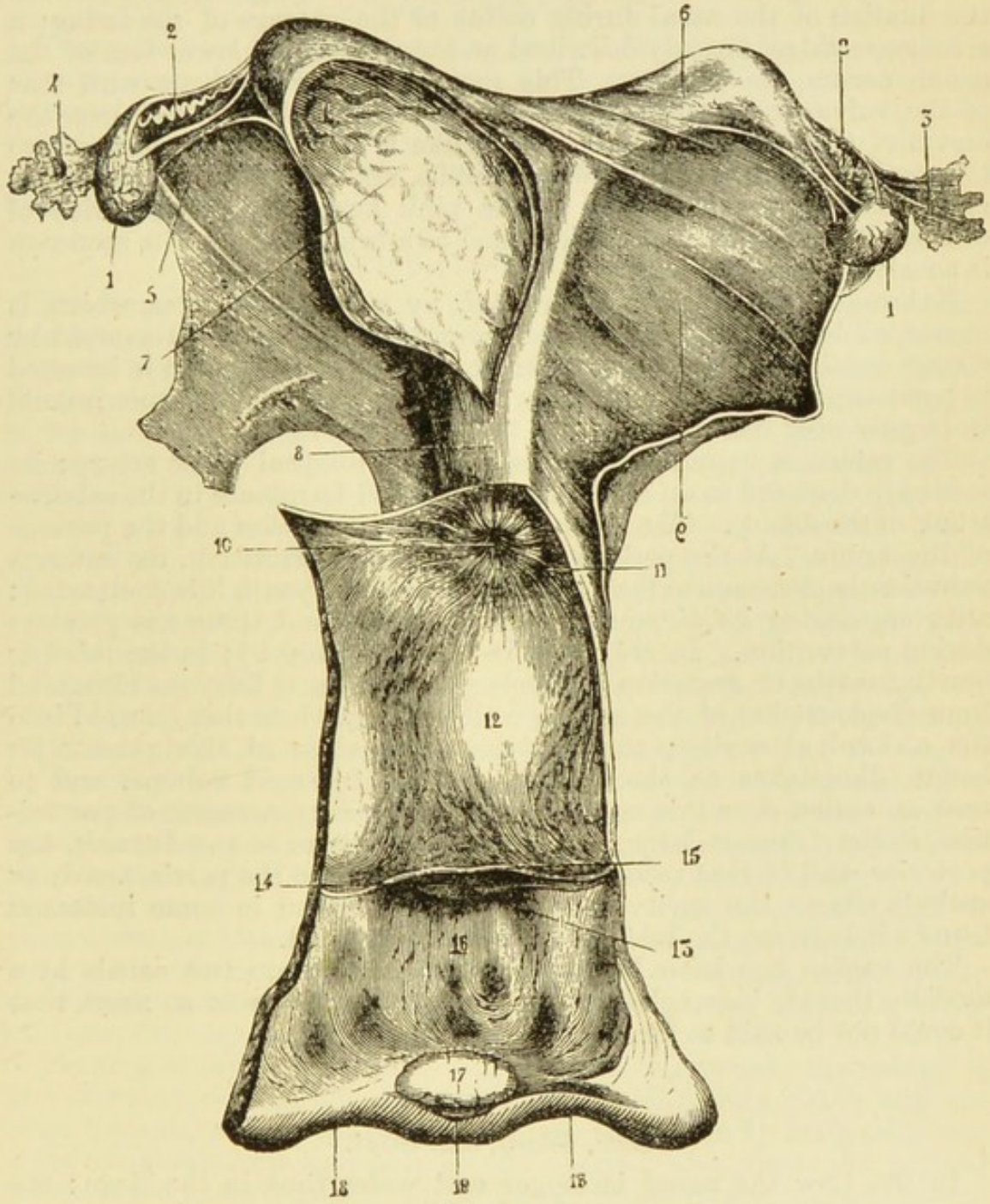

Fig. 21.

GENERATIVE ORGANS OF THE MARE: ISOLATED AND PARTLY OPENED.

1, 1, Ovaries; 2, 2, Fallopian Tubes; 3, Pavilion of the Tube, External Face; 4, *Ibid.*, Inner Face, showing the Opening in the Middle; 5, Ligament of the Ovary; 6, Intact Horn of the Uterus; 7, A Horn opened; 8, Body of the Uterus, Upper Face; 9, Broad Ligament; 10, Cervix, with its numerous folds, or *Palma plicata;* 11, *Cul-de-sac* of the Vagina; 12, Interior of the Vagina, with its Folds of Mucous Membrane; 13, Urinary Meatus and its Valve, 14; 15, Mucous Fold, a Vestige of the Hymen; 16, Interior of the Vulva; 17, Clitoris; 18, 18, Labia of the Vulva; 19, Inferior Commissure of the Vulva.

more or less so. *Laterally*, it is attached to the muscular and aponeurotic structures in the cavity of the pelvis. *Internally*, it is lined by a thin mucous membrane, which is always abundantly covered with

mucus (in woman this mucus is acid, while that of the uterus is alkaline), and is disposed (in the Mare) in longitudinal rugæ, which are more conspicuous after several births. These rugæ no doubt favour the dilation of the canal during coitus or the passage of the fœtus; a transverse ridge, already described as existing on the lower face of the canal, covers the meatus. This membrane is continuous with that of the vulva, and anteriorly, at the *cul-de-sac*, it is reflected over the cervix of the uterus, which projects, like a cauliflower in shape, into the cavity. It is provided with papillæ, and covered with pavement epithelium. It usually has a pale pink hue, but at the period of œstrum its colour becomes heightened to a bright red, and its secretion is considerably increased.

Externally, the vagina is invested by a muscular coat, which is enveloped by an abundant layer of connective tissue, and traversed by a large number of bloodvessels; in front, however, this tunic is invested in peritoneal membrane, which is applied in a circular manner around it, to pass over the uterus.

The vagina is supplied with blood by the internal pudic artery; its veins are disposed as an encircling plexus, and terminate in the satellite trunk of the artery. The vagina serves for copulation and the passage of the fœtus. At the periods of œstrum and parturition, the mucous secretion is more active than at other times. In youth it is contracted; after copulation its dimensions are increased, and these are greatest during parturition. In old age it is much diminished; in the third or fourth months of gestation in the larger animals, it becomes elongated from displacement of the uterus, which is carried farther forward into the abdominal cavity; towards the termination of this process its length diminishes as the uterus acquires increased volume, and to such an extent does this occur, that at the commencement of parturition, if the fœtus is large, and especially if there be two fœtuses, the posterior wall of that receptacle, pushed back into the pelvis, nearly or entirely effaces the cavity of the vagina, and even in some instances thrusts it between the labia of the vulva or beyond.

The vagina has been found partially divided into two canals by a median, though incomplete, vertical septum, which was so short that it could not be said to form a double vagina.

Differences.

Cow, Sheep, and Goat.

In the Cow the canal is longer and wider than in the Mare; the mucous membrane of the vagina is thicker, is disposed in transverse rugæ as in the human species, and at each side of the passage for a certain distance, between the mucous and muscular layers, there exists a mucous canal that opens into the vulvar cavity, in front of, and at the side of the meatus urinarius.

The uses of these canals, which are not present in the Sheep or Goat, and rarely in the Mare, and which are usually known as the "canals of Gærtner," are unknown. They pass backwards into the broad ligaments of the uterus, and terminate in a *cul-de-sac*. They probably have some function during fœtal life.

Pig.

In the Pig these canals are present; the folds of mucous membrane are longitudinal, and gradually subside towards the line of separation

between the vagina and vulva. The vagina is from eight to nine inches long.

Bitch and Cat.

There are no "Gærtner's canals" in the Bitch or Cat. The vagina is of comparatively great length, and has longitudinal rugæ, which are interrupted by transverse folds. In both animals the canal is wider towards the vulva than towards the uterus, and its walls are rendered very thick by white fibrous tissue, in addition to the non-striated muscular fibres it contains.

SECTION II.—THE UTERUS.

The UTERUS, or WOMB (Figs. 17, 1; 21, 8), is an elongated musculo-membranous sac which receives the ovum, and constitutes the receptacle for the nutrition, development, and, finally, after a certain period, the expulsion of the fœtus. It is situated in the sublumbar region of the abdomen, towards the inlet of the pelvic cavity, into which its posterior extremity enters. This portion—the *body*—represents a simple cylindrical reservoir, slightly flattened above and below, while the anterior part is bifid; the two divisions—the *cornua* or *horns*—curve upwards and forwards. The *body* is situated horizontally beneath the rectum, which is in contact with it after passing between the two cornua; on each side of its upper external face it receives the insertions of wide ligaments; and its sides and anterior face are in contact with the intestines. Its lower surface is in contact with the bladder and the pelvic curvature of the colon; while its anterior extremity is continuous with each of the cornua, and the posterior is separated from the vagina by the constriction named the *col*, *cervix*, or *neck* of the uterus. The *cornua* are cylindrical tubes, and, lodged among the intestines occupying this region, proceed at an angle from the body in an upward direction, describing two curves—an inferior, convex, which is free; and a superior, concave, to which the suspensory ligaments are attached. Each horn has also a posterior extremity or base, a continuation of the body of the uterus; and an anterior extremity or summit, rounded into a *cul-de-sac*, which is turned upwards, and has at the bottom a small tubercle, the insertion of the oviduct.

Floating in the abdominal cavity, like the intestines, the uterus is also attached, as they are, by two membranous bands which suspend them from the sublumbar region, and are consequently designated the *broad* or *suspensory ligaments* of the uterus; also, from the general resemblance to the wings of a bat, the *alæ vespertilionis*. These bands, derived from the peritoneum of the abdomen, are larger in front than behind, and in shape are irregularly triangular; behind, they are close to each other, but in front diverge like the sides of the letter V. They descend from the lower face of the lumbar region, and attach themselves, by their inferior border, to the sides of the upper surface of the body and the smaller curvature of the cornua; their anterior border is free and sustains the oviducts and ovaries, the first being included between the two layers of the ligament, while the ovary, placed within it, also receives a layer detached from the principal one, which with it forms a little cup-shaped cavity. Another small, long, and narrow band of peritoneum is observed external to the broad ligament; this can be traced posteriorly to the internal inguinal ring, and anteriorly it presents a little enlarged appendix. Between the two layers com-

posing this band, is a thin muscle similar to the cremaster of the male before the descent of the testicle into the scrotum; this band is the analogue of the round ligament in woman. The uterus is also maintained in position by the vagina posteriorly, and by the peritoneum, which at this part forms four bands — the *recto-uterine* and *vesico-uterine*.

The interior of the uterus is divided into three compartments, corresponding to its divisions into body and cornua. The cavity of the body communicates with the vagina by a narrow canal which traverses the constriction or cervix of the uterus, and is designated the *canal of the cervix*. In all the domesticated animals, except the Rabbit, this canal is prolonged into the anterior extremity of the vaginal cavity like the end of a tap into a barrel; forming a very marked protrusion—the cervix. In this is the opening (*orificium uteri externum*) leading from the vagina to the body of the uterus—the *os uteri* or *os tincæ;* around this aperture the utero-vaginal lining membrane is curiously arranged in transverse rugæ disposed in a circular manner, and which gives to this prominent part the appearance of a radiating flower. In woman the rugæ of the canal are differently disposed, and resemble the branches from the stem of a tree; consequently, they have been named the *arbor vitæ uterina* or *palma plicata*.

The uterus is composed of three membranes—an *external*, or *serous;* a *middle*, or *muscular;* and an *internal*, or *mucous tunic*. The *serous* or *peritoneal* membrane envelops all the organ, and is in reality only an expansion of the broad ligaments, which are prolonged backwards on the posterior extremity of the vagina, which they encircle and then pass to the rectum and bladder, as well as to the lateral parietes of the pelvis, constituting the four ligaments already referred to. Between the two cornua this membrane forms a peculiar frænum, which is very developed in Solipeds. Owing to this arrangement, the cervix does not receive any peritoneal covering. The *muscular* layer is composed of longitudinal and circular fibres, analogous to those of the small intestines. At the insertions of the broad ligaments into the uterus, a series of fasciculi are given off from this layer, which pass up between the folds composing them, and have been found throughout their extent, especially towards the ovaries. The fibres composing this coat belong to the class of non-striated or involuntary muscles, being made up of fusiform nucleated fibres lodged in a matrix of exceedingly coherent granular matter. The appearance of this coat is different to that of ordinary muscle, being much more dense and of a faint yellowish-red hue, like the middle coat of arteries or the small intestines. The superficial set of fibres are irregularly longitudinal in their direction, and frequently interlace with each other; the deep set are circular, especially around the orifice of each oviduct and the os uteri, where they are thick and close; though even among these fibres irregular fasciculi pass in different directions. Both layers are thicker in the cornua than the body; their obvious function is to diminish the volume of the uterus during parturition.

At an early period of life these fibres are perceptible, but during gestation they are greatly increased, and present a manifest striation. Their increase is doubtless to permit the necessary dilatation of the uterus, without allowing its parietes to become too attenuated and feeble; though to some extent they do diminish in thickness, according to the species. The inner set are loosely adherent to the lining or mucous

membrane of the uterus. A rich venous network is lodged in the muscular tunic of this organ.

The *mucous* layer is a thin, delicate, pulpy membrane, covered by ciliated columnar epithelium in the body and cornua of the organ, ordinary cylindrical squamous or stratified epithelium in the canal of the cervix, like that of the intestines, and tessellated or squamous on the rugæ of the cervix. This differs from ordinary mucous membrane in the presence of a very delicate sub-mucous connective tissue, in which the utricular glands, blood and lymph vessels, as well as nerves supplying the membrane, are situated; for this reason it appears to receive its vascular supply directly from the muscular coat, its vessels being continuous with those of that layer. This difference is probably related to its intermittent, though higher, organising function.

In the cervix, the basement membrane covers multitudes of villi, the points of which in woman are nipple-shaped, with a depression in the centre; within the cervix these villi are very large, but in the body of the organ there are none. The membrane here is remarkable for the series of longitudinal rugæ formed on it, and which are not effaced by ordinary distention of the organ; though they disappear during the increase in size of its cavity in pregnancy. On these rugæ and in the fossæ between them, particularly towards the cervix, are a great number of simple mucous and special cylindrical glands. The first are particularly abundant towards the cervix; some here and there have closed mouths, are enlarged, and form small vesicular prominences, which have been named the "ova of Naboth" (*ovula Nabothi*), from their supposed identity with the ovarian ova.

The cylindrical, uterine, or utricular glands (*glandulæ utriculares*), are situated close to each other; they are sometimes bifurcated, frequently spiral, and terminate in a *cul-de-sac* in the substance of the mucous membrane, something like the agminate glands. In the Mare they are long, slender, and tortuous, and divide repeatedly in the deeper part of the mucosa, and in such a manner that numerous branching tubes are connected with a single stem or gland-duct. They are lined by columnar cells, which project vertically into the gland tube: these cells have a ciliary movement. The utricular glands do not exist at birth, and it is probable that they are only fully developed when sexual maturity is reached. At certain periods, as during œstrum, they throw out a large quantity of very viscid, almost transparent, mucus. They are secreting structures, and during gestation play a most important part, becoming largely developed, and furnishing a thin, white, albuminous fluid, the so-called "uterine milk." This secretion comes more particularly in contact with the intervillous portions of the fœtal placenta, in which are curious pockets that act as receptacles for this milk, which is absorbed by the vessels on their walls.

The uterus is supplied with blood by the *uterine* and *utero-ovarian arteries*, which arise from the posterior aorta, and passing between the layers of the broad ligament reach the uterus. The first divides into two branches—an ovarian and a uterine; the former is very flexuous and goes to the ovary, while the second passes to the cornua of the uterus, where its ultimate divisions anastomose with those of the proper uterine artery. This vessel, on reaching the smaller curvature of the cornua, also divides into two portions—an anterior, anastomosing its branches with the utero-ovarian; and a posterior, spreading over the body of the organ and communicating with the artery of the vagina. The blood is

conveyed from the uterus by corresponding *veins*, which are more numerous than the arteries, and are capable of great distention. They have no valves. In animals which have bred frequently, the vessels are greatly enlarged and very flexuous; indeed, from an early period the arteries are remarkable for their large size, their tortuous course, and their frequent anastomoses; while the considerable calibre of the veins is as conspicuous as the complex networks they form.

The *lymphatic vessels* issuing from the organ are as remarkable for their large size as for their number; they all proceed towards the sublumbar region.

The *nerves* are derived from the small mesenteric and pelvic plexuses.

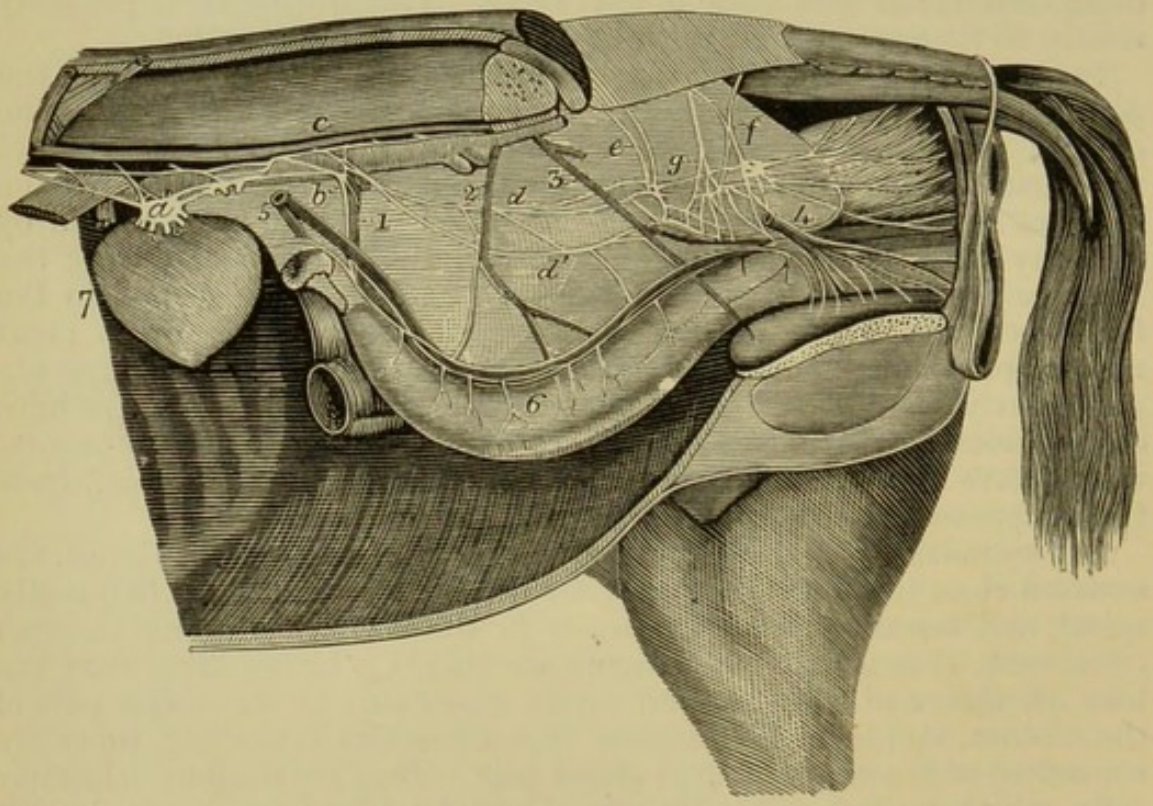

Fig. 22.

Nerves of Mare's Uterus.

a, Anterior Abdominal Ganglion; *b*, Posterior Abdominal Ganglion; *c*, A Lumbar Ganglion of the Sympathetic Chain; *d'*, *d*, Anterior Hypogastric Nerves; *e*, Lymphatic Connection with the Right Pelvic Plexus; *f*, *g*, Branches from the Third and Fourth Sacral Nerves to the Pelvic Plexus; 1, Ovarian Artery; 2, Uterine Artery; 3, Uterine and Vesical Artery; 4, Branch of the Internal Pudic Vein; 5, Ovarian and Uterine Vein; 6, Left Uterine Cornu.

When the gravid uterus increases in volume, it pushes the pelvic flexure of the colon before it as it advances into the abdominal cavity, on to the floor of which it gradually descends and rests until the termination of pregnancy. As has been mentioned, in this advance and descent it carries with it the cervix and vagina, which is considerably lengthened, the traction being extended even to the vulva, this appearing to be buried between the ischiatic tuberosities toward the end of pregnancy.

Differences.

Cow.

The uterus of the Cow, with regard to its general disposition in the pelvic and abdominal cavities, does not offer any striking differences

from that of the Mare, except that the body is short (its interior space being also much less than in the Mare's uterus), and it does not extend so far into the latter cavity. If the uterus were perfectly horizontal, a transverse line drawn across the abdomen, in front of the external angle of the ilium, would be exceeded to the extent of some one and a half to two inches by the extremities of the cornua; so that if the animal were placed on its back, the uterus would only be found to reach to the fourth or fifth lumbar vertebra.

With regard to shape, however, the uterus of this animal offers some noteworthy features. For instance, the concave curvatures of the cornua look downwards, whereas in the Mare they are in the opposite direction; though in both the broad ligaments are attached to this concavity. The consequence is, that in the Cow, if the uterus be considered as freely suspended in the cavity of the abdomen, the extremity of the horn is twisted outwards and upwards; while its base near the body of

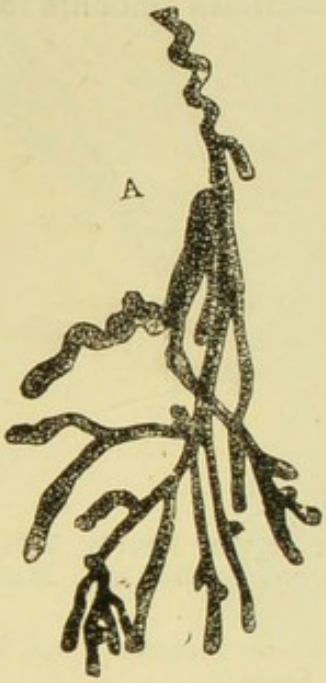

Fig. 23.
A, Utricular Gland of a pregnant Goat.

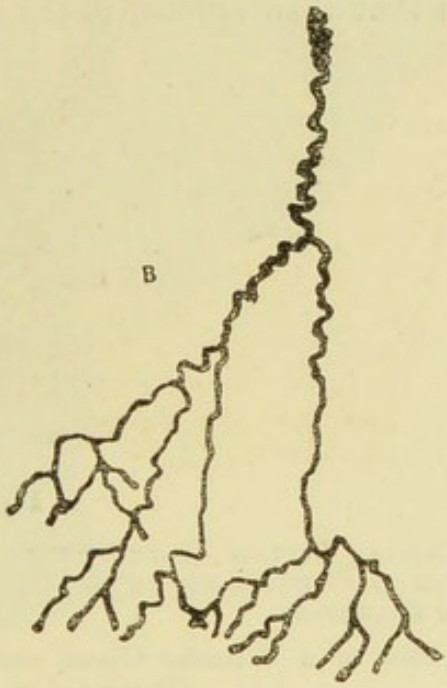

Fig. 24.
B, Utricular Gland of a pregnant Cow.

the organ, although drawn in the same direction by the ligaments, yet retains its position, being firmly maintained in it by the body of the uterus, which also receives the insertion of the broad ligaments on its *lower plane.* This insertion causes the uterus to project above them; while in the Mare, in which the ligaments are inserted at the upper part of the body, the uterus projects below them. In the Cow these ligaments are very extensive, particularly at their anterior border, and widely separated from one another in front near their lumbar attachment, which is prolonged as far as the flank. The ligaments, taken as a whole, may be compared to a triangular sheet, one angle of which is fixed to the floor of the pelvis, and the other two to the tuberosities of the ilia; on this sheet rests the body of the uterus and a portion of the cornua. This peculiarity in the suspensory apparatus of the uterus of the Cow explains the occurrence of torsion of the organ during pregnancy—an accident to which reference will be made hereafter.

The cornua are thin and tapering at their anterior extremity, and the body is short and narrow; while the interior of the uterus is not so ample as in the Mare. Here it offers a peculiarity which is not observed in the latter animal, the Carnivora, or the Pig, in the presence of rounded smooth prominences named *caruncles* or *cotyledonal processes* (*placentæ uterinæ*), which increase in number with the size of the species. The maternal cotyledons are most numerous in the cornua, and few and small in the body of the uterus; they are about the size of a pea or haricot-bean, in calves; at a later period they have acquired the dimensions of a button, and they increase largely and assume variable shapes during gestation. In the Cow they are flat or slightly convex on the top, but concave in the Sheep and Goat, and their colour is usually pale; after conception, however, they become red from the afflux of blood to them. They are intended for the reception of similar processes on one of the fœtal membranes, the chorion, and will be noticed more fully hereafter. It may be sufficient now to mention that their number in the Calf sometimes amounts to thirty or

Fig. 25.

HORIZONTAL SECTION OF THE UPPER SURFACE OF THE MUCOUS MEMBRANE, NEAR TO A COTYLEDON, OF THE UTERUS OF A NON-GRAVID COW: MAGNIFIED 180 DIAMETERS.

a, Section of a Utricular Gland, and *a'* its Proper Structure; *b*, *b*, Mucous Glands; *c*, *c*, Adenoid Tissue.

forty; and after parturition there have been counted as many as from eighty to one hundred and twenty. They are disposed in linear or longitudinal series which are all the more numerous as the cornu is wide; there being four series near the body of the uterus (which has none), two at the anterior extremity, and three in the middle. Each is attached to the mucous membrane by a narrow pedicle, and in removing the fœtal placenta after parturition, care has to be taken not to tear them off.

The *cervix uteri* of the Cow is from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches in length; it is narrow, almost as firm as cartilage in texture, and irregular in shape; the mucous membrane is more finely plicated over it, around the *os tincæ*, than in the Mare. The fibres composing the cervix are divergent and circular. At an early age this part is nearly circular in shape, and the body of the uterus is so small that the cervix and cornua are close together, or joined to each other at their origin from it. Towards puberty, however, in all the larger domesticated animals it becomes fusiform, and shows two lips, about two inches in length—an anterior and posterior, the last the longest—which are pulpy to the touch; these

lips are composed of flattened, dense, transverse fibres. The orifice, or *os uteri*, is either circular or elongated transversely, and corresponds to the middle of the posterior part of the vaginal cavity. During pregnancy the cervix is firm and tense, and appears to become shortened in animals which have had young several times. The folds of mucous membrane which we have described as existing in its anterior and around the os, permit its dilatation during the passage of the fœtus. A knowledge of the presence of the two lips of the cervix, and also their

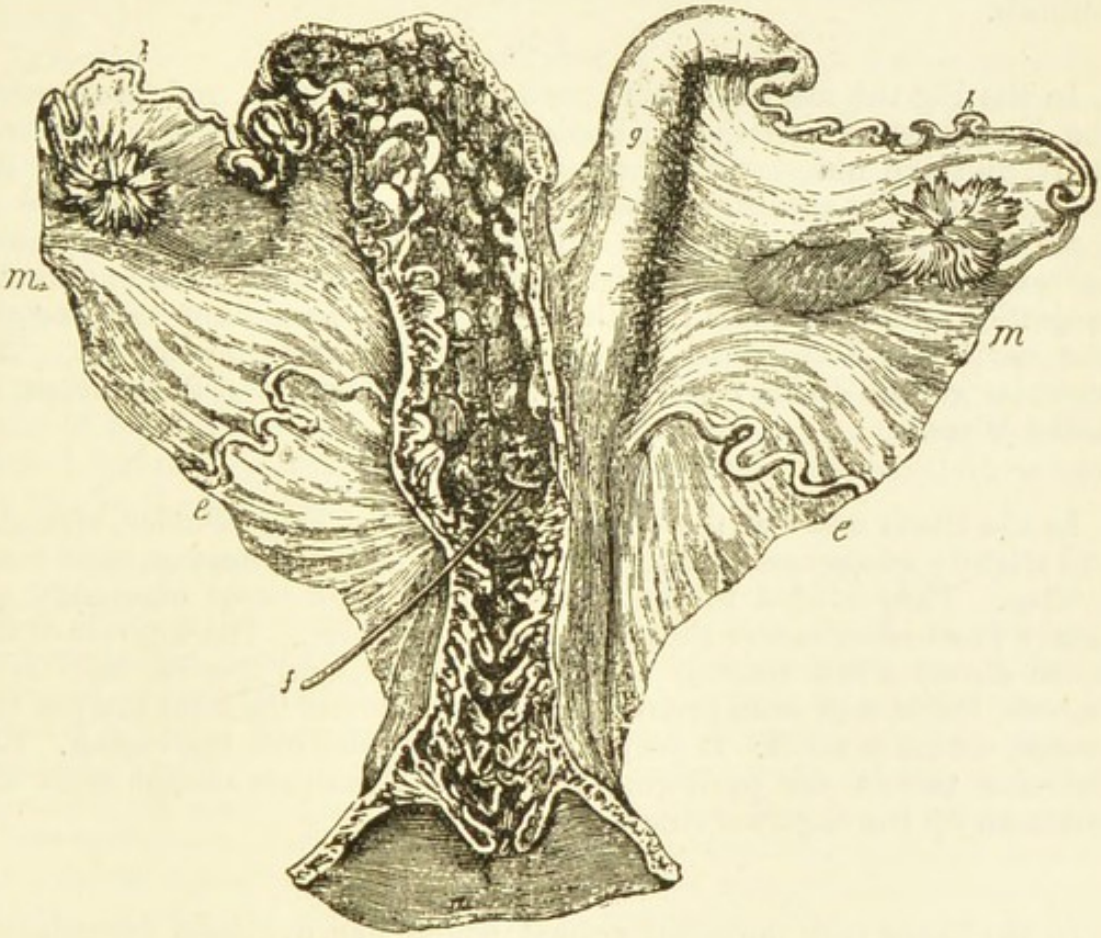

Fig. 26.

UTERUS, OVIDUCTS, AND OVARIA OF THE SHEEP.

a, Vagina ; *b*, Os Uteri ; *c*, Transverse Folds of Cervix Uteri ; *d*, Body of Uterus ; *e*, *e*, Caruncles or Cotyledonal Processes ; *f*, Confluence of the Cornua ; *g*, Intact Cornu ; *h*, *h*, Oviducts or Fallopian Tubes ; *i*, *i*, Fimbriæ ; *k*, *k*, Ovaries ; *l*, Round Ligament ; *m*, *m*, Broad Ligaments ; *n*, *n*, Cotyledons.

position, is useful when explorations by hand are necessary in cases of inversion of the uterus.[1]

The utricular glands are wider than in the Mare, and have lateral diverticuli.

The muscular tunic altogether is thicker in the Cow than in the Mare; indeed, the walls of the uterus in this animal are more dense than in any of the domesticated creatures, the muscles having a red tint, and being continued well into the broad ligaments.

[1] Professor Violet found two distinct cervices in the uterus of a Cow, both projecting into the vagina, but the canal in one of them was very short, and terminated in a *cul-de-sac*.

Sheep and Goat.

In the Sheep and Goat the disposition of the uterus is similar to that of the Cow. The cornua are relatively longer, more tortuous and pendant, and expand more gradually from the termination of the oviducts; while the longitudinal rugæ in the body and cervix are disposed in a series of transverse folds in the latter, which gives them the appearance of so many *ora tincæ*. The cotyledons we have mentioned already; they are concave, or *cupuliform*, in their centre in these animals.

Pig.

In the Pig the uterine cornua are long and tortuous, and float among the intestines, which they resemble; the body of the uterus is very short, and the numerous irregular ridges on the inner surface of the cornua gradually subside towards the cervix, where they form two or three series of thick, soft rugæ. The os uteri is marked by a series of narrow, close-set, longitudinal laminæ, but there is no labial or valvular projection into the vagina; so that there is no exact limit between the two cavities. The broad ligaments resemble the mesentery. The utricular glands divide repeatedly in the deeper parts of the mucosa, as in the Mare.

Bitch and Cat.

In the Bitch and Cat the cornua are also very long, slender, straight, and slightly compressed, with a number of flat eminences on their inner surface. They extend to the lumbar region, and unite externally for nearly two inches before they join the *corpus uteri*. The interior of the latter shows a few smooth longitudinal rugæ, and the os uteri is a smooth, thick, and even prominence, larger almost than the body of the uterus, which is short. It projects very markedly into the vagina. The utricular glands are pyriform; the round ligaments escape from the abdomen by the inguinal rings.

DEVELOPMENT.

In the fœtus and the adult animal which has not been fecundated, the uterus is comparatively small, narrow, and insignificant; but it increases in volume with age after the venereal desires become manifest. In a Calf a little more than a month old, the total length from the vulva to the extremity of the cornua was about ten inches, of which the vagina formed about five-eighths. In the Lamb the uterus and vagina only measure about six inches in length. From this period until the animal is capable of breeding, the uterus receives so little blood that it may be removed without much risk.

During gestation the uterus acquires a great volume, and its cavity, usually less than that of the vagina, is considerably increased, its shape then bearing some resemblance to one of the large intestines. The cornua vary in size, according to the dimensions and species of the different animals. In those which are uniparous (one fœtus), as the Mare and Cow, they are short; but in those which are multiparous (more than one fœtus)[1] they are long in proportion to the number of

[1] In order to avoid confusion in the employment of terms, and also on the score of convenience, it may be as well to observe here that *uniparous* animals are those which generally produce only one at a birth; *multiparous*, those which bring forth more than one; *primiparous*, those which produce young for the first time; and *pluriparous*, those which have bred more than once.

young they bear, while the body is diminished in length. In the uniparous animal the fœtus is usually developed in the body of the uterus, and its posterior extremities only are sometimes engaged in one of the cornua; but in the multiparous females the cornua resemble the intestines, and the young are developed in them, the body of the uterus seldom containing any. In the Rabbit, indeed, there is no *corpus uteri*, the cornua opening independently and directly into the vagina.

After parturition the uterus gradually diminishes in size, and some of its supplementary structures disappear; but it never resumes its previous volume.

The *ligaments* of the uterus suspend it loosely, yet securely in the abdominal cavity; and while allowing it a certain range of movement, permit its full development during gestation. At this period they become developed in a peculiar manner, and, as we have seen, between their laminæ appears a layer of muscular fibres; in the Cow these fibres are arranged in fasciculi, one of which, larger than the others, extends from the ovary to the *cervix uteri*. These ligaments would also appear to stretch considerably in version or inversion of the uterus in Herbivorous animals; even in the Carnivora they accompany the uterus when hernia takes place; and in the torsions of this organ which sometimes occur in Ruminants—when its upper face becomes the lower, or even when it has made a complete turn upon itself—they encircle and strangle the uterus at the cervix.

SECTION III.—FALLOPIAN TUBES, OR OVIDUCTS.

The FALLOPIAN TUBES, or OVIDUCTS, are two small, cylindrical, flexuous canals, about ten inches long, white in appearance, one of which is lodged in each broad ligament, between its serous layers, and near its anterior border. Each tube commences at the extremity of the uterine horn, at a small hard tubercle in its *cul-de-sac* (*ostium uterinum*). This tubercle is its opening into the cornu, and from this it proceeds, more or less tortuously, and increasing slightly in diameter, towards one of the ovaries, upon which it terminates by a free, widened extremity (*ostium abdominale*) in the *pavilion* of the tube. The calibre of this canal is small, and scarcely admits a thin straw at its middle portion, and it is still smaller towards the uterine extremity; as it approaches the ovary, however, it increases in width until it ends in the pavilion. The uterine extremity of the canal opens through the small hard tubercle just referred to as existing at the *cul-de-sac* of the cornu. The ovarian extremity offers, in all the mammalia, a peculiar disposition. It opens into the peritoneal cavity of the abdomen (the only instance of a serous cavity communicating with the exterior), near the ovarian fissure, in the middle of the pavilion, which is also named the *fimbriæ tubarum*, or *morsus diaboli*, from its fringed or dentated border. This pavilion is fixed to the external side of the ovary, and its inner surface is marked by numerous narrow, close-set, minutely plicated laminæ, while its circumference is irregularly disposed into a number of unequal, fringe-like prolongations (*fimbriæ*) which hang into the abdominal cavity. This arrangement is interesting, from the fact that it gives us a unique example of a breach of continuity between a gland (the ovary) and its excretory canal (the tube).

Each tube is composed of three tunics: an *external* or *serous*, formed by the broad ligament; a *middle* or *muscular*, constituted by longitudinal and circular non-striated fibres, continued from those of the

uterus, which are also disseminated in the pavilion and its fimbriæ; and an *internal* or *mucous*, which exhibits longitudinal rugæ in the tube, and radiated in the pavilion; this membrane is covered by ciliated epithelium, and its villi are greatly enlarged after impregnation. It ceases abruptly at the margin of the fimbriæ, where it meets the peritoneum.

The bloodvessels supplying the Fallopian tubes are derived from the ovarian arteries, and their nerves are from the great sympathetic.

Their *function* is to convey the spermatozoa of the male to the ovary in the first instance, and afterwards to transmit the impregnated ovum to the uterus or its horn; in this respect they are the excretory ducts of the ovaries. When the Graafian vesicle of the ovary ruptures, the fimbriæ of the tube grasp the ovary, and receive the ovum, which they carry to the ovarian extremity of the canal; this act, together with the application of the pavilion to the ovary, takes place either through the contraction of the non-striated muscular fibres which this part contains, or from the swelling of the bulb of the ovary. At times, however, the act is not properly accomplished, and the fecundated ovum, instead of passing into the uterine cavity, escapes the fimbriæ and falls into the abdomen, where it constitutes that most remarkable form of gestation termed *extra-uterine*.

Differences.

Cow, Sheep, and Goat.

In the Cow, Sheep, and Goat, the fimbriated extremity of each tube is expanded upon the outer margin of the ovarian capsule; the inner surface of the pavilion is beset with numerous fine oblique striæ, and is further increased by narrow folds or laminæ converging toward the contracted opening of the duct. The duct itself forms three or four wavy folds, and is then continued along the walls of the wide ovarian capsule to the extremity of the uterine horn, which makes an abrupt curve to meet it.

Pig.

In the Pig the oviduct has few or no inflexions, but its length is proportionately greater than in the other species. The pavilion is wide and deep, and the margin of its abdominal opening is almost even; its inner surface is augmented by many long, narrow, and highly vascular folds, which radiate from the commencement of the contracted part of the tube upon the expanded pavilion.

Bitch.

In the Bitch the fimbriated commencement of the oviduct is attached to the exterior boundary of the aperture, opposite the ovarium; while the tube itself, long and fine, passes in a wavy course round the anterior aspect of the latter to the uterus. The length of the tube is from two and a half to three and a half inches.

SECTION IV.—THE OVARIES.

The Ovaries (*testes muliebres*), the essential organs of generation in the female, and analogous to the testes of the male, are two ovoid or elongate reniform bodies, smaller than the latter, but of the same shape, and situated in the abdominal cavity. They are loosely suspended in the

sublumbar region, behind the Fallopian tubes and the kidneys, among the convolutions of the intestines, though sometimes their position is altered. In four instances in the Pig they have been found in the perineal region, occupying small cavities analogous to the scrotum of the male.[1] Smooth externally, each ovary shows in the middle of its upper portion a more or less oblique, but deep fissure, resembling the hilus of the kidney, and which gives attachment to the pavilion of the Fallopian tube. Each ovary is suspended at the anterior border of the broad ligament, and is also sustained *in situ* by the vessels passing to and from it, as well as by a small cord of non-striated muscular fibres called the *ligamentum ovarii*, which connects it with the uterus.

The *structure* of the ovary comprises a *serous* and *fibrous* membrane, the *proper tissue* of the ovary, and the *Graafian vesicles* embedded in it. The *serous* membrane is continuous with the broad ligaments—is, in fact, a peritoneal tunic which entirely envelops it, adhering closely to the covering beneath. This is the *tunica albuginea*—a dense resisting membrane similar to the structure enveloping the testicle, and sending lamellar prolongations into the substance of the ovary.

The *proper tissue* or *stroma* of the ovary is solid and hard, and has a speckled-grey tint. It is divided into two layers, which are distinct in appearance and structure. The *medullary* layer is nearest the hilus, and is somewhat red and spongy; it is formed by the intercrossing of connective tissue, non-striated muscular fibres, and by a large number of vessels which radiate from the centre towards the periphery of the organ and nerves. The *cortical* layer has connective tissue for its basis; it is not very vascular, but it contains in its substance the *Graafian vesicles* or follicles, and for this reason is named the *ovigenic layer*.

These *Graafian vesicles* are generally in various stages of development; the smallest are situated beneath the tunica albuginea, and they descend towards the deeper layer, increasing in volume as they do so. When they have reached their period of full growth, they are filled with a transparent, citron-coloured fluid, and the ovigenic layer being incapable of containing them, they form a more or less considerable prominence on the surface of the ovary. A *Graafian vesicle*, when perfect, is composed of an envelope and its contents. The *envelope* comprises two tunics—a fibrous membrane (*tunic of the ovisac*), which is continued externally with the stroma of the ovary, and internally is rich in bloodvessels; an inner (*ovisac*), formed by a smooth membrane which derives its bloodvessels from the latter; it is lined by an epithelial or granular membrane (*tunica granulosa*), composed of round or polygonal granular cells. At the bottom of the vesicle this epithelium forms an aggregation (the *cumulus*, or *discus proliger*), in the centre of which exists the *ovum* or *ovulum* of mammalia. The contents of the vesicle is a yellowish, transparent, albuminous mass, that becomes reddened by an admixture of blood when the vesicle ruptures.

The *ovulum*, *ovule*, or *ovum*, is a small cell imbedded in the cumulus, and surrounded by an amorphous, thick, white membrane, which has been designated the *zona pellucida;* within this membrane is a granular

[1] A remarkable, if not unique, case of displacement of the ovaries is recorded by M. Dupont, in the *Journal des Vétérinaires du Midi* for 1869. In four female Pigs, fifteen days old, beneath the vulva were observed two protuberances exactly like the testicles of the male, and which, on examination after death, proved to be the ovaries. The other organs of generation were normal. The same Sow which produced them, had, in a previous litter, brought forth two females with the ovaries similarly misplaced.

layer, the *vitellus* or *yolk*, the larger granules of which are superficial and compact, while internally it is a transparent albuminous fluid, in which are but few granules. Enclosed in this vitellus, though nearer its circumference than centre, is the nucleus—the *germinal vesicle*, or

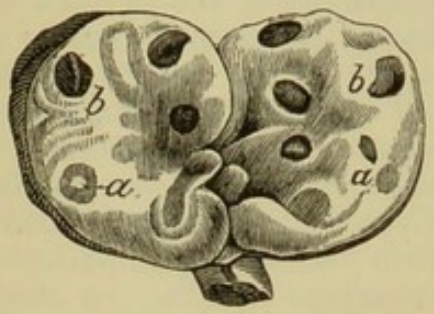

Fig. 27.

OVARY OPENED VERTICALLY.

a, *a*, *b*, *b*, Graafian Vesicles at different stages of development.

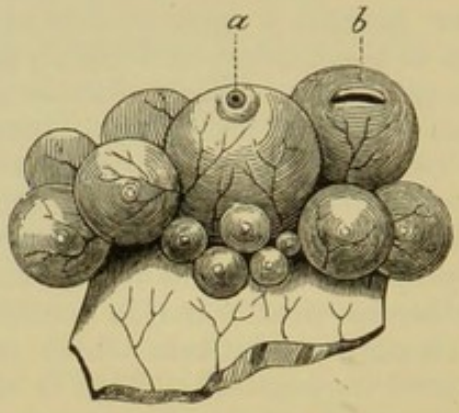

Fig. 28.

PORTION OF THE OVARY OF A PIG.

a, Point at which a ripe Vesicle is about to escape; *b*, Fissure by which an Ovule has escaped.

vesicle of Purkinje, a most important portion of the ovum; it has the appearance of a very small clear ring, measuring about 1-60th of a line in diameter, and upon its surface is a dark spot, the *macula germinativa*. This is always observed as a simple rounded body, measuring from

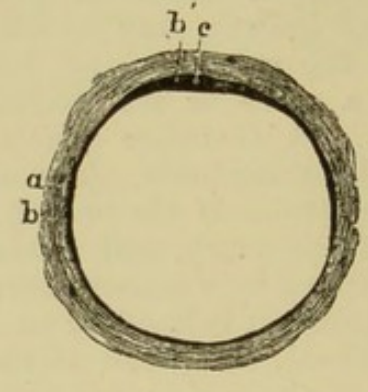

Fig. 29.

GRAAFIAN VESICLE IN MARE'S OVARY.

a, Membrana Propria of the Graafian Follicle; *b*, Membrana Granulosa; *b'*, Discus Proligerus; *c*, Ovum. Magnified 5 Diameters.

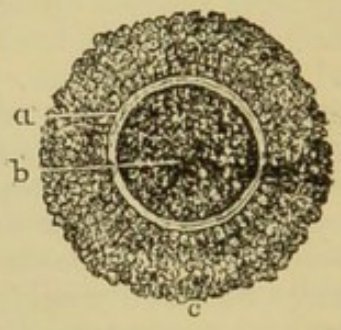

Fig. 30.

OVULUM OF THE MARE.

a, Zona Pellucida; *b*, Vitellus, containing the Vesicula Germinativa; *c*, Cells of the Discus Proligerus.

1-200th to 1-300th of a line in diameter; it is rarely found double or as an aggregate of granules, except in miniature ova.

The large flexuous arteries supplying the ovary are from the utero-ovarian trunk; they spread over the spaces in the tunica albuginea, before entering the hilus of the organ to be distributed in its interior.

The veins are extremely large, and form a very close plexus around the gland (*bulb of the ovary*), emptying themselves into the vena cava near the renal veins. The lymphatics pass to the sublumbar ganglia, and the nerves come from the small mesenteric plexus.

Differences.

Cow, Sheep, and Goat.

In the Cow the ovaries are relatively smaller than in the Mare, but their form and structure are the same. Each is lodged in a depression or sacculus of the broad ligament, which is more or less deep, and the Graafian vesicles are visible through the tunica albuginea. The same arrangement is observable in the Sheep and Goat.

Pig.

In the Pig the ovaries are comparatively large, oblong bodies, with an irregular, tuberculated, or lobulated aspect, due to the Graafian vesicles, which, when well developed, project beyond the surface of the organ, instead of remaining within it. When these ovisacs enlarge, the stroma is scanty in proportion. Each ovary is enclosed within a peritoneal sac, near the opening of which it has a pedunculate attachment. The posterior wall of this sac, as we have seen, appears to be formed by the wide and deep pavilion of the Fallopian tube.

Bitch and Cat.

There is nothing particular to indicate in the ovaria of the Bitch and Cat, except that the ligaments suspending them to the spine are very short, and they are contained in a fold of peritoneum.

Development.

The development of the ovaria and the ova is very interesting. In the Mare, the ovaria of the fœtus are, when compared with the uterus, of an immense size, and at six months are almost as large as in the adult. In aged animals they become atrophied, and it is not unusual in old Mares to find either one or both in an unhealthy condition. Not infrequently they are hypertrophied, and their fibrous envelope and stroma are much thickened. Sometimes the vesicles are greatly enlarged, and converted into cysts which contain a limpid, sanguinolent, or purulent fluid, secreted from their walls. Flandrin cites the case of a Mare, one of whose ovaria weighed 26½ pounds, and measured 14½ inches in its long, and 12 inches in its short diameter. The texture of the ovaries is also liable to various abnormal alterations.

The Graafian vesicles are present in the ovary of the fœtus, but they do not attain their full development until puberty; neither are they all present at birth, but are continually being developed beneath the *tunica albuginea*. The first-formed elements in the fœtal ovary are cells and cell-nuclei; these next appear in somewhat circular groups, which are more opaque than the other parts of the regularly uniform mass (Fig. 31, A). A kind of film soon condenses round these groups (B), and upon the inner surface of this there is fixed an epithelial precipitate from the fluid and granules of the interspaces of the contained primary cells. Within the ovisac thus formed, a large nucleate cell becomes visible: this is the commencement of the ovum (C, *g*). As this expands, the proportion of fluid to the formed particles increases, and the latter

are attracted to the contiguous surfaces: some to that of the ovisac, which thus becomes lined by a thicker layer of cells; others to the ovum, accumulating round it. With the enlargement of the ovisac, the stroma of the ovum condenses round its delicate membrane (Fig. 32, *b*), to form what has been called the "theca folliculi" of Baer—the fibrous tunic already noted; this vascular tunic (*a*), with the other (*b*), constituting the *vesicle;* while the stratum of nucleate cells lining this double covering is the *membrana granulosa*, and those surrounding the ovum itself form the *proligerous disc* (*e*), the mass of cells adhering thereto being the *cumulus*.

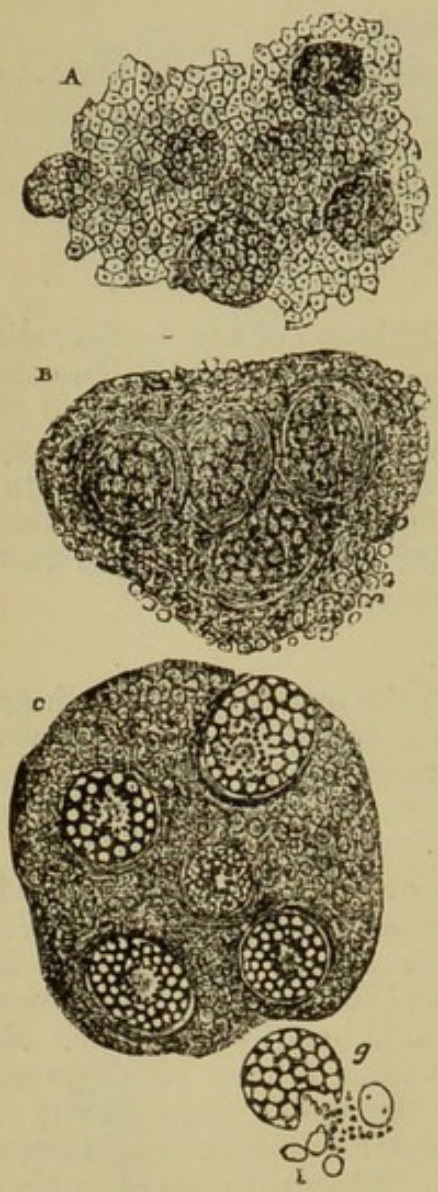

Fig. 31.

FORMATION OF THE OVISAC IN THE BITCH'S OVARY.

The *hyalinion*, or proper tunic of the ovum, thickens into the clear substance improperly named the *zona pellucida* (*f*), which in reality is a bag. As the cells and cell-nuclei of the ovum become developed, they are pushed deeper into the stroma by those of more recent formation; while, as the ovum ripens, the cells immediately around it become elongated and pyriform, the tapering extremity being attached to the zona: those of the cumulus diverge irregularly into the fluid intervening between them and the membrana granulosa of the ovisac. What have been termed *retinaculæ* (*d*) have been described by some authorities; they are four processes formed by the cells of the cumulus, and may be merely exceptional divergences.

Until puberty there is no great activity apparent in the vesicles; but at this time the ovary becomes more vascular, and certain vesicles increase in volume. At the period of "rut" or "heat," one or more vesicles, according to the species of animal, show evidence of increased vascularity and become distended; the ovisac thins at the most prominent part to which the ovum tends, and blood is extravasated into it; then, partly by absorption and partly by pressure, the coverings give way, the proligerous disc and ovum escape outwards, and are either received into the Fallopian tube for conveyance to the uterus, or, which is very rare, fall into the cavity of the abdomen.

The size of the mature ovum in the Cow is $\frac{1}{250}$, Pig $\frac{1}{200}$, Cat $\frac{1}{180}$, Bitch $\frac{1}{160}$, Rabbit $\frac{1}{150}$ of an inch.

After the rupture of a Graafian vesicle and the escape of the ovum, the cavity of the ovisac is filled with a clot of blood, while its walls are thickened and altered in colour, being in most animals partially everted

at the ruptured orifice. In the Cow and Sheep the follicle has a brick-red colour, and in the Pig it is yellowish-brown—it is then designated in the human subject, from its colour, the *corpus luteum;* but gradually the clot shrinks, loses its tint, and the cavity contracts; at the same time the walls are hypertrophied, and the tunica granulosa becomes wrinkled and transformed into cylindrical epithelium. By the time the

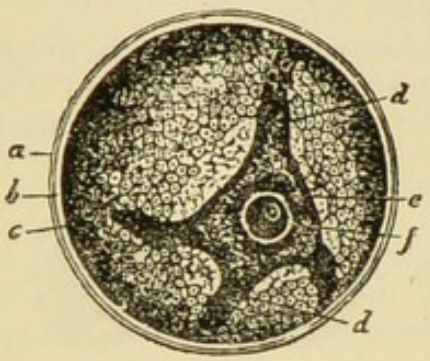

Fig. 32.

GRAAFIAN VESICLE AND OVUM.

succeeding ovisac with the ripening ovum has begun to protrude from the surface of the ovary, the old ovisac has lost its colour, with much of its dimensions, and fallen inwards; the cylindrical epithelium becomes infiltrated with fat and is gradually absorbed. This change, with collapse of the wall, depresses the cicatrix of the aperture; and these suc-

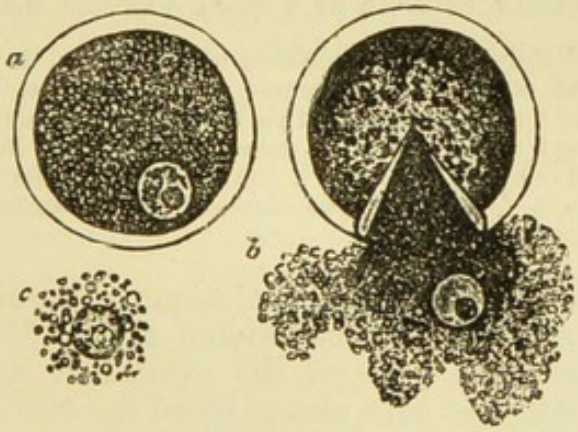

Fig. 33.

ESCAPE OF OVUM FROM OVISAC.

cessive shrinkings and cicatrisations of the ruptured ovisacs give the ovary a pitted and furrowed appearance in advanced life.

If the expelled ovum be not impregnated, the changes of the ovisac into the yellow convolute cavity, then into the depressed stellate cicatrix, occur somewhat rapidly; but if impregnation takes place, the maturation of successional ova is delayed, and the first change in the ruptured ovisac goes on to a greater extent, the *corpus luteum* not becoming obliterated for a comparatively long time. In this period the inner coat, or original ovisac, is much thickened by a larger deposit of yellow oil-granules; it becomes more deeply plicated, is impacted into a yellowish

mass, and gains an adventitious white lining membrane, and it rarely happens that the cavity is obliterated before full gestation. It is then, in the human species, represented by a stellate linear figure surrounded by the corpus luteum, which is ultimately absorbed, but usually not before some weeks after parturition.

It is this difference between the impregnated and unimpregnated condition which enables us to distinguish, in these ruptured vesicles, the *true* and *false corpora lutea*.

In the Mare the retrocession of the true corpus luteum is more rapid than in the other domesticated animals, and it has not that deep yellow colour observed in the Cow; but it is of a darker, dull reddish-brown

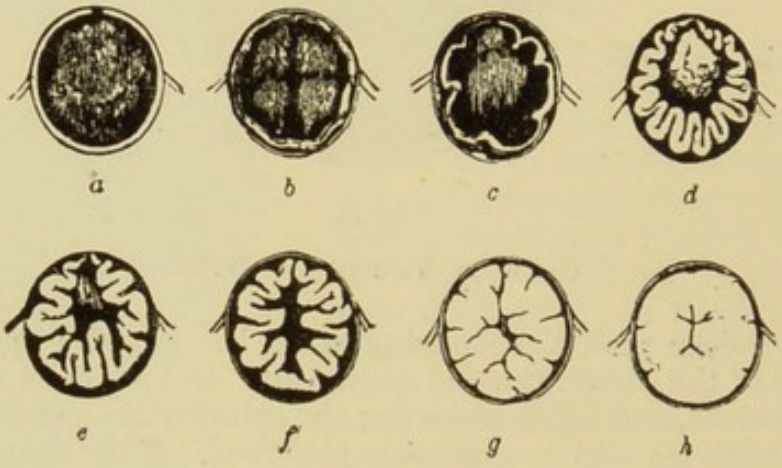

Fig. 34.

SUCCESSIVE STAGES IN THE FORMATION OF THE CORPUS LUTEUM IN THE GRAAFIAN FOLLICLE OF A SOW: VERTICAL SECTION.

a, Follicle immediately after the expulsion of the Ovum, its cavity being filled with blood, and no ostensible increase of its epithelial lining having yet taken place; at *b* a thickening of this lining has become apparent; at *c* it begins to present folds, which are deepened at *d*, and the clot of blood is being absorbed and decolorised; a continuation of the same process, as shown at *e*, *f*, *g*, *h*, forms the *Corpus luteum*, with its stellate cicatrix.

hue, and on section presents convolutions resembling those of the brain. When recent, the corpus luteum of the Mare is voluminous, and drawn towards the hilus of the ovary; it has two layers, the internal being constituted by a clot of blood the size of a small nut.

Franck has convinced himself, by *post-mortem* examination of Mares, of the possibility of ova being thrown off from the ovary during pregnancy.

It is to be remarked that the number of ovisacs and ova which became matured at each "rut" or "heat," depends upon the multiparity or uniparity of the species; in the Mare and Cow there is usually only one, in the Sheep and Goat one or two, in the Pig from four to a dozen, and in the Bitch a variable number.

BOOK II.

OBSTETRICAL PHYSIOLOGY.

REPRODUCTION.

HAVING described the situation, structure, and peculiarities of the external and internal organs of the female domesticated animals, we have now to inquire into their functions. Some of these functions have for their end the conception, development, and preservation of the young animal for a certain period, until it can maintain a more or less independent existence, when others of them are brought into play in order to place it in direct relation with the external world in the act of parturition, while others cease. But in order that generation should take place in the higher classes of animals, it is necessary that the two sexes be placed in favourable relations with each other. This preliminary condition is indispensable, as the essential of reproduction is the contact with, and action of the male fecundating fluid on, the ovum of the female. Nature has ordained that this creative act should be accomplished by engendering in these animals an instinctive, copulative, and irresistible desire at a certain stage of existence; which desire, continuing only for a brief period, is renewed after particular intervals, until the faculty of reproduction ultimately ceases.

The advent of the power of reproduction in the male and female sex of animals is very unequal among the various species, and is generally in relation to the duration of their existence—the creatures which are short-lived being capable of bringing forth young at an earlier period of life than those which enjoy a longer term.

The Elephant only brings forth one at birth, and this occurs but once in three or four years; while the descendants of the Rabbit in the same space of time may be reckoned at more than a million. This great disparity has nothing of chance or accident in it, but is in admirable harmony with the designs of Nature. The individuals of every species produce, as has been justly remarked by Verheyen, a total number of germs which amply covers the losses caused by death; and the premature destruction of many of these germs is likewise a providential safeguard against their too numerous multiplication.

Two factors regulate fecundity; these comprise the nutritive excess which the maintenance of the individual renders disposable, and the sum total of the materials necessary for the embryonic evolution; but the divergences of these two factors are as extensive as those of fecundity itself.

If we take the weight of the fœtus at birth as the equivalent to the nutritive matter that the parent has endowed it with, and multiply this weight by the number of young annually produced, we shall obtain the total amount of the materials which have been derived from the maternal organism. Then weighing the mother, and comparing her weight with that of the fœtus, we shall arrive at the disposable nutritive excess; and from this, according to Leuckart, be able to calculate the fertility of a species. Although this calculation is only approximate, it none the less demonstrates, in principle, the relations between fecundity and the two before-mentioned factors. This is shown in the following table, drawn up by Leuckart, with reference to the domesticated animals.

Species.	Weight of Body.	Annual Number of Young.	Weight of each Young Animal.	Annual nutritive excess of the Maternal Organism.	Relation between the living weight of the Mother and that of the Young.	Nutritive Matter yielded to the Fœtus.
	Grammes.		Grammes.	Grammes.		Per cent. of the living Maternal Weight.
Horse	325,000	½	50,000	25,000	100 : 7,7	14
Cow	175,000	1	35,000	35,000	100 : 20,0	20
Sheep	50,000	2	4,500	9,000	100 : 18,0	9
Pig	90,000	20	2,400	48,000	100 : 53,0	3
Dog	22,000	18	0,440	7,950	100 : 36,0	2
Fowl	0,900	100	0,044	4,400	100 : 500,0	5

The nutritive reserve of the Horse, compared with that of the other animals, is here seen to be very limited; while, on the contrary, the Fowl yields in reproductive material a sum equivalent to five times the weight of its own body. When a balance is struck between the profits and losses in the animal economy, it is found that the great difference existing has its own reasonable explanation. The function which makes the greatest demand upon the nutritive capital, is doubtless that with which the muscles are charged, and their maintenance in power exacts the heaviest compensation; as they consume material in proportion to the weight of the body, and the energy, extent, and frequency of the movements. In proportion as the height increases, the cubical weight augments at the expense of the motive power; while the latter, equal to the square of the transverse section of the muscles, follows an arithmetical, and not a geometrical, progression.

The nutritive maintenance, then, demands in an absolute manner an expenditure much more considerable in the larger than the smaller animals; so that the latter are more fruitful than the former, and their economy renders them more apt to hold in reserve a much greater nutritive capital.

A rich and abundant aliment, given regularly, increases reproductiveness; as is evidenced in the case of our domesticated animals, if compared with the wild creatures of the same species; and their fecundity increases or declines as their food is plentiful and good, or scarce and bad. But this influence of alimentation on fecundity, and the faculty of living beings to maintain a nutritive reserve, has its limit; for the intestinal absorption goes on in direct proportion to the superficies of the mucous membrane lining it, and this is definite.

The sum of materials necessary for embryonic evolution is also founded on the nutritive reserve. In proportion as the organisation is simplified and the various apparatus decrease in number, so does the maturity of the embryo gain in precocity, and the nutritive matter serve for a larger number of germs. Thus, as has been aptly said, what would be required to maintain the single fœtus of a large mammal, whose organisation is complete at its birth, would suffice for the evolution of many million of frogs. Besides, the parent having once evacuated the product of her fecundation, has done with it—the tadpoles issuing from the ova find their nourishment in the outer world; but the young mammal derives its sustenance from the mammæ of the mother, at whose expense it continues, for a more or less protracted period, to live as a parasite (as it really was *in utero*). With the higher animals,

which give birth to an incomplete being, there is observed an increase in fecundity: the Bitch only yields two per cent. of its weight, but the Calf absorbs twenty per cent. of its parent's weight.

This unequal distribution of fecundity among the animal species is a conservative element in the scheme of organic nature. The reproductiveness and the numerous chances of destruction surrounding the germs, are compensated for in just proportion; for out of many thousands of ova furnished by the most prolific species, a comparatively limited number only find all the conditions favourable for their development.

CHAPTER I.

Generation.

THE processes by which generation is accomplished are four; these are *copulation, fecundation, gestation, and parturition;* but it is only on the attainment of a certain age—that of *puberty*—that these sexual acts are in activity, and they continue so for a variable period, according to the species. During this time, ova from the ovaries, fecundated by the male seminal fluid, are received into the uterus, and remain there for a regulated period, until they have become transformed into young creatures possessing certain physical attributes and resemblances to their parents. This is the gestation period, and is followed by that of parturition, when the young are born.

SECTION I.—PUBERTY.

The generative organs of the domesticated female animals are, like those of the human female, only in a state of greatest activity during the prime of life; and the most notable characteristic of their functions, as in woman, is their periodicity. These functions lie dormant from birth until puberty, when, somewhat suddenly, certain very marked modifications occur throughout the whole organism, but particularly in the generative organs of the male and female animals. In the first the testicles become more voluminous, and in some species they leave the abdominal cavity to be lodged in the scrotum; they also begin to secrete an abundance of a special fluid—the "spermatic" or "seminal," in which particles of a definite shape—*spermatozoa*—and endowed with motion, appear. This fluid is stored up in the *vesiculæ seminales*, which, until this period, were small and wasted-looking. The organ for the conveyance of this spermatic fluid to the female becomes more developed, and is capable of complete and frequent erection. In the female the mammæ enlarge, the ovaries are more vascular and turgid-looking than before, and the Graafian vesicles are more or less developed. The periodic ovipont then begins to be carried on, with all the distinctive peculiarities that attend it, and which it is to bear during the prolific period of life.

The age at which animals arrive at *puberty* or *sexual maturity*, is not only different in different species, but is influenced to some extent by the rapidity of their growth and the duration of their life. Domestication has more particularly brought about changes in this respect, and by inducing a more rapid development of the organism, has hastened the advent of this period. And it may be said that puberty is sooner attained in the female than the male, and also that domesticity has

considerably modified the periodicity of the procreative manifestations in the former; though in the latter it may also be affirmed that this periodicity is not so marked, the generative functions being always more or less in activity.

The aptitude to procreate, though generally admitted as an indication of adult age, yet appears before animals have attained their full physical development, and is present in some creatures at a comparatively early period of life—depending upon climate, food, and other circumstances. The Pig may conceive when only four or five months old, or earlier; the Sheep and Goat at eight to twelve months; the Bitch at seven to ten months; the Cat at from eight months to a year, though it is usually in "heat" for about ten days before it is a year old; the Cow at twelve to eighteen months; and the Mare at from twelve months to two years.

Saint-Cyr has seen Mares which foaled when thirty months of age; and others which, going at large with Colts of their own age, have become pregnant before the end of their first year, and foaled at twenty-two months; also Heifers bring forth their first Calf before they were two years old. Heifers have also taken the Bull at five, six, seven, and nine months, and calved at fourteen, fifteen, sixteen, and eighteen months. He gives the period of puberty as commencing in the Equine species at from fifteen to eighteen months; in the Bovine species at from twelve to fourteen months; in the Porcine species at about eight months, and about the same time for the Ovine and Caprine species—the Canine species being a little earlier.

An instance is recorded by M. Abadie of a Heifer four and a half months old, which accidentally received the Bull—which was six months old—and produced a Calf soon after reaching her thirteenth month; this did not check her development, and she subsequently became a remarkable dairy Cow. In the first volume of the *Lancet* (1835-36), there is mention made of a Bull Calf less than three months old, which copulated with a Quey Calf about two months old, and within nine months the latter brought forth a Calf. Quey and Calf did well.[1]

With regard to the period when procreation ceases in animals, I cannot discover any reliable data on which to arrive at a trustworthy conclusion. The Mare has not ceased to breed after thirty years of age,

[1] Such instances might be considerably added to, but the following will suffice, as they corroborate the statements given above. In the *Veterinary Journal* Mr. Adams, M.R.C.V.S., writes as follows: "About three years ago a Calf, about three months old, was sucking by its mother's side, when its owner, Mr. James Lowe, saw a young Bull, owned by Mr. White, his neighbour, jump over a hedge and run towards the Calf. Mr. Lowe hastened with all speed to stop his progress, but before he could arrive on the scene of action, the Bull had jumped the Calf, and *coitus* took place as usual. Fearing the consequences, Mr. Lowe took what care of the Calf he could, but at the end of the natural term of gestation it brought forth a good Bull Calf—healthy, sizable, and strong—and which at the end of a year was sold for £9. The mother and Calf are now both living."

A gentleman in Richmond, Natal, South Africa, writes to the *Cape of Good Hope Agricultural Journal*: "Mr. R. W. Cockerell, Fondeling, Polela, had a Heifer calve down at thirteen months, twenty-four days, and, to be very exact, four hours old. This is a fact, and at eighteen months it is nothing unusual."

Another gentleman residing near Birmingham, states in the *Live Stock Journal*: "In 1887 I had a very nice yearling Filly served by a yearling Colt, and the result was that the little Filly foaled when she was one year and eleven months old. I took particular attention of the Mare and Colt, as she was bred from one of the best mothers in this district." The Filly did not turn out satisfactorily afterwards.

and the Cow and Sheep have bred beyond twenty years. I have notes of Mares producing foals at twenty-eight, thirty-two, and thirty-eight years of age.

The changes incidental to the procreative period of life in the female are chiefly centred in the ovaries and uterus: organs destined to play a pre-eminent part in the perpetuation of the species, and whose functions are interdependent. The ovary is doubtless the principal and essential agent in generation; as it gives the necessary and effective stimulus to the condition termed *rutting* or *heat*, and furnishes the germ which has been, or is intended to be, fecundated; while the uterus secretes mucus and the peculiar fluid ejected at that period, receives the ovum, forms the decidual temporary or enveloping membranes in some cases, nourishes the fœtus, and finally expels it. So that the ovaries and uterus co-operate in the accomplishment of the four chief functions of the uterine system—*œstrum*, *conception*, *gestation*, and *parturition*. These we will consider in the order in which they stand, describing the phenomena that characterise or accompany them, and noting the conditions upon which their evolution mainly depends.

SECTION II.—ŒSTRUM OR MENSTRUATION.

The *rutting*, *heat*, *œstrum*, or *venereal œstrum* of animals is analogous to "menstruation" in woman, and marks the period of maturation in the ovarian ova or ovum, according to species. This condition is *intermittent* or *periodic*, not continuous; it is characterised by a peculiar systemic excitement that usually continues for a somewhat definite period in the two sexes. In the male and female, but especially the latter, the generative organs at this time become more or less turgid and sensitive, and the uro-genital secretions are increased. In the female there is a determination of blood to the ovaries, and changes take place in these which have already been described. The excitement in the generative apparatus reacts on the whole system, and produces a kind of fever or irritability in the animal; its sensibility is increased; the appetite is more or less in abeyance or capricious, and usually there is thirst; if the secretion of milk has been active, it now diminishes, and in the non-impregnated Bitch milk even appears in the mammæ; restlessness is a notable feature, and the movements betray the prevailing desires. There is an uncontrollable tendency to seek the opposite sex; with some animals the ordinary disposition becomes strangely perverted; and in others, again, certain physical changes accompany the sexual perturbation. The Mare is generally irritable or sluggish, and less able to sustain fatigue; the Cow frequently bellows and mounts other cows, and if at pasture runs about with raised tail, and may even wander away in search of the Bull; the Sheep is less excitable, though it shows a change in its habits; the Sow grunts in a peculiar manner and becomes torpid, and manifests its amorous desires by mounting others; while the Bitch is still more demonstrative, and frequently runs about accompanied by a crowd of males, not returning home until her desires have been gratified.

Attempts at micturition in the female are frequent, but only a small quantity of urine is passed; the mucous membrane of the vagina is injected; and with Solipeds there are oft-repeated movements of the clitoris and vulva, and an opaque white secretion—or even emissions of blood—is ejected spasmodically *per vulvam*.[1] Well-marked symptoms of hysteria have been observed in some Mares.

[1] Kaiser, in the *Magazin für die gesammte Thierheilkunde* for 1859, mentions a Mare,

In other animals this ejection sometimes consists of a viscid, red-tinted, or sanguinolent fluid. In all it has a special and powerful odour, which attracts the males, and enables them to distinguish between the females which are in "rut" or "heat," and those which are not, as well as exciting in them the most ardent amatory desires.

The uterine mucous membrane is also very congested, and there is poured out on its surface a fluid containing epithelial *débris*, mucus corpuscles and blood globules.

The existence in the lower animals of what is analogous to the *menstrual discharge* in the human female, has frequently been denied, but without any reason or proof. A discharge of blood from the sexual organs of woman announces the advent of puberty; and its coincidence with the maturity and escape of the ovarian ovule, as well as its periodical appearance until the termination of fertility, establishes between this phenomenon and the "heat" or "rut" (*œstrum*) of animals a very close analogy. And this analogy is rendered complete by the fact that animals also at this period have more or less evident sanguine emissions. Kahleis, Fuchs, Spinola, Numann, and others have observed this in the Cow, and have also noted that the discharge occurs regularly at intervals of nineteen or twenty days, when the animal is not giving milk or in calf. The hæmorrhagic flow appears two or three days after the commencement of "rutting," and when this is most intense. The amount of blood does not exceed one or two ounces, and the coagulated clot remains in the vagina until it is expelled with the urine. There can be no doubt as to its source. If, at the moment when traces of it are perceived externally, the Cow is killed and the inner surface of the uterus examined, blood will be seen exuding from the cotyledons. And this phenomenon has been proved to extend beyond the Bovine species, for it has been witnessed in the Mare, Bitch, Cat, Rabbit, etc.; and in the red-coloured mucus of the vagina and uterus, multitudes of blood-corpuscles have been found.

Not only is the existence of a menstrual discharge in animals a well-ascertained fact, but the ill effects of its retention in cases of uterine obstruction or occluded vagina, have been recorded as occurring in both the Bovine and Equine species.

The cause of menstruation or periodical discharges of blood in female animals, has received a satisfactory explanation from the researches of Rouget, who has established the fact that the utero-ovarian artery, on arriving at the body of the uterus, near the Fallopian tube, divides into curved or spiral *bouquets* of vessels which open into veins, like the helicine arteries of the male cavernous sinus. Along the inferior border of the ovary, this artery forms a series of branches that wind and twist exactly like the arterial ramifications at the root of the *corpus cavernosum*, penetrating the stroma of the ovary, and giving rise to spiral convolutions. The venous system composes the uterine sinuses—contorted venous canals not unfrequently spiral, like the arteries.

The uterus is, therefore, an erectile organ like the penis, and its erection is connected with the periodic hæmorrhage from its inner surface. The venous sinuses in the meshes of the muscular tissue, crossing each other at the hilus of the ovary, are partially compressed, and

twenty-four years of age, which every three weeks had a sanguineous emission from the vulva; this discharge ceased towards the middle of pregnancy, but returned after parturition. I have frequently witnessed the periodic discharge from Mares either streaked with blood, or blood-tinted.

the immediate result is the distending and erection of the bulb of the ovary. This modification in the ovarian circulation extends to the uterus, so that both are in a state analogous to erection ; the prolonged tension is communicated to the vessels and capillaries of the mucous membrane ; the epithelium is shed, leaving the tunic of the capillaries exposed, and this soon gives way, whence results the hæmorrhage, which persists as long as the erection and obstruction to the free flow of blood through the veins continues. This is the case in the human female, but it must be admitted that, in several animals, the erectile formations are either in a rudimentary condition or entirely absent.

In the Bitch the bulb of the ovary is moderately developed ; but the arteries of the uterus, although contorted in a spiral form, are not such a vascular mass of vessels as to constitute a real erectile organ. In Ruminants, small vascular masses or formations are observed near the cotyledons, which may be taken to represent the spongy texture of the human uterus.

That the menstrual flow is independent of the influence of the ovaries, and even nearly all of the uterus and its appendages, would appear to be established by several important facts connected with the subject of ovariotomy or "spaying." There is a tradition among those who practise this operation on Sows, Bitches and Cats more particularly, that it does not prevent their showing signs of œstrum unless they are operated upon when pregnant ; this is more especially the case with animals which have already produced young, but it is nevertheless the case also sometimes with young animals which have never been bred from.[1]

With regard to the season at which this "heat" takes place, it has been observed that it is usually the spring-time, when food becomes plentiful, especially with Herbivorous animals. The Carnivora are in heat during winter. The Mare is usually in heat from April to June, or later. With the Cow whose Calf is sold at from one to two months old, with a view to utilising the milk, the season of course is varied, as care is taken to induce conception again as soon as the lacteal secretion begins to diminish ; but it has been observed that midsummer is more particularly the rutting period. And the "heat" in Sheep, though naturally present in September, is usually only shown during summer, because the Ewes are kept apart from the Ram at the natural time, in order that the Lambs may be born at a favourable season—the spring ; and the period of suckling over (four or five weeks), they may be weaned when the herbage is tender and nutritious. And in other circumstances, particularly with animals bred for the butcher, the rut is induced sooner by putting the Ewes in contact with the Ram at an earlier period, so as to obtain two or three lambings in the year.

The Bitch is in heat from December to February, or in the autumn and spring-time.

[1] A striking instance of this has been given recently by Barthelmy, in the *Journal de Médecine Vétérinaire*, who asserts that the œstrum or "rut" can occur in Pigs after complete removal of the ovaries. A professional spayer operated on thirty-eight young Pigs under sixty days old, yet these animals showed the symptoms of "rut" at from three to eight months, and monthly after that age, as though they had not been spayed. An action was brought against him, after M. Barthelmy had given his opinion that the œstrum indicated incomplete removal of the ovaries. The defendant declared that he had seen œstrum in pigs which had been properly spayed. The court ordered that five of the Pigs which showed all the phenomena of œstrum to the greatest extent, should be killed and examined by a competent veterinary surgeon. This was done, and it was found that in each case the operation had been well performed—the ovaries, tubes, and almost the entire cornua of the uterus having been removed.

The Cat is in this state in January and February, and also in the spring and autumn; sometimes the heat appears three or four times a year, and the animal may produce young as frequently; though in the wild state it seldom does so more than twice a year.

The Pig manifests rutting in October or November—at least that is the period when it is usually put to the male; and it may be put a second time towards the end of spring, in order to have two litters within the twelvemonth.

The *frequency* and *duration* of the period of "rutting" or "heat" depend upon age, species, and other circumstances; but it may be said to persist in the domesticated animals from one to fifteen days at the most. The shortest period is witnessed in the Cow and Sheep, and the longest in the Bitch. It is sometimes only present from twelve to twenty-four hours in some non-fecundated animals. With impregnation, however, it ordinarily ceases until after parturition; and if impregnation does not occur, it gradually disappears until the next period, which is somewhat variable. Its re-appearance in the Cow has been noted every month or three weeks, and sometimes at closer intervals; and in the Sheep and Pig it lasts for one or two days, and again appears from the fifteenth to the thirtieth day, but usually every month. When removed from artificial conditions, it is stated that the Ovine species is in rut in September, that this persists only for a day, but re-appears every fourteen days until the end of December. From the spring until the end of summer, it may be said the Mare manifests a desire for the Horse every three or four weeks, and the objective phenomena which announce it continue from two to four days. In the Bitch they last for nine or ten days, and, as has been stated, only appear in the spring and autumn.

This periodicity is regulated by Nature, with a view to the preservation of species; and in animals not influenced by artificial conditions, it is so arranged that the young creatures may arrive during the season when their maintenance will be best assured.

With the subsidence of venereal excitement in unimpregnated animals, there succeeds a period of calm, which is almost equivalent to that of gestation in impregnated creatures. And, strange to say, with Bitches at the end of this interval—from the fortieth to the sixtieth day—there sometimes appear phenomena allied to the parturient period; these are: tumefaction of the mammary glands, followed by swelling and increase of the opening of the vulva, with reddening of the vaginal mucous membrane and the escape of a viscid fluid. The animal also acts as if about to bring forth—making a bed for her young; moving about uneasily; neglecting her food for three or four days, during which the mammæ become still more developed, firm, and elastic, the teats elongated, and the lactiferous sinuses filled with an abundance of good milk, which is easily obtained by slight pressure. If a Bitch in this state is presented with a young Puppy, she will take to it as if it were her own, and rear it most affectionately. This strange condition has been observed, though more rarely, in the Cat; and Chauveau has also noticed it in a Mare which had been put to the Horse, but did not prove in foal.

The years during which œstrum continues varies with species, and particularly with regard to the age they attain; but it always disappears towards the decline of life.

Climate, inseparable from the conditions of alimentation, exercises a

marked influence on the "rut," in hastening its development and its periodicity; but the economical law to which it is subordinate does not vary. With many species, the rut only appears once a year; while in others which are favourably placed with regard to alimentation, it persists in every season, or at least during a large part of the year. Domesticity, in assuring animals food and shelter, and removing them from the risks and alternations of an erratic life, multiplies the periodical returns of this condition. Fowls, Pigeons, etc., lay despite the rigours of winter, and the domesticated mammals are in heat at short intervals.

Though, as a rule, œstrum does not appear until after parturition is achieved, and lactation has nearly or quite ceased, yet it is not rare to find some animals—as the Mare and Pig—manifest a desire for the male, and even copulate; and it is no less a fact that rutting and impregnation may and does occur soon after parturition. The Cow, Ass, and Sheep, and, it is believed, the Mare, will copulate with greater certainty of success on the ninth day after parturition than at any other time.

As has been just stated, various conditions influence the appearance of this state, and more or less change the period and the intervals of its advent. Warmth, shelter from vicissitudes of weather, an abundance of nourishment, especially that of a stimulating nature, and easy labour, favour its more frequent and early appearance, and especially a judicious bringing together of the male and female. It has also been induced by the injection of certain substances into the vagina.

The persistence of this condition for longer than the natural period is a symptom of uterine or ovarian derangement, and therefore unfavourable. It renders Mares and Cows less serviceable, and even dangerous, constituting the disturbance designated "nymphomania." Repeated intercourse with the male will not allay the abnormal condition, but frequently aggravates it. Such animals will not breed. Ovariotomy is often practised for "nymphomania," and in the Cow the operation is frequently followed by subsidence of the troublesome symptoms for a time; in the Mare it is much less successful.

SECTION III.—MATURATION OF THE GRAAFIAN VESICLES.

The spontaneous and periodic ripening and dehiscence, or discharge, of the ovarian vesicle that marks the period of œstrum in the domesticated animals, though independent of fecundation, yet is doubtless intended to commence the act of generation. The peculiar condition which accompanies the maturation of the ovum, the intense desire of the female for the male, and the excitation produced in the latter at this period, with its aptitude for procreation, conclusively demonstrates this. At this time, as we have seen, particular changes occur in the ovaries. A certain Graafian vesicle or vesicles, according to the species and whether the animal is uniparous or multiparous, becomes more voluminous than the others, raising the enveloping membrane of that body, and makes a more or less salient projection on its surface, as is witnessed in the ovary of the Pig. Around this vesicle the bloodvessels enlarge, and the stroma is congested; while in its interior an effusion of blood takes place; the capsule becomes greatly distended and injected, and at a particular point gives way, leaving an irregular gap through which the ovum (Fig. 28, *a*) escapes. In the Pig, during the evolution of the vesicle, the corpus luteum is red, deep red, blue, or nearly black. It is probable that the Graafian vesicles open at any part of the surface

of the ovary, in those animals in which the pavilion of the Fallopian tube is large enough to envelop it more or less completely. But in those creatures, such as the Mare, in which the ovary is so voluminous, the pavilion cannot cover it; and it is not at all unlikely that in this case the rupture of the vesicles occurs at the hilus of the ovary, as the corpora lutea have only been observed at this part. In multiparous animals, the rupture of the vesicles at one period of rutting does not appear to take place simultaneously, but successively.

The number of Graafian vesicles which come to maturity and rupture at each period of œstrum, depends, with some exceptions, upon the number of young each female brings forth at a birth. The Mare, Cow, and Sheep, having usually only one offspring at a time, only one vesicle ripens during œstrum; the Goat has most frequently two young, and in this case a vesicle ruptures in each ovary; while the Pig and Carnivora having several at a birth, a corresponding number of vesicles open, and their contents occupy each cornu of the uterus.

The ovum liberated by the bursting of the vesicle is seized by the pavilion of the oviduct, which is applied somewhat closely to the surface of the organ, and is carried down the tube to the uterus, where, if fecundation does not ensue, it remains only a brief period before it is expelled or perishes. The seizure of the ovum, as has been stated, is all the more certain in proportion as the pavilion is large enough to grasp a large surface of the ovary; this condition is found most developed in the Carnivora.

CHAPTER II.

Fecundation.

The effective intercourse of the male with the female is followed by certain remarkable changes in the ovum and generative apparatus of the latter, which, at first known as *fecundation*, *conception*, or *impregnation*, ultimately results in the formation of a new creature possessed, to a certain degree, of individual or independent life. The intercourse, to be effective, depends upon the presence of a healthy ovum in the generative apparatus of the female, and the introduction into this apparatus of the seminal fluid by the special organ of the male. This fluid contains the essential elements known as "spermatozoa"—organic particles of a particular shape, and endowed with motion. For conception, it is absolutely necessary that the ovum of the female should be brought into contact with these particles; though whether this contact can occur in the ovisac, prior to its escape, has not yet been definitely ascertained. It is certain that, by reason of their particular movements, and also doubtless through the aid they receive from the special motion of the ciliated epithelium covering certain portions of the lining membrane of the uterus, these spermatozoa, when the uterine opening is patent, are diffused soon after *coitus* to the most distant parts of that cavity, and high up in the Fallopian tubes; though they have never been traced so far as the ovisac. Nevertheless, a very strong argument in favour of their attaining this region, and producing what is called "ovarian" or "tubal impregnation," is afforded in the occurrence of extra-uterine—ovarian or tubal—gestation; for in this case the spermatozoa must have reached both oviduct and ovary.

Before the ovum leaves the ovary, changes occur in it which may be

noted here. The germinal spot, previously at the inner surface, passes to the centre of the germinal vesicles; and this, which was before at the surface, goes to the centre of the yolk or *vitellus;* while the membrane investing the latter, from being thin, suddenly thickens. When the ovum is discharged, the *tunica granulosa* and *retinacula* accompany it through the small opening in the vesicle; the whole being received into the pavilion or infundibulum of the Fallopian tube, which at this time is firmly applied against the ovary. Arrived at this part, the ovum is carried along by the slow vermicular motion or contraction of the tube, as well as by the ciliary movement of the cells covering the mucous membrane lining this duct, until at last it reaches the uterus.

CHAPTER III.

Sterility.

HITHERTO we have been treating of fecundation as if it were always a sure result of the coupling of the male and female sexes at a certain period. Successful fecundation, however, is not always the case, and in some species—particularly the Equine—sterility, temporary or permanent, in the female is far from being uncommon, and is sometimes serious. Sterility, barrenness, or infecundity depends on numerous causes, to some of which we must allude, as in distinguishing their presence we may be able to remove or counteract them.

It is difficult to ascertain the extent to which it prevails, especially in the larger and more important animals. In the Stud Book, it is shown that among thoroughbred Mares the percentage of those which carry foal is 73·36, and those which abort or are infecund 26·64. In the studs of France the fruitful Mares are 59·57, and the unfruitful ones 40·43 per cent. The Duc de Guiche gives 68 per cent. of fecund Mares. At the haras of Pin, during a period of twenty years, there was a percentage of 68·27 fecund Mares, abortions 5·06, non-fecund 26·67; while at the Pompadour haras, where Oriental horses were chiefly bred, the births in three years were 79·55, abortions 2·27, and non-fecunds 20·45.

In the Cow, the fecundations appear to average about 79 per cent.

With the Sheep, sterility or infecundity is not so common. Rueff, at Hohenheim, found among 8,500 sheep, only 740, or 8 per cent., unfruitful.

Sterility may depend upon organic or physical causes, and may amount to permanent impotence, more particularly when congenital and located in the generative apparatus. Monstrosities, hermaphrodites, animals in which one or more important organs of the sexual apparatus are absent, and hybrids, are generally permanently sterile.[1]

Prolonged continence and old age are not infrequent causes of infecundity, as is witnessed in Mares which have worked for many years in towns, and then been transferred for breeding purposes.

Change of climate has in many cases a marked influence on fecundity—sometimes putting it altogether in abeyance, and at others rendering the animals infecund for only a longer or shorter period. It may also be impaired, or suspended temporarily or permanently, by abuse of the generative functions, bad hygiene, etc.

[1] There are exceptions to this rule. Several well-authenticated instances are recorded in which the soliped mule has bred, as well as other hybrids.

It may likewise be due, though temporarily, to premature or tardy coition when the generative organs are not in a physiological condition for conception, or when they are in an irritable, abnormal state. Under-fed or over-fed animals generally do not breed so readily as those which are in moderate condition; fat animals are especially unfruitful. Excitable, vicious Mares are less likely to procreate than those which are of an equable and gentle disposition. The latter are often impregnated at one attempt; and it has been observed that with Mares accustomed to work, active exertion, even to produce fatigue, before being put to the horse, is favourable to conception. So it is that the Arab submits his Mare to a severe gallop, and brings her almost breathless before the Stallion, when, the act being accomplished, he leaves her quietly at rest for some hours.

Various diseased conditions of the generative or other organs, as well as general derangements, may also prove antagonistic to fecundity. There may be disease or alterations in the ovaries, Fallopian tubes, uterus, or vagina, which will hinder conception; and if any material obstacle to the contact of the spermatic fluid with the ovum be present in these parts, fecundation cannot take place. Tumours of various kinds in this region are not an infrequent cause of sterility.

Rueff and others have observed an imperforate, dense, and tough hymen to be a cause of infecundity in the Mare.

The fault may rest with the male, and be due to imperfection in his generative organs, the absence of spermatozoa in the seminal fluid, or general or sexual debility of a temporary or permanent character. Or the spermatozoa, when introduced into the genital canal, may have their vitality destroyed by the secretions they meet with; or the impregnated ovum may be unable to fix itself on the mucous membrane of the uterus because of disease existing there, such as endometritis.

In all these conditions a careful examination should be made, as removal of the obstacle to generation may, in many instances, be quite within the scope of surgical or medical measures. More particularly is this the case when the obstacle is related to some abnormal condition of the cervix uteri—a circumstance more common than is generally supposed.

Occlusion of the canal leading to the cavity of the uterus—the os—has been known as a cause of sterility in the Mare and Cow from the earliest times. This occlusion may be complete during coition, and prove fatal to conception; or it may be due merely to a spasmodic condition of the muscles of the cervix. The oiled hand should be introduced into the vagina to ascertain the state of the part; when, if the closure is suspected to be owing to muscular defect, the cervix may be smeared with extract of belladonna. If, however, this does not succeed, or if there be hypertrophy, disorganization, or rigidity, then an operation will be necessary. Hypertrophy from plastic exudation and the formation of false membranes, is a frequent cause of sterility, and usually occurs during or after the first birth, particularly in the Cow. In many cases the morbid closure of the os can be remedied in a very safe and simple manner. The animal is secured—if a mare by the "side-line," if a Cow by fastening the two hind-legs together, though not too close—and the oiled hand, in the form of a cone, passed up the vagina to the cervix in a half-rotary or screwing manner; on reaching this, the tips of the fingers are to be gently insinuated by the same movement into the os, and pushed on until the cavity of the uterus is reached. A

simple sound, the size of an ordinary catheter, well greased, may be employed with the same object as the fingers, and appears to answer quite as well. Various instruments have been devised to dilate the cervix, but nothing is equal to the fingers or the sound. The animal may be put to the male on the same or the following day. This simple operation for the cure of sterility has been very often practised, and is well known to the Arabs of the Sahara, who treat their barren Mares in this manner, and in the majority of cases with success.

In the United States of America, Lyford's method of ensuring fertility when the cervix is at fault, has been extensively practised, with excellent results. Use is made of what he terms impregnators and dilators. The former consist of a hollow tube or cone, composed of soft rubber of sufficient thickness and firmness to retain its shape and resist the pressure of the cervix. Somewhat constricted at the disc portion, in order that it may be self-retaining (Fig. 35, *a*), the posterior surface of the disc is somewhat concave, to admit the urethral sinus of the glans penis; while the canal in the body is sufficiently wide to allow the semen an easy passage through the tube to the end (*b*) which projects

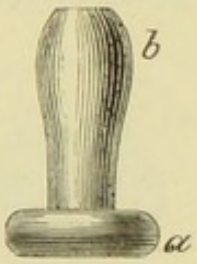

Fig. 35.

IMPREGNATING TUBE.

a, Disc; *b*, Bulb.

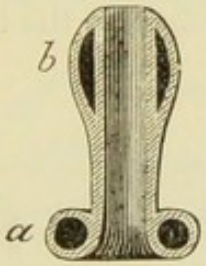

Fig. 36.

SECTION OF IMPREGNATING TUBE.

a, Disc; *b*, Bulb.

Fig. 37.

DILATOR OF THE CERVIX.

into the uterus. These impregnators are in three or four sizes, to fit different-sized cervices; and to render them less objectionable to the Stallion and Mare, the disc (Fig. 36, *a*), as well as the bulb (*b*), is hollow and very elastic, so that connection between male and female takes place almost as if no foreign body intervened. The advantages claimed for these articles are: close approximation to the normal condition of the cervix during copulation, and so rendering the communication between the cavity of the uterus complete, thus assuring easy access for the semen; they are easily inserted; are ready for immediate use; and they are cheap and durable. The dilator (Fig. 37) greatly facilitates the introduction of the tube, by dilating the os uteri and displacing any obstruction that may exist, thus allowing the cervix to envelop the impregnator easily and closely, as well as saving much time in inserting it. This is accomplished by the left hand in the vagina placing the tube—in which is the dilator—at the entrance to the os, while the right hand makes the necessary pressure on the handle of the dilator to push it into the canal; the left hand retains it there until the dilator is with-

drawn. The Stallion is then allowed access to the Mare, and within five minutes after copulation the tube is extracted by means of a tape attached to it, the end of which has a ring, and hangs outside the vulva.

Moderate rigidity of the cervix, which cannot be overcome by prompt manipulation, may be combated by means of sponge tents introduced into the os. These are made by soaking a sponge of the necessary size, and to which a long string is securely tied, in a strong solution of gum arabic ; it is then closely wound round with a thread, so as to form an elongated, pointed mass four or five inches long. When dry the thread is removed, and the sponge, being slightly smeared with grease or glycerine, is passed into the os, where it is left to soften and expand, in doing which it widens the canal. In some instances it may be necessary to assist the dilatation by making some slight incisions through the cervix.

In rare instances complete dilatation may require to be effected by a cutting instrument, but this should never be resorted to until the simpler and safer means have failed.

Disease of the mucous membranes, with altered secretions, must be treated according to the indications.

CHAPTER IV.

Changes in the Ovum.

During the progress of the ovum towards the uterus, and soon after its reception into that cavity, some remarkable alterations occur. The ovum has encountered the fructifying element of the male semen—the spermatozoa ; at least, this has been established in the Rabbit, in whose oviducal ovum they were found to have passed through the *zona pellucida*, though no opening has yet been discovered in that extremely fine evanescent film. The germinal vesicle disappears, or has changed its character, and a somewhat more opaque *embryonal cell* succeeds, which may be, or includes, a combination of the nuclear matter of the sperm-cell with that of the germ-cell. Then the vitellus, escaped from its enveloping membrane, becomes depressed in a circular manner, and breaks up into independent masses.

This change, and others to be described, takes place during the course of the impregnated ovum through the Fallopian tube. It may chance, however, that impregnation takes place in the uterus ; for it is probable that the ovum may be retained there for a certain time previous to perishing or being ejected, and that, should it meet the spermatic fluid, impregnation will ensue and the usual results follow.[1] But it is more

[1] It may be remarked that, with multiparous animals, the number of young in the cornua are not in proportion to the corpora lutea of the same period. Franck mentions an instance in which there were eleven corpora lutea and only five fœtuses ; from which it might be inferred that six ova had perished, or, if they had been impregnated, that the fœtuses must have died at a very early period, and been absorbed. It has also been stated that an ovum from the right ovary (which bore recent traces of the rupture of a Graafian vesicle), has been found in the left cornu, whither it must have wandered. This has been observed in woman, in the Bitch, the Guinea-pig, and also in the Sheep. Kehrer, in the *Monatsschrift für Geburtskunde* (vol. xxii., p. 225), mentions finding a fœtus in each horn of the uterus, and in the right ovary two true corpora lutea. One ovum had migrated to the left cornu by means, probably, of the uterine contractions.

likely that the initial changes are, in the majority of instances, accomplished in the tube. There, the ovum is bathed and moved about in the clear fluid containing the spermatozoa, by the peristaltic action of the walls of the duct, in order to enable the largest number of the fertilising particles to obtain access to the yolk, and thus ensure fecundity.

With the formation of the embryo-cell, the vitellus becomes separated or retracted by fluid from the zona pellucida, and begins to rotate therein; while one or two minute granular or oil-like bodies may appear in the surrounding fluid (Fig. 38).

A division or *segmentation* of this primary embryo-cell into two portions (Fig. 39), each provided with a nucleus, is the next step; then there is mutual repulsion of these secondary globes, and further cleavage of each into two portions (Fig. 40), and these again into other binary divisions (Fig. 41) of the germ yolk, through attraction round each cell of the particles contiguous thereto, until the whole is worked up into a mass of finely nucleated corpuscles — the ultimate segmentations of the impregnated parent embryo-cell. Each of these corpuscles contains a colourless pellucid nucleus, and each of these again a nucleolus. The

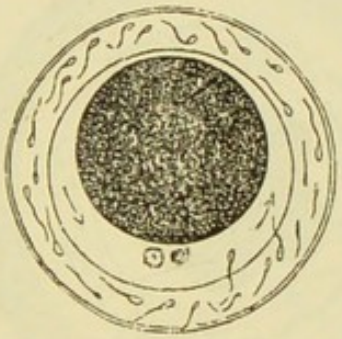

Fig. 38.

OVUM FROM OVIDUCT OF RABBIT, PENETRATED BY SPERMATOZOA IN ITS VITELLINE LAYER.

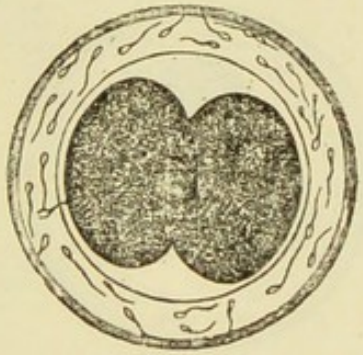

Fig. 39.

AN OVUM MORE ADVANCED IN THE OVIDUCT.

eight-fold cleavage of the yolk has been observed three days after impregnation in the Rabbit, four days in the Guinea-pig, and ten days in the Bitch; and always in the ova found towards the uterine extremity of the oviduct. In the latter animal the smooth surface of the zona pellucida becomes irregularly flocculent, as if a granulo-mucous substance had been deposited thereon; in the Rabbit the ovum acquires a thick adventitious layer of albumin before entering the uterus (Fig. 42, *a*); in the Guinea-pig the zona continues smooth. After entering the uterus, on the fourth day the zona becomes fainter, as the final segmentation or mulberry state of the yolk is attained, and it disappears altogether when the germ-mass is completed. The act of impregnation is thus consummated, and a series of new changes begin, which are replete with interest and importance.

When arrived in the uterus, a layer of very small vesicles makes its appearance on the whole of the inner surface of the membrane now investing the yolk. The *mulberry* structure then passes from the centre to a certain part of that layer, the vessels of the latter coalescing with those of the former, where the two sets are in contact, to form a membrane—the future amnion; while the interior of the mulberry-like body

is now seen to be occupied by a large vesicle, containing a fluid and dark granules. In the centre of this fluid is a spherical body, composed of a substance having a finely granular appearance, and containing a cavity filled with a colourless and pellucid fluid; this hollow and spherical body seems to be the true germ. The vesicle containing it disappears, and in its place is seen an elliptical depression, filled with a clear fluid, and in the centre of this is the "germ," still presenting the appearance of a hollow sphere.

The fluid presses the nucleate corpuscles of the yolk outwards against the inner face of the enveloping membrane, and as it increases the pressure from within flattens these corpuscles, until they resemble pavement epithelium; and, finally, they all coalesce to compose a membrane lining the zona, which has been named the *blastoderm*. This blastodermic vesicle divides into two layers—an *external* and *internal*—the first of which is pale and only slightly granular, while the cells of the second are filled with fat granules; it is consequently of a deeper tint.

Fig. 40.

OVUM FROM THE UTERINE HALF OF OVIDUCT.

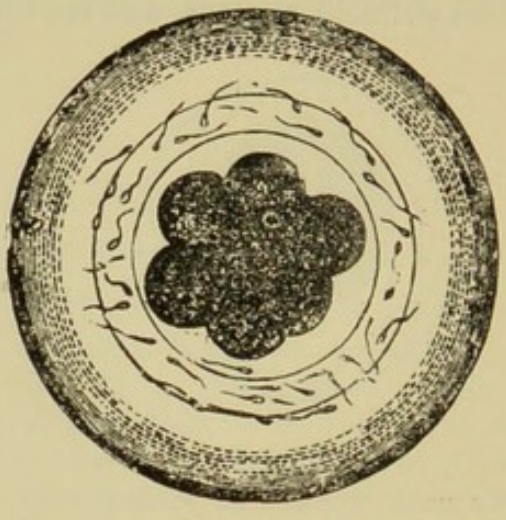

Fig. 41.

OVUM FROM THE UTERINE END OF THE OVIDUCT, WITH AN ADDITIONAL LAYER OF ALBUMIN.

Though the foregoing changes in the impregnated ovum have been chiefly observed in the Rabbit and Guinea-pig, yet there can be little doubt that they are of the same character in the domestic creatures whose embryology we are now studying.

It is only to be remarked that, in hoofed animals, no envelope of the ovum is superadded to the zona pellucida before it enters the uterus; impregnation of the ovum taking place in the Fallopian tube, where it meets the spermatozoa, the first stages of cleavage in its interior go on there, but the germ-mass is completed in the uterus. In this process the zona thins away and finally disappears, and a mass of albuminoid matter accumulates around the ovum, which affords material for imbibition. The germ-mass becomes fluid at the centre, and expands into a hollow sphere, the hollow wall of which offers two layers: both consisting of coherent cells, and only differing, as just remarked, in the size and proportion of the oil-globules.

SECTION I.—DEVELOPMENT OF THE EMBRYO.

The ovum having been lodged in the uterus, and the *germ-membrane* or *blastoderm* having divided into two layers—an upper or *serous*, and a lower or *mucous*—and between which, at a later period, a vascular layer is developed, another modification occurs by which the outline of the embryo becomes evident.

In the centre of the blastoderm, where it is supposed to divide into these layers, there is observed a clear space which has been designated the *area proligera* or *pellucida*, in the centre of which, and in the transverse axis of the vitellus, there is going on a multiplication of loosely connected cells in a small rounded mass, which forms the *germinative area*, *primitive streak*, or *trace* of Von Baer ; while around this another space—the *area vasculosa*—is developed. The "primitive streak" is the centre where the blastoderm commences to be separated into the external and internal layers ; the middle layer, which is to form the fœtal organs, not extending beyond the "germinative area" or "streak."

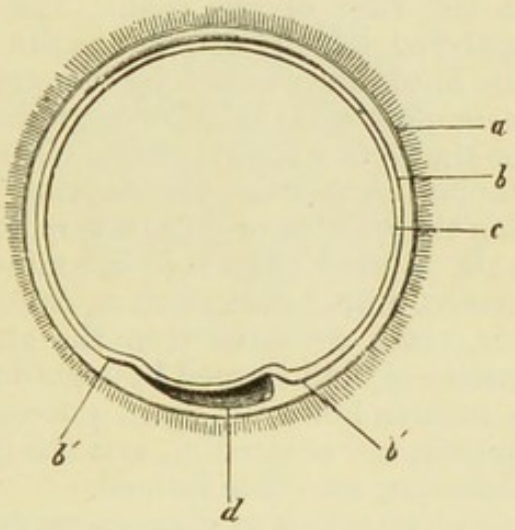

Fig. 42.

BLASTODERM AND PRIMITIVE TRACE.

a, Vitelline Membrane with its commencing Villosities ; *b*, External (or Serous) Layer of the Blastoderm ; *c*, Internal (or Mucous) Layer ; *d*, Body of the Embryo ; *b'*, *b'*, Earliest Cephalic and Caudal Elevation of the External Layer.

By a proliferation of the elements of the outer and middle layers of the blastoderm, the primitive trace increases in surface and thickness, becoming clearly defined and prominent, in the form of a shield, and is named the *opaque area*, which, when it grows transparent in its centre, is named the *transparent* or *pellucid area ;* the clear spot, narrowing or constricting in its middle part, is named the *area vasculosa* or *embryonic*. In the middle of this embryonic area appears a dark line, or median furrow, due to changes occurring in the primitive streak ; and below it a round cord—the *chorda dorsalis*—the axis of the future embryo, and which is to develop the spine ; on each side of the streak is the *lamina dorsalis*, and the portion of fluid separating them from the chorda dorsalis is the future spinal cord and brain. The inner layer of the blastoderm, at the points corresponding to the embryo, becomes doubled, so as to form a new layer—the *middle layer*. The *chorda dorsalis*

thickens at the front part, to form the first appearance of the skull, and the fluid between the dorsal laminæ is in larger quantity, in correspondence with it; so that the central parts of the nervous system and their coverings are laid down at the same time and grow simultaneously. The separation between the spinal cord and brain takes place early, being coincident with a curving downwards, towards the yolk, of the anterior part of the laminæ dorsalis, which defines the limit between the skull and spine, brain and cord.

Next follows the closing of the dorsal laminæ over the fluid which is to constitute the brain and cord. Two other laminæ are in the meantime proceeding from the axis of the embryo, one on each side. They grow out laterally, and tend to converge in the median line, as did the dorsal laminæ; but they form a larger curve, and follow a different direction, converging to meet *below* the axis, where they join, except at the umbilicus.

After the rudiments of organic life have been commenced in the central portion of the serous layer, a fold of its peripheral portion arches over the dorsal surface of the embryo, so as to represent a sac whose opening is at the edge of the fold. The opening gradually decreases until the opposing folds of membrane are in contact; it then disappears, leaving the fœtus surrounded by two membranes. The one next the fœtus is the *amnion*, and the other is gradually separated from the amnion, and joins the serous lamina of the blastoderm, forming the "false amnion" of Pander, or the "serous covering" of Von Baer. The membrane surrounding the vitellus or yolk is very vascular; it becomes oval in shape, and more pointed when it is in contact with the embryo, until at length it contracts into a narrow duct, constituting the *vesicula alba* and duct. Thus, then, we have seen the embryo developed in the layers of the blastoderm, and formed by a gradual closing in of the laminæ towards the median line; the brain and spinal marrow, which are its earliest rudiments, are covered in, and the parts anterior to the spine—the thorax, abdomen, etc.—are formed.

We will now direct our attention to changes occurring elsewhere, and return to the development of the embryo again.

Towards the twelfth day, in the higher orders of animals, the chief modifications which have just been described as occurring in the condition of the ovum after fecundation, are accomplished. The ovum then measures from one-third to one-fourth of an inch in diameter, and is composed in reality of four layers or shells, enclosed one within the other, but only three of which are complete; they are: (1) the yolk membrane; (2) the external layer of the blastoderm; (3) the middle layer; (4) the inner layer.

By ulterior modifications, the layers of the blastoderm form the various organs of the fœtus, and what have been termed its *annexes*, or enveloping membranes. The different layers have also received other names than those mentioned, according to their functions: thus, the external or serous has been named the *sensitive* layer, because it originates the epidermis and the organs of sense; the middle layer has been named the *vascular* or *germinative*, as it contains the principal vessels of the embryo, and the locomotory organs are developed in its substance; while the internal layer is known as the *mucous* or *intestino-glandular*, from its constituting the mucous membranes, its principal portion forming the intestines and glands. Each of these layers furnishes, in the course of its development, the intra-fœtal and the

extra-fœtal parts. We shall examine the latter first; merely noting, in the meantime, that the intra-fœtal parts of the external or sensitive layer of the blastoderm form the epidermis and its appendages—as the hair, claws or hoofs, glands of the skin etc.—the central nervous system, and the organs of sense—such as the retina and the labyrinth of the ear; while the extra-fœtal parts it forms are due to its alteration in shape.

The fœtus, as we have seen, is a circular body applied against a certain point of the blastoderm, whose outer layer is continuous, and extends over the internal face of the chorion and the surface of the embryo without any limit. But the inflection or bending of the latter at its two extremities causes the external layer to become depressed, and to constitute two folds; one investing the head, the other the opposite extremity of the body. The lateral parts of the embryo are also inflected towards each other to form the thoracic-abdominal cavity,

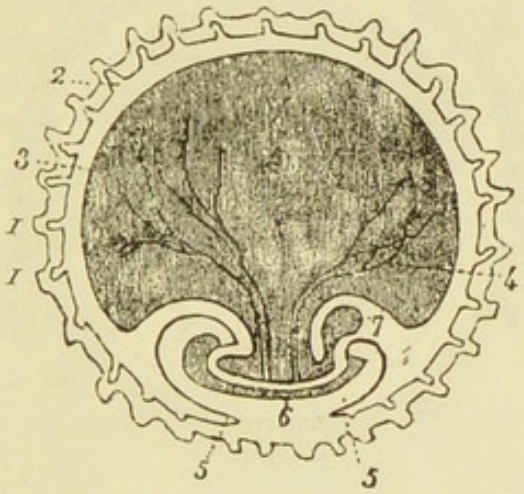

Fig. 43.

OVUM TWENTY TO TWENTY FIVE DAYS OLD.

1, Villosities of the Vitelline Membrane; 2, External Layer of the Blastoderm, or Second Chorion, with its Villosities; 3, Umbilical Vesicle, formed by the Inner Layer of the Blastoderm; 4, Vessels of the Umbilical Vesicle; 5, Cephalic and Caudal Processes; 6, Embryo; 7, Allantoid Vesicle.

and it is thus enclosed in the serous layer, whose sides soon meet above the back of the young creature, and a short pedicle—the superior umbilicus—joins the two portions of the blastoderm. This pedicle soon disappears, and the embryo is then enclosed in an independent sac—the *amnion* already referred to. The sensitive layer is, therefore, decomposed into two sections: an internal, the *amnion;* and an external, the *serous vesicle*, which is applied against the inner face of the zona pellucida, and concurs to form the chorion.

The middle layer will be noticed hereafter, and we now go to the internal layer. The intra-fœtal parts of this so-called "mucous layer" form the epithelium of the intestines and the glands belonging thereto, the respiratory apparatus, the kidneys, and the bladder. These organs are developed at the same time as the extra-fœtal parts.

In curving in upon itself, the embryo encloses a portion of the internal blastodermal layer, but the union between the free and the imprisoned parts is at first largely maintained; soon, however, it contracts, and in

a brief period is only represented by a somewhat narrow canal, the *inferior umbilical ring*. The mucous layer is therefore divided into two distinct portions: the *intestinal furrow*, or *intra-fœtal* portion; and the *umbilical vesicle*, *vesicula alba*, or *extra-fœtal* portion. These two divisions communicate by the *omphalo-mesenteric* or *vitelline duct*. The "umbilical vesicle" is filled with a granular fluid, which is conveyed by the omphalo-mesenteric vessels for the nutrition of the fœtus; when this alimentary reserve is nearly expended, the *allantois* appears. This begins by a small enlargement, which the intestinal furrow pushes towards the inferior part of the abdominal cavity; the enlargement becomes elongated and vesicular-looking, and gradually increases in size by bringing the umbilical vessels towards its borders. Becoming

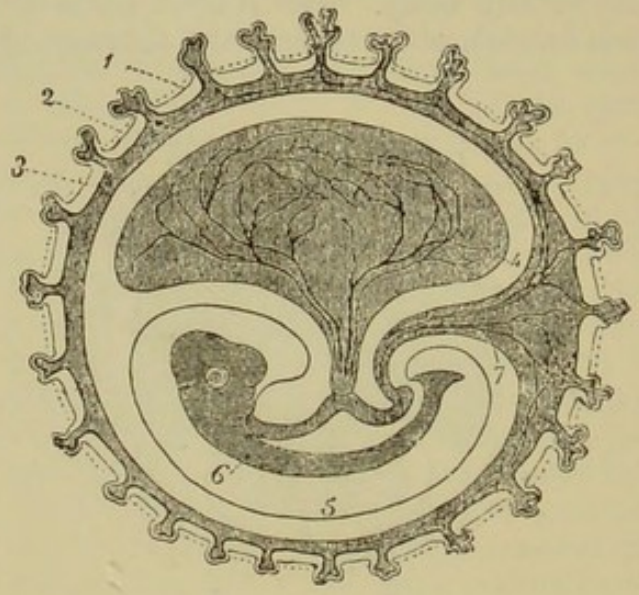

Fig. 44.

OVUM ABOUT A MONTH OLD.

1, Vitelline Membrane or Primitive Chorion, which has almost disappeared; 2, External Layer of the Blastoderm or Second Chorion; 3, Allantois penetrating the Villosities; 4, Umbilical Vesicle; 5, Union of the Caudal and Cephalic Processes, and Formation of the Cavity of the Amnion; 6, Embryo; 7, Allantois.

still more elongated, it passes through the umbilicus and spreads itself over the inner face of the chorion, between the latter and the amnion. It is divided into two sacs by a constriction, the *urachus*, at the umbilical ring; the inner sac is the smallest, and forms the *bladder;* while the external, the most voluminous, composes the *proper allantois*.

We have now seen that the vitelline membrane, lined by the serous vesicle, forms a complete shell around the ovum in process of development; and that the layers of the blastoderm eventually constitute three membranous sacs, two of which envelop the embryo. These various membranes constitute the "envelopes" or "annexes" of the young creature during utero-gestation, and in describing them it is usual to include the "cord" composed of bloodvessels, as well as the capillary ramifications which establish and maintain such important relations between the mother and its offspring during this period.

SECTION II.—APPENDAGES OF THE FŒTUS.

The appendages or annexes, then, comprise the *chorion*, a membranous envelope exactly adapted to the uterus; the *amnion*, a second ovoid sac included within the latter, and containing the fœtus; the *allantois*, a membrane composed of two layers, which are spread over the external face of the amnion and the inner surface of the chorion, and thus lines the cavity formed by these two envelopes; a small bladder of a pyriform shape, the *umbilical vesicle;* the *placenta*, a collection of vascular tufts grafting the fœtus to the mother; and the *umbilical cord*, composed of vessels that attach the fœtus to the envelopes which contain it, and which ultimately ramify in the placental tufts. We will describe each of these in detail, as a correct knowledge of their anatomy is essential to the comparative obstetrist. As before, we will take Solipeds as the type of comparison.

Chorion.

The *chorion*, the outer envelope proper to the ovum, is found covering it loosely at the earliest period of its existence, and corresponds to the membrane lining the egg in oviparous animals. It is a vast mem-

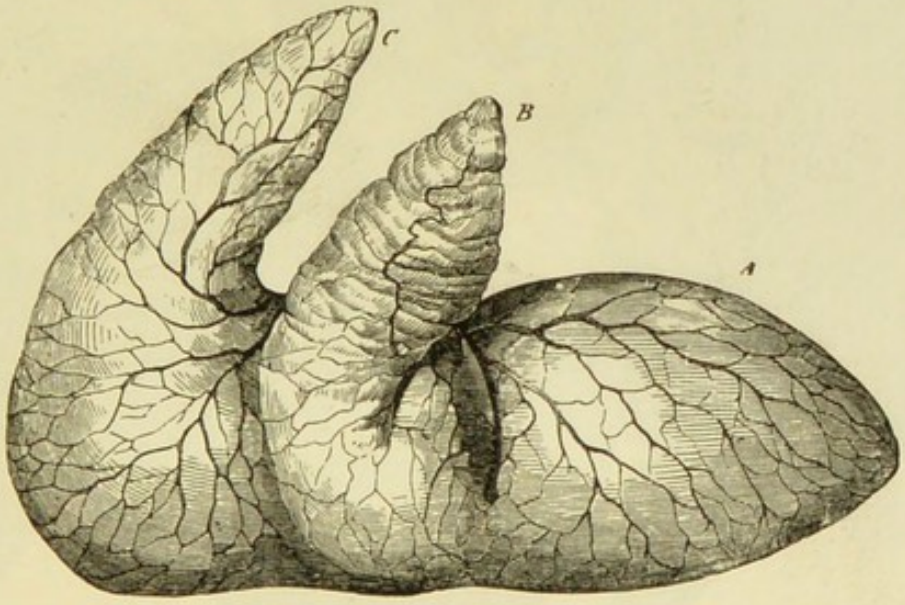

Fig. 45.

Chorion of the Mare at Mid-term: Inflated.

A, Posterior portion occupying the Body of the Uterus; B, Left Cornu plicated and sacculated; C, Right Cornu, longer than the left, and containing a portion of the Fœtus.

branous sac, completely closed, and which, being moulded upon the uterine cavity, resembles the uterus in form, having a body and two cornua; the latter, however, are not co-extensive with those of the uterus. When the chorion is distended, its cornua show fine and deep plicæ or bulgings, like the cæcum; the cornua are always unequal in size, that in which the fœtus is developed being of course the largest. The external surface, otherwise smooth, is studded with innumerable small, red, short papillæ or "processes," which are formed by the placental villous tufts. This papillary face adheres slightly to the internal surface of the uterus, and between the two surfaces a trifling quantity of brown or blood-coloured fluid is found. The inner face is

lined by the external layer of the allantois, to which it is closely adherent except at the insertion of the vascular cord, where there exists a kind of conical infundibulum occupied by the umbilical vesicle. On this surface the umbilical arteries and veins ramify, their minute divisions traversing the membrane to form the placental villosities. The

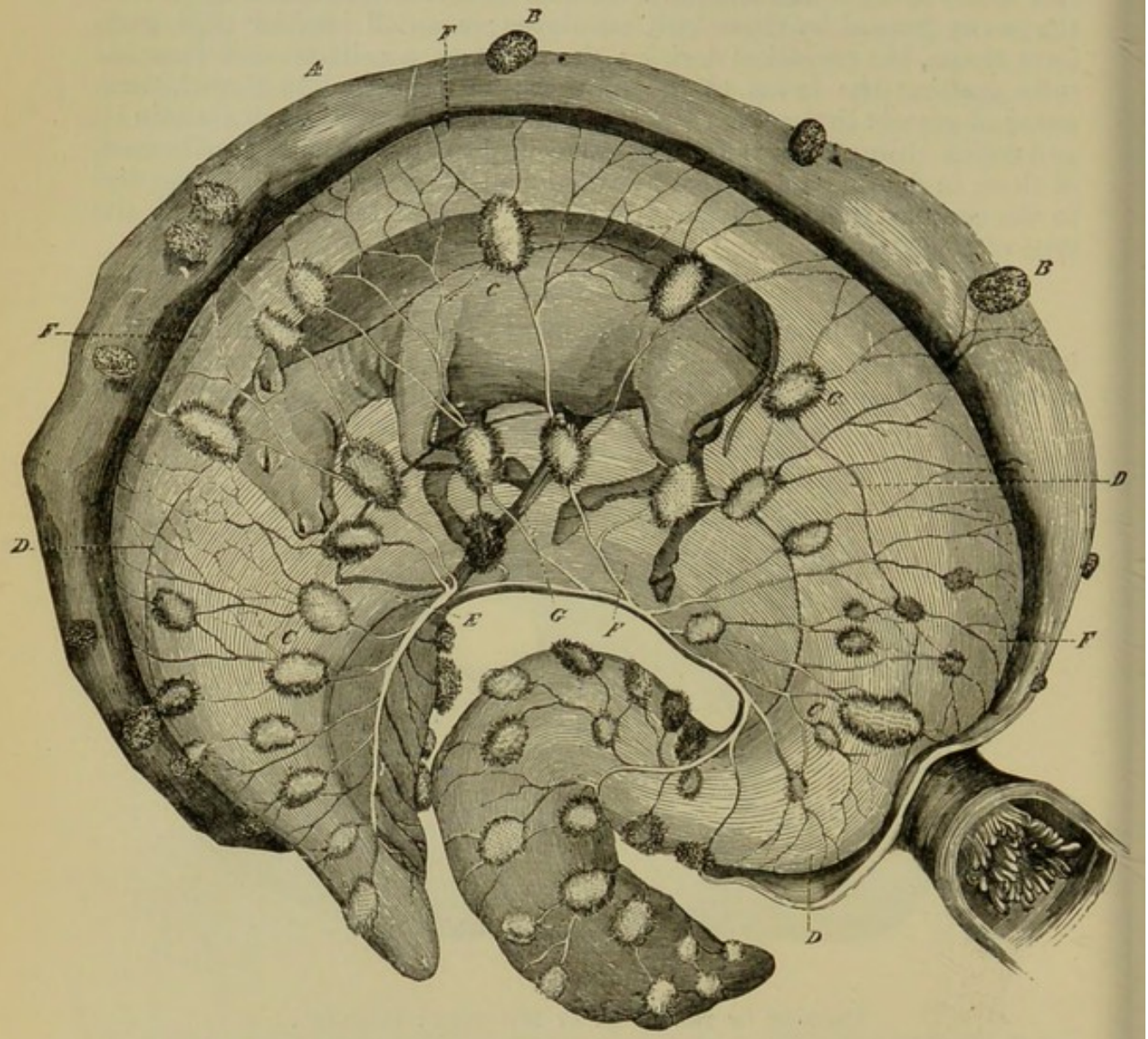

Fig. 46.

Fœtal Membranes of the Cow at Mid-term.

A, Uterus opened on its left side; B, B, Cotyledons of the Uterus; C, C, Placentulæ; D, D, Allantois; E, Vesicle of the Urachus; F, Amnion; G, Umbilical Cord.

chorion may be divided into two laminæ, the outer of which has been called the *exochorion*, and the inner the *endochorion*. From the endochorion are derived the vessels which pass to the villi, the chorion itself being destitute of vessels until the allantois is developed. The structure of this envelope is that of a delicate cellular membrane, traversed by the vascular ramifications of the placenta. In many places its cellular

arrangement closely resembles that of vegetables, each cell containing a distinct nucleus; the villi have the same texture, but their cells are filled with a granular matter. The strength of the membrane is greatest in the early ovum; it is formed by the *zona pellucida*, which is lined by the external layer of the blastoderm. It is thought that the primitive chorion disappears by resorption, and that this blastodermic layer becomes the definitive chorion; also that when the allantois has spread

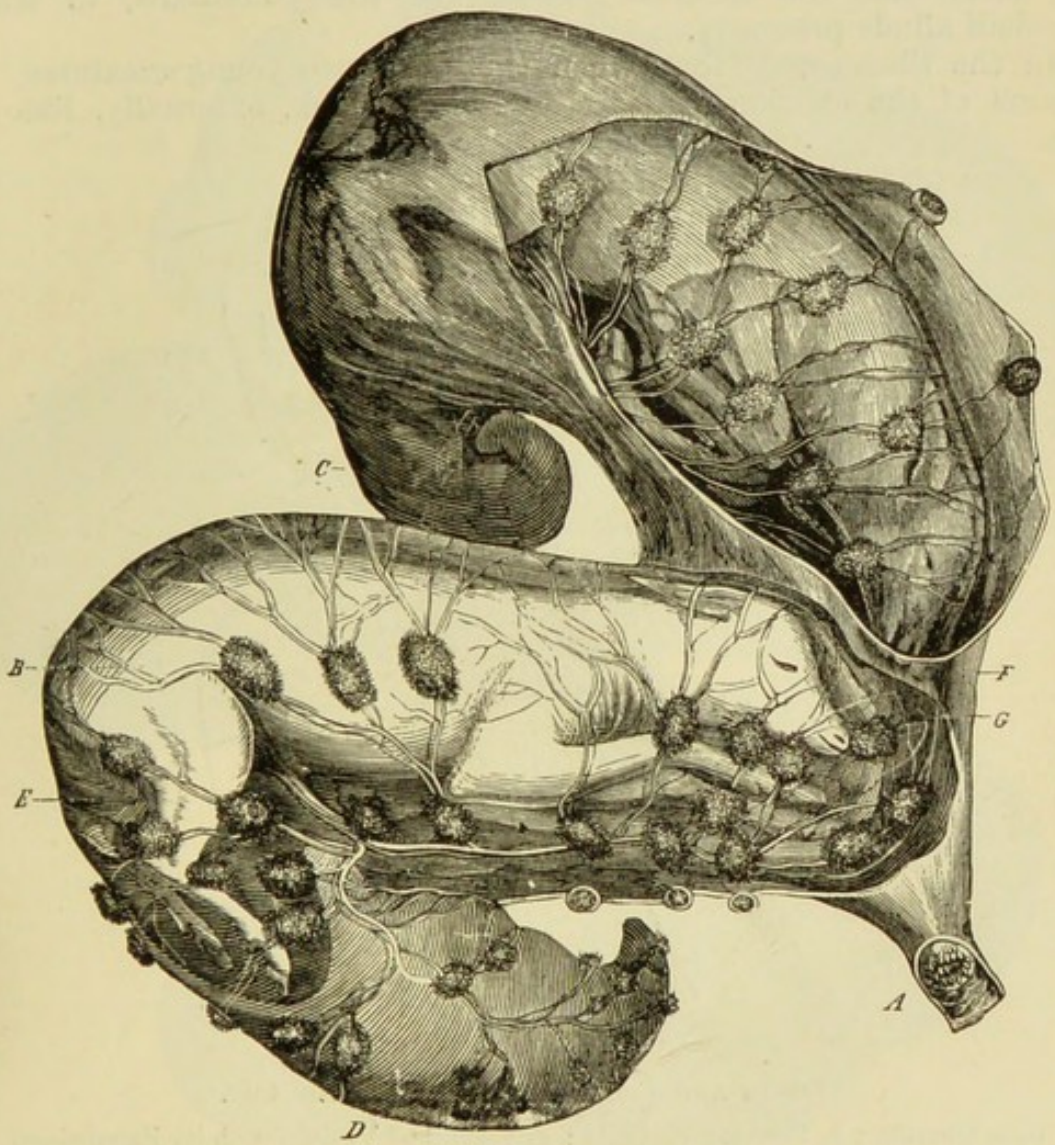

Fig. 47.

FŒTAL MEMBRANES OF THE GOAT AT FULL TIME: TWINS.

A, Cervix of the Uterus; B, Left Cornu; C, Right Cornu; D, Allantois of one of the Fœtuses; E, Amnion of ditto; F, Portion of the Uterine Wall left at the middle of its Body, where the Fœtuses come in contact; G, Union of the Two Chorions at the Cervix Uteri.

itself between the amnion and the external envelope, carrying outward the umbilical vessels, this definitive chorion becomes vascular, and furnished with its numerous villosities.

DIFFERENCES.

Ruminants.

In Ruminants, the chorion corresponds to the internal face of the uterus, whose form it repeats, and with whose surface it is more or less

in contact. The middle of its inner surface is united to the amnion and the allantois by loose gelatinous connective tissue, so laminated that it might be mistaken for different layers of membrane. It is only covered by the allantois in the portions corresponding to the cornua, which are longer than those of the uterus. It offers numerous small red masses, studded at variable distances from each other on the surface next the uterus, and which effect a very important connection between the latter and the chorion. These are the *placentulæ*, to which we shall allude presently.

In the Sheep and Goat, when there are two young creatures, the cornua of the chorion are joined, so as to look, externally, like one sac.

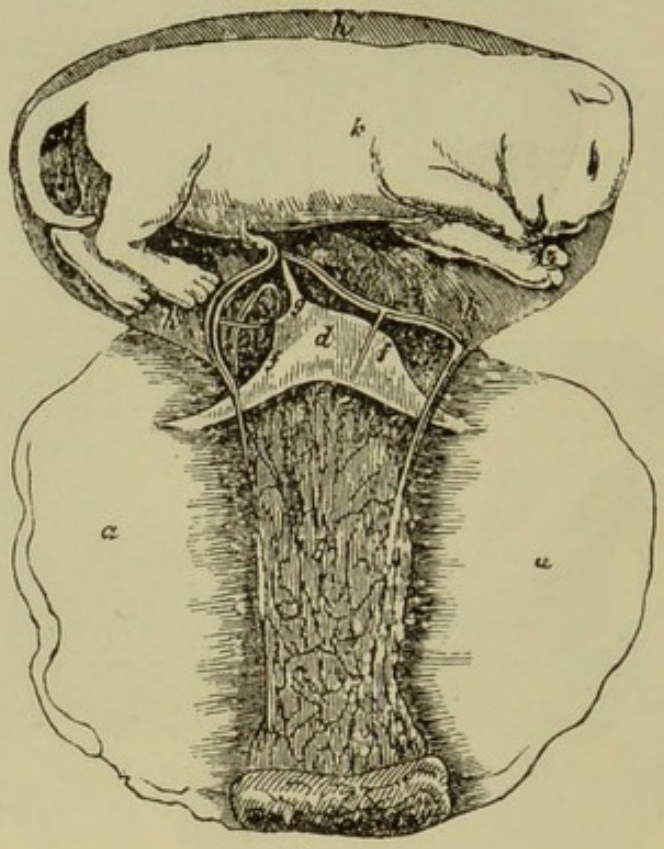

Fig. 48.

FŒTUS AND FŒTAL MEMBRANES OF THE CAT.

a, *a*, Chorion ; *b*, Zonular Placenta ; *d*, Umbilical Vesicle, with its Expansions, *f*, between Amnion and Placenta, and *g*, its Pedicle of attachment to a loop of small intestine ; *h*, Allantois ; *k*, Fœtus.

Pig.

In the Pig there are no cornua, but the whole appears as an elongated sac, whose two extremities, much exceeding those of the embryos, are related to the envelopes of the contained progeny. Its internal face is similar to that of Ruminants; on its external face are groups of numerous small papillæ; so that placentation in this animal is disseminated, though here and there, between the innumerable groups of papillæ, are bare spots merely covered with epithelium, and there are no papillæ at its extremities.

Bitch and Cat.

In the Bitch and Cat, the arrangement of the chorion is similar to that of the Pig; it has no cornua, its extremities are obtuse, and its

inner face is everywhere in contact with the allantois, though it does not adhere closely to it.

Amnion.

The *amnion* is the second complete sac enveloping the fœtus. It floats freely in the chorial sac, to which it is only attached at a single

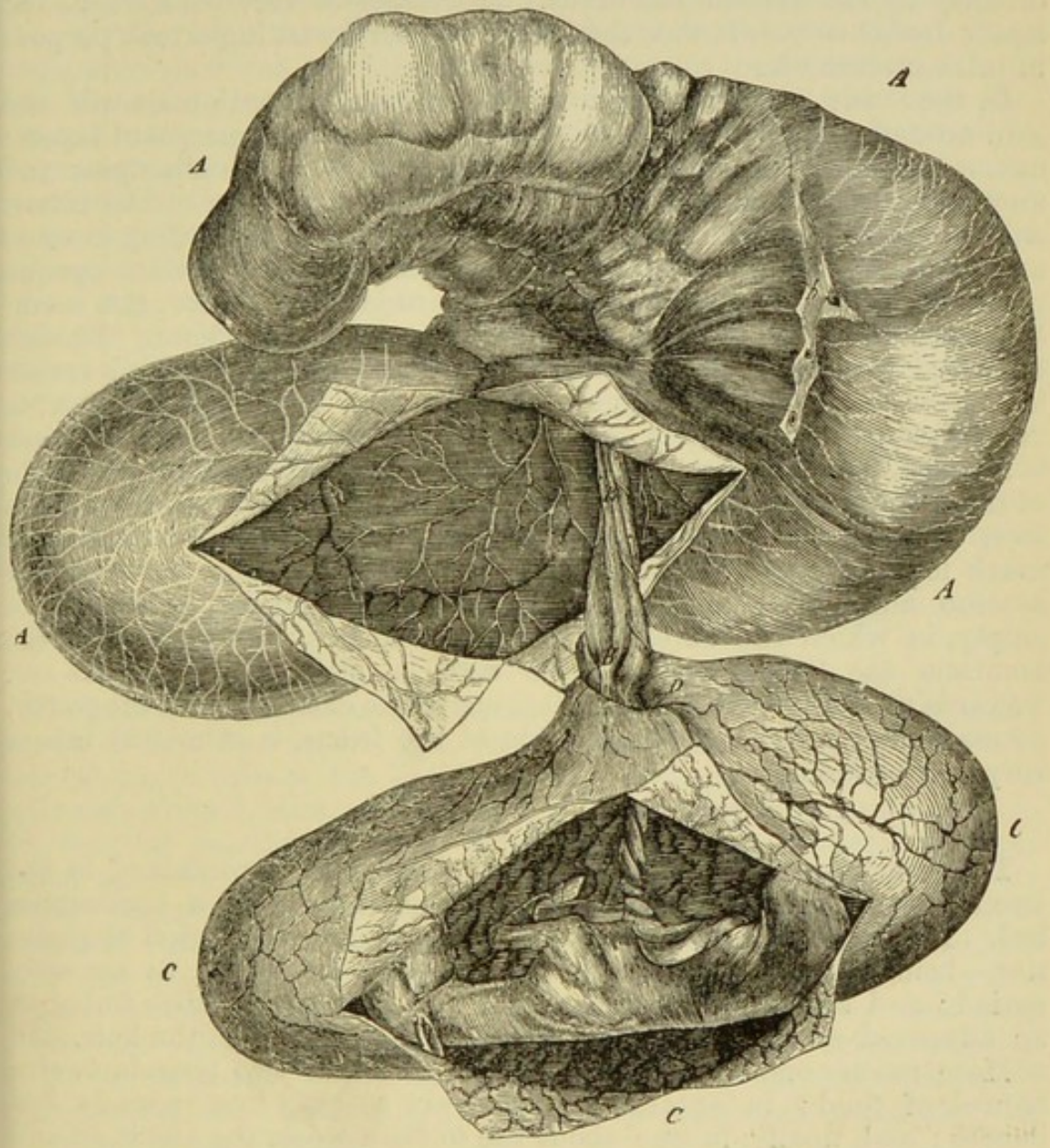

Fig. 49.

Fœtus of Mare and its Envelopes.

A, Chorial Sac; C, Amniotic Sac withdrawn from the Allantoid Cavity, and opened to expose the Fœtus; D, Infundibulum of the Urachus; B, Allantoid portion of the Umbilical Cord: *b*, Portion of the External Surface of the Chorion destitute of Placental Villosities, and corresponding to the point of insertion of three pediculated Hippomanes.

point, through the medium of the umbilical cord; and it contains the fœtus, which is fixed to its inner face by the same means. It is formed by the external layer of the blastoderm. It envelops the embryo very closely at an early period, and is continuous with the common integument of the fœtus at the open abdominal parietes. At a later period it

is distended with fluid, and so is separated from the fœtus; and after being reflected upon the funis, of which it forms the outer coat, it terminates at the umbilicus. In shape it is at first spherical, but is afterwards ovoid, and it has thin transparent walls. The external face is covered by the inner layer of the *allantois*, to which it slightly adheres. The internal face is quite smooth, and applied more or less directly to the skin of the fœtus. It exhales or secretes a fluid—the *liquor amnii*—which bathes the fœtus, and serves an important purpose in intra-uterine life.

In the fœtus, as above mentioned, the amnion is continuous with the skin around the umbilicus, and is constituted by two superposed layers: one, a very fine fibrous membrane that adheres to the allantois; and another, an epithelial layer, which lines the inner face of the latter. At certain points of its internal surface in Solipeds, according to some authorities, though denied by others, there are small white opaque masses of what are supposed to be epidermic cells; hence, this membrane has been designated a true epidermis of the blastoderm. Though thin and transparent, it is nevertheless of a firm texture, and resists laceration better than the other membranes. It does not exhibit either vessels or nerves when in a healthy condition. When the amniotic sac is inflated, there is observed, at the portion adjoining the infundibulum of the urachus, a kind of vascular plexus, having the shape of a goose's foot, between the branches of which the two superposed layers are much less transparent than elsewhere. At this part, between the amnion and the allantois, is the small membranous pouch, quite empty, in which the umbilical vesicle terminates; and here also the amniotic sac forms, opposite the cord, a little conical *cul-de-sac*. Towards the termination of gestation, one of the extremities of the pouch, corresponding to the posterior limbs of the fœtus, is stretched into a very short wide horn.

Liquor Amnii.

The *liquor amnii* is an albuminous alkaline fluid contained in the amniotic sac, in which the fœtus is suspended as in a hydrostatic bed. It is in greater or less quantity, according to the period of gestation—being abundant and limpid, or slightly lactescent, at an early period; and becoming scantier, viscid, and citron or reddish-tinted at an advanced stage, when it is adhesive and agglutinates the hair. In a Mare twenty-one weeks pregnant, Gurlt found two pounds twelve ounces of fluid; in another at thirty-six weeks, four pounds five ounces; and, finally, in one about the fortieth week, the allantoid and amniotic fluids weighed collectively nineteen pounds and half an ounce. Its colour during this period may be due to the meconium thrown out from the digestive passages of the fœtus; and its composition doubtless varies with the development of the latter. It is somewhat salt to the taste, and contains 99 per cent. of water, as well as albumin, mucosine, kreatin, glycose, and salts, the chief of which are chlorides of sodium and potassium, and the sulphate and phosphate of lime. There is also a yellow matter analogous to bile, as well as urea. A peculiar acid, the *amniotic*, has also been found in it, in addition to fragments of meconium from the intestines of the fœtus, epithelial cells and their nuclei, besides portions of the thick epidermis which covers the plantar surface of the hoof of Solipeds. Towards the end of gestation the albumin diminishes. Probably the formation of the mucous layer

that invests the young animal at birth, is due to the precipitation on its skin of the mucus and yellow matter contained in this fluid. Hoppe-Seyler gives its chemical composition as water, holding in solution a small quantity of casein, kreatin, lactic acid, grape-sugar, and saline matter, and therefore resembling very dilute serum.

The *uses* of the *liquor amnii* are varied and important. It is not very probable that it serves as nutriment for the fœtus in the early period of intra-uterine life; though it has been found in the stomach of those young animals which had been purposely frozen in their membranes, and then dissected; portions of the hoof epithelium have also been discovered in the fœtal stomach. It preserves an equable temperature for the young creature; maintains the integrity of its exterior before the skin is covered by the peculiar sebaceous coating; favours its movements and its development, by removing it from unequal pressure; diminishes the impression from sudden external movements and shocks, thus preserving it from injury; and allows it to obey the laws of gravitation. It also protects the mother from injury by the fœtus, towards the termination of gestation. During parturition, it protrudes the membranes; is the primary agent in dilating the os uteri; shields the fœtus from the direct action of the uterine contractions, whose violence might compromise its existence; renders the dilatation of the os easy and prompt; and, finally, by lubricating the vagina, causes the passage of the fœtus through it to be more gentle and expeditious than it would otherwise be.

Differences in the Amnion of other Animals.

Ruminants.

The amnion in Ruminants is similar to that of the Mare. It is easily separated into two layers, and shows on its inner surface, particularly near where it invests the umbilical cord, a large number of white or yellowish-white bodies. In the Cow these are sometimes elongated in the form of papillæ; at other times they exist in flattened, slightly raised patches, about one-fourth of an inch long. Sometimes they are single; occasionally they are in clusters. They consist of large, flat, nucleated cells, resembling a squamous epithelium; it is concluded that they are the seat of formation of a glycogenic material. Up to a certain period of intra-uterine life they increase in size, and then degenerate—their organization and development being in inverse relation to the development of the liver, whose function they assume, with regard to glycogenation. Externally the amnion is altogether in contact with the allantois and chorion.

Pig.

It does not differ in the Pig.

Bitch and Cat.

In the Bitch and Cat the amnion is entirely covered by the amniotic layer of the allantois, to which it adheres in the same manner as in the Mare; the two membranes are only separated by the umbilical vesicle, and there is no trace of the pouch and vascular plexus seen in that animal. In the amniotic liquid, crumbs of meconium are found towards the end of gestation.

Allantois.

The *allantois* arises on the front part of the posterior extremity of the mucous layer which is closing to form the intestine, as a growth of the

intestine, which proceeds very rapidly. It passes out where the ventral laminæ are still unclosed, in the region of the umbilicus, and reaches, either mediately or immediately, the inner surface of the exochorion. By the constriction of the umbilicus, it is separated into two portions which communicate; that within the body of the embryo is the sacculated urinary bladder, with the *urachus* or tube of communication. It receives its vessels from the hypogastric artery; these are spread out as a vascular layer, especially upon that portion of its surface which faces the exochorion. The vessels form a distinct layer—the endochorion. As a membrane it lines the inner face of the chorion, and is reflected around the point of insertion of the umbilical cord, to be spread over the outer face of the amnion; in this way it transforms the chorionic sac into a kind of serous cavity, in which the amniotic sac is enclosed like a viscus.

The inner, or amniotic layer, is so loosely united to the amnion, that

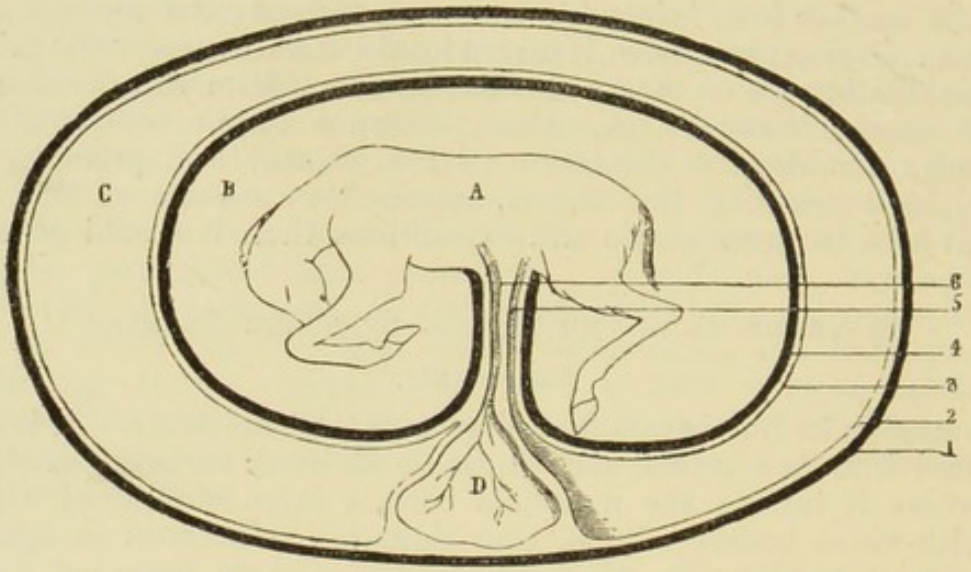

Fig. 50.

A, Fœtus; B, Cavity of the Amnion; C, Cavity of the Allantois; D, Umbilical Vesicle: 1, Chorion; 2, Chorial Layer of the Allantois; 3, Amniotic Layer of the Allantois; 4, Amnion; 5, Urachus, the expansion of which forms the Allantois; 6, Pedicle of the Umbilical Vesicle.

a slight dissection or inflation will readily detach it. When inflation is practised, the separated membrane presents a wavy appearance, from the presence of numerous cellular attachments it has with the amnion; as the inflation is forced these bands tear with a noise like the crackling of parchment, and with care the whole of the portion, which is equal in extent to the amnion, may be removed. The chorial allantois adheres much more firmly, and in some parts it can scarcely be dissected away. Inflation, however, demonstrates its existence and continuity with that on the amnion; for if, after opening the allantoid sac by cutting through the chorion and the layer covering it, we introduce a tube between the two membranes—which is easily done near a large vessel, a slight inflation causes the air to penetrate between the allantois and chorion, though only in the track of the vessels of a certain size, where the adherence is slight; a more powerful inflation will cause the air to follow the smaller vascular ramifications, and render the membrane still more apparent, but not at the points where the vessels have almost

become capillaries. If, instead of forcing the air towards the ramifications, it is sent in the contrary direction, it will be seen to pass to that portion of the membrane covering the umbilical cord, and insinuate itself between the amnion and the layer of allantois enveloping it, thus proving the continuity of the membrane.

As has been stated, the cavity of this sac is in communication with the interior of the bladder by means of the *urachus*—a narrow canal in the amniotic portion of the umbilical cord, and which widens at the origin of the allantoidean portion, where its walls are continuous with the amniotic layer of the membrane, as well as the chorial layer, after being prolonged as a sheath around the cord. These arrangements show the allantoid cavity to be a kind of urinary reservoir or dependency of the bladder, the fundus of which is prolonged in an infundibular manner as far as the umbilicus, to constitute the urachus, which follows the umbilical vessels in the amniotic portion of the cord, and ends by forming the allantoid cavity.

The structure of this membrane is slightly fibrous, with a layer of epithelium; it is thin and pellucid, and appears to be destitute of vessels at a late period of fœtal life. It bears on its surface the umbilical vessels, from the umbilicus to the chorion.

The allantois contains a fluid—the *allantoic liquid*—the quantity of which, like that of the amnion, is greatest at an early period. It is then colourless or slightly turbid; but with the growth of the fœtus it gradually assumes a yellowish hue, until near parturition, when it is brown. It presents somewhat the same physical properties as the liquor amnii, and contains albumin, osmazone, a nitrogenous mucilaginous matter insoluble in alcohol, a particular principle named *allantoïne*, which appears to be the urate of urea, with lactic acid, lactate of soda, and phosphates of soda, lime, and magnesia. Allantoic acid is not found in this fluid in Solipeds. In addition to the large percentage of water, there is a notable proportion of sugar at an early epoch of fœtal life; this, however, gradually and finally disappears towards the termination of gestation.

It is probable that before the fœtal circulation is fully established, the allantoid fluid serves to nourish the young creature, but that towards the end of gestation it is a product of the urinary secretion of the fœtus. It is certain that as gestation approaches its termination, the renal excretion of the young animal passes from the bladder along the urachus, and deposits near the allantoic orifice of that tube a thick fluid of a reddish colour, and possessing a urinous odour; it contains uroerithrin and hippuric acid.

The fluid contains, besides, whitish filaments, and small oval or discoid masses of a brownish colour from the size of a pea to that of a hen's egg, either floating about in the cavity or attached to the allantois by a narrow pedicle. Sometimes they are very numerous, and at other times there is only one. From the fanciful notions attached to them in ancient times, they were named the "*hippomanes*." Usually they have the consistency and elasticity of gluten, are flattened, and are thinner at the border than the centre. Those attached to the allantois are generally pyriform, and their pedicle is narrower as they are more developed: proving that the loose bodies in the fluid were originally appendages of the allantois. It is not improbable that they are inspissated parts of the allantoic fluid which were originally deposited upon the membrane. They contain much oxalate of lime.

Differences.

Ruminants.

In Ruminants the allantois is different to that of the Mare, being less complex. It represents a very elongated cavity, the middle portion of which is not extensive, and receives the insertion of the urachus; while its extremities, which are unequal, are prolonged into the cornua of the chorion, where they are attached by a small ligament. This sac is in reality an expansion of the urachus; it is always thrown back on one of the sides of the amnion. In the completely developed fœtus, even at birth, the allantois still communicates directly with the bladder by means of the *urachus*. Frequently in the Sheep this membrane exceeds the chorion, and in the case of twin embryos, although the two chorial sacs unite by one of their cornua, there is only a simple external union between the two allantoid membranes, the cavities remaining isolated.

Laminated deposits, like the *hippomanes*, are found in the allantoic fluid of Ruminants, though not very frequently. These deposits are less dense, smaller, and of a lighter colour.

Pig.

In the Pig the allantois does not offer any marked difference from that of Ruminants, except that it is less sacculated, and shows at the extremity of each cornua a small portion projecting beyond the chorion, which it seems to pierce, while it is strangled by a kind of rings formed by that envelope. In the gelatinous tissue connecting the allantois to the chorion are numerous small, white, spherical bodies, each possessing a distinct capsule; they are composed of multitudes of circular cells, the size of lymph corpuscles, and quantities of granular particles —being, in fact, histologically the same as the *hippomanes*, with which they are probably homologous.

Bitch and Cat.

In the Bitch and Cat it is disposed in the same fashion as in Solipeds. Its external layer adheres less closely to the chorion, except at the part corresponding to the placenta, where it is more intimately united.

Umbilical Vesicle.

The *umbilical vesicle*, *saccus intestinalis*, or *vesicula alba*, is a small fusiform or pyriform pouch lodged in the infundibulum at the extremity of the umbilical cord. Its fundus adheres to the chorion, while the opposite end is prolonged to a certain length in the substance of the cord, being even continued, in the very young fœtus, to the abdominal cavity by a narrow canal that communicates with the terminal portion of the small intestine.

This pouch has a red colour, due to its great vascularity, its walls receiving a special vessel from the anterior mesenteric artery; the terminations of this vessel give rise to a corresponding vein that terminates in the vena portæ. These are the two omphalo-mesenteric vessels. The umbilical vesicle in Solipeds is constantly present as a normal formation in the earlier months of fœtal development, being formed from the extra-fœtal portion of the internal layer of the blastoderm. It is connected with the intestinal canal of the fœtus; being in reality the vitellus surrounded by the blastoderm upon which the embryo is first formed; and it bears a perfect analogy to the yolk of the egg, except that it is not ultimately enclosed within the fœtal abdomen. It is a

transitory organ, and in the last months of fœtal life, though in Solipeds traces of it continue until parturition, it is always more or less atrophied, its cavity has disappeared, and nothing is left of it but a small reddish-brown cord, adhering to one of the sides of the infundibulum. Its vessels also atrophy in the same manner, the artery being nearly always found reduced to the dimensions of a thread.

Its use is evidently to contain nutriment for the fœtus, before the development of the placenta; though it may also serve other purposes. It is the first organ which elaborates and supplies blood to the fœtus. In some instances the chorion has been found perforated at its junction with the umbilical vesicle, which was therefore in communication with the cavity of the uterus.

Differences.

Ruminants and Pig.

In Ruminants and the Pig, the umbilical vesicle is longer than in Solipeds; it also bulges in the middle, and its ends terminate in a canal. It is longest about the twenty-fifth day, and disappears very early; no traces of it can be observed between the second and third month, after the abdominal parietes have been formed.

Bitch and Cat.

In the Bitch and Cat it remains very developed up to the time of parturition, and in form resembles the allantois of the Pig. It is a transversely elongated sac (Fig. 48, *d*), extending into the pointed cornua (*ff*) comprised between the amnion, the inner layer of the allantois (*h*), and the placenta (*b*); it is provided at its middle part with a narrow pedicle (*g*), which is prolonged into the umbilical cord and has very vascular walls.

The Placenta.

The *placenta* varies extremely in different species. In Solipeds it is constituted by a multitude of short villosities or filiform papillæ, which are spread in a uniform manner over the whole external surface of the chorion (*diffused villi* or *placenta*, constituting a *chorion frondosum*); though there is sometimes observed a tendency to bare patches, one especially being noticed opposite the os uteri, where there is no mucous membrane for the villi to penetrate. These villi are received into corresponding depressions or follicles in the lining membrane of the uterus. The villi are very red in colour, and consist, like the chorion itself, of an epithelial and a vascular layer, they being, in fact, the terminal ramifications of the vessels of the umbilical cord. They are slender and easily torn; and each is composed of a small quantity of delicate nucleated connective tissue, covered by a simple epithelial layer, enclosing the capillary vessels, which are arranged in loops made up of a principal arteriole and two veins, there being generally only a single, or at most, a double, capillary loop.

The villosities of the fœtal placenta, penetrating the newly-formed crypts in the uterine mucous membrane, bring the capillary systems of mother and fœtus into the closest relationship, only the very thin coats of the vessels and the epithelium intervening in the two circulations. There is no fusion, vascular continuity, or direct communication between the maternal and fœtal systems, as was at one time taught; all the important changes that occur taking place through the walls of the capillaries by virtue of osmotic force.

The function of the placenta, then, is to minister to the nutrition

and development of the fœtus by means of its intimate relations with the uterine vascular system, until the time has arrived for the expulsion of the young animal. Notwithstanding their close apposition, the adherence of this papillary layer of the chorion with the inner surface of the uterus is so slight, that this organ can scarcely be opened without more or less destroying it. A small quantity of a brownish fluid is found between the two.

At an early stage of gestation there is no placenta; a temporary mass of albuminoid substance accumulating around the ovum in the uterus, affords material for its nourishment until the vascular intussusceptive relations between the chorion and uterine lining are established. When gestation is terminated, the placenta becomes remarkably rigid, the vessels are obliterated and transformed into fibrous tissue, and the external face of the chorion is wrinkled and withered-looking.

Differences.

Cow.

In Ruminants, there is an important difference in the arrangement of the placenta from that just described. In the Cow the villi of the chorion are developed and agglomerated in large numbers at certain points of its surface, to constitute a *multiple* or *tufted* placenta, which is composed in this way of from sixty to eighty *placentulæ*, or "fœtal cotyledons." These are of a bright red colour, of various sizes, and generally oval in shape; they correspond to the prominences on the lining membrane of the uterus from which the deciduous maternal parts of the placenta grow, and which have been already described as the "maternal cotyledons" or "placentæ"; into these latter the fœtal processes are received. The maternal cotyledons are nothing more, as has been stated, than appendages or thickened points of the mucous membrane, whose utricular follicles, more numerous than elsewhere, have become enormously enlarged, and crypts have been formed. They are permanent, as before conception they are certainly present on the inner surface of the uterus, and traces of them may be already found in the fœtus of four or five months; observation also appears to have demonstrated that they may be increased in number, or regenerated, when accidental circumstances render those in existence insufficient.[1] They have been discovered in the fœtus in process of formation, and regularly disposed, beside the ordinary cotyledons.

Chauveau's experiments have proved, that after all these placentulæ have been extirpated from the uterus of the pregnant Cow, sterility does not necessarily follow; but if, on the contrary, the animal survives the operation, it is still capable of breeding. In such circumstances, accessory cotyledons are developed upon the surface of the uterine mucous membrane, where previously none existed. Chauveau has also stated that during pregnancy the number of cotyledons is increased; and Colin, in his *Physiologie Comparée*, makes a similar statement. Professor Franck, of Munich, in his dissections of the gravid uterus of bovines, has found, in a large number of instances, a more or less abundant quantity of accessory caruncles (*karunkeln*) on the mucous membrane, and which had no corresponding relations with the chorion. In one instance the ordinary cotyledons were entirely

[1] In the *Journal de Méd. Vétérinaire de Lyon*, M. Strebel, of La Tour, Switzerland, gives an instance in which there was absence of the uterine cotyledons in a Cow, and the placenta was like that of the Mare. Conception took place, gestation went on favourably, and parturition was normal.

absent in an unimpregnated cornu, and in their stead were thousands of the accessory processes grouped together in small clusters. The whole of the lining membrane of this cornu had a peculiar mossy or velvety appearance. In a number of instances Franck has observed, in the immediate neighbourhood of the os uteri, where cotyledons proper were absent, groups of the so-called accessory cotyledons, in their form representing a *placenta prævia* (Figs. 53, 54). Certainly, this kind of *placenta prævia* in Cattle has not the disadvantages it offers in woman; for although a premature delivery may occur, a sufficiency of the placenta always remains to maintain the nourishment of the fœtus. Serious hæmorrhage is likewise little to be apprehended in such cases; and even disconnection between the placenta fœtalis and the placenta uterina in the Cow causes no injury. This is not the case with the human female and the Bitch. Small hæmorrhage streaks at the summit of the finer tufts, or on their upper surface, are often noticed in the

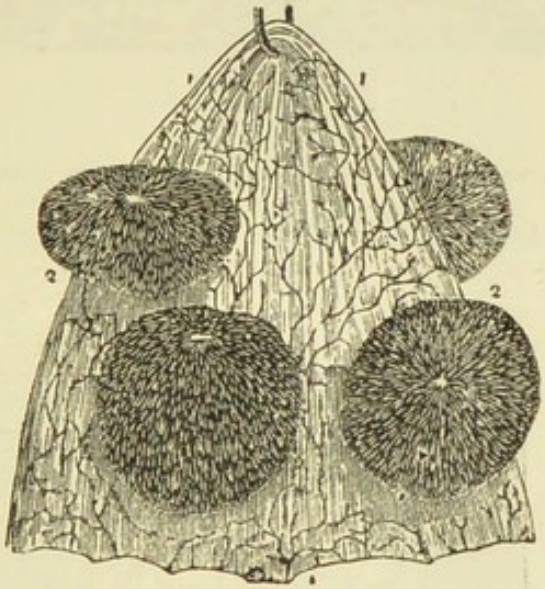

Fig. 51.

PORTION OF CHORION WITH PLACENTULÆ: COW.

1, Chorion; 2, Placentulæ.

uterus of Cows which have been slaughtered and bled. Birnbaum attributed these streaks to a plethora *ex vacuo*.[1]

The accessory placentulæ are, both in shape and situation, as well as in development, different from the cotyledons proper; for while the latter, and of course also the fœtal cotyledons, are arranged in four regular rows, in the gravid uterus, through the rapid increase of the amnion towards the poles of the ovum, they lie somewhat closely together, and the accessory processes are placed between these rows in an irregular manner. In their highest development, the latter are so disposed as to constitute a variable-sized, felt-like patch; the largest and widest are usually observed behind the ordinary cotyledons, and their form is very irregular, but normal. As a rule, the largest are not so big as a walnut, and they are widest at their base. In structure they resemble the ordinary cotyledons, their bloodvessels being arranged in the same manner, while they are covered externally by a sheath of epithelium. In the early period of pregnancy—about the second or third month—they are found in largest number on the entire upper surface of the chorion, also on the parts between the ordinary coty-

[1] *Untersuchungen über den Bau der Eihäute der Saugthiere*, p. 90.

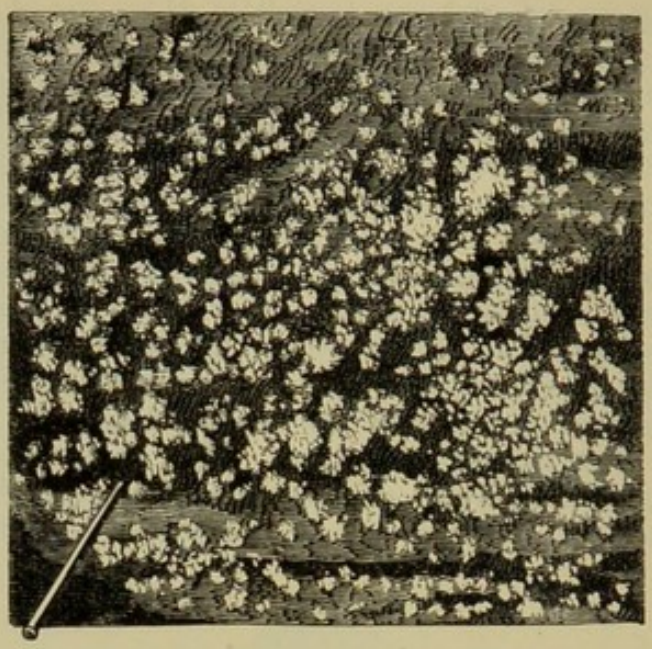

Fig. 52.

ACCESSORY PLACENTULÆ IN A COW'S UTERUS.

They appear like innumerable miniature cauliflowers growing from the surface of the mucous membrane.

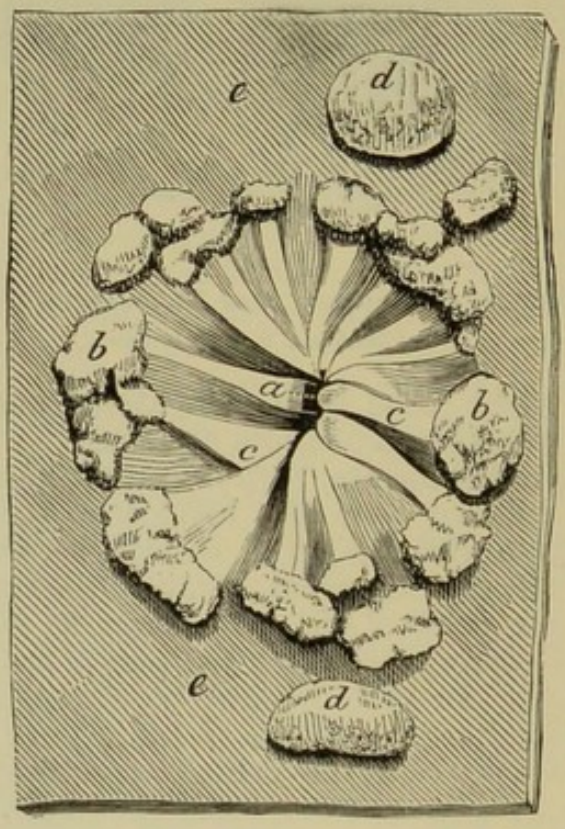

Fig. 53.

ACCESSORY PLACENTULÆ ON THE COW'S UTERUS, CONSTITUTING WHAT IS KNOWN AS "PLACENTA PRÆVIA."

a, Internal Os; *b*, *b*, Placentulæ; *c*, *c*, Radiating folds of Mucous Membrane, from which the newly-formed Placentulæ have sprung; *d*, *d*, Two Normal Placentæ Uterinæ; *e*, *e*, Uterine Mucous Membrane.

ledons and the finest caruncles. It may here be mentioned that the ovum of the Cow in the first week of pregnancy is smooth. Franck has never been able to discover the vascular semi-detached caruncles which are afterwards developed through the prolongation of the blood-vessels; though they are found in the Canine species. He has, however, observed definitely-formed vascular chorion-cotyledons between the fourth and sixth weeks of pregnancy. The interposed cotyledons observed by Franck have been noticed by other anatomists. Birnbaum mentions them, but he is in error with regard to their development, inasmuch as he believed that they arose from the uterine glands, which is certainly not the case. The chorial tufts penetrate the uterine

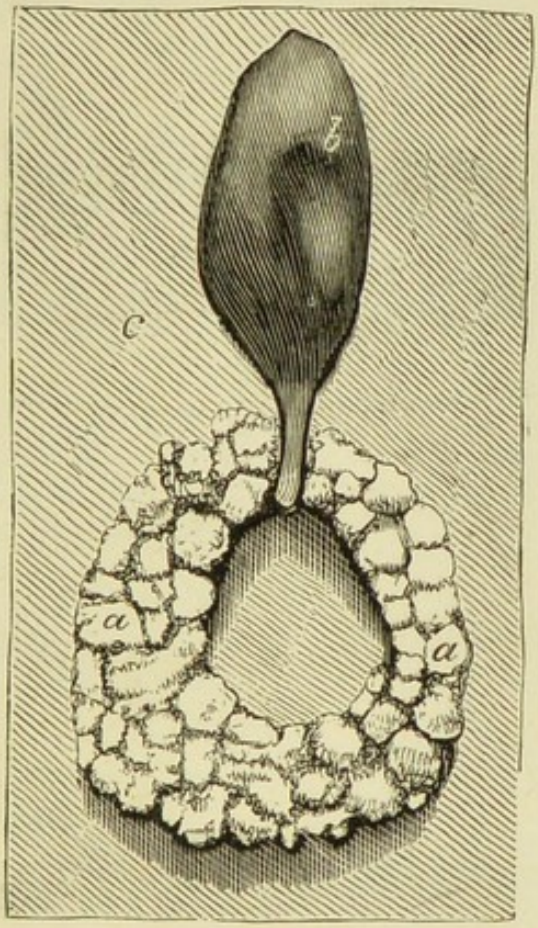

Fig. 54.

Fœtal Portion of Placenta Prævia.

a, *a*, Newly-formed Fœtal Placenta Prævia, a Placentule having been developed on the Internal Os; *b*, Blood-clot and portion of Fœtal Membranes which lay in the Os; *c*, Chorion.

mucosa by four digitations, fixing themselves in the so-called simple follicles, according to Franck.[1]

This excellent authority also points out, with regard to this circumstance, that in the vicinity of the uterine glands there are found small follicles which are nearly always unobserved. The connection between these chorial tufts and the uterine mucosa is extremely slight.

At a later period of pregnancy, there appear other caruncles in the form of fœtal tufts and cotyledons, which the previously developed and prominent maternal cotyledons and caruncles lie opposite to and in contact with. The reason for this fact is to be sought for in the circumstance, that the fœtal caruncles pass into the most developed

[1] *Deutsche Zeitschrift für Thiermedicin.*

uterine cotyledons, and in consequence bring the larger tufts of the allantois into contact with the opposite parts of the chorion. The intermediate caruncles become entirely wasted. Nevertheless, with isolated tufts, sometimes in a great many, we find an increased development, which gives rise in the corresponding uterine mucosa to a similar formation, and a close co-optation, or even an inter-penetration of these accessory fœtal and maternal cotyledons.

When gestation has commenced, the surface of the maternal caruncles, previously smooth, becomes convex, and is covered with

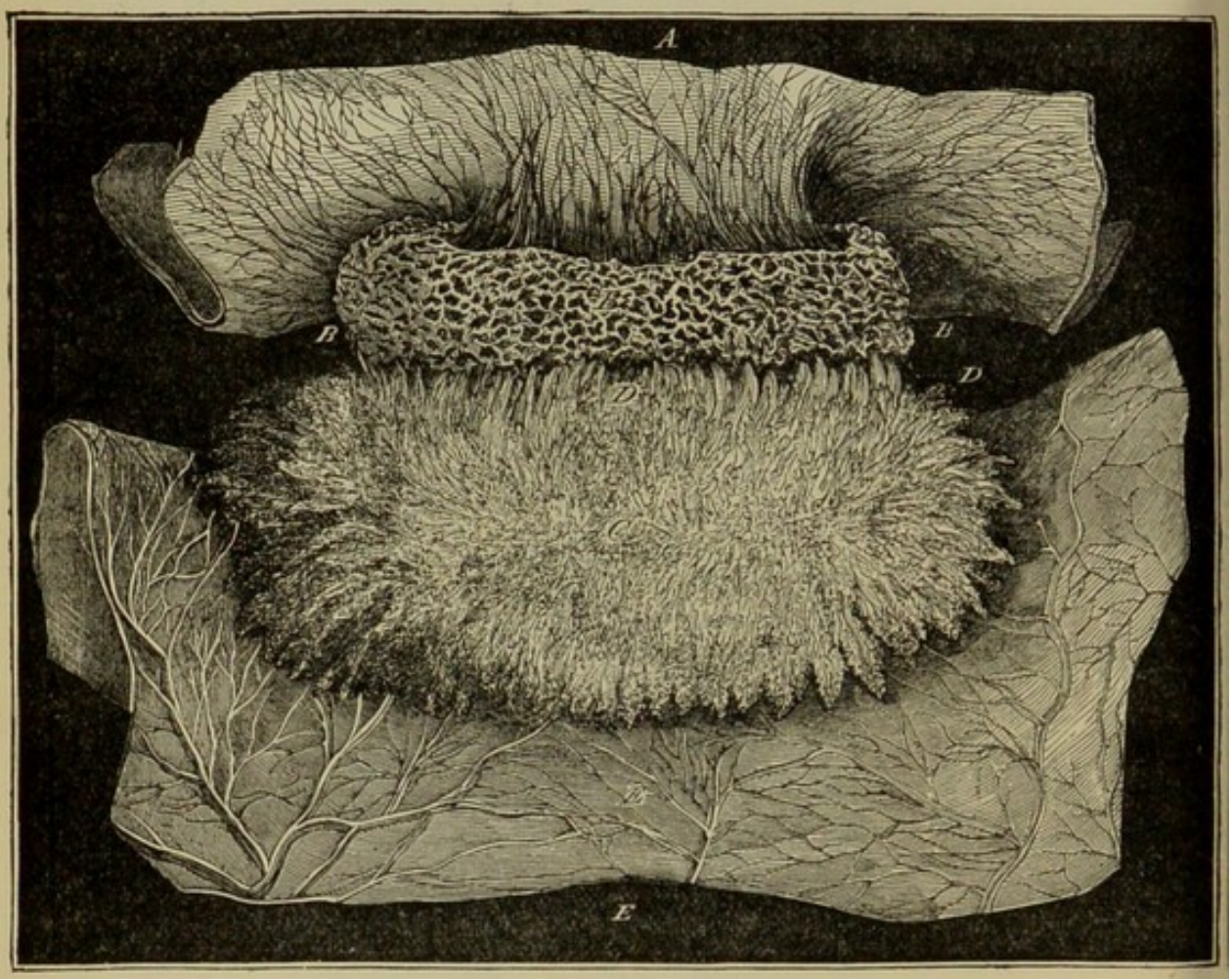

Fig. 55.

MATERNAL AND FŒTAL COTYLEDONS OF THE COW.

A, Pedicle of the Maternal Cotyledon; B, B, Maternal Cotyledon; C, Fœtal Cotyledon; D, Placental Villi; E, Chorion.

reticulate processes which border the crypts, and give it a finely cribbled appearance. The largest are found in the body of the uterus, and they become smaller as they approach the extremity of the cornua. They arise from the uterine surface by a somewhat narrow pedicle, through which they receive their bloodvessels, and their colour is nearly always dark yellow; altogether in shape, hue, and general appearance, they are not unlike a morel mushroom.

The "fœtal" or "chorial cotyledons" repeat the disposition of the maternal cotyledons. They are bright-red concave patches, each exactly fitting into the sinuses of the corresponding uterine processes, with which they strikingly contrast in hue; on their surface they offer a multitude of long, conical, ramifying, or branched villi, measuring

from 4 to 6-10ths of an inch, which are received into the depressions of the maternal cotyledons. This ramifying or racemose disposition of the chorial villi is peculiar to the Bovine and Ovine species. The chorial cotyledons are attached to the chorion by a very short, thick and vascular pedicle; between them and the maternal cotyledons there is always to be found a small quantity of thick, white, milky-looking fluid —the so-called "cotyledonous" or "uterine milk."

According to Schlossberger, this uterine milk should be considered as a fluid analogous to milk or chyle. It contains 88 per cent. of water, 1·5 of fat, 0·7 of salts, and 9·6 of a protein substance. In the cotyledonal fluid, as well as in that on the surface of the uterine mucous membrane of a Mare towards the end of pregnancy, Ercolani has demonstrated the presence of albumin; in the same fluid he has also proved the existence of amidon, dextrin, and sodium chloride.[1]

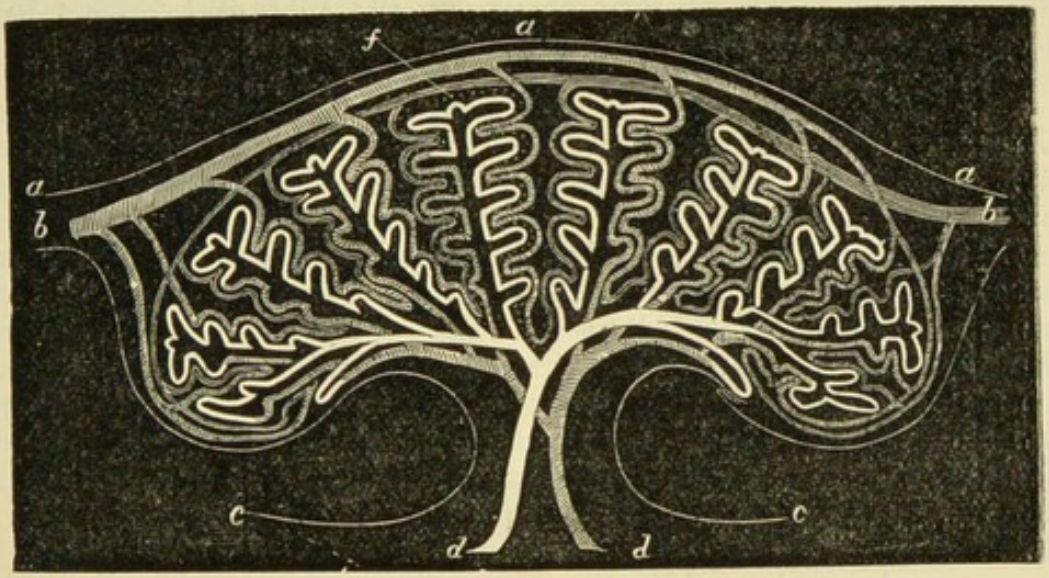

Fig. 56.

COTYLEDON OF A COW'S UTERUS.

a a, Surface of Fœtal Chorion; *b b*, Bloodvessels of Fœtal Chorion; *c c*, Surface of Uterine Mucous Membrane; *d d*, Bloodvessels of ditto; *f*, Secretion from Utricular Glands—Cotyledonous Milk—between Maternal and Fœtal Vessels, and which is necessary to the Mutual Interchange of Gases, and Nutrient, Effete, and other Matters between Parent and Offspring.

The reticulated surface of the maternal cotyledons is homologous with the *decidua serotina* of other mammals; but it possesses a firmer texture, and usually remains attached until the termination of gestation—allowing the fœtal villi to be withdrawn from it at birth; it is afterwards

[1] We must not overlook the fact, that the existence of the "uterine milk" in the living pregnant animal has been denied by M. Colin (*Traité de Physiologie Comparée des Animaux*, 1872, vol. ii., p. 870), who states that this fluid is simply a product of cadaveric decomposition, and is not found during life; as he has assured himself in the most evident manner, by opening the uterus of a pregnant Mare and Cow. It is not found immediately after death, as he has demonstrated on many occasions in Cows and Sheep slaughtered in the abattoirs at all periods of gestation; it is not even observed after six, twelve, or twenty-four hours, or longer, when the surrounding temperature does not favour decomposition. It is only when the placentæ spontaneously separate, or are disunited by slight traction, at a greater or less time after death, according to circumstances, that the white or yellowish-red coloured fluid appears between the chorion and uterine mucous membrane. In proportion as decomposition has advanced, the fluid is abundant. Colin therefore concludes that it is a product of softening and progressive dissolution of the uterine mucous membrane and its cotyledons, as well as the placentæ themselves.

shed or disappears in some obscure manner, and the caruncle again assumes its smooth surface.

As in Solipeds, there is no direct vascular communication between the maternal and fœtal cotyledons, the villi of each being distinct, though in close contact, being only separated at points by the lactescent fluid just alluded to. This fluid, which is present in all the domesticated animals, can be readily discovered by carefully withdrawing a chorionic tuft from the alveolar cavities of the uterine cotyledon.

Sheep and Goat.

In the Sheep and Goat the arrangement of the placenta is essentially the same as in the Cow, except that the maternal cotyledons are deeply concave or cup-shaped in the middle, and into this cavity the fœtal placentula is received and closely retained. This placentula is not so wide as that of the Cow, though it is thicker and the villi are more delicate. The mode of termination of the placental vessels in the Sheep is villous ; in the Goat it is pilose.

Pig.

In the Pig the placenta may be designated as " diffused," not " polycotyledonary " as in Ruminants ; though the tufts do not form a continuous layer, as in the Mare, the papillæ being collected in small but closely-grouped clusters. When uninjected they appear as white masses or spots scattered over the external surface of the chorion, thus giving it a mottled aspect, caused by the presence of feebly vascular and non-vascular areas ; but when the allantoic veins are filled, these are seen to form plexuses in the centre of each spot. The uterine veins have a corresponding arrangement, and the arterial capillaries form a fine network, the meshes receiving the villosities which carry the fœtal arterial capillaries ; whence it might seem that the nutrition of the fœtus is effected principally at the points of contact of the fœtal with the maternal venules, while the respiratory process took place at the surface of contact between the fœtal and maternal arterial capillaries. The chorion is destitute of these papillæ at its extremities, which are in contact with the chorion of other fœtuses in the uterus.

Bitch and Cat.

In the Bitch and Cat the placenta forms a thick annular band or zone, about one or one and a half inch wide, passing round the middle of the chorion ; it is therefore said to be " zonular." This zone is concave within, of a mixed grey-and-red colour when uninjected, livid or dark brown during gestation ; its fœtal surface is lobulated, and the zone is limited at each side by a dark green border, the colouring matter of which can scarcely be removed by repeated washings.

The placenta is studded with ramified villi of a leaf or plate shape, which are implanted in the uterine mucous follicles. The mucous membrane in which these are situated, and which corresponds to the placenta, presents a kind of vascular fungous development that appears after parturition, but which at an early stage of pregnancy has a quantity of fluid along its margin ; the maternal placenta, or *serotina decidua*, is present during gestation, and can be separated as a distinct layer. There cannot be a doubt that the uterine mucous membrane in Carnivora secretes a kind of plastic lymph, which forms this caducous lining, or *membrana decidua ;* but it is only present at a certain period of fœtal life, and forms the base of the uterine placenta.

Functions.

The functions of the placenta are obvious: it is the nutrient and respiratory apparatus during a portion of intra-uterine existence; and for the accomplishment of these functions it must rely upon its intimate and healthy relations with the uterine surface. The special and temporary processes of development being completed, and the task of providing capillary superficies being terminated, whether on the part of the mother or fœtus, the placenta of the latter disappears, as well as the decidua; though they may not be thrown off together, and the maternal decidua may not be shed all at once, but in successive portions. The long period of gestation necessary to endue the young of defenceless hoofed animals with sufficient strength before birth, is perhaps a reason for the firmer texture, better organisation, greater extent, and more persistent character of their "deciduous" formations.

The comparative study of the disposition of the different kinds of placentæ, may furnish valuable indications as to the procedure which ought to be adopted in artificial delivery—the surgical manipulation necessarily varying with the extent and arrangement of the points of union existing between the uterus and the fœtal envelopes.

It has, therefore, been thought useful to arrange the domesticated animals into two groups—those with a single placenta, and others with a multiple placenta; the first group being again subdivided according as the placenta is "diffused" or "localised." This arrangement and subdivision may be expressed as follows:—

Single Placenta	Diffused	Horse.	
		Pig.	
	Zonular	Dog.	
		Cat.	
Multiple Placenta	Localised	Cow.	
		Sheep.	
		Goat.	

Umbilical Cord.

The *umbilical cord*, *funis*, or *navel-string*, is a collection of vessels which form the means of communication between the mother and fœtus during the uterine existence of the latter, and which loses its functions when birth occurs. It is visible at the earliest period of pregnancy, and is formed by the vessels which convey the blood between the fœtus and its envelopes—chiefly the placenta. It is divided, for facility of description, into two portions: an *amniotic*, the longest, always twisted on itself like a rope, and covered by the amnion, which passes along it to become continuous with the skin at the umbilicus; and an *allantoic* portion, much shorter, less twisted, and covered by the sheath that continues the two layers of the allantois until it is inserted into the upper wall of the chorial sac, between the cornua.

Three vessels enter into the composition of the cord: two *arteries* and a *vein*, which are embedded in embryonic connective tissue (*Whartonian gelatine*), that make them appear more voluminous than they really are. This "Gelatine of Wharton" consists of a mucous basis, in the substance of which is fibrillar tissue. The umbilical arteries arise from the internal iliac artery, and course along the sides of the bladder; reaching the umbilicus, they pass through it and arrive at the terminal extremity of the amniotic portion of the cord, where they give off some branches

to the amniotic sac, and then continue to the end of the allantoic portion, where they terminate by an expansion of placental branches. The *amniotic divisions* of these arteries are extremely flexuous and few in number; they are included between the allantoic layer and the membrane of the amniotic sac, within which they are prominent.

The *placental* or *chorial* divisions are infinitely more numerous and arger, and starting from the terminal extremity of the cord, pass in every direction between the chorion and the external layer of the allantois, beneath which they can be seen. By their anastomoses they form a beautiful network, whence proceed the capillary vessels that form the placental villosities. As we have already stated, these capillaries have no direct communication with the maternal vessels, but after attaining their finest dimensions pass into the veins which finally constitute the UMBILICAL VEIN. This vessel, then, owes its origin to the capillary radicles of the placental villosities; which radicles, by their union between the chorion and amnion, form a voluminous network whose richness is even greater than the arterial arborisation. Two chief trunks finally issue from this plexus, and these soon join to form a single trunk, which accompanies the two corresponding arteries in the cord. On reaching the umbilicus, this vessel, now the *umbilical vein*, bends forward on the inner surface of the abdominal wall, where it is covered by peritoneum, and on gaining the liver enters that organ to open directly into the vena portæ. Owing to this junction, it happens that the two vessels compose, in the interior of the liver, a single canal, from which proceed the hepatic veins. In other animals than Solipeds, this single canal sends off a particular vessel of considerable size—the *ductus venosus*—that passes directly into the posterior vena cava. The umbilical vein has no valves.

Besides these three principal vessels, the cord contains, in its amniotic portion, the duct of the umbilical vesicle, the *urachus*, and the *omphalo-mesenteric* vessels, as well as the extremity of the fœtal intestine at an early period. The *urachus* is an irregularly bulging canal, continued from what is eventually the fundus of the bladder, and on reaching the umbilical opening it passes between the chorion and the amnion to form the allantois.

After birth it rapidly contracts, especially at the fundus of the bladder, until it is quite closed, and nothing is left but the fold of peritoneum that sustained it, and which now becomes the middle ligament of the bladder. It sometimes happens with the Foal, however, but more frequently with the Calf, that it persists, the urine in this case escaping by the umbilicus.

The *omphalo-mesenteric vessels* are an artery and a vein. The first is given off from the anterior mesenteric artery, and passes to the amniotic extremity of the umbilical vesicle; while the vein arising from this vesicle terminates in the vena portæ. These two very thin vessels become obliterated with the vesicle towards the end of gestation, or the artery may be found reduced to the smallest dimensions.

DIFFERENCES.

Ruminants.

In Ruminants, the two veins passing from the chorion remain separate in the umbilical cord until they enter the umbilical ring, where they become one vessel. There are, therefore, two veins and two arteries; the latter unite at the umbilicus, the resulting vessel entering

the vena cava and vena portæ, between which it establishes a communication by means of the *ductus venosus*. The chorion and the amnion being in immediate contact over a wide surface, the umbilical vessels are reflected over the inner face of the first-named membrane on their leaving the amniotic sheath; they do not have a fold of allantois, as in Solipeds. No trace of the omphalo-mesenteric vessels has been found in the umbilical cord, and the umbilical vesicle disappears at an early period of fœtal life.

Pig.

In the Pig the arrangement of the cord is the same as in Ruminants.

Bitch and Cat.

In the Bitch and Cat the cord resembles that of Solipeds, in having an allantoic portion; but it is extremely short, and enveloped in a large fold of allantois. The omphalo-mesenteric vessels are very apparent until the end of gestation, and are proportionately larger than in Solipeds; this is due, in all probability, to the persistence of the umbilical vesicle. These are an artery and a vein; the former arises from the anterior mesenteric, descends in nearly a direct line to the umbilical opening, and is expanded in the umbilical vesicle. The vein originates from the terminal divisions of the artery, passes towards the abdomen, and terminates in the *vena portæ*.

The dimensions of the umbilical cord vary with the species of animals. Compared with that of the human fœtus, it is short in Solipeds and Ruminants. At the commencement of gestation in the Mare and Cow, it is not so long as at a later period, though it is thicker; towards the termination of gestation, it is at least as long as the young animal is tall. Its length in the Mare has been variously estimated. Immediately before birth it has been found to measure three feet four inches long, and three and a half inches in circumference (three-fourths of an inch in diameter). Daubenton found it to be, in one instance, from the umbilicus to the amnion eighteen inches, though the period of gestation is not mentioned. Bourgelat gives it as about two and a half feet; Blaine, from two to two and a half feet. Goubaux found it to measure, when untwisted, at six months' pregnancy, thirty-four inches; but it was so very twisted (twelve turns) that in this state it was only twenty-nine inches in length.

In the Cow, Vitet gives it as from nine to ten inches; but Goubaux, in a Cow at the eighth month of pregnancy, found it to be about sixteen inches; while Colin, in another Cow at the same period, gives eighteen inches.

In the Sheep, at two months' gestation, it has barely measured one inch; Rainard gives it at from three-fourths to one and a quarter inch at the end of gestation. Daubenton says it is two inches at parturition.

In the Pig it is comparatively very long, sometimes stretching the whole length of the fœtus. Daubenton found it to be one inch in length in a fœtus measuring three inches and three lines from nose to anus.

In the Bitch and Cat it is very short, and measures from one to two inches at birth; or about two-fifths of the length of the body.

In the early days of fœtal life, the cord contains a portion of the intestines, but as the cavity of the abdomen is formed and closes, the viscus is retracted within it. Very rarely, however, this retraction is

not complete, and hernia of the intestines exists at birth, or even for some time after that event.

With regard to the curious torsion of the cord on itself—as many as twelve complete turns having been counted in the cord of a six-months-old fœtus—it has been held by some authorities that this is only accidental, and depends on the movements of the fœtus during the latter stages of gestation, or the displacement it undergoes on leaving the uterus; consequently, that the spiral twisting of the vessels is not normal. It is improbable, however, that the twisting can be due to muscular movements of the fœtus; as it is unlikely these should be entirely, or even mostly, in one direction. It has been recently attributed to the excessive growth of the umbilical arteries, whereby they are compelled to take a tortuous course; and when a slight obliquity has once been established, every pulsation will tend to increase the spiral; at the same time every movement of the fœtus or the mother would be taken advantage of, the cord and fœtus revolving together until, with the growth of the latter, the friction of the amnion puts an end to the rotation. It does not appear that any advantage accrues to either fœtus or mother from the torsion of the cord; on the contrary, it increases the resistance to the flow of blood, and also augments rather than diminishes the danger of stoppage of the circulation by accidental pressure. Examination of non-displaced fœtuses proves that it is far from being constant.

At birth, the umbilical cord is usually torn or gnawed through at a short distance from the umbilicus of the fœtus; the remaining portion dries up, dies, and falls off in a few days.

SECTION III.—DEVELOPMENT OF THE FŒTUS.

Having studied the conception and partial development of the young creature, and described the envelopes which surround it, we will proceed to notice the various changes which occur in it until gestation is completed and parturition is about to take place.

This division of our subject is of much importance in several respects, but more especially with regard to the relation it bears to *teratology*—the branch of science which treats of congenital defects, malformations, and monstrosities.

The transition from the condition of the embryo, when the young animal has scarcely assumed a definite form, to that of the fœtus, when it presents the lineaments of the species to which it belongs, is very gradual.

The *dorsal cord*, as has been stated, is a cylindrical body developed above the primitive furrow, with slightly attenuated extremities, and at each side small opaque quadrangular masses, the *vertebral laminæ*, which are in reality the *proto-vertebræ*, or first rudiments of the vertebræ. Each of these masses is perforated by a small opening, and is resolved into three portions—the *proto-vertebral cavity*, the *muscular lamina*, situated above the cavity, and the *proto-vertebra* placed below the cavity. The *muscular laminæ*, increasing in volume, are inflected upwards and at last unite on the median line of the back, chiefly forming the muscles of the vertebral furrows; they also send off prolongations downwards, which concur in the development of the intercostal and abdominal muscles, as well as those of the limbs. The *proto-vertebræ* bend upwards and downwards on each side, so as to enclose the proto-vertebral cavity or spinal canal,

and the dorsal cord; the upper ring represents the rudiments of the annular portion of the vertebræ, while the lower ring and the dorsal cord constitute the vertebral bodies and the discs uniting them.

The *lateral laminæ* arise from the portion of the middle layer of the blastoderm placed on each side of the vertebral laminæ. In the region of the trunk these laminæ are separated for a certain time from the latter; but in the cephalic region they are always adherent to them, and at this part they are usually designated the *cephalic laminæ*. The *proper lateral laminæ* are divisible into two layers, external and internal, united by a *middle layer;* they comprise between them a space which becomes the *pleuro-peritoneal cavity*, after the formation of which the lateral are joined to the vertebral lamina. The *internal* or *fibro-intestinal layer* envelops the deeper portion of the blastodermic layer or intestinal furrow, the umbilical vesicle, and the allantois; it constitutes the fibrous and vascular parts of these membranes, and carries the vessels to the inner face of the chorion. The *external* or *cutaneous layer* is developed in two ways: above, it glides between the muscular laminæ and the fœtal portion of the external layer of the blastoderm to form the cutaneous envelope on the back; below, it separates into two leaves which receive between them the prolongations of the muscular laminæ destined to constitute the intercostal, abdominal, and other muscles of this part of the body. Of these two secondary leaves, the external forms the skin of the trunk, and the internal the parietal layer of the peritoneum. The cutaneous laminæ also furnish an extra-fœtal prolongation—the fibrous layer of the amnion.

The *middle* or *mesenteric laminæ* join at the median line, and in their substance are developed the Wolffian bodies, or antecedent deciduous kidneys, and the principal vessels of the trunk.

The *cephalic laminæ* always remain adherent to the vertebral laminæ, and are inflected inwards with them to form the anterior part of the cephalo-intestinal cavity, which is divided into two compartments—the pharyngeal and œsophageal cavities. The pharyngeal cavity opens externally by the mouth, and is partly enclosed on the sides by the pharyngeal arches. The œsophageal cavity soon shows a diverticulum, which is not long in communicating with the pleuro-peritoneal cavity, and subsequently contains the heart; it is therefore named the *cardiac cavity*. The cephalic laminæ also form the derm of the cranium, and the fibrous layer in which are developed some of the cranial bones.

The Nervous System.

The development of the *nervous system* comprises the growth of the *brain*, *spinal cord*, and *nerves*. The initial steps in the development of the brain and cord have been already indicated. At each extremity of the medullary cavity, which is a modification of the median furrow, is a slight bulging. From the posterior, or *rhomboidal sinus*, the sacro-lumbar nerves are given off, while the anterior gives origin to the brain. This anterior enlargement appears as three successive dilatations named the *cerebral vesicles* or *cells*, which are distinguished as anterior, middle, and posterior. They are filled with fluid, and the middle slightly surmounts the other two, which gives the whole the figure of a small triangular mass. The vesicles increase irregularly in volume, and their walls, in developing, form the nervous tissue; while their cavity persists and becomes the space observed in each portion of the encephalon. The *anterior vesicle* represents the cerebral hemispheres, the *thalami optici*

and the lateral ventricles. The *middle vesicle* forms the *crura cerebri*, *corpora quadrigemina*, and the *aqueduct of Sylvius* or middle ventricle. The *posterior vesicle* gives rise to the *medulla oblongata*, *pons varolii*, cerebellum, and fourth ventricle. The middle vesicle increases more rapidly in volume at first than the others, but it soon stops and allows the anterior cell to develop: from this time the encephalon assumes its oval shape, with predominance of the anterior part.

Towards the end of their first third of intra-uterine life, nearly all the parts of the encephalon are distinct; the two hemispheres are separated by the development of the *septum lucidem*, and the convolutions are apparent on their surface: while the *corpora quadrigemina* and *crura* are well defined. At a later period the cerebellum is seen, as well as the *pons Varolii*, *corpora restiformia*, and *corpora pyramidalia*.

With regard to the development of the *spinal cord*, we have observed that the medullary canal is the first trace of this part. It occupies the whole length of the vertebral stalk, and its cavity communicates anteriorly with the fourth ventricle. When the spine is developed the cord only increases longitudinally to a certain degree, and appears to ascend in the canal; it stops at the middle of the sacrum in the Equine fœtus, but ascends higher in the other species. During this apparent ascensional movement is developed the *filum terminale*, and the terminating nerves of the cord (*cauda equina*). The parietes of the medullary canal are at first very thin, but increase in thickness with the appearance of the nervous substance of the cord, and soon divide into two layers: an internal, the *epithelium* of the central canal; and an external, the *grey substance* of the cord. Gradually the canal contracts, and the cord shows longitudinal furrows. At the end of the first month the inferior roots of the nerves are in existence, as well as the spinal ganglia, which are developed at the expense of the proto-vertebræ; the superior roots are not distinguishable for some time after. The *envelopes* of the nervous centres are furnished by the proto-vertebral laminæ, and are developed after the sixth week, following the formation of the parts they are destined to cover.

The *nerves* are not so definite in their development, and some obscurity prevails with regard to them. It would appear that the motor roots originate in the cord, but that the ganglia are formed separately in the proto-vertebræ, and perhaps become the point of departure of the sensitive roots. The nerve ramifications grow from elongated ramified cells, which are joined by their extremities. The nuclei of the cells, joined to the periphery, become the nuclei of the sheath of Schwann, and the nerve tissue is afterwards deposited gradually between the axis-cylinder and the envelope. The great sympathetic nerve is perceived at an early date as a nodulated cord; it is probably developed in the same manner as the other nerves.

The Organs of Sense.

The principal portion of the *organs of sense* belong to the nervous system, and are, of course, developed with it; the other portions belong to the external epithelial layer, and to the derm or germinative layer. With regard to the *organs of vision*, two tubulous prolongations arise from the anterior cerebral vesicle and, passing forward, terminate in the *primary ocular vesicles*, traces of the ocular globes; the hollow prolongments form the optic nerves, and the vesicles furnish the choroid layer and retina. The crystalline lens, vitreous body, cornea, and sclerotica

are derived from the external blastodermic layer. The part of the integument not required to form the lens constitutes the envelope of the globe. The latter forms the sclerotica and cornea; while the epiderm furnishes the epithelium to the latter, which becomes distinct from the sclerotica in about the fourth month. A slit occurs at the lower part of the fibrous envelope of the globe; this is related to the development of the vitreous humour, a prolongation of the derm passing through this slit and entering between the lens and the anterior wall of the secondary ocular vesicle which appeared shortly before. There this prolongation becomes developed and transformed into the vitreous humour, which at one period is surrounded by vessels, but shows none immediately before birth. It exhibits in its centre a transverse canal, which lodges a branch of the arteria centralis of the retina.

The *optic nerve* is developed in the pedicle connecting the ocular vesicle with the anterior cerebral vesicle, and the *retina* is formed by the inner layer of the secondary ocular vesicle; it extends to the lens in changing its character in front. The *choroid* coat is constituted by the posterior layer of the ocular vesicle; it extends as far as the lens, and is then inflected in front of that body to form the iris. The borders of the pupil embrace the vascular envelope of the lens, and the anterior face, as well as this pupil, is covered by a very vascular membrane, the *membrana pupillaris;* behind it is the equally vascular covering, the *membrana capsulo-pupillaris*, that passes through the pupil to the lens to envelop it in a kind of sac that disappears towards the end of gestation. Previous to this time this aperture is very wide; but as the iris is developed the pupil contracts, and the vessels of the vascular or pupillary membrane diminish in size and number, until at last only a few are seen crossing the transparent membrane.

The protective and motor apparatus of the eye is gradually developed around the globe. The eyelids are small cutaneous folds which are formed in the first third of uterine life, and grow and unite by their margins until a short time before or after birth, according to the species, when they separate. They are maintained closed by a thin membrane, which disappears in Solipeds, Ruminants, and the Pig, before birth; but in Carnivora it remains until some days (eight or ten) after that event. So long as the lids are closed, the conjunctiva is only a sac communicating with the lachrymal canal. The crystalline lens in the fœtus and new-born animal distinctly shows the three septa peculiar to it; three diverge from each pole at angles of 120°. The lachrymal gland is an appendage of the epithelial layer which is intruded above the globe; at first compact, it becomes gradually excavated into cavities, from which arise the excretory ducts.

The *auditory apparatus*, consisting of the internal ear, auditory nerve, and middle ear, is developed separately. The labyrinth appears in the form of a vesicle which is not in direct relation with the posterior cerebral cell, but is constituted by a depression of the epidermic layer—the *auditory fossa*—that becomes more and more marked until it is finally a closed cavity. At this time the wall of the labyrinth is only a simple epithelial membrane; but this is soon increased externally by a connective membrane which vascularises it, and then gives rise to three layers: an external, which adheres to the epithelium to form the membrane of the labyrinth; an external, that lines the labyrinthic cartilage; and a middle, whose soft embryonic connective tissue disappears and is replaced by a fluid, the *perilymph*. At the same time that these

changes of structure are taking place, the vesicular shape of the labyrinth is modified, and shows the *cochlea*, *semicircular canals*, *utriculus*, and *sacculus*. The *middle* and *external* ear are formed by the first pharyngeal slit, which is never completely closed, while the others disappear. At first there is a cavity communicating externally by the pharynx; this cavity contracts, then divides into two portions by a septum in its middle; this septum becomes the *tympanum*, while the inner cavity forms the *middle ear* and *Eustachian tube*, and the external portion the *external auditory canal* or *meatus*. The *ossicula auditûs* are at first cartilaginous, and appear towards the third month; after which they gradually ossify, and have nearly assumed their definitive shape at birth.

The *concha* is developed beneath the integument after the second month.

The *organs of smell* begin by two depressions in the epidermic layer, analogous to the crystalline lens and auditory fossettes. These two olfactory fossa appear below the ocular vesicles, and, becoming deeper, their depth is further increased by granulations which spring up on their borders. Behind, they communicate with the pharynx, and the formation of the palate separates them in front from the buccal cavity. From this time the nasal fossæ are constituted and completed by the development of the bones of the face. The *olfactory lobes* and *nerves* are at first tubular, and are related to the anterior cerebral vesicle. In the young fœtus the nostrils are formed by a collection of mucus and epithelium; they open towards the middle period of gestation.

The Skin and its Appendages.

The *skin and its appendages*, which might be designated the *tactile apparatus*, are developed by the epidermic and middle layer of the blastoderm. The cutaneous laminæ, by the modification of their elements, form the *derm*, in which vessels are readily seen after three months. In the *epiderm* it is not long before the mucous and horny layers can be distinguished; in the first, pigment cells are observed at the commencement of the fifth month in the larger quadrupeds. The epiderm is easily detached from the derm; it forms a peculiar white, completely-enveloping pellicle on the surface of the latter, apparently separated from it by the growing hairs. Frequently we find the integument covered by a special coating that looks like varnish (the *varnix cascosa*); this would appear to be intended to protect the epidermic epithelium from the destructive solvent action of the alkaline amniotic fluid. It is very abundant on the human fœtus at all periods, but is not found on that of animals so long as the skin is glabrous. As soon as the hairs begin to appear, the epiderm is partially detached in the form of the thin pellicle just alluded to, and the decomposition of which gives rise to an appearance like varnish. It is best seen in the fœtal Pig, the hairs on the skin appearing all at once over the body; in the other domesticated animals they are only developed successively, and consequently the shedding of the epiderm occurs partially and in patches, which are insensibly confounded with the normal epidermic layers. Microscopically, these flakes offer the same characters as epidermis removed by a vesicant; the points where the hairs have passed appear as regular infundibuliform openings. When the fœtus increases in volume the epiderm desquamates, and the *débris* floats in the amniotic fluid.

In the third month, the hairs are perceptible on the fœtus of the Mare and Cow. Hair follicles have been observed in embryos of the Pig which did not measure more than two inches in length. They first appear about the eyebrows, lips, and joints of the limbs, and the whole of the body is covered at the sixth or seventh month; they are usually observed in the fœtus of the Mare and Cow around the lips, towards the eighteenth week of gestation. The hair may be shed and renewed before birth, for it has been found in the amniotic fluid and in the stomach of the fœtus. Each hair is developed in a prolongation of the epidermic layer which is imbedded in the substance of the derm; this prolongation is constituted by a bottle-shaped mass of cells. In the centre the cells are modified and heaped up, so as to form a small cone whose base covers the growing papilla; this cone elongates, until it touches the superficies of the epidermis, when it becomes bent in the effort to push itself through, but, finally, it issues beyond the surface, where it may grow freely.

The *sebaceous* and *perspiratory* glands are developed in a similar manner, at the middle period of uterine life. The horny productions, such as the *claws*, *hoofs*, *ergots*, and *chesnuts*, are apparent at an early stage. Towards the end of the second month there can be perceived in the fœtus of the Cow, at the extremity of each digit, a small, pale, and transparent conical tubercle; this is the rudiment of the claw. The hoofs of Solipeds appear towards the twelfth week, and about the commencement of the fourth month they are more developed; their texture has become firm and opaque, whereas before it was gelatinous and transparent, and has assumed a fine yellow tint. They are always soft, however, until birth, in order to guarantee the integrity of the fœtal envelopes. At mid-term, brown or black patches appear, if the coronet is provided with pigmentary stains; but it is not until about the end of gestation that the horn begins to show the greenish tint proper to it when destitute of pigment; though the remainder of this production, particularly its lower part, preserves its yellow colour until the young animal is born. In Solipeds the chesnuts are seen at mid-term, in the form of thin brownish plates, which soon become darker. The structure of the hoof is not tubular until after birth, when, the fœtal hoof gradually disappearing, the horn that replaces it is fibrous and tubular, and much more consistent.

The corneous substance is developed at the expense of the blastema which the capillaries of the modified derm throw out on its surface. In this material appear nucleated cells which, pressing against each other, become at first polygonal in shape and flattened, then lose their nucleus and are confounded with each other. At a later period, cells of a new formation are moulded on the papillæ of the coronary cushion and plantar surface of the foot of Solipeds and Ruminants, giving it that fibrous appearance which is so striking during extra-uterine life.

The Locomotory Apparatus.

The development of bone, and with it the locomotory apparatus in general, next demands our attention. Bone is developed in the blastema or primitive basis — a transparent glairy mucous matter containing numerous minute corpuscles. This progressively acquires increased firmness, sometimes assuming a membranous or ligamentous condition, usually of a gristly consistence before its conversion into bone. The change into cartilage is denoted by the appearance of minute nucleated

cells, which increase in number and size, and are aggregated in rows, with intercellular tracts where the ossification is about to begin. These rows, in the cartilaginous basis of long bones, are vertical to its ends; in that of flat bones they are vertical to the margin. The cells furthest from the seat of ossification are flattened and in close contact; nearest that seat they become enlarged and separated. The first appearance of bone is that of minute granules in the intercellular tissue. Canals are next formed in the bone, by absorption; these ultimately receive blood-vessels, and become the "vascular canals." The immediate nutrition of bone is provided for by the production of minute "plasmatic canals," "lacunæ," or "bone-cells" from the vascular ones. Ossification begins at the centre of round bones, and proceeds towards the surface; in flat bones it extends between two membranes, and from a central point towards the periphery; in short bones, towards the circumference; and in long bones, from a central point or *diaphysis*, towards another centre—the *epiphysis*, situated at each end. Particular parts or processes are furnished with a separate centre of development, named the *apophysis*. Length occurs at the extremity of the diaphysis, and bulk by deposition on the surface, the medullary canal of certain bones being due to internal absorption.

The *spine* is the first portion of the skeleton observed in the embryo, it being represented by the *chorda dorsalis*, which is composed of a mass of cells in the interior of a transparent sheath. The proto-vertebræ appear on each side of the cord, and ultimately enclose it and constitute the spinal canal; in this way results the *external sheath of the cord*, and the *superior uniting membrane*. The vertebral stalk now exists as a membranous axis, but not for long, as it becomes segmented in order to form the vertebræ, and these segments are gradually converted into cartilage. Each persistent vertebra does not correspond to a proto-vertebra, the latter dividing into two portions to constitute two vertebræ. The body of the vertebra is developed more quickly than the spinous portion; at the end of the second month all the vertebral bodies are cartilaginous, while the laminæ are yet in a membranous condition. In the third month ossification commences, and during this process the dorsal cord disappears, except between the vertebræ, where it is developed to form the intervertebral fibro-cartilage.

The *face* and *cranium* are formed by a membrane that envelops the encephalon, and which is due to the proto-vertebral laminæ. This cranial membrane becomes partly cartilaginous and partly fibrous, the cartilage existing at the base of the cranium, and appearing to be a prolongation of the bodies of the vertebræ: indeed, there is a resemblance between a vertebra and the cranium, in so far as the latter can be resolved into four portions, each corresponding to a vertebra. This cartilage is slowly transformed into bone; while the fibrous part, answering to the roof and sides of the skull, passes directly into the osseous state. The bones of the face are formed by the *pharyngeal*, *branchial*, or *visceral arches*—a name given to four laminæ which, springing from the anterior extremity of the dorsal cord, curve downward to meet those of the opposite side; the spaces between them are named the "pharyngeal clefts." The upper jaw, mouth, and nasal cavities—composed by the nasal, maxillary, and palate bones—come from the first pharyngeal arch; while Meckel's cartilage, which passes from the handle of the malleus towards the lower jaw, is also an appendage of it. This cartilage disappears about the sixth or seventh

month. At first the mouth communicates with the nasal cavities; the palate is developed in two portions, which advance towards each other, but remain for some time apart; so that during this time the young animal has a cleft palate.[1] The second pharyngeal arch forms the stapes, the petrous portion of the temporal bone, the styloid arch and the hyoid branch. The third originates the hyoid bone with its cornua, while the fourth only constitutes the soft parts in this region of the throat.

The *thorax*, consisting of the ribs and sternum, is an appendage of the proto-vertebral laminæ, which incline towards the lower face of the vertebral spine. The true ribs are developed most rapidly, and before attaining the middle line they unite by their inner extremity to form a moiety of the sternum. A fissure at this part separates the ribs of one side from those of the other; this gradually closing, ends by disappearing altogether, and then the sternum is constituted. The ribs are, after the petrous portion of the temporal bone, the parts of the skeleton which ossify most promptly; ossification begins in the middle bones. The ribs do not belong exclusively to the dorsal vertebræ, but have a tendency to be developed along the length of the spine; it is not rare to see a small cartilaginous nucleus attached to the lumbar vertebræ, and which is soon lost in the substance of the abdominal parietes; in Birds this body assumes large dimensions on the last cervical vertebræ.

The shape of the thorax differs with species, being round in some and oval in others, but it is always less developed in the fœtus than in the young or adult animal.

The *limbs* do not appear until after the formation of the vertebral spine, the pharyngeal arches, and the thorax. They show themselves as four small prolongations from the pelvis and chest, slightly thickened at their origin and contracted in the middle. Their free extremity is flat, and is either simple or divided, according to the foot of the species. In these prolongations the cartilaginous segments are formed, which, when ossified at a later period, constitute the bones of the limbs.

The *muscles* are divided into four groups, after their origin. They are the *vertebral muscles*, which arise from the muscular laminæ of the proto-vertebræ; the *visceral muscles* for the thoracic and abdominal cavities, the neck and jaws, and having the same origin; the *cutaneous muscles*, which originate from the cutaneous laminæ of the middle layer of the blastoderm; and the *muscles of the limbs*, the development of which is not fully understood.

It was believed at a certain period, that the muscular fibres are formed by the joining together at their ends of several elongated cells. It is now known that each fibre is constituted by a single cell which extends in length, and whose nuclei are multiplied and placed at the surface; while the contents are transformed into a substance that presents all the characteristics of contractile tissue. The sarcolemma is formed after the fibre, by a modification of the connective tissue surrounding it.

The locomotory apparatus of the majority of the domesticated species of animals is so developed at birth, that immediately after that event the young creature can move with more or less alacrity. With the

[1] This cleft condition of the palate would sometimes appear to persist after fœtal life. In April, 1876, at the Middle Park Stud, in Kent, I saw a thoroughbred Foal with a cleft palate. It was being suckled, and a portion of the milk, instead of passing down the œsophagus, escaped from the nostrils. It was this unusual course of the milk which led to the detection of the abnormality.

larger herbivorous quadrupeds, the limbs of the new-born animal are long to enable it to reach the teat, as well as to enable it to escape by flight should danger be apprehended.

The Circulatory System.

The development of the circulatory system is not apparent until some days after the appearance of the embryo in the blastodermic layer, there being no trace of vessels in the germinative space. It is not long, how-

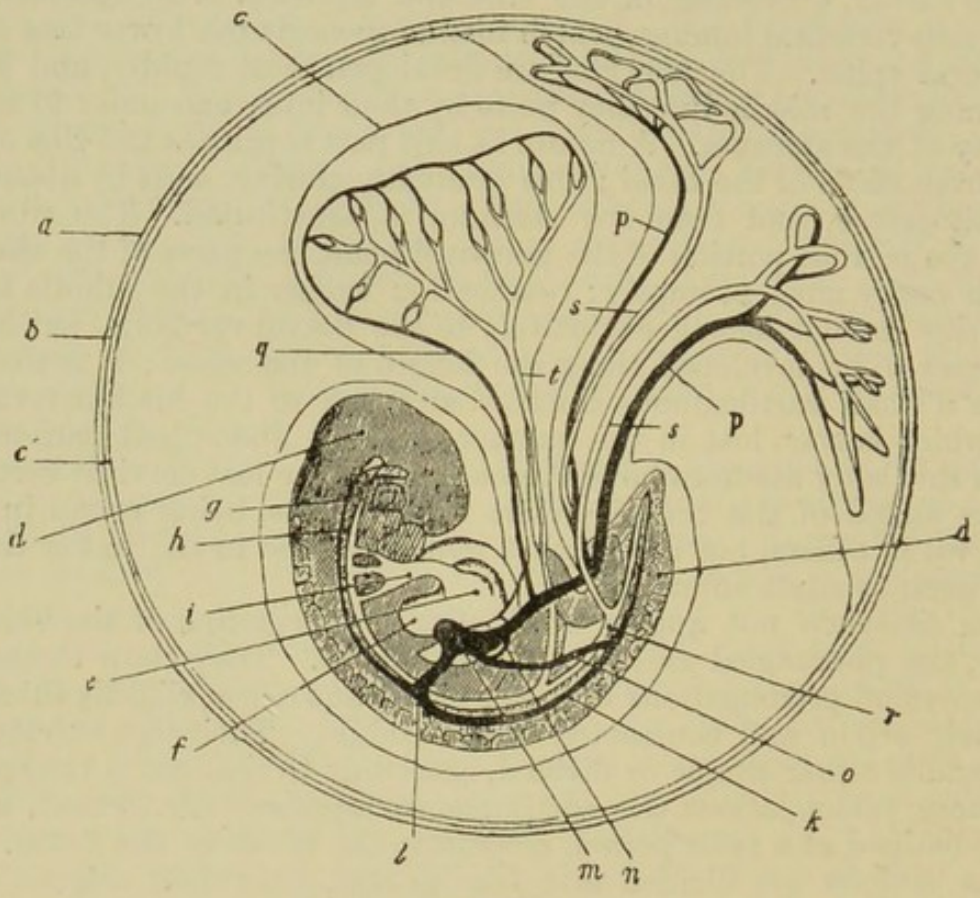

Fig. 57.

FŒTAL CIRCULATION IN A TRANSITION STATE.

a, *b*, *c'*, Circle or Envelope resulting from the Fusion of the Vitelline Membrane, External Layer of the Blastodermic Vesicle, and the Transformation of the Allantois; *c*, The Diminishing Umbilical Vesicle; *d*, Cephalic Portion of the Embryo; *d'*, Caudal Portion; *e*, Ventricle of the Heart; *f*, Auricle of the Heart; *i*, Aorta, forming the Aortic Arches; *h*, Trunk representing the Thoracic Aorta; *g*, Vessel which becomes the Anterior Vena Cava; *k*, Vena Azygos; *l*, Confluents of the two Veins *g* and *k*; *m*, Confluent of all the Veins at their Entrance into the Auricle of the Heart; *n*, Vessel resulting from the Union of the Allantoid Veins *p*, *p*, and the Omphalo-Meseraic Vein *q*; *o*, Posterior Vena Cava; *p*, *p*, Allantoid Veins; *q*, Omphalo-Meseraic or Umbilical Vesicle Vein; *r*, Posterior or Abdominal Aorta; *s*, *s*, Allantoid Arteries; *t*, Omphalo-Meseraic Artery.

ever, before the central organ of circulation and some vessels appear in the middle layer, and canals also spread to the surface of the umbilical vesicle. While the contents of the vitelline vesicle are being imbibed by the embryo, the heart is in course of formation; bloodvessels are increasing and extending, the allantois is completed, and, finally, the placental circulation is established and continues until birth.

The pleuro-peritoneal cavity in the embryo shows a diverticulum in

front—the *cardiac cavity*, in the interior of which the heart is developed. This organ is at first a small mass of cells, the innermost of which separate in order to leave a little space, and to create blood globules. As soon as it appears, the heart contracts and relaxes alternately, the movements being very slow, though they gradually become accelerated. Towards the twelfth day the organ has the shape of a cylindrical contractile tube. From its anterior part arise two branches, the *aortic arches*, which at first proceed towards the head of the embryo, but afterwards are bent backward and downward. These arches join to form the *single aorta*, which in its turn divides into two branches —the *subvertebral* or common aortæ—which run parallel along the lower surface of the embryo, giving off four or five branches, the *omphalo-meseraic* arteries, which ramify in the germinative area and end in a vein—the *terminal sinus*. From this ramification and sinus arise two vessels, the *omphalo-meseraic veins*, which return to the posterior extremity of the heart. The circulation in the umbilical vesicle is very ephemeral in several species, while it is as persistent in others; varying, of course, with the duration of the vesicle itself.

The heart, from being merely a cylindrical tube, undergoes considerable modifications before it arrives at its complete development, passing through all the different forms which characterise the organ in the various vertebrate animals. The first change consists in an inflexion, by which the inferior part becomes the superior; then it dilates at three distinct points—one anterior and superior, at the origin of the aorta, named the *aortic bulb;* a middle one, the *ventricular cavity;* and a posterior, the *auricular cavity*. The constriction between the auricle and ventricle is named *Haller's passage* (*détroit*).

These two cavities are single only for a brief period; the ventricular first divides into two—a division marked externally by a furrow which is visible on the surface of the heart of a fœtal Lamb at the nineteenth day, and the twenty-fifth in the Foal. This furrow corresponds to an interventricular septum which arises insensibly at the bottom of the ventricles and reaches the auricles, where it concurs to form the *auriculo-ventricular orifices*. The borders of the openings are furnished with a slightly salient lip, which at a later stage develops, and constitutes the mitral and tricuspid valves. The heart now contains three cavities—two ventricles and an auricle, but it is soon to have a fourth; for the auricle becomes partitioned into two portions, and externally this division is marked by another depression, corresponding to the septum formed in the cavity. It is to be remarked, however, that the partition remains incomplete during the whole period of uterine life, being perforated by an opening—the *foramen ovale* or *foramen of Botal*. The aortic bulb now contracts and forms two vessels—the aorta and pulmonary artery.

The *arteries* are developed, partly at the expense of the primary circulation, and partly in the vascular layer of the embryo. The aortic arches, situated at the inner face of the first two pharyngeal arches, form five new vessels, which are placed within the other arches; all these, however, do not exist at the same time, some becoming atrophied while the others are forming. For instance, the first two completely disappear; the third forms the carotids; the fourth, the axillary artery and the arch or cross of the aorta; the fifth is atrophied on the right, but on the left forms the pulmonary artery, the *ductus arteriosus*, and the aorta. The latter is continued along the spine by the fusion of the

two primitive aortæ, and shows at its posterior termination the small pelvic vessels and the large umbilical arteries.

The peripheral vessels originate independently of the central vessels, in the interior of the vascular layer. They appear as solid cellular branches, which soon become hollow in their interior, and free cells become visible. As these new channels are developed, the omphalo-meseraic vessels gradually diminish and disappear, until at last only one or two pass to the umbilical vesicle.

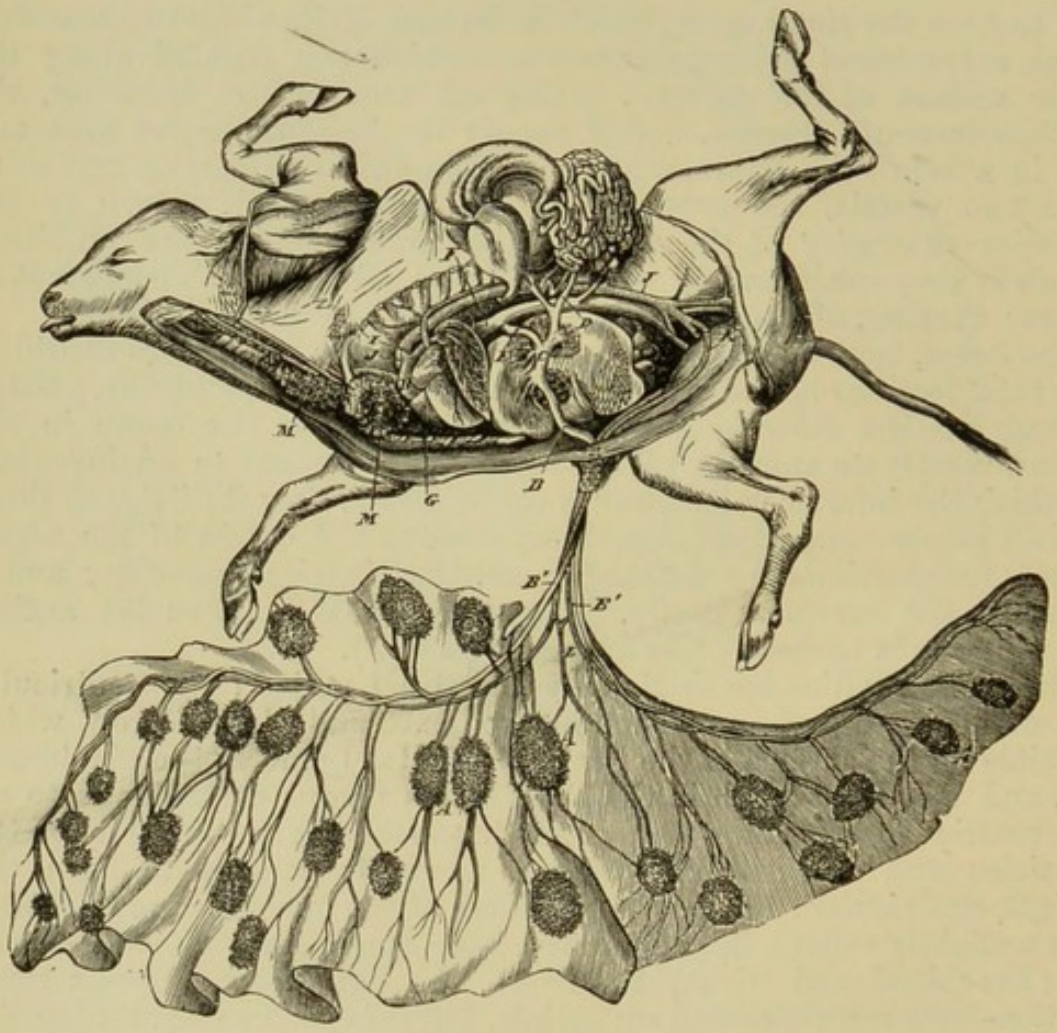

Fig. 58.

FŒTAL CIRCULATION: ADVANCED PERIOD.

A, Placentulæ; B′, B′, Umbilical Veins, with their Common Trunk, B; D, Vena Portæ, and its Anastomosis, C; E, Ductus Venosus; F, Posterior Vena Cava; G, Right Ventricle of Heart; H, Pulmonary Artery; J, J, Aorta; I, Ductus Arteriosus; K, Umbilical Arteries, with their Anastomosis at the extremity of the Umbilical Cord.

The *umbilical veins* are developed immediately after the formation of the omphalo-meseraic veins, and join these; as the ramifications of the latter diminish in size the former increase rapidly, and when the liver is formed around them they throw into it those branches which are the rudiments of the hepatic plexus. Between the portal and hepatic veins, the umbilical vein communicates with the vena cava by the *ductus venosus of Aranzi*, which does not exist in the fœtus of Solipeds in the last month of gestation. The embryonic veins form four chief trunks—two anterior, the *anterior cardinal veins;* and two posterior, the

posterior cardinal veins. The veins on each side unite in pairs to form the *ductus Cuvieri*, which opens transversely into the omphalo-meseraic trunk near the auricular cavity. The anterior cardinal veins issue from the cranium, forming the jugular veins, and communicate by a transverse anastomosis between the right and left veins. Below this the left vein gradually atrophies, as does the ductus Cuvieri of the same side; while the right vessel enlarges, and is ultimately the anterior vena cava.

The posterior vena cava appears in the liver about the fifth week; it receives the veins of the kidneys and the Wolffian bodies, and behind it anastomoses with the cardinal veins. The middle portion of the latter disappear and are replaced by the *vertebral veins*, the right of which forms the vena azygos. There, then, only remain two cardinal veins for the two extremities—the anterior which enters the ductus Cuvieri, and the posterior which constitutes the hypogastric and crural veins. It therefore happens that the venous system of the fœtus, which was at first symmetrical, becomes asymmetrical in the adult animal.

As a result of these successive developments, the placental circulation is instituted, and continues the same until the end of gestation, the heart being the organ which circulates the blood in the fœtus. This fluid, carried by the arterial vessels, reaches the umbilical arteries, and from them is distributed to the placenta. There it is respired, depurated, or *arterialised*, through indirect contact with the blood of the parent, and is returned by the umbilical veins. In the texture of the liver it is mixed with the venous blood of the intestines and the hinder part of the body, conveyed by the *ductus venosus*, and is finally thrown into the right auricle, then into the ventricle, whence it is expelled by a contraction of that cavity. Instead of entering the lungs, which do not act during fœtal life as respiratory organs, the blood is forced into the *ductus arteriosus*, and thence into the aorta. So that the organs of the young creature are never supplied with pure blood, but with a mixture of arterialised and venous blood; this mingling taking place through the *foramen ovale*, in the aorta by the *ductus arteriosus*, and in the liver by the *ductus venosus*. The head and neck receive the purest blood, a circumstance which probably explains the predominance in size of the upper to the lower parts of the body of the fœtus.

At birth, the conditions of existence being suddenly changed, very marked modifications occur in the circulation. The lungs then become the organs of respiration, and rapidly increase in capacity, while the thorax enlarges in a commensurate degree; the pulmonary artery also dilates to admit the increased flow of blood, and the ductus arteriosus is obliterated to prevent the mixture of arterial and venous blood. The ductus venosus also aids in the isolation of the two kinds of blood by becoming atrophied, as does also the occlusion of the foramen ovale. This opening, however, not infrequently remains intact in young animals; though, as a rule, this does not greatly affect the circulation, for when the heart contracts the auricles are isolated by the narrowing of the orifice and the elevation of a valve.

The Respiratory Apparatus.

There is an absence of unanimity as to the mode of development of the respiratory apparatus, and particularly the *lungs*. Some assert that the latter are derived from two little distended cellular masses attached to the anterior part of the intestinal tube, and which afterwards become

perforated with numerous ramifying cavities, that communicate with the trachea; while others describe them as commencing by a median enlargement, which is hollow, and opens into the œsophagus. The walls of the orifice of communication with the digestive passage become considerably lengthened, and afterwards form the trachea and larynx; while the vesicle or enlargement representing the lungs divides into two pyriform sacs, each of which is greatly subdivided to constitute the pulmonary lobes, with their vesicles and infundibula. The *trachea* is completed through the formation of the cartilaginous rings in the tube that attaches the lungs to the œsophagus; the larynx is developed in the same manner, at the pharyngeal opening of the tube. This organ, however, is not very distinguishable during fœtal life, and only assumes its definite form and volume at puberty.

Up to birth the placenta retains the function of the lungs, which, though ready to act, only come into play when the creature is born. Previous to this event they are of a dark-red colour, firm and compact, heavier than water, and apparently destitute of alveoli; though these latter exist, but are filled with embryonic elements, and their walls are in contact. A moderate insufflation is sufficient to distend the air-vesicles, when the lungs become crepitant and enlarged, have a rosy colour and spongy appearance, float in water, and the air cannot be completely expelled from them. The same change immediately occurs in these organs when the young creature is born alive; the external atmosphere, acting upon the surface of its body, causes it to inspire deeply, the chest dilates, the air rushes into the lungs, and respiration commences only to cease with life. This alteration in the colour, texture, and specific gravity of the lungs enables us to decide, in certain cases, whether or not an animal has been born alive.

The *thymus gland* first appears towards the second month, as a growth from the respiratory mucous membrane, near the larynx; it then descends gradually along the trachea until it reaches the thorax, where it is situated between the layers of the anterior mediastinum. It increases in size until birth, after which it remains stationary for a short time; then it gradually diminishes and disappears at a period which varies according to species, and even individuals. Exceptionally it has been found in Horses three years of age. It is a gland in structure, though it has no excretory canal. Its uses are unknown, but it is surmised that it plays a part in the nutrition and hæmatosis of the fœtus and young animal. It may be that, like the spleen, it assists in converting the white corpuscles of the blood into red corpuscles.

The Digestive Apparatus.

The development of the digestive apparatus comprises the formation of the alimentary canal and the organs attached thereto. The *alimentary canal* begins to appear after the first outlines of the nervous centres and the vascular apparatus have been manifested. We have already described the manner in which the intestinal cavity was formed from the inner lamina of the blastoderm. This cavity, for convenience of description, may be divided into three portions: the *anterior intestine*, which originates the pharynx and œsophagus; the *middle intestine*, which becomes the stomach and intestines proper; and the *posterior intestine*, which constitutes the rectum. The chief, or middle intestine, is at first a cylindrical uniform tube, the diameter of which is after-

wards modified to constitute the organs comprised between the œsophagus and rectum.

The *mouth* begins by a depression or *cul-de-sac*, which is limited by the maxillary tubercles; it increases as it dips towards the pharynx, from which it is only separated at last by a thin membrane; this is eventually absorbed, and the mouth then communicates with the commencement of the digestive canal. Towards the third month the mouth is confounded with the nasal fossæ, but after this the palatine bones appear, and finally isolate the two cavities.

The *tongue* is at first only a small protuberance from the maxillary tubercles, but is completed by the addition of a little growth from the second branchial arch. Its epithelium and glands are derived from the external layer of the blastoderm; they are apparent at the third or fourth month.

The *pharynx* and *œsophagus* lengthen and widen as the fœtus grows; the latter at first communicates with the trachea, but it gradually closes, and ends by separating entirely from that tube.

The *stomach* is formed by the dilatation of the anterior part of the middle intestine. This dilatation is fusiform, its larger axis being longitudinal; but it soon curves on itself, and then this axis becomes transversal.

In Ruminants the stomach is single when it first appears, though it is not long before furrows are observed on its outer surface; while internally the particular septa are seen as in adult life. In the fœtus the stomach is small, but its volume increases rapidly after birth, when the animal commences to take solid food. During the sucking period in Ruminants, there is a predominance of the fourth over the other gastric compartments; but as soon as the young animal begins to consume fibrous aliment, the rumen increases rapidly, until it is by far the largest cavity.

The *intestines* are at first of uniform calibre, though in a short time it is easy to distinguish the different sections of which they are ultimately composed. In hoofed animals the cæcum appears very early; it is situated near the omphalo-meseraic duct, which is detached from the extremity of an intestinal loop that is drawn towards the umbilical ring; while the latter is becoming obliterated, this loop ascends in the abdominal cavity. The intestines are quite smooth on their inner surface during the first two months, and towards the third month show the villi and glands of Lieberkühn; the Brunnerian glands and the follicles are only seen later.

The *rectum* arises from the posterior intestine, and is developed like the other portions.

With regard to the *anus*, there is observed towards the caudal extremity of the fœtus a depression analogous to the buccal *cul-de-sac*. This becomes deeper, and joins the rectum and genito-urinary organs; later, it separates from the last, and then belongs exclusively to the alimentary canal.

The APPENDAGES OF THE ALIMENTARY CANAL are the salivary glands, teeth, liver, pancreas, and spleen. The *salivary glands* are developed in a solid cellular tubercle, which is connected with the epithelium at the upper part of the digestive apparatus. With the growth of this tubercle, it is converted into a series of cavities having the form of glandular *culs-de-sac*. The submaxillary gland appears first, and is entire in a fœtus of only twelve lines in length; the parotid gland is the last formed.

The *teeth* are developed in the interior of a cavity called the "dental follicle" or "sac," by means of the elements of three germs corresponding to the anatomical constituents of the teeth—enamel, ivory, and cementum. The follicle is an oval cavity whose wall comprises two layers—an external fibrous sac, and an internal gelatinous lining, at the bottom of which is the *ivory pulp* or *germ*. This is a prominence detached from the bottom of the sac, and has exactly the shape of the tooth. It is composed of a mass of delicate cellular tissue provided with vessels and nerves, and on the surface a layer of elongated cells. At the summit of the follicle, facing this pulp, is the enamel pulp, which fits accurately on the dental pulp like a cap. This is made up of a small quantity of mucoid cellular tissue, covered by a layer of cylindrical cells connected with the buccal epithelium by the *gubernaculum dentis*. The *cement organ* manifestly exists in the Foal, being found at the base of the ivory germ, though it disappears quickly after having performed its function. It is unnecessary in this place to enter into a consideration of the development of the teeth.

The *liver* commences to be formed at an early period in all animals, appearing at the surface of the duodenum in the shape of one large tubercle or two small ones, according to the number of lobes in the organ of the adult. To these external tubercles, corresponding internal ones arise from the intestinal epithelium; the first increase and enclose the omphalo-meseraic vein, while the second ramify in their interior and form the biliary ducts.

The liver grows rapidly, and when about one-third of the period of gestation has elapsed it nearly fills the abdominal cavity. At a later date this increase is less marked, although when gestation is nearly terminated the gland is proportionately more voluminous than in the adult.

The *pancreas*, like the salivary glands, is first seen as a solid cellular tubercle, which is subsequently hollowed out by ramescent cavities.

The *spleen* is developed about the second month, on the great curvature of the stomach; it would appear to be formed at the same time as the pancreas, in a band extending from the stomach to the duodenum; but it is separated from the pancreas and becomes attached to the stomach, where its elements assume the character of splenic tissue.

The Genito-urinary Organs.

The genito-urinary organs are related to each other in their development, and have some parts in common. Immediately after the formation of the intestines, these organs are anticipated by the *Wolffian bodies* or *primordial kidneys*. These are glandular masses extending in front, or one on each side, of the vertebræ, from the heart to the pelvis. They are composed of small transversely disposed tubuli filled with a white fluid, and opening into a common duct running parallel to the spine, which again enters, inferiorly, that portion of the allantois which becomes the bladder. The duct is formed before the tubuli, and is one of the earliest developed structures in the embryo. Placed behind the peritoneum, the Wolffian bodies are attached by two folds of serous membrane—one, the anterior, named the *diaphragmatic ligament of the Wolffian bodies;* and the other, posterior, the *lumbar ligament of the Wolffian bodies*. These organs secrete at first a fluid resembling wine, though their function is soon greatly modified, as they are not long in becoming atrophied; then a portion serves for the

development of the genital organs, while another gives rise to organs whose use is not exactly known—such as the Rosenmüller organ, which is very developed in the Equine fœtus, and the canals of Gaertner visible in the Cow.

With regard to the URINARY ORGANS, we have mentioned how the allantois was derived from the terminal portion of the intestine; it only now remains to add that the *urinary bladder* is derived from the abdominal portion of the allantois, which is merely a dilatation of that sac. During fœtal life the bladder is extended, by the *urachus*, to the umbilical ring; but after birth this canal is obliterated, and the bladder retires to the bottom of the pelvic cavity.

The *kidneys* appear a long time after the Wolffian bodies. They

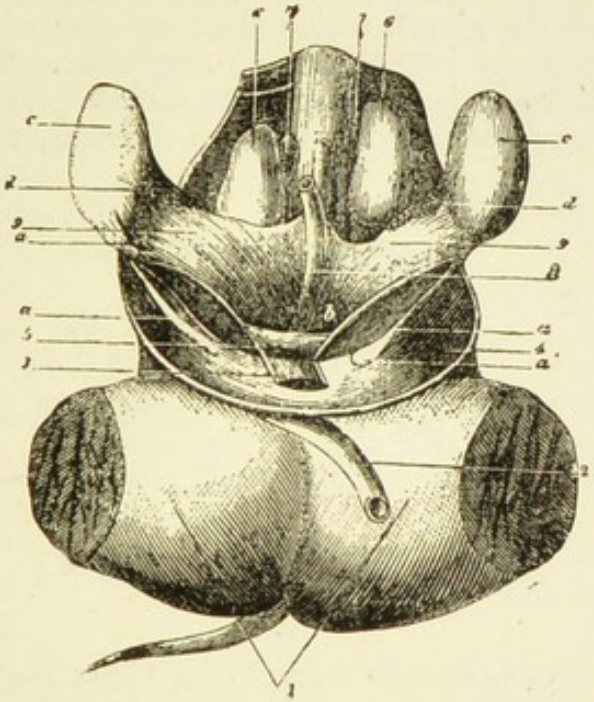

Fig. 59.

MALE FŒTUS OF THE MARE AT FIVE AND A HALF MONTHS: THE ABDOMEN OPENED AND TESTICLES EXPOSED.

1, Thighs; 2, Penis—neither Scrotum nor Prepuce are yet formed; 3, Bladder, with the two Umbilical Arteries; 4, Abdominal Parietes; 5, Douglas' Foramen, with the two Afferent Canals, *b*, *b'*; 6, Kidneys; 7, Supra-renal Capsules; 8, Rectum; 9, Mesorchis or Spermatic Cord; *a*, Gubernaculum Hunterii; *a'*, Internal Inguinal Ring; *b*, *b*, Efferent Ducts; *c*, *c*, Testicles; *d*, *d*, Pampiniform Plexus.

show themselves in the form of two *culs-de-sac*, constituted by the upper wall of the small vesicle of the allantois. These small cavities become ramified, and are ultimately replaced by solid tubercles, in whose interior are developed the tubuli uriniferi and the Malpighian tufts. According to some observers, the kidneys only subsequently communicate with the ureters, which are developed separately in the middle lamina of the blastoderm, and terminate in the pelvic portion of the allantois.

The genital organs of the *male* and *female* offer, at the commencement of their development, the greatest analogies. For a certain time it is impossible to distinguish the sexes; so that some authorities propose to term this the "indifferent" state of the genital organs. Afterwards

the sexes become defined, and at this stage the organs may be studied as internal and external. The indifferent stage begins about the sixth week, when there appears on the lower face, and near the inner border of the Wolffian body, a small white cord, which, in keeping this position, increases in volume. This is the *genital gland*, which is fixed to the body by folds of the serous membrane, and is composed of a collection of young cells enclosed in an envelope. The development of this gland is coincident with the formation of *Müller's duct* or the *genital canal*, which lies inside and in front of the Wolffian duct. Müller's duct is at first a solid cellular column, but is afterwards hollowed out into a cavity; it terminates in a *cul-de-sac* at its upper extremity, and opens below into the bladder, near the Wolffian duct. From these modifications of the genital gland and the ducts of Müller, it results that the *testicle* arises from the gland, which shortens and widens a little, while its tissue is transformed into the *tubuli seminiferi*. The *head* or *globus major of the epididymus*, is formed by the middle portion of the Wolffian body; the *tail* or *globus minor*, the *vas deferens*, and the *ejaculatory*

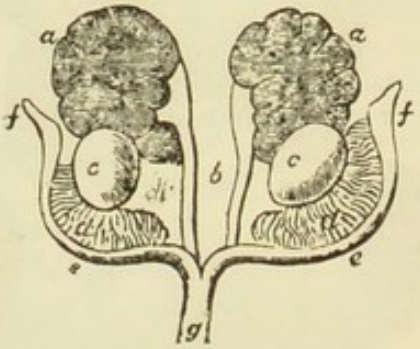

Fig. 60.

GENITO-URINARY ORGANS OF A FŒTAL SHEEP.

a, a, Rudimentary Kidneys; *b*, Ureters; *c, c*, Testes; *d, d*, Wolffian Bodies; *e, e*, Excretory Ducts of Wolffian Bodies or Sperm Ducts; *g*, Oviduct with its openings *f, f*.

canal, are derived from the Wolffian duct. Lastly, the *vesiculæ seminales* and the *commencement of the urethra* are formed by the posterior extremity of the ducts of Müller, which joins the uro-genital sinus—the very short canal communicating between the bladder and cloaca. The developed testicle remains in the abdominal cavity, maintained there by a peritoneal fold, the *plica gubernatrix;* or descends by the inguinal canal into the scrotum. This descent is preceded by the appearance of a preparatory structure—the *gubernaculum testis*—consisting of a central axis of soft gelatinous substance containing many nucleated cells and surrounded by fibrous tissue, which soon exhibits the striped characteristics of voluntary muscle. Some of these fibres spring from the bottom of the scrotum and traverse the abdominal ring, while others arise from Poupart's ligament—the whole, enclosed by connective tissue and connected by a fold of peritoneum to the psoas muscle, extending to the testis. This gubernaculum, in shrinking or contracting, draws the testis below the kidney to the abdominal ring, where it rests for a brief space; after which it reaches the scrotum, where it is found after birth with the remains of the scrotal part of the gubernaculum. The iliac

and pubic portions of the muscular tissue now become the "cremaster" muscle, while the sac of peritoneum carried down with the testicle is converted, by obliteration of the neck, into the *tunica vaginalis testis.*

In Solipeds the testicles do not usually descend into the scrotum until six months after birth; when one or both do not appear, as sometimes happens in the male domesticated animals, and remain in the abdominal cavity during life, the gubernaculum, or what corresponds to it, is reduced to a small thin cord, without a trace of cavity, and showing only some few pale fibres of the atrophied cremaster muscle. In the Foal they are voluminous, and somewhat reddish in colour; they are occasionally found in the scrotum at birth; but they soon ascend into the abdomen, to redescend during the first year. With some animals, however, as has been already mentioned—and far more frequently with the Horse and Pig than any others—the testicles remain in the abdomen during life, or only one descends to its natural situation. When they remain in the abdominal cavity, the animal is said to be "anorchid" or "cryptorchid;" and it has been shown that, although such animals have the sexual propensity well marked, yet they are unproductive; their semen does not contain any spermatozoa.

When one testicle has migrated to the scrotum, leaving one in the abdomen, the Horse is "monorchid," and possesses the power of reproduction unimpaired.

In Ruminants the testicles are small, and are in the scrotum at birth, where they remain. Sometimes there is a strange malposition of the testicles, and especially in the Pig, they having been found beneath the chin, in the flank, and elsewhere.

In the female, the *ovary* is derived from the genital gland, whose anatomical elements are disposed so as to form the stroma, Graafian follicles, and the ova.

In fœtal Solipeds the ovary is of an immense size, especially about the middle of gestation, and its stroma is red and extremely soft. In other animals, and particularly Ruminants, this disproportion is not observed.

The *Fallopian tube* and its pavilion are formed by the anterior portion of Müller's duct, the extremity of which presents a small linear orifice. The *uterus* and *vagina* arise from the posterior part of these ducts, which approach each other, and finish by amalgamating posteriorly to form a single canal. This fusion originates the vagina and body of the uterus, the two diverging portions of the ducts comprised between the point of union and the Fallopian tubes forming the uterine cornua. The uterus and vagina are at first continuous and without any sign of demarcation, but towards the sixth month the neck of the uterus begins to become apparent.

The external organs of the female in their indifferent state demand notice. The intestine terminates in the *cloaca*, a cavity into which not only this tube but also the bladder enters, through the uro-genital sinus. This arrangement ceases somewhat suddenly, by the development of a transverse septum that divides the cavity into two portions—the anal opening, and the uro-genital orifice. At the lower end of the latter appears the *genital tubercle*, the rudiment of the penis or clitoris, and which is surrounded by cutaneous ridges—the *genital folds.* This tubercle increases in size, and is traversed by a groove or fissure

passing from behind forward. Up to this time the sexes cannot be distinguished.

The male sex is marked by the rapid development of the genital

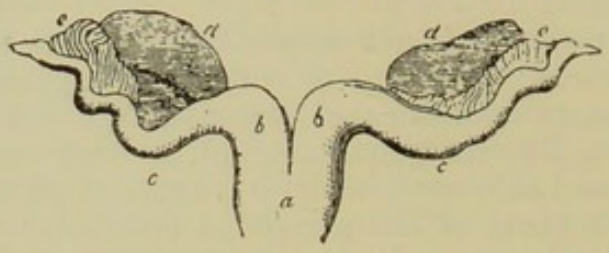

Fig. 61.

FEMALE ORGANS OF A FŒTAL DEER.

a, Uterus; *b*, *b*, Cornua; *c*, *c*, Oviducts; *d*, *d*, Ovaries; *e*, *e*, Wolffian Bodies.

tubercle, which becomes the penis, whose extremity is enlarged to constitute the "glans." The furrow or groove is closed behind, and forms the urethra; while the genital folds, meeting each other below the penis, join to complete the scrotum. Owing to these changes, the

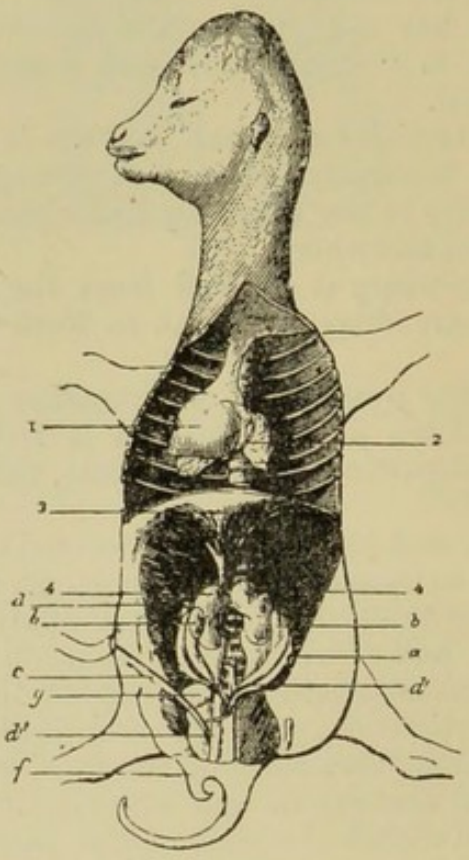

Fig. 62.

FEMALE FŒTUS OF THE COW (NATURAL SIZE).

1, Heart; 2, Lungs; 3, Diaphragm: 4, Kidney: *a*, Wolffian Body; *b*, Germinal Gland; *c*, Wolffian Duct; *d*, Müllerian Duct; *d'*, Uterus and Vagina; *d''*, Abdominal Opening of the Oviduct; *f*, Clitoris; *g*, Round Ligament of the Uterus.

digestive are separated from the urino-genital organs, and the urethral canal is connected with the bladder and the excretory ducts of the testicle.

The organs in the female also soon indicate the sex. The uro-genital sinus forms the *vulvar cavity* or *vestibule of the vagina*, so marked in the lower animals. The genital tubercle becomes the *clitoris*—the homologue of the penis. The cutaneous folds constitute the *labia of the vulva;* while the genital groove is closed at one part of its extent to form the *perinæum*. The *mammæ*, appendages of the generative organs, appear in the early months of uterine life, and the teats are perforated very soon. They are also seen very distinctly in the male fœtus in the early months.

In certain malformations of the generative organs, more or less of

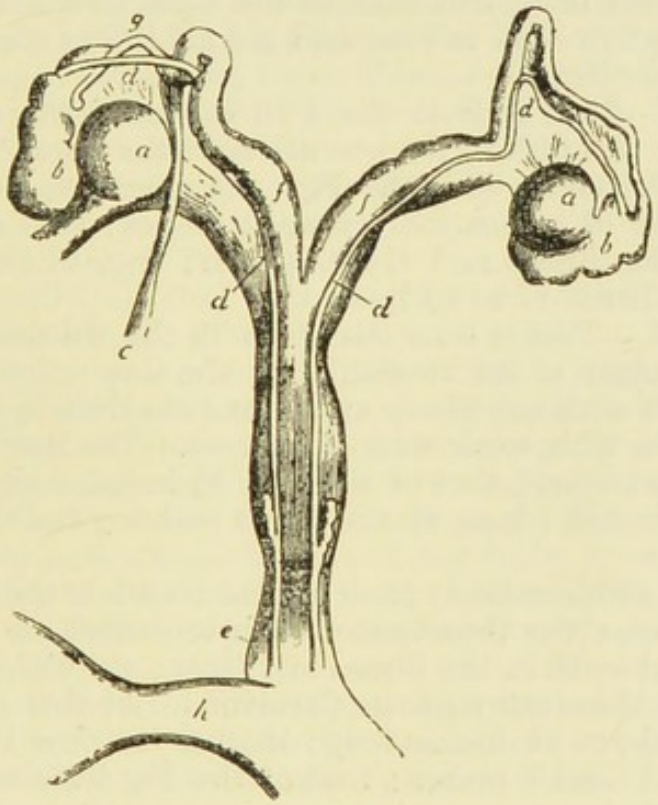

Fig. 63.

GENITAL ORGANS OF A HERMAPHRODITE GOAT, THE MALE PARTS PREDOMINATING.

a, *a*, Testes; *b*, *b*, Combination of Epididymis with Abdominal Ends of Müllerian Ducts; *d*, *d*, Vasa Deferentia; *e*, Body of Uterus and Vagina; *f*, *f*, Uterine Cornua; *g*, *g*, Fallopian Tubes.

their primitive conditions are retained; the most frequent of these malformations is hermaphrodism. Examples of this are by no means uncommon among the lower animals, and the annexed drawing gives a good example of the organs of a hermaphrodite goat, with the male parts predominating.[1]

SECTION IV.—PERIODS OF DEVELOPMENT.

Thus far we have traced the development of the young creature in the uterus; but as our description may appear a little confused from our having described the growth of individual organs, rather than the

[1] For further details on the subject of embryology of these creatures, see my translation of "The Comparative Anatomy of the Domesticated Animals," by A. Chauveau and S. Arloing, second edition, London, 1891.

fœtus as a whole, it may be advisable to adopt the plan of dividing this bodily development into periods, which will also give an approximate idea of its age. From conception to maturity, utero-gestation may therefore be divided into seven periods or stages, as follows:—

First Period.—Towards the second week after conception, the ovum or germ has passed from the ovary into the uterus; it is then about a line in diameter (one-twelfth of an inch).

Second Period.—In the third and fourth weeks of gestation in the Mare, Ruminants, and Pig; the third week in Carnivora; there appear the first traces of the embryo, and the head, body, and limbs can be distinguished. Towards the twenty-eighth day, the embryo of the Mare measures about six lines, and that of the Cow four lines; that of the Sheep at twenty-five days is four and a half lines; and the Bitch at eighteen days two lines.

Third Period.—This is from the fifth to the eighth week with the Mare and Cow; the fifth to the seventh with the Sheep and Goat; and the fourth to the sixth with the Pig. The embryo of the Mare has acquired a length of rather more than 2 inches; that of the Cow $1\frac{3}{4}$ inch; that of the Sheep and Goat $1\frac{1}{4}$ inch; that of the Pig $1\frac{3}{4}$ inch; and that of the Bitch 11 to 12 lines.

Fourth Period.—This is from the ninth to the thirteenth week with the Mare; the ninth to the twelfth with the Cow; the seventh to the eighth and ninth with the Sheep and Goat; the sixth to the eighth with the Pig; and the fifth week with Carnivora. The length of the fœtus of the Mare is 6 inches; that of the Cow $5\frac{1}{2}$ inches; that of the small Ruminants $3\frac{1}{2}$ inches; that of the Pig 3 inches; and that of the Dog $2\frac{1}{2}$ inches.

Fifth Period.—This extends from the fourteenth to the twenty-second week in the Mare; the thirteenth to the twentieth in the Cow; the tenth to the thirteenth in the Sheep and Goat; the eighth to the tenth in the Pig; and the sixth week in Carnivora. At this stage the fœtus of the Mare is about 13 inches long; that of the Cow 12 inches; that of the Sheep and Goat 6 inches; that of the Pig 5 inches; and that of the Bitch $3\frac{1}{2}$ inches.

Sixth Period.—From the twenty-third to the thirty-fourth week in the Mare; the twenty-first to the thirty-second in the Cow; the thirteenth to the eighteenth in the Sheep and Goat; the eleventh to the fifteenth in the Pig; the seventh to the eighth in Carnivora. The fœtus of the Mare in this period has acquired a length of more than 2 feet; that of the Cow is about the same dimensions; the fœtus of the Sheep is more than a foot; that of the Pig about 7 inches; and that of the Bitch 5 inches.

Seventh Period.—From the thirty-fifth to the forty-eighth week—up to parturition, in the Mare; the thirty-third to the fortieth in the Cow; the nineteenth to the twenty-first in the Sheep and Goat; the fifteenth to the seventeenth in the Pig; the ninth in the Bitch; and the eighth in the Cat.

A newly-born Foal measures about $3\frac{1}{2}$ feet long; a Calf 2 feet; a Lamb $1\frac{1}{2}$ foot; a Pig about 9 or 10 inches; a Puppy 6 to 8 inches; and a Kitten about 5 inches.

In this study of the evolution of the young animal *in utero*, one cannot fail to be struck with the slowness with which development progresses for a certain period, and its rapidity afterwards. The slowness in growth may be accounted for by the extreme minuteness of the ovum

at the moment of impregnation, and its containing within itself alone the elements upon which the primary steps of evolution depend, there being at first no direct connection between the embryo and the uterine vessels. The parts which in reality grow most rapidly in the early period of gestation, are the enveloping membranes and the fluids they contain. In the Sheep, towards the end of the first quarter of gestation, the membranes alone weigh from five to nine times more than the fœtus; while the allantoic and amniotic fluids are from eight to ten times as heavy. These fluids increase in an absolute manner from the commencement, until within perhaps a short time of parturition. Rapid at first, towards the middle period their secretion abates, and then begins the more active development of the fœtus, with a relative diminution in the proportion of the fluids; until about the end of the fourth month they only represent something like a third of its weight. In the Sheep a few days after the fifth month, or about birth time, they are a sixth of the weight of the young animal.

The development of the fœtus is so tardy at first, that the fœtal Lamb at the fortieth day has scarcely acquired the 300th part of the weight it has at birth; at two months it has only a 60th, but now it grows more rapidly; so that at the expiration of the fourth month it has gained more than one-third of its total weight.

The inequality in the growth of the different organs is also very notable; those whose functions are most required, such as the nervous centres, liver, etc., attaining considerable proportions very quickly. The *brain*, for instance, soon acquires a marked predominance over the other organs. In the fœtus of the Lamb at the fifty-seventh day, the proportion of the entire brain to that of the body in weight is as 1 to 15; at the seventieth day it is as 1 to 55; and at birth as 1 to 65. At mid-term with the Calf, its weight is to that of the body as 1 to 53, and at birth as 1 to 120.

The *spinal cord* does not follow the same progression in growth. In the Calf at mid-term it is only the 421st part of the weight of the fœtus, and at birth the 470th part. In the Lamb at birth, it is equal to the 340th part of the body.

The *heart*, which appears so early, is more voluminous in the embryo than towards the termination of gestation and after birth. The heart of a Calf at mid-term equals 125th of the weight of the body; that of a Lamb at birth the 120th; in the adult Bull it is only the 264th part.

The *lungs* have, relative to the total bulk of the fœtus, a variable weight according to age. In those of the Lamb at fifty-seven days, they are equal to a 20th part of the weight; in a Calf at mid-term, the 33rd; in another at eight months, the 34th; and at birth, the 35th and 55th; in a Foal a little more than eight and a half months, they were the 33rd; in Lambs and Goats at birth, they averaged from the 24th to the 61st part of the whole weight.

The development of the *thymus gland* also varies considerably according to age and species. In a Calf at mid-term, its weight was the 137th part of the body; in another at seven months, it was the 197th; in a Foal at birth, the 200th; in a Goat at the same period, the 130th; and in a Lamb eight days after birth, the 228th part. It is always proportionally more voluminous in Ruminants than Solipeds, and in them and the Pig it extends in front nearly to the larynx. In the Dog it does not get beyond the anterior mediastinum, and is small, though more persistent. It has in rare cases been found in Horses more than three

years old; but, as a rule, in the adult animal it is only represented by a small and variable quantity of adipose tissue.

The *liver* is extremely voluminous in the early period of embryonic and fœtal life, but decreases proportionately as gestation approaches its close. In the fœtus of a Lamb at the fifty-seventh day it has been found equal to 1-6th of the body in weight; in Calves at mid-term and birth to 1-29th; with the Foal at birth 1-21st, and 1-24th in Lambs at the same period. In the adult Horse it has been found to represent 1-75th of the total weight, and 1-83rd in the Ox.

The *intestines*, during fœtal life, do not grow in length so as to attain the proportionate dimensions they offer in adult life. In an Equine fœtus of eight or nine months, the small intestines measured about 15 feet, the cæcum $6\frac{7}{10}$ inches, and the large intestines $3\frac{1}{2}$ feet, or a total of about 20 feet—about 1-5th of their length in after-life. Shortly after birth they acquire 1-3rd the length to which they attain when fully developed. The Calf at mid-term has only 1-10th the length of the adult intestine—being only sixteen times the length of the body, instead of twenty times. The Lamb and Kid at birth have 1-3rd of their intestines complete—their length is seventeen to eighteen times the length of the body, instead of twenty-seven times in adult life.

The general proportions of the body, and especially those of the skeleton, are not in fœtal life what they are after birth. The bones are, relatively to the other parts, more voluminous as a whole, and notably at their extremities, than in the adult. The limbs in particular, and this more so in Solipeds and Ruminants, have attained a length which is not at all proportionate to that of these parts when their growth is completed. And several bones of the limbs, such as the radial, tibial, metacarpal, and metatarsal bones, are almost fully developed in their dimensions at birth. The following interesting table exhibits the comparative weight of the different bones in the Foal and the adult Horse.

The weight is given in grammes (15·432 troy grains):

Species.	Cervical Region.	Dorsal Region.	Lumbar Region.	Sacro-Coccygeal Region.	Scapula.	Humerus.	Radius.	Carpus.	Metacarpus.	Digital Region: Anterior.	Coxæ.	Femur.	Tibia.	Tarsus.	Metatarsus.	Digital Region: Posterior.
	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.
Foal at Birth	315	390	130	383	195	188	243	59	238	139	227	232	262	66	271	17
Foal at Birth	370	350	135	226	190	205	250	40	240	131	245	254	280	62	275	173
Foal two days old	—	—	—	—	159	170	224	—	218	—	—	223	246	—	255	—
Adult Horse: large size	—	—	—	—	370	310	36	45	240	170	450	390	360	70	280	180

SECTION V.—PHYSIOLOGICAL PHENOMENA IN THE FŒTUS.

With regard to the physiological phenomena which occur during fœtal life, we cannot presume to speak in detail in this place. It is, however, interesting, and perhaps necessary, to allude briefly to several of the most important, in order to complete this portion of our subject.

Nervous Functions.

The development of the *nervous functions* is one of these phenomena worthy of attention. It appears certain that the young creature is formed and developed without the direct intervention of the nervous influence of the parent, as there is no communication between the nerves of the uterus and the fœtal envelopes; and it has not been shown that there are nerves either in the latter, or yet in the umbilical cord. The progressive animation of the new creature cannot, therefore, be derived from immediate nervous propagation, or direct extension of the nervous activity from the mother to its offspring; and we must look upon this animation as originating in the embryo, and becoming developed under the influence of inappreciable causes. At the very commencement of embryonic life, the nervous system, which, in extra-uterine existence, holds under its control the organic functions, appears now to have no possible influence on the phenomena that gradually manifest themselves. The primary changes in the ovum occur before the earliest traces of the nervous system are apparent; and while its rudiments are forming, those of other parts are also being developed. Even when the nervous system has attained a somewhat considerable growth, it does not appear to have assumed those controlling powers with which it is so largely endowed at a subsequent period.

In the homogeneous plasma of the ovum, in the common blastema, coincidently or successively, a multitude of different parts are being formed independently of each other, as if each contained within itself the why and wherefore of its formation and ulterior perfecting. The nervous system itself seems to be submitted to the same general laws, and it does not appear to be dependent upon any other part, neither does any part depend upon it; even when it is fully formed, the phenomena pertaining to growth are evidently effected without its stimulating intervention. Besides, it is well known that the monstrosities which are sometimes seen destitute of brain and spinal cord, may yet reach the end of their fœtal development. True, certain facts have appeared to demonstrate that the formation of parts is dependent on nervous action. In certain monstrosities, organs have not become developed when the nerves which should have been distributed to them were absent; in others, several organs have become fused together when their nerves were similarly aggregated; while an organ has been divided into fractions corresponding to the accidental development of its nerve. The muscles of the posterior part of the body of the fœtus of the Cow and Pig have been observed to be absent when the corresponding portion of the spinal cord was, with its nerves, very imperfectly developed. But these facts do not prove that the absence of the nerves was the cause of the non-development of the muscles; for in such cases there is a correlation between the non-formation of the nerve and the absence of the muscle; the same cause which has hindered the formation of the one in a certain part of the body has also prevented the growth of the other in that part. It is the same, to a certain point, with the relative development of vessels and the increase of the parts to which they are distributed. In the original homogeneous plasma, there were developed the diverse elements of an organ at the same time as its vessels, and the force which created the connective, nervous, and muscular tissues, created also the elements of the vessels—arteries, veins, and capillaries; they are closely related to each other, and their

growth goes on concurrently. If the vessels do not carry a sufficient supply of formative material, the development of the part is tardy or ceases; and, on the other hand, if the latter from some cause becomes feeble and cannot assimilate this material, the vessels gradually cease to carry it; consequently, both become atrophied when they cease to grow.

When the nervous system has arrived at a certain degree of development, it begins to assume its functions; though the first manifestations of its activity are very obscure, and probably limited to mere tactile impressions, evinced by movements more or less appreciable. It is well known that in the pregnant Mare and Cow, after their ingestion of a large quantity of cold water, the fœtus, towards the end of the second third of gestation, and more particularly in the later months, executes movements which are at times so marked that they can be felt if the hand is applied to the abdominal parietes, or even seen in the region of the flank. It is very probable that these automatic or reflex movements may produce torsion of the umbilical cord, and in this way become a predisposing cause of abortion. Colin, having had occasion to lay open the abdomen of a living pregnant Mare within two or three months of parturition, saw the fœtus, immediately after the incision in the abdominal walls, jumping about in the uterus in a very lively manner without any external stimulus being applied; it moved the whole of its body, or withdrew its legs or head when pinched through the uterus and the envelopes. In a quarter of an hour after removal from these and the mother, it no longer moved. The human fœtus at five months has been seen to flex and extend its limbs when removed from the uterus.

Towards the termination of gestation, there can be no doubt that the fœtal movements are somewhat energetic, for at this period the fœtus changes its position preparatory to passing through the pelvis. Thus the young Soliped, during the whole of its intra-uterine existence, lay with its abdomen turned upwards and the posterior limbs lodged in the largest of the two cornua; but it now turns over on its belly, with the legs downwards and the umbilical cord passing across one of its sides.

The movements connected with *deglutition* also appear to be performed at an early stage of development, for some of the hairs which are so often observed in notable quantity floating in the amniotic fluid, have been discovered in the fœtal stomach.

Absorption.

The phenomena of absorption play a considerable part in the development of the young animal. As soon as the microscopic ovule reaches the uterus, its vitelline envelope or pellucid zone becomes studded with delicate, hair-like prolongations—villosities without vessels—which, steeped in the fluid thrown out on the uterine surface, transmit this to the laminæ of the blastoderm. At first this absorbent surface is very small, and the growth of the embryo is consequently slow; nevertheless, this trifling absorption is sufficient to increase the ovule to forty or fifty times its original volume before the blastodermic laminæ and the germinative space are completed.

Later, when the umbilical vesicle is formed at the expense of the vascular and mucous laminæ, its vessels absorb the soluble matters that are added to the mass of elements necessary for the growth of the

embryo. And, finally, when the chorion is at last organised, and furnished with its myriads of vascular papillæ in the form of disseminated or agglomerated placentulæ, absorption goes on with exaggerated activity over the whole uterine surface and texture, in order to supply all the nutrition required for the now rapid development of the fœtus.

The nutritive elements are absorbed by the vessels of the placental villosities, transformed into blood, and conveyed to the young creature by the umbilical veins. This extra-fœtal absorption is supplemented by that which is taking place in the fluid of the envelopes, and also in the organs and tissues of the fœtus itself. It is certain, however, that the placental absorption is by far the most important, and that the rapid development of the fœtus is mainly, if not altogether, due to the nutritive elements obtained there; while it is not improbable that the amniotic fluid found in the stomach and intestines may act as a dilator of these, modify the action of the bile accumulated in the latter, and perhaps yield a small amount of nutriment; though it must be remembered that it does contain much of the nutritious elements, and that the fœtus which is unprovided with a mouth, and therefore cannot swallow, is nevertheless as well developed as one that does ingest this fluid.

Nutrition.

It has been shown that the fœtal vascular system is quite distinct from that of the mother, the isolation of the two systems being complete, and only brought into contact at the placenta or placentulæ. There the maternal blood is conveyed by certain arteries into particular sinuses or receptacles of the uterus containing the ultimate radicles of these vessels, which emerge into veins; while the fœtal vessels, extremely attenuated, dip down into these receptacles and are bathed in the blood of the parent, as the "gills" or branchiæ of aquatic creatures are in the water in which they live. But the actual blood of parent and offspring never meet: they are only brought into indirect contact; and between them are the thin coats of vessels, basement membranes, and cells. This indirect contact is sufficient to permit the venous fœtal blood to become arterial, by enabling it to part with its carbonic acid, and also to get rid of excrementitious matter derived from the different processes connected with the growth of the fœtus, and whose retention in the blood of the young creature would doubtless be a source of injury to it. This arrangement of the two systems of vessels also, as has just been said, allows certain nutritious elements of the maternal blood—its fluid portion only—to be taken up into the system of the fœtus. In this way, as has been pointed out, these vascular rootlets of the placenta closely correspond to the villi of the mucous membrane of the intestines; and the analogy is rendered more complete when we know that the nutrient material is selected and prepared by two sets of cells, one of which—the maternal—transmits it to the other—the fœtal—in the same manner as the epithelial cells of the intestinal villi seem to take up and prepare the nutrient matter that is destined to be again assimilated by the cells which float in the circulating fluid. No other communication between two vascular systems exists; and the fact that the blood corpuscles of each are different in size, conclusively demonstrates that they must be distinct. Nevertheless, the special function of the placenta, and the intimate relation existing, through it, between the fluids of parent and offspring, renders it evident that the maternal

blood may become impregnated with substances, or impressed with attributes, which will affect the development or modify the constitution of the fœtus; while pernicious matters generated in the latter may prove more or less noxious to the mother.

Circulation.

In order that the nutritive matters absorbed by the placental villi may reach the fœtus and be circulated in its body, it is necessary that a determining and regulating power should be brought into play at an early period in the existence of the fœtus. This power appears with the formation of the contractile organ which has been named the *heart*. From the moment when this important organ appears in the form of a cylindrical tube at the commencement of embryonic life, it dilates and contracts alternately, first to receive the venous blood, and then to propel it into the arteries.

The fluid which is at first received and propelled by the heart is transparent, colourless, and destitute of morphological elements, and the organ itself exists in its most primitive form. As has been stated, the situation of the heart and the course of the principal trunks of the vascular area are early visible, and are marked by the peculiar disposition of the aggregations of cells from which these organs are to be developed. It was shown that whilst the outer portions of these aggregations were transformed into the *walls* of the respective cavities, the inner portions appeared to deliquesce, and partly to remain as isolated cells floating in the resulting fluid. These isolated cells are supposed to be the first blood corpuscles. They are large, colourless, vesicular, spherical cells, full of yellowish particles of a substance like fatty matter. Many of these particles are quadrangular and flattened, and have been called stearine-plates, though their composition is not ascertained; each cell has a central nucleus, which is not at first very distinct, and the development of these embryo-cells into the complete form of corpuscles is effected by the gradual clearing-up, as if by division and liquefaction, of the contained particles, the acquirement of blood colour and of the elliptical form, the flattening of the cell, and the more prominent appearance of the nucleus.

In tracing the development of the red-corpuscles of the blood, it is found that at first their nuclei have no envelope, but contain nucleoli; that they present all the characters of pale elementary cells, whilst they are so numerous as to give the blood a whitish hue. When more fully developed they acquire a cell and a reddish tint, and at a later stage are circular, thick and disc-shaped, full-coloured, and about 1-2500th of an inch in diameter; their nuclei are central, circular, very little prominent on the surface of the cell, and apparently slightly granular or tuberculated.

When the liver begins to be formed, the multiplication of blood-cells in the entire mass of the blood ceases, and in a short time all trace of the development of the red from the original colourless formative cells is lost; whilst, on the other hand, there takes place in the vessels of the liver a new production of colourless nucleated cells, which are formed around free nuclei, and which undergo a gradual change, by the production of colouring matter in their interior, into red nucleated cells. This new formation of blood corpuscles in the liver continues to take place during the whole period of fœtal life; but whether these nucleated cells themselves undergo transformation into the non-nucleated discs

which constitute a gradually increasing proportion of the corpuscular components of the blood during the latter period of embryonic life, or whether these are formed only by the metamorphosis of lymph-corpuscles, has not yet been determined.

From the manner in which the circulation is carried on during fœtal life, and which has been adverted to, it is seen that the chief propelling power is centred in the right side of the heart; the force of the left heart being mainly spent in effecting a due supply of blood to the head and upper extremities. And the structure of the heart proves this to be the case, for the walls of the right ventricle have been found as thick as those of the left; while the walls of the right auricle are even thicker and more muscular than those of the left auricle—a condition which persists for a short time after birth.

The isolation that exists in the two circulatory systems might lead to the inference that there was no relation between the contractions of the heart in the fœtus and those of the maternal organ, and experience proves this to be the case. Naegelè has noted that there is no relation between the beats of the heart of the human fœtus and those of its mother's heart. By auscultation he was able to distinguish the two sounds of the fœtal heart, and found it beat on an average 135 times per minute—never more than 180, nor less than 90; and he remarked that the beats were sensibly the same from four and a half months, when they are first perceptible, until birth. And Hollmann, in resorting to the same mode of investigation in Cows, ascertained that, in one which was advanced eight and a half months in pregnancy, and whose pulse was 64 per minute, the fœtal beat was 124; in another Cow, but which was ill, the pulse was from 70 to 112, while that of the fœtus was 113 to 128.

Colin opened a living Mare which had been pregnant for nine or ten months, and a Cow whose gestation dated about three months. When the uterus of the Mare was opened, and the contained envelopes incised to extract the fœtus, the latter moved actively and respired deeply, though at rare intervals. The umbilical arteries and vein yielded some blood, from the small punctures made through their walls; the first throbbed with a certain amount of force, and the pulsations were rapid. When the cord was divided and tied, the fœtus appeared to be dead: there were no more spontaneous movements, and the respiration had ceased. The thorax and the abdomen were now thrown open, and it was observed that the heart contracted spontaneously and strongly, and the pulsations of the aorta and umbilical arteries could be very distinctly felt. At first the contractions of the auricles regularly alternated with those of the ventricles, as in a normal condition; but soon, as occurs in expiring animals, the auricles contracted several times for one contraction of the ventricles, as if it required several systoles of these to fill the ventricular cavities. At each contraction the auricles diminished much in volume, became nearly empty, and looked very pale, but assumed their reddish-violet colour again during their diastole. At last the rhythmical movements became altogether perverted; the auricles and ventricles contracted simultaneously and quickly, but more and more feebly, and finally ceased altogether half an hour after the thorax had been opened. The Cow in which the fœtal circulation was studied had its flank widely incised, and one of the cornua of the uterus withdrawn through the opening. Some of the placentulæ were removed with difficulty from their cotyledons, and both bled a good deal. When the

umbilical cord was exposed, the beating of its very tense arteries could be distinctly felt; and when compressed, these enlarged between the fœtus and the point where the pressure was applied. On removing the fœtus from the uterus, it did not make any perceptible movement, but then it was only three or four months old. The thorax having been opened, the action of the heart was observed to resemble that of the other fœtus; there were 31 pulsations in the first minute, 18 in the third, 11 in the fourth, and 21 in the fifth. The beats ceased in about twenty-five minutes. In these two experiments, as well as in others made on smaller animals, M. Colin found it impossible to perceive any difference in colour between the blood of the umbilical arteries and that of the veins, both fluids showing a tint intermediate to that of the arterial and venous blood of the adult.

Secretion.

With regard to *secretion* in the fœtus, it is worthy of remark that several glandular structures at an early period and during fœtal life exhibit a remarkable degree of activity; and more especially is this the case with those of the stomach and intestines, the liver, the mucous membrane of the air-passages, and the kidneys. The glands of the mouth and œsophagus only furnish the mucus that covers the membrane lining these parts, but it is not long before the stomach is filled with a white or colourless viscid fluid, in which is a large proportion of epithelial cells and nuclei. Colin has found as much as 229 grammes of this fluid in the stomach of a Foal at birth, from 150 to 180 in Lambs at the same period, 200 to 300 in Calves towards the middle of gestation, and 500 to 600 in those at birth. It is neutral or slightly alkaline, and contains, more especially in the fœtuses of Solipeds and Ruminants, a very large proportion of sugar, with mucine and salts. This fluid can scarcely, however, be looked upon as a gastric secretion, but rather as a mixture of this with the amniotic liquid swallowed by the fœtus; and it appears certain that, though the mucous glands are active, yet those which elaborate the pepsine are inactive. The stomach of a fœtal Calf twenty weeks old, digested for eight days in milk at a temperature of 20 degrees (Cent.), transformed that fluid into a gelatinous mass, but did not coagulate it.

The secretory function of the pancreas is so obscure, that it has not yet been determined.

The biliary secretion soon appears, and is remarkably abundant. In the fœtus of the Cow at birth, a small quantity of clear bile having a slight greenish tint is found in the gall-bladder; and at the fourth month of gestation, the large intestines of this creature and the fœtuses of Solipeds are filled with meconium, which is recognisable through the walls of the tube by its green hue. The fœtal bile becomes thicker and deeper-coloured as birth approaches; it is insipid and alkaline. M. Lassaigne analysed that of the fœtus of a Cow six months old, and found two colouring matters, mucus, the carbonate and chloride of sodium and phosphate of lime, but no picromel.

Mixed with the fluids thrown out by the intestines and the other matters entering them, it forms the *meconium*, which is composed, according to Simon, of cholesterine 16,00; extractive matter and biliary resin 10,40; caseous matter 34,00; picromel 6,00; green colouring matter 4,00; and epithelium, mucus, albumin 26,00. This meconium is scanty in the first periods of fœtal life, and has been found to be

white in fœtuses destitute of a liver, as well as in others whose intestine was obliterated below the entrance of the biliary duct. It is very consistent and plentiful in the intestines at birth. In those of a Foal whose stomach contained 229 grammes weight of the white viscid fluid above mentioned, there were found 216 grammes of greyish meconium in the small intestines, and 559 of green in the large intestines. This product is frequently expelled in certain quantities towards the end of gestation, and is found in the liquor amnii, which owes its yellow colour to its presence; it is swallowed with this fluid, and is then observed in small masses in the stomach.

The liver appears to be engaged, during fœtal life, in the depuration of the blood, as appears from this accumulation of meconium, which is chiefly altered bile; but at the same time, as has been stated, it is serving as a blood-making organ, and this is probably its principal function before birth.

The secretion of urine is somewhat active during intra-uterine life, and appears to be effected by the Wolffian bodies before the kidneys begin to act. It is not, however, until the end of gestation that a notable quantity of urine is found in the bladder, and urea in the allantoic fluid of the Cow. It is certain, however, that this fluid is not altogether the urine of the fœtus, as its proportion is relatively larger at an early epoch of fœtal life, and the communication between the bladder and allantois is more limited towards parturition.

With regard to the function of the thyroid and thymus "glands," as they have been termed, and the spleen and suprarenal capsules, during fœtal life, there is but little positively known. It appears, however, to be admitted that the office performed by these ductless or vascular glands, is to restore to the circulating current any substances which they may withdraw from it, and that their action is subsidiary to the process of sanguification; being exercised, perhaps, chiefly upon that portion of the nutrient materials which did not pass through the absorbent system when first introduced, but was taken up directly by the bloodvessels.

SECTION VI.—WEIGHT AND DIMENSIONS OF THE FŒTUS AT BIRTH.

The various phenomena connected with development having been completed, so far as uterine existence is concerned, it may be useful to note what has been ascertained with regard to the *weight* and *dimensions* of the fœtus at birth; the latter being of much importance from an obstetrical point of view, though it is a subject which has not received all the attention it merits from veterinary obstetrists.

Weight.

With regard to *weight*, we find, as might be expected, that this varies considerably, according to the size, breed, and condition of the parents, and other circumstances which more or less influence growth.

For the *Horse* species, Boussingault estimated that Foals from parents weighing from 400 to 500 kilogrammes, weighed at birth from 50 to 51 kilogrammes.[1] Franck estimated that the Foal weighs 0·0685 the weight of the mother before parturition. According to a table drawn up by Saint-Cyr, it appears that a Foal at birth may vary in weight between 31 and 55 kilogrammes, according to breed and individual

[1] The kilogramme is equal to 2·205 pounds avoirdupois.

peculiarities; though between 38 and 45 kilogrammes may be accepted as the average weight.

With regard to the *Bovine* species, Tisserant has stated that Calves weigh at birth from $\frac{1}{13}$th to $\frac{1}{15}$th of the weight of the Cow; whereas Riedesel gives it as $\frac{1}{10}$th. Magne mentions that Calves vary between 20, 25, 45, and 50 kilogrammes. Saint-Cyr alludes to the observations made at the Agricultural School of Saulsie, France, where Cows of the Ayrshire breed were chiefly kept. The animals were maintained in good condition all the year round, and though they were only middle-sized, their weight varied between 400 and 650 kilogrammes. The Cows were regularly weighed, as were the Calves immediately after birth, and the register for 1868 gave the following results. The weight varied from 31 to 55 kilogrammes—the average being 32½ kilogrammes. The males were a little heavier than the females. In twenty-eight instances, the average weight of the Calf compared with that of the Cow was as 2 to 31.

The average weight of one hundred *Lambs* weighed at the Alfort pens, is given by Magne as about 4 kilogrammes for both sexes. The males were heaviest.

For the *Goat*, Colin gives the weight of twins in two instances. In the first, one twin weighed 3·530, and the other 3·585 kilogrammes—together 7·215 kilogrammes; in the second instance, one twin weighed 2·6330, and the other 2·680 kilogrammes—the weight of the two being 5·310 kilogrammes.

Dimensions.

With regard to *dimensions*, Saint-Cyr justly regrets the paucity of observations which have been made on this important point. It is of course well known that, in a general way, the fœtus is larger than the pelvic opening through which it has to pass at birth, but we have to ascertain how much larger it is than that canal, and what is the amount of reduction in volume to which it has to submit in passing the outlet of the pelvis. Rainard merely states that some measurements he had made gave the diameter of the thorax of Calves, from withers to sternum (vertical) as from 10¼ to 11 inches; and the diameter from side to side (transversal) as 6¼ to 7 inches. Saint-Cyr, anxious to arrive at some definite conclusion in the matter, in order the better to understand the mechanism of natural parturition, as well as to gain a knowledge of how to surmount the difficulties of protracted labour, undertook some researches in this direction. His object was to ascertain the depth and width of the chest, and width of croup of the fœtus, these being the dimensions which it is most important to compare with the different diameters of the pelvis of the mother, so as to understand how the former may accommodate themselves to the latter. He gives the name of *sterno-dorsal* line to the vertical measurement taken from the summit of the highest dorsal spines to the sternum, and *biscapulo-humeral* line to the distance measured from one scapulo-humeral articulation to the other; while the *bicoxo-femoral* line is the measurement of the croup from one coxo-femoral articulation to the other. From the measurements in the Horse species, we find that a Mare measuring a trifle over fifteen hands in height, and whose pelvis was nearly nineteen inches in width, brought forth a Foal weighing slightly less than thirty pounds, and whose sterno-dorsal measurement was nearly twelve inches, biscapulo-humeral line 7⅛ inches, and bicoxo-femoral line nearly

8 inches. The other measurements of Mares and Foals yielded similar results, and give an idea of the expulsive efforts the uterus must make to expel the fœtus. In the case first cited, it may be admitted that the pelvis of the Mare had, approximately, the following dimensions: inlet of the pelvis—sacro-pubic diameter, 9 inches ; inlet of the pelvis —bi-iliac diameter, $8\frac{3}{4}$ inches. In comparing these dimensions with those of the Foal to which it gave birth, it is obvious that the biscapulo-humeral and bicoxo-femoral diameters of the latter could be easily accommodated by the bi-iliac diameter of the mother, as they are less by $1\frac{1}{4}$ and $\frac{3}{4}$ inch ; but it is not the same with regard to the sacro-pubic diameter, which is less by nearly three inches than the sterno-dorsal line of the fœtus. It is therefore evident that, in order to pass through the pelvis, this line must be diminished at least by three inches. In the second edition of his work, he gives the measurements of other parts of the body of the fœtus, but their consideration leads to complexity. In studying the table he has drawn up of these various measurements in the Foal, he thinks an idea may be formed of the force of the uterine contractions necessary to expel the fœtus; and again remarks that, even when the largest circumference of Foals only slightly exceeds that of the pelvic inlet of the Mare, or is equal to it, a great amount of accommodation must nevertheless take place in the thorax of the young creature, as the *sterno-dorsal* diameter is greater than the *sacro-pubic* diameter of the mother, When gestation is prolonged the fœtus is still larger, and the difficulty in its expulsion is increased.

With regard to the Bovine species, nine Cows were tabulated. The first, the smallest, was $11\frac{3}{4}$ hands high, and the width of the croup $18\frac{1}{3}$ inches; the weight of the fœtus was about sixty-two pounds, the sterno-dorsal diameter $10\frac{1}{3}$ inches, the biscapulo-humeral $6\frac{7}{10}$ inches, and the bicoxo-femoral $7\frac{3}{10}$ inches. Another Cow was $12\frac{1}{2}$ hands high, the width of croup $18\frac{9}{10}$ inches; the weight of the fœtus was about seventy-three pounds, the sterno-dorsal diameter $10\frac{1}{4}$ inches, the biscapulo-humeral 6 inches, and the bicoxo-femoral $8\frac{7}{10}$ inches. With a Cow $12\frac{3}{4}$ hands high, and croup 18 inches in width, which had experienced a protracted *accouchement* in consequence of the size of the calf, and which had aborted the previous year, the weight of the fœtus was sixty-six pounds, the sterno-dorsal diameter 15 inches, the biscapulo-humeral $7\frac{3}{4}$ inches, and the bicoxo-femoral $8\frac{1}{2}$ inches. The circumference of the chest of the Calf being so much greater than the inlet of the Cow's pelvis, explains why it is that parturition in this animal, even when normal, is longer than in the Mare.

With regard to the Ovine and Caprine species, the fœtus is relatively smaller in dimensions than the Calf ; while in animals which are usually multiparous, the young are always less in circumference than the pelvic inlet, though when it happens that they have only one fœtus this is often so increased in size that birth becomes very protracted, and may even be impossible.

CHAPTER V.

Pregnancy.

Gestation, or *pregnancy*, comprises the period during which the female animal carries its young while this is undergoing development. Its consideration is of much moment, and we will, with regard to it, study

it in this chapter from a normal or physiological point of view—noticing the anatomical and functional alterations attending it, the mode of recognising it, its duration in various species of animals, and the exceptional departures from the usual law with respect to the number of young produced.

It has already been remarked that soon after fecundation the female becomes generally more tranquil, and indifferent to the male, who also does not seek her company so ardently as before; while a certain amount of sluggishness may be observed in her movements. These changes in habit become more marked as time advances, and along with them the other alterations referred to, and now to be described.

SECTION I.—MODIFICATIONS IN THE UTERUS DURING PREGNANCY.

With the development of the fœtus, the *uterus* undergoes important anatomical and physiological modifications; while the system of the mother also, as stated, participates more or less generally in the phenomena which mark the period of gestation. The modifications and phenomena are worthy of attentive notice, not only from the importance they hold with regard to the reproduction of animals, but also from the practical issues involved in the study.

The anatomical changes in the uterus are those relating to its *volume*, *structure*, *form*, *situation*, and *direction*.

Volume.

With regard to *volume*, we have seen that during and after copulation the uterus is congested, and that, when conception has taken place, the thin pulpy secretion corresponding to the *decidua* of the human female covers its internal surface. The vessels, distended with blood, gradually enlarge to a great size—from the smallest to the largest forming most intricate and beautiful plexuses on and in the texture of the organ. The coats of the arteries are thickened to compensate for their distension, and the additional labour they have to perform; while the veins are still more enlarged in calibre. The lymphatics are likewise augmented in number and dimensions; and the nerves, which were comparatively small in the unimpregnated state, enlarge and anastomose so freely as to compose a network similar to that of the vessels—the increase taking place in the nerve terminations, not in the nerve substance.

In uniparous animals in which the fœtus is developed in one of the cornua, this becomes greatly increased, and appears to be continuous with the body of the uterus, the other horn looking like a mere appendage projecting from its side; but with multiparous females the cornua increase nearly alike in size, owing to their being each occupied by the fœtuses (Fig. 65).

Structure.

These changes add to the thickness and density of the uterus; but there are others still more remarkable. While the organ is increasing in volume, becoming rounder, acquiring a greater capacity, and its cervix widening, its proper *structure* is exaggerated to an extraordinary degree. This exaggeration, however, does not occur equally throughout; it is most marked in the cornua of multiparous creatures at the points where the young are fixed—in Ruminant animals at the situation of the cotyledons, and in Solipeds at the part of the body of the

uterus corresponding to the fœtal placenta. So that, at least in the early months of pregnancy, it is thinnest towards the cervix. The increased thickness of the organ, however, never equals that observed in the human female, compared with which the walls of the uterus of the domesticated animals are thin.

The firmness or density of the organ is always most conspicuous in the cornua, and in the operation of "spaying," or castration of the female, this serves as a useful guide in enabling the operator to distinguish between them and the intestines, which they so closely resemble in appearance.

But during pregnancy this density seems to diminish as the organ

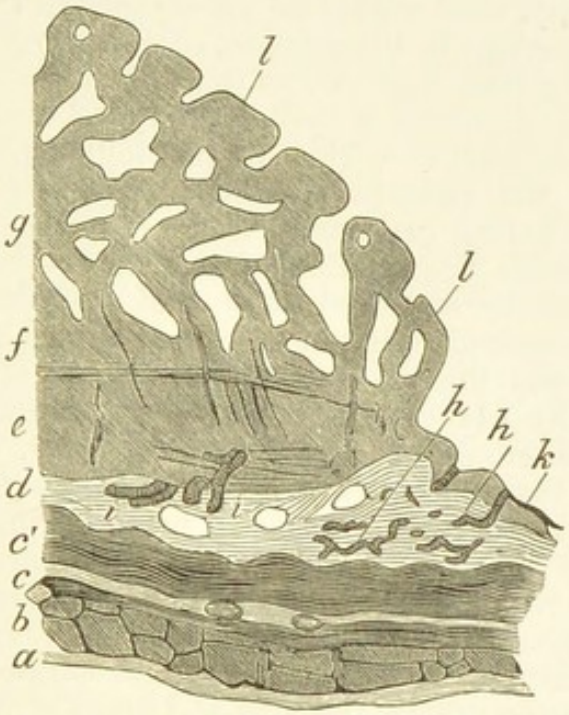

Fig. 64.

VERTICAL SECTION THROUGH A PORTION OF THE UTERINE COTYLEDON OF A COW IN AN EARLY STAGE OF PREGNANCY.

a, Serous Membrane; *b*, Section of Longitudinal Muscular Layer; *c*, External, and *c'*, Internal Layers of the Circular Muscle; *d*, Submucosa, with Vessels; *e*, Adenoid Tissue of the Cotyledon; *f*, New Tissue of the Placenta Uterina; *g*, Section of the Mucous Layer of the Cotyledon, with the Interspaces into which the Fœtal Cotyledons are inserted; *h*, *h*, Utricular Glands passing under the Side of the Cotyledon; *i*, *i*, Large Cotyledonal Vessels; *k*, Uterina Mucosa; *l*, *l*, Epithelial Layer of the Cotyledon.

becomes more vascular, and the cervix assumes a much softer condition than usual. For instance, in the fœtal cornu of a Cow advanced three months in pregnancy, the thickness of the wall was only 2·5 millimetres, while in the other horn it was 4 millimetres. In another Cow at five months, it was 4 millimetres in the fœtal horn and 5 millimetres in the vacant one. The mucosa is thicker, redder, more pulpy and vascular, than before impregnation; the longitudinal rugæ it then exhibited gradually disappear; the epithelium covering it usually loses its columnar form; the utricular glands enlarge—they are longer and their orifices wider, and their secretion, as well as that of the other glands, is increased; the interglandular tissue is largely and rapidly augmented by multiplication of the cells of the surface epithelium, and

proliferation of the corpuscles of the sub-epithelial connective tissue, so that the glands are more widely separated; while the uterine cotyledons grow quickly, and there can be no doubt that new ones appear. Rainard speaks of examining the uterus of several calves and lambs, and finding only thirty or forty cotyledons; while after parturition he has counted more than a hundred; and more recent observers have testified to this fact. In the uterus of a six months pregnant Cow, Franck found that the horn containing the fœtus had forty-seven cotyledons and weighed 3,54 pounds; while the other horn had only forty-two placentæ, and weighed no more than 0,22 pound.

In addition to these supplementary appendages of the mucous membranes, a new glandular apparatus, of which no trace was to be found previous to gestation, now makes its appearance in the form of a large number of small openings in the mucosa, each leading into a depression which was for a long time regarded as the dilated mouth of the tubular or utricular glands, but which is really a "crypt" formed in the hypertrophied tissue of the uterus—a kind of open follicle placed in the interglandular part of the mucous membrane. These crypts are new structures, formed during pregnancy, and are for the lodgment of the villi that project from the chorion of the fœtus—being, in fact, the maternal cotyledons or maternal portion of the placenta. They are small straight depressions, lying more or less closely together throughout the whole of the uterine mucous membrane of the Mare, their cavity being lined by a layer of tessellated epithelium, and a very fine capillary network surrounding each. In the Cow, these crypts are assembled on the surface of the projections designated cotyledons, of which they constitute nearly the entire mass during pregnancy. In the Bitch they are only developed where the ovum is fixed, forming then a glandular layer occupying the contour of the uterine cornu.

The utricular glands do not open directly into crypts, nor is their secretion poured into them, but on a definite surface of the mucous membrane between the crypts, the size and areas of which correspond, of course, to the size and arrangement of the fœtal tufts.

Between the fœtal and maternal placentæ there is always a layer of epithelial cells of varying thickness, which represents the *membrana decidua* or *serotina* of woman. If not during parturition, at least afterwards, all placental mammals are more or less "deciduate." With the Cow and Sheep, for example, large quantities of cells, possessing the character of epithelial cells of the pits and crypts of the maternal cotyledons, have been found, mingled with the villi of shed fœtal cotyledons, in the fluid extruded during and after parturition—showing that a portion of the maternal structure is carried away at this time. The crypts possess the structural characters of secreting organs; and, indeed, we cannot but look upon the maternal placenta and the remarkably modified mucous lining of the uterus as a great secreting apparatus.

In addition to the mucous membrane, the outer or serous membrane is also hypertrophied, the broad ligaments are increased in every direction, but especially in length, and muscular fibres are abundantly developed between their layers, in order to give them sufficient strength to sustain the weight of the uterus. In the Cow, the fibres even form very distinct intercrossing fasciculi.

The greatest increase of all noted in the texture of the uterus, occurs in the middle or muscular tunic. There appears to be a vast multiplication of the fusiform nucleated fibres going on during pregnancy, as

well as an immense increase in the volume of those already existing. This tunic gradually becomes redder as well as thicker, and the muscular fasciculi more distinct, and visibly more numerous; its contractile power also increases. The inner layer, composed of circular fibres, is most conspicuous in the cornua of Carnivorous animals, and there they contract in the interspaces between the young, so as to form well-marked constrictions. The connective tissue which unites the muscular fibres also increases during pregnancy, and becomes markedly fibrous.

Sensibility.

With the increase in volume, weight, and capacity, the uterus likewise acquires a higher degree of *sensibility*, doubtless from the development of its nerves. So that between the cervix, the body, and the cornua, there is established a sympathetic relation that is sometimes not advantageous; for irritation of the cervix, howsoever produced, may bring on violent contractions of the whole organ, and lead to the premature expulsion of the fœtus. This expulsion, as is well known, sometimes follows copulation; though, as a rule, animals usually do not seek to copulate during pregnancy if left to their own natural instincts. It may also be a consequence of manipulation by the hand of the explorer.

This contractility of the uterus is sometimes evidenced before parturition, when animals have been killed and quickly opened. Colin has witnessed well-marked movements in the uterus of a Cat which contained five young—three in one horn and two in the other; these contractions were most energetic at the constricted spaces between the fœtuses. The same talented veterinary physiologist has seen similar phenomena in Sheep at different periods of gestation; the cornua contracted and dilated alternately, and approached or withdrew from each other or the body of the uterus; the movements persisting sometimes for forty or fifty minutes after the animal's death. In a pregnant Cow opened when alive, the same contractions were noted; they became more active and stronger under the influence of a slight irritation; the cornua changed their form in contracting; they shortened sensibly, and became twisted on themselves at their anterior extremity. In a Mare identical contractions were seen.

Haller had long ago remarked that, even in unimpregnated animals, these uterine contractions were present—though they were most energetic in the pregnant Bitches, Cats, and Rabbits he opened; the movement was spontaneous and peristaltic, like that of the intestines, and it continued in the organ, even when it was removed from the body. Those veterinarians who have had occasion to insert their hand into the uterus of one of the larger animals, to adjust the fœtus or for any other object, must have been astonished, and frequently embarrassed, at the firmness with which the arm was grasped at the cervix during the expulsive efforts the creature made.

These uterine contractions are very powerful, and in all probability their rhythm is analogous to that of the intestines—extending from the extremity of the cornua towards the cervix in a peristaltic manner, particularly in those animals which, like the Bitch and Pig, have very long cornua, with the young arranged one after another in them.

This increase in sensibility which the uterus acquires during gestation, must be considered as the organic cause of its contractions; the sensibility and contractility gradually diminish after parturition, during

which they reach their apogee. Its contractility, which signifies also its retractility, enables it to contract on itself after delivery, and to nearly obliterate its cavity. This rapid diminution in the capacity of the organ closes the orifices of the vessels which open on its internal surface during the act, and thus prevents fatal hæmorrhage.

Its main function, however, appears to be concerned in the expulsion of the fœtus, and then, as at other times, it is entirely independent of the will. Besides, the intensity of the contractions is not always related to the strength of the animal; pain deadens and paralyses the contractile force, as is seen in primiparous creatures. When the contractions have been vigorous, the uterus rapidly diminishes; but if they have been slow and weak, the organ slowly contracts on itself. When it does not contract quickly after delivery it is said to be inert, and the cause is to be found in the expenditure of its contractile power, either through excessive distension, a delivery too prompt or too slow, or general weakness of the maternal system. By prolonged exertion, like the voluntary muscles, those of the uterus become weakened; so that when the act of parturition has been protracted, the contractions of the organ become slow and feeble, or cease altogether. Opiates and narcotics generally produce the same effect, and are therefore successfully administered when the contractions are too energetic or painful during delivery or before abortion. The contractions are stimulated by irritation of the cervix or body of the uterus—such as is produced by retention of the whole or a portion of the placenta, titillation of the cervix by the finger, frictions on the belly, the application of cold to this part, or the administration of ergot of rye.

Form.

The uterus, after conception, begins to change in *form* as well as in volume and structure; this alteration, like the others, proceeds *pari passu* with the development of the fœtus. The body becomes round, and in the Carnivora, as already described, the cornua elongate and show the alternate dilatations and constrictions due to the presence of the young in their cavities. In the Mare, Cow, and Sheep, if there is but one fœtus, a single horn is enlarged—usually the right—to contain the posterior limbs, while the other is relatively smaller and contracted, and looks a mere appendage. When a Carnivorous animal contains only one fœtus, it is developed in the horn, and not in the body of the uterus, and it is not until parturition commences that it descends into the latter; should the creature die before delivery, the offspring will be found there. In this species each horn generally contains one or more young; should there be only two, one occupies each cavity; but when there is only one fœtus, it is then in one of the cornua.

The changes taking place in the cervix of the uterus during pregnancy have not been accurately ascertained in the domesticated animals, as in the smaller species there is usually no occasion or necessity to make an examination; while in the larger the risk of injury to the examiner, and of abortion in the animal, militates against such an investigation. It is only known as a fact, that it widens at the termination of gestation, and loses its cervical character, as well as its longitudinal mucous folds. It may also be noted that, from being firm and dense at ordinary times, its texture becomes gradually soft and elastic; while it diminishes in length, its projection into the vaginal cavity is lessened, and indeed at a late period almost effaced, it appearing merely as a kind of ring

separating the uterus from the vagina, and which is sometimes a little open. Not infrequently, if not always, the cavity of the cervix is filled with a plug of thick, adherent, glutinous matter, sometimes so abundant that it also occupies the vagina, and forms an unpleasant obstacle to

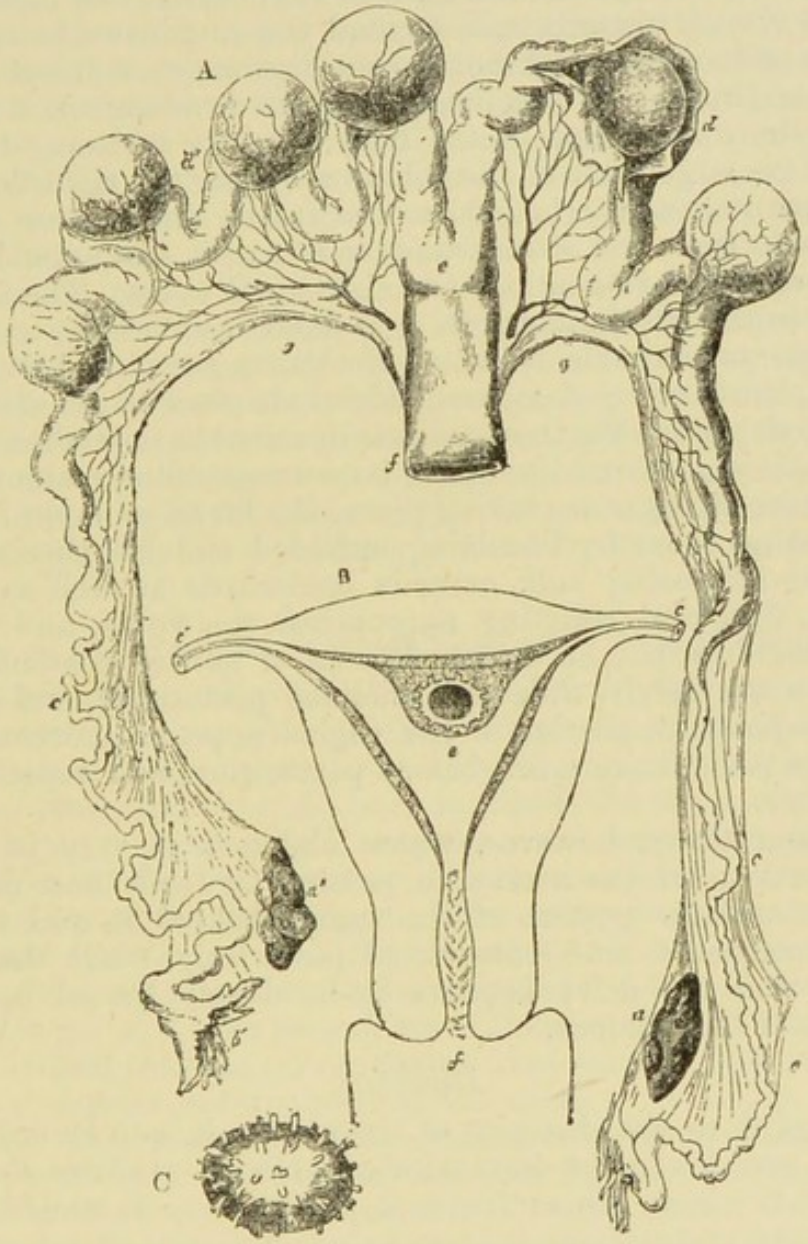

Fig. 65.

THE GRAVID UTERUS OF A MULTIPAROUS AND UNIPAROUS ANIMAL.

A, Multiparous Uterus: *a*, *a'*, Ovaries; *b*, *b'*, Fimbriæ of Fallopian Tubes, *c*, *c'*; *d*, *d'*, Cornua of Uterus—that on the left contains four Embryos, on the right two, one of which is exposed; *e*, Body of Uterus; *f*, Vagina; *g*, *g*, Mesometry or Ligament of Uterus. B, Uniparous Uterus: *c*, *c'*, Fallopian Tubes; *e*, Body of Uterus, containing early Uterine Ovum; *f*, Vagina. C, Early Uterine Ovum.

exploration, though it does not interfere with parturition. We have already alluded to the sensitiveness of the cervix. The cornua, also, in becoming wider lose their inferior and posterior curves.

Situation.

The uterus cannot change its form and volume without its *situation* becoming altered. Before, and until a certain time after conception, the body of the uterus is contained in the pelvis, but as it and the fœtus increase the position changes, and this also causes an alteration in the situation of other organs. In the Mare the uterus gradually displaces the pelvic flexure of the colon lodged in that cavity, and passes forward below that viscus, towards and beyond the umbilicus, to rest on the floor of the abdomen, in proximity to the diaphragm, stomach, and liver, near the termination of pregnancy. In its development it is situated chiefly in the middle line of the body, slightly inclining to the left, because of the large mass of the colon occupying the right flank.

In Ruminants, the uterus pushes the rumen and cæcum out of the pelvis, presses the mass of intestines to one side, and extends between the right sac of the rumen and the abdominal walls. The presence of the rumen in the left flank causes it to deviate somewhat to the right.

In *multiparous* animals, in which the young are placed end to end in the cornua, the latter rest on each side of the floor of the abdomen and curve upwards; in the Pig they incline somewhat to the right side, though in all animals each cornu lies above its corresponding mammary line.

While these changes are taking place, the broad or lateral ligaments are facilitating them by becoming unfolded and lengthened, and the uterus in its increasing bulk extends backwards as well as forwards. The cervix, firm and resisting, approaches the vulva, and to such a degree sometimes that, in certain breeds of cattle—particularly those which have the pelvis wide and inclined posteriorly, and bear large calves—the posterior portion of the vagina appears between the labia of the vulva a month or more before parturition, and especially when they lie down.

With other Cows, however, whose abdomen is very pendant, the opposite occurs; for the uterus, in passing forwards and downwards, carries the anterior portion of the vagina behind it, and this cavity becomes lengthened and constricted posteriorly, while the cervix is shortened, and the vulva appears to be deeply buried between the tuberosities of the ischium.

Direction.

With regard to the *direction* of the uterus, it is to be noted that its horizontal position in the domesticated animals obviates those lateral displacements which are so frequent in woman—its weight, and that of its contents, maintaining it in an antero-posterior direction, and in a line with the body of the animal. This direction rarely varies to any appreciable degree, and it is only in a case of hernia at the flank, which is very uncommon, that it inclines to one side. The only marked inclination it assumes is forward and downward in Cows, whose abdomen is very wide and pendulous. Otherwise, the uterus keeps its normal direction. Rainard draws attention to a form of abdominal hernia which gives the uterus a particular direction; it is that which takes place in the Mare or Cow, in the vicinity of the crural arch, when the uterus, or one of its horns containing the fœtus, descends behind the corresponding mammary gland, or into the subcutaneous connective tissue of the inguinal region, forming a large tumour in which the limbs of the young animal can be felt.

Another change in the direction of the uterus, which it is most

important to consider in the larger animals, is the more or less complete rotation or twisting on its axis of this organ—its upper face becoming the lower, or again becoming superior after describing an entire circle; for this torsion occasions serious changes in the form of the cervix and the direction of its cavity. The position of the cervix is the inverse of that of the uterus, being always found on the side opposite to that of the new direction of the organ itself; it is directed upwards if the uterus is downwards, and if the latter twists to the right or left the cervix goes to the left or right. Cases are mentioned in which torsion of the cervix itself has been found; and though it has been argued that the lateral ligaments would not permit this malposition, yet there can be no doubt as to the fact. Lecoq of Bayeux, cited by Rainard, found in a Cow that had died through non-delivery, the upper face of the uterus turned towards the floor of the abdomen, rotation having taken place from right to left; the utero-vaginal portion was twisted on itself, and the suspensory ligaments were themselves twisted around this part. Numerous cases are recorded which incontestably prove that, during pregnancy, the uterus performs a half, or even a complete revolution on itself, producing torsion of the cervix and the posterior part of the vagina, and consequent strangulation of the organ near the neck, by the suspensory ligaments; so that spontaneous delivery of the young animal by the natural passage is impossible.

Influence on and Alterations in the Position of Neighbouring Organs.

The alterations occurring in the uterus necessarily bring about others in the neighbouring organs with which it has mechanical relations. The changed position of the organ in the abdominal cavity has been alluded to In the Mare and Cow the horn in which the limbs of the fœtus is lodged becomes extended and displaces the intestines, pushes the stomach more to the left, rests on the liver, and is an obstacle to the free movements of the diaphragm. The suspensory ligaments of the uterus retain that organ and the cornua *in situ;* but when they, in the early stage of gestation, begin to extend forward, the vagina is lengthened, until at a later period, when the size of the fœtus forces the uterus backwards into the pelvic cavity, that canal is also pushed back and forms a circular enlargement in the vulva. Its lining membrane, owing to the compression and the increased circulation of blood through it, assumes a violet or dark-brown tint, and appears to become thickened, while it secretes a larger quantity of viscid mucus.

The pressure the gravid uterus exercises on the bloodvessels of the hind limbs and the vulva and rectum, retards the venous and lymphatic circulation; so that towards the end of gestation, and especially in the Mare, there is often considerable œdema of these parts. This œdema is all the more marked, in the Cow as well as in the Mare, when the compression is greatest at the posterior parts of the abdomen, towards the commencement of the saphena and mammary veins.

The œdema is always greatest in those cases, somewhat rare it is true, in which there is a giving-way of the abdominal parietes near the crural arch and above one of the mammæ, when the uterus forms a hernia beneath the skin; then there is seen an enormous swelling at the upper part of the limb.

The udder increases notably in volume, and it and the teats become tense. In the Carnivora, the prominences of the mammæ, especially

the ventral ones, are increased by two rows of elevations on each side of the linea alba, which correspond to the portions of the cornua in which the young are being developed, and where they form projections on the wall of their sac.

The increase in volume and the various changes which the gravid uterus undergoes, bring about alterations in, and frequently derangement of, certain functions. Fortunately, however, these alterations are slow and gradual; so that the different organs concerned generally adapt themselves to their changed condition without much inconvenience. The animal becomes lazy and slower in movement, and is more desirous of quiet and tranquillity as gestation advances. These indications are observed at an early period. At the same time the abdomen enlarges and changes its shape: it becomes rounded, and projects below and on each side beyond the crural region, while the flanks become hollow, the croup and thighs wasted-looking, and the sacrum and external tuberosities of the ilium more salient.

In the domesticated animals there are rarely observed those disturbances in the digestive organs so marked at the commencement of pregnancy in woman. On the contrary, immediately after conception, possibly because the œstrum has disappeared, the appetite is increased, digestion is usually easier, and all the formative phenomena seem to acquire increased activity; more use appears to be made of the food in the economy, and there is a notable tendency to fatten. This tendency has been taken advantage of by breeders and feeders of animals which are destined more for food than reproduction; and those intended for slaughter are usually rendered pregnant, and fed until about the middle period of gestation, when they have reached their most favourable condition—as towards the last period this tendency vanishes, and wasting is more apparent, due to the increased demands of the fœtus and the enlargement of the mammary glands.

In some cases, however, and particularly with the Cow, the appetite becomes somewhat depraved, the animals eating soil, gnawing the walls or woodwork of their stable, drinking foul water, etc., and very exceptionally there may be vomiting.[1]

With the increased bulk of the uterus, as has been observed, the abdominal and thoracic organs experience more or less the effects of the compression it exercises on them. The diaphragm is pushed forward, and diminishes the capacity of the thorax and the expansibility of the lungs; the ribs, encumbered by the weight of the fœtus, are raised with difficulty by the muscles of inspiration, so that respiration is frequent and shallow, and the creature is readily "blown" and fatigued. Digestion may be somewhat impaired and retarded, and slight constipation is not rare. The strain induced by the uterus on the vagina, and indirectly on the neck of the bladder, causes attempts at micturition to be more frequent; while the compression on the liver, vena portæ and vena cava, explains the mechanical obstruction to the circulation and subsequent œdema, particularly in the Mare.

In addition to all this, the blood is more or less modified. Its absolute quantity is certainly not diminished; on the contrary, it may be increased to a certain extent; but its corpuscles diminish in number in a very perceptible manner, giving rise to a hydræmia more allied to anæmia than anything else.

[1] An instance of this very rare accident is given in the *État Sanitaire des Animaux Domestiques de Belgique* for 1877, p. 65.

SECTION II.—POSITION OF THE FŒTUS IN THE UTERUS.

The position of the fœtus in the uterine cavity is pretty well constant in the same species; and this position it retains more or less during intra-uterine existence and until parturition occurs, when it is changed.

Brugnone, cited by Rainard and Saint-Cyr, writes: "If the uterus of a Mare be opened longitudinally at the ninth or tenth month of gestation, we find the fœtus with its head directed backwards, and bent in such a way that its lower jaw touches the throat and its mouth the breast. It forms an arc of a circle—the neck being in contact with the sacrum, and the spine being bent round is turned towards the right or left side of the lower part of the abdomen. The limbs are flexed, the fore ones in such a manner that the knees reach the middle of the head and the feet the umbilicus; while the hind limbs are doubled under the abdomen. The croup and haunches are at the bottom of the uterus, in the vicinity of the stomach." The head may sometimes be directed forwards.

Colin states that towards the termination of pregnancy, the fœtus of the Mare lies with the belly upwards, the hinder limbs in the longest of the uterine cornua, and the anterior limbs and head directed towards the cervix uteri.

In the Cow, according to Saint-Cyr, the uterus is curved downwards, the superior convexity of the body being prolonged forward by the cornu in which the fœtus is partially developed. When the uterus is opened, the fœtus is discovered with the head bent back, the body much inclined and looking as if almost lying on one side, and pressing on the empty cornu, which is considerably less developed than that of the opposite side, and which is also lower. Otherwise, like the Foal, the Calf is curved *en arc*, the head more or less near the sternum, and the limbs flexed and close together (Fig. 46).

According to Colin, the belly of the fœtus is downwards in Ruminants, and towards the concavity of the cornu, the head being directed backwards.

In multiparous animals, the fœtuses are distributed in the two cornua, one after the other, the head being usually turned toward the cervix uteri, sometimes to the opposite side, and the abdomen lying towards the concave portion of the cornua, where the broad ligaments are attached and the vessels enter. In the Sow, however, it has been noted that the young lie in a contrary direction; the head, instead of being presented to the cervix uteri, is turned towards the ovarian extremity of the cornu, though the abdomen and limbs always correspond to the concave border of the horns, as it is there the placenta is situated.

In forty-three Cows and Sheep, Colin found in twenty-five the fœtus in the right cornu, and in the left cornu in eighteen. At first sight it might be supposed that the preference for the right cornu was due to the impediment offered to development in the left by the large digestive organs of these animals; but this difference cannot have any influence on the function of the ovaries, the dehiscence of the Graafian vesicles in the right being apparently more frequent than in the left. In multiparous animals, the fœtuses are rarely equal in number in both cornua, though neither of the latter has a constant advantage over the other in this respect.

The position of the fœtus towards the termination of gestation may

vary occasionally, and even frequently, owing to the active reflex movements which it performs; and to these energetic movements, it cannot be doubted, are due the difficult presentations which the fœtus offers so frequently (at least in some species) at birth.

SECTION III.—SIGNS OF PREGNANCY.

Having traced thus far the process of utero-gestation, we have now to study the signs by which this process reveals itself. This study is very important, in several respects, to the comparative pathologist, or rather to the veterinary surgeon, whose science extends beyond pathology, and who is frequently called upon to give an opinion as to whether an animal is or is not pregnant.

The signs which announce pregnancy are numerous and varied, though they are not all reliable, and several are very deceptive and not peculiar to gestation. Indeed, it has frequently happened that animals whose condition was not at all certain have brought forth young, and others have done the same without giving rise to any suspicion that they were pregnant; though it must be remembered that at first there is nothing present to guide one in forming an opinion as to the animal having conceived.

Nevertheless, in order that a correct opinion may be arrived at, the most equivocal signs must be taken into consideration, as well as those which are, so to speak, unequivocal—indeed, they ought to receive, for this very reason, more than ordinary attention; as it is a matter of much moment, and particularly in cases of jurisprudence, that the veterinarian should be able to speak positively as to the existence or absence of pregnancy.

The diagnosis of pregnancy is not always easy, and it is all the more difficult as the stage is early.

In order to study the signs of pregnancy conveniently, it is usual to divide them into two categories—the *certain* and the *probable* signs; or into three categories as follows: 1. The *rational, physiological,* or *subjective signs;* 2. The *material* or *objective signs;* 3. The *sensible signs* which are derived from *observation* and *manipulation,* in order to ascertain the presence of the fœtus. In this study, of course the larger animals will be more particularly referred to, because of their relatively higher value and importance, and their longer period of gestation; and also because the veterinary surgeon is most frequently consulted as to their condition.

Rational Signs.

There are several *rational signs* due to the modifications brought about in the economy of the pregnant animal, and manifested by alterations in temperament, character, and aptitudes.

The *cessation of heat* or *rutting* is, perhaps, the earliest subjective, though it is certainly not the most certain, sign of gestation, and may even lead to mistakes. It is usually manifested soon after conception has taken place (six or eight days), by a decrease in the venereal excitement which marks the period of œstrum; the animal, as has been mentioned, is comparatively tranquil and does not exhibit any desire for the male, neither does she neigh, paw, or show the usual concomitant symptoms of "heat." If the male approaches, the sexual desires are not excited, and in refusing him the female may even resort to aggres-

sive movements. So that it has usually been held as a sign of conception, if the female refuses the male soon after copulation, and particularly if a month or two has elapsed, and the Mare is in good condition and well fed. But in some cases the symptoms of "heat" persist for some time after coition, and the erethism of the generative organs is not allayed, although in reality impregnation has taken place; and in very exceptional instances the "heat" will return after having disappeared for a certain time. Some Mares which have been pregnant for two or three months, and especially those which have been put to the Stallion early in the year, will exhibit indications of œstrum when the weather becomes warmer and the pastures afford more nutriment. When in this state the female may again accept the male, and it may even happen that a second fecundation takes place at this time—thus occasioning those somewhat unusual conceptions which give rise to superfœtation; though if pregnancy is somewhat advanced it is dangerous, and may occasion abortion. A story is told of a Mare in the Saint-Leger stud, France, which, after being pregnant for some months, yet showed symptoms of "heat." Louis XIV., who was more inclined to favour the desires of the animal than to listen to the opinion of Garsault, the famous equestrian of that period, ordered her to be put to the Stallion. This was done, copulation took place, and the Mare aborted.

Stallions exclusively employed for breeding, frequently refuse to approach pregnant Mares in which the "heat" persists or reappears; though this is not always the case, particularly with young Stallions.

In the Cow, as in the Mare, œstrum may continue or reappear after fecundation; though as a rule, I believe, the male refuses to copulate again when the female is in this condition. "Very often," says Grognier, "the Mare and Sheep, as well as the Cow, manifest signs of 'heat'; but the Bull, better than the Stallion or Ram, knows the indications of gestation, and abstains from having intercourse with Cows which are in this state." M. Magne remarks that the Bull accustomed to consort with pregnant Cows, smells at them as it does at others going with it, but without being excited by their emanations. Exceptionally, however, it must be noted that Cows have been known to manifest œstrum regularly, and to receive the Bull, even a month before parturition. But these instances are very rare. For cattle, therefore, it is an almost certain sign of pregnancy when the Bull refuses a Cow, though the latter may be in heat.

With Sheep œstrum may continue after fecundation, and the Ram may copulate with them.

In general terms, then, it may be repeated that the cessation of œstrum before its regular period, and soon after copulation, indicates that conception has taken place; that its persistence or reappearance in the Mare and Sheep some time after the first copulation, does not absolutely imply that impregnation has not occurred, even though the male again consorts; but if it frequently appears it is a presumption that the female is not only not pregnant, but that fecundation is not readily induced.

It has been generally observed that a change takes place in the character of the animal which has conceived, and this sometimes almost immediately after conception; the change being something analogous to that produced after castration. Mares which were previously vicious,

troublesome, or unsteady when in "heat," are nearly always gentle and tractable when in foal; the genital excitement which caused their capriciousness or viciousness being allayed, they are no longer under its influence. This change, when occurring after copulation, is a valuable sign of successful impregnation; and though it may sometimes fail, yet when present it can scarcely lead to a mistake. If, on the contrary, the animal has not been fecundated after one or more coverings, if previously vicious its vices become exaggerated when again put to the Horse.

In the Cow a similar phenomenon may be remarked, though it is not so frequent or marked as in the Mare.

The other animals are seldom so irritable in their disposition as to lead anyone to notice a similar change in them.

A tendency to fatten is such a notorious consequence of impregnation, that with the Cow and Sheep graziers usually resort to it in order to get these animals in good condition for market, when they are intended for slaughter. But this aptitude is most marked in the early months of gestation; for in the Cow towards the last three months, and in the Sheep and Pig at the last month, when the mammæ begin to enlarge, there is a tendency to lose condition. According to the butchers, there is less internal fat, and the animals altogether are not so heavy as they appear externally, when gestation has advanced. It often happens, particularly with Cows, that the appetite is depraved, the animals eating earth, drinking filthy water, licking walls, and gnawing innutritious substances.

Coincidentally with the progress of gestation, those animals employed in labour for speed or draught lose their vigour somewhat, particularly towards the end of pregnancy; they become "soft," and their paces slower and heavier—consequently, they require more urging to make them perform a certain amount of work. They, if Mares, trot, gallop, and jump with more fatigue, and yield themselves far less readily to inordinate exercise than before—either because their temperament alters, their instinct urges them to preserve their progeny, or the fœtus itself physically embarrasses them in their movements.

But this is not always a sure sign; for sometimes, though rarely, Mares will perform their work with the same energy and speed as before conception, even up to a very brief period before parturition commences. Taken with other signs, nevertheless, this may afford assistance in diagnosing gestation.

At pasture, Cattle and Sheep are more tranquil, and rest much; as do also Pigs and Bitches during this period.

Material Signs.

The *material*, *physical*, or *objective* signs are those depending upon the change in *volume* of the *abdomen* and the *mammæ*, the appearance of the *milk* in the latter, alterations in the composition of the *urine*, and *increase in weight* of the animal.

The abdomen enlarges in every direction, and at the same time changes its shape. It descends or "drops," becoming larger inferiorly; the flanks become hollow, and the spine appears more concave in the dorso-sacral region; while the lateral portions of the croup sink so much as to make the sacrum and haunches towards the root of the tail look more salient. These phenomena are progressively developed as gestation approaches its term, when they are very evident. In the

Mare they are irregular in their appearance, commencing three or four months after conception, and do not possess the same value in every instance; for there are some animals in which the abdomen is scarcely at all unusually developed, and particularly the Mare—which is uniparous—until near parturition; and others, generally those at pasture, or which have had a number of foals, that always have the belly considerably developed and pendulous, and in which it is difficult to perceive any increase, even when they are in foal.

Besides, some diseased conditions—as ovarian dropsy, uterine polypus, hydrometra, ascites, impervious vagina, etc.—may give rise to amplification of the abdomen; and it must not be forgotten that Mares fed on poor fibrous forage not unfrequently have the belly enlarged. So that of itself this is not at all a sure criterion of pregnancy.

Taken in connection with the other signs, however, the increase in the abdomen—most marked towards its inferior third, and becoming evident toward the fifth or sixth month of pregnancy—has a certain value. It is most noticeable, perhaps, in looking at the animal from behind; though repeated examinations at various intervals may be necessary to ensure certainty, and in important cases it may even be necessary to have recourse to measurement of the abdomen.

The *enlargement of the mammæ* is a sign which varies considerably in different species, according to the condition of the females. In primiparous animals, as the Mare and Cow, they begin to increase soon after conception—towards the second or third month. The udder is more prominent and firm to the touch, loses its wrinkles, and the teats are more visible. This appearance is generally only ephemeral and partially disappears, to reappear again more markedly after some weeks; then to subside and show itself several times during the period of gestation.

Besides this mammary enlargement in the primiparæ, and which may be accepted as a certain indication, these glands furnish, towards the last third of the period of gestation, a yellow, viscid, transparent liquid —the colostrum—similar to white of egg, and which can be easily extracted from the teats by milking. In those which have never conceived, manipulation of the teat may furnish a drop or two of a watery-like fluid, but in two or three months after fecundation it becomes slightly increased in quantity, and is now viscid in consistency. It gradually increases in quantity and quality, and about the period mentioned it has changed into colostrum. In the last weeks of pregnancy this liquid sometimes become white and opaque, as well as less viscid, and is then proper milk. When the animals have bred several times, the increase in the size of the udder is only remarked in the last days of gestation. In milch Cows, and particularly in those which are not good "milkers," another sign is to be found in the diminution of the lacteal secretion, and the shrinking of the gland some time after conception—usually about the twentieth day.

In the pregnant Mare which still has a Foal running with her, the secretion of milk also ceases some time before parturition; and the animal appears to be aware of this, for it weans the Foal generally between the sixth and eighth month.

In the smaller animals the enlargement of the mammæ and the appearance of the milk are usually remarked earlier, and more regularly, than in the larger creatures.

In animals which have borne young, similar changes to those

observed in primiparæ take place, but the mammæ may be later in enlarging.

Though, in a natural state, the mammary glands are only intended to furnish aliment to the young creature until it is sufficiently strong and active to find its own food, when they suspend their function; yet domestication has greatly modified their secretory power in some species—as with the Cow, Goat, and sometimes the Ass and Sheep—and the secretion of milk becomes an almost permanent function. Not only this, but at times the secretion, as observed in the unimpregnated Bitch, is very anomalous and unnatural. In the non-pregnant female of various species—not excepting the human species—the secretion may appear naturally, or be induced by mulsion or frequently repeated suction of the teats, even in very young creatures, a short time after birth; and what is more astonishing, male animals have in rare instances assumed a function which is always looked upon as specially characteristic of the female sex at the maternal period. So early as the days of Aristotle—who mentions a he-goat which yielded milk—this strange phenomenon has been at times observed; and M. Lecoq testifies to an Ox, in process of fattening, having the four rudimentary mammæ increased in volume and yielding milk which furnished cream, and became casein when an acid was added to it.

Certain alterations in the *composition of the urine* have been reported by M. Keiner of Günsback, which, with other circumstances, might, if found to be trustworthy, be valuable as an aid in the diagnosis of pregnancy. He has discovered that the salts of lime in the urine diminish in proportion as the fœtus requires these for the formation of its bones; and his discovery has been tested by a chemist whose analysis of this fluid, obtained from a pregnant Mare, shows that the lime lessens very much as the time for parturition draws nigh. At the fifth or sixth month it is diminished 55 per cent., and to 70 per cent. from the sixth to the ninth month.

It has been proposed to *weigh* animals which are suspected to be pregnant, at certain intervals; an increase in weight being an evident accompaniment of growth in the fœtus. In this direction, Rueff has recorded that Mares, towards the fourth or fifth month of pregnancy, have shown an average increase in weight of more than eleven pounds in eight days, and he particularly recommends this aid to diagnosis, which appears to be most useful at mid-term.

It may be noted as an additional aid in diagnosis, that with the progress of gestation the mucous membrane lining the vulva and vagina becomes swollen, and assumes a red or bluish-red hue, instead of its usual pink colour; and towards the termination of pregnancy, the secretion of vaginal mucus, particularly in the Cow, is largely increased.

All these numerous signs are by no means to be implicitly relied upon, however, as they are not infallible in proving the existence of pregnancy in every case; some of them are only noticeable at a late period, while others may be absent. It is necessary in taking them into consideration, to distinguish those animals which are kept at pasture and destined for breeding, from those which are kept in the stable and used for various purposes. With the first, the cessation of œstrum and the refusal of the male are almost certain indications of conception; while, with the latter, the same phenomena may be the result of fatigue or bad food and mismanagement.

With regard to fattening, change of temper, etc., it is evident that they may depend upon other causes than pregnancy; and obesity can only be very conspicuous in primiparous animals, or those which are not rearing young; for Mares or other creatures put to the male a few days after parturition, are not likely to accumulate fat and rear their progeny at the same time. When, however, all the above signs are manifest in an animal, they establish a very strong presumption, though not an absolute certainty, as to its condition. It is not until a later period, when the abdomen begins to increase more rapidly in volume, the animal becomes sluggish, and the mammæ enlarge and secrete the viscid fluid just described, that the existence of pregnancy might safely be affirmed.

The chances of error in diagnosing pregnancy in the first half of the period are numerous, and even up to a later stage—until parturition, in fact—these indicative signs may be absent. I know of an instance in which an unfortunate Mare was ridden to hounds until the day before it gave birth to a dead foal, and perished.

Sensible Signs.

When the contractility of the fœtal muscles begins to be developed—which is towards the fourth month in the larger animals—the young creature can move, though the movements are too feeble to be recognisable externally at an early period; but later, towards the end of pregnancy, they become vigorous and unmistakable.

To obviate as much as possible the risks of error in diagnosing pregnancy, various expedients have been resorted to in order to ascertain with certainty the presence of the fœtus in the uterus, by exciting these movements. Some of these are as barbarous as they are stupid. One especially merits the strongest condemnation; this is pouring water into the ears of the Mare or Cow, under the supposition that if the animal is not pregnant it will shake its whole body to get rid of the fluid, but if pregnant that it will only shake the head and ears. Another cruel and dangerous test is causing these animals, but especially the Mare, to run very quickly for a certain time, and to give them cold water to drink or oats to eat immediately afterwards, in order to excite inordinate movements in the fœtus. It will readily be understood that these and other vicious practices are very likely to produce abortion, and that they should therefore be discountenanced and discontinued. The only useful and practicable means that can be resorted to, are those which appeal to the senses of touch, sight, and hearing. But it must be remarked that these have fewer opportunities for their exercise, and are more limited in their application, in animals than in woman.

On feeling or touching, watching the movements of the fœtus as they are manifested externally, and auscultation, we must mainly rely, and these afford, with the other signs, the only conclusive evidence we can obtain.

The indications obtainable by manual exploration are through the *abdominal*, *rectal*, and *vaginal* touch. The *feel* of the abdomen does not yield equally certain results in all the domesticated animals. In those which are small, as the Bitch and Cat, a little careful manipulation will render the presence of the creatures *in utero* very evident towards the middle period of gestation; but in the larger animals—the Mare and Ass on the one hand, and the Cow on the other—there exist considerable differences, as pointed out by Trasbot.

In the Cow after the fifth or sixth month, the presence of the fœtus can be readily ascertained by this means; but in Solipeds it is not until the seventh or eighth month that the same information can be derived; and, besides, it is not always easy to apply this mode of investigation to these animals, because of their fidgetiness. It is better to examine the animal when it is standing, as the signs are not so perceptible when it is recumbent. The examiner stands on the right side of the Cow, the left of the Mare, with his back towards the animal's head, and applies the palm of his right or left hand against the abdomen, immediately below the flank, about eight or ten inches in front of the stifle, and just above the udder, pressing moderately, the other hand resting on the back. At this part of the abdomen a hard voluminous mass can be felt in the uterus, while the movements of the fœtus are perceptible as it stirs at irregular intervals, and causes the jerks and shock of its displacements to be communicated to the walls of the abdomen. These movements are strongest in the morning, and are more distinct if the mother is eating or drinking, especially if the water is cold, or immediately after feeding. Some old authorities recommend that, to render the movements of the fœtus more perceptible, the Mare should be trotted, put in the stable and given some food, and then, by placing the hand on the before-mentioned region, the foal will be felt if it is there. The distention of the stomach by food compresses the other abdominal organs, and especially the uterus, and the inconvenient displacement excites the young creature to movement. The ingestion of fluids does the same, and particularly if they are cold; for then they powerfully affect the fœtus by the uncomfortable sensation they give rise to. Cold water thrown against the belly, or the application of the cold wet hand, will produce a similar effect. In the Cow, smart compression of the abdomen with the closed fist at the part just indicated, so as to push the uterus upwards and allow it to return with a little force, is also a good method of ascertaining the presence of the fœtus, and will prove successful when simple application of the flat hand will fail. It is most likely to succeed when there is not much food in the stomach and intestines, as the uterus is then much easier displaced. When this compression has been made with some energy, the uterus strikes the abdominal wall immediately afterwards, and then there can be perceived a firm voluminous mass; this is the uterus containing the fœtus.

At a more advanced period, in the last two months, the movements of the fœtus can be easily remarked as it jumps about briskly, striking the interior of the abdomen at brief intervals. This, and the other signs appreciable at this time, leaves no doubt as to the existence of pregnancy. The fœtal movements are never more marked and precipitous than immediately before abortion, at a late period of gestation; they are then energetic, and to all appearance convulsive.

With the smaller animals the same methods of exploration may be resorted to, and with the same, or even more marked results. The perceptible movements of the fœtus of course settle the question as to pregnancy and the vitality of the young creature; but their absence is not conclusive as to the contrary, for it has not infrequently happened that the fœtus remained insensible to this kind of excitation, and yet was alive at birth. The tests should be applied more than once in these doubtful cases.

It may be noted that the "feel" of the abdomen distended by the

uterus is very different when the distention is caused by fluid, flatus, etc. The uterine tumour is firm, hard, elastic, and defined, preserving its form in all positions of the body; whereas in ascites the swelling is not defined, there is no repercussion on compression at the flank of the Cow, the fluid obeys the laws of gravitation, and the abdomen has not the same firm, elastic feel. Percussion will aid in distinguishing between pregnancy and tympanitis. In certain diseased conditions of the uterus, however, a diagnosis is very difficult, and the next means of exploration will have, in some of these embarrassing cases, to be adopted.

Rectal exploration, as well as that by the vagina, can only be successfully carried out in the larger animals, because of the small dimensions of these passages in such creatures as the Bitch and Cat. The risks attending this mode of examination have been at times much exaggerated, and there is really but little danger to the animal so long as reasonable precautions are taken not to produce injury; the fœtus has even been pushed gently about in the uterus without any accident to it or the parent. After the third month it will afford an indication of pregnancy.

To examine an animal *per rectum* it should be standing, and, if dangerous or irritable, the twitch may be applied to the nose, or for safety to the operator the hind limbs must be secured; with the Cow, the nose seized by one hand of an assistant and a horn by his other hand, will be sufficient. The bowel should be emptied of the fæces it may contain, so as to allow the oiled hand and arm of the explorer to be introduced and freely moved about. When the abdomen is large and pendulous, it is useful to place the animal higher before than behind, and to have the lower part of the belly raised by assistants on each side, by means of a sheet or sack, or even their hands joined beneath, so as to throw the uterus backwards and upwards; though in the majority of cases these measures are not necessary. The hand being passed into the rectum to beyond the brim of the pubis, it is opened and the palm placed on the lower surface of the intestine and gently pressed downward, towards the floor of the abdomen; when there will be felt, if the animal is pregnant, a hard irregular mass, more or less voluminous according to the stage of gestation, and capable of being displaced to a certain extent—even partially brought into the pelvis, if parturition is near. In this case, the head or other parts of the fœtus can be distinguished through its envelopes and the uterine and rectal walls. But if pregnancy is not so advanced—say only at the sixth month, the fœtus cannot be so readily felt, and it may happen that at this period it is situated low down in the abdomen, or well forward in one of the horns of the uterus, and lying to one side of the mesial line (nearly always to the right in the Cow); so that an inexperienced or careless examiner might miss it altogether at the first exploration. This error can be avoided by carefully moving the introduced hand to the right and left as far as the intestine will permit, with the animal's body inclined backwards and the belly raised by assistants, as just described. The fœtus should be excited to move, if possible, so as to guarantee its presence.

The difficulties are greater if it is desired to know whether the fœtus is alive or dead. Sometimes we may at once perceive the movements of the young creature in the uterus; but at other times it is motionless, and cannot be made to exert itself except by moving and pushing it

several times. This, however, is not commendable, unless performed with the greatest gentleness and care; and if there is nothing urgent, it would be preferable to make an examination at another time, rather than incur the dangerous results that might follow this manipulation.

The prominences of the fœtus might be mistaken for the hard masses of fæces lodged in the intestines; but a distinction can generally be made by the rapidity with which these prominences appear and disappear through the sudden movements of the young creature, compared with the slow, regular, peristaltic motion of the intestine and its fæcal contents.

Vaginal exploration, as mentioned, can only be practised on the larger animals. It is not attended with any more danger than the rectal examination; but though it is of great value in woman, especially when *ballottement*[1] is resorted to, yet it is not nearly so useful in animals; for in consequence of their horizontal position, this repercussion is not possible. Neither is it so valuable as the exploration *per rectum*. It is practised with the animal in the same position as for the last-named examination, and the hand, well lubricated with soft soap or, better still, with olive oil, is inserted into the vagina as far as the cervix uteri. In the first months of gestation the uterus descends into the abdomen; consequently, the vagina is longer and more inclined downwards in front: while the fœtus is beyond reach of the hand. Towards the fifth or sixth month, the uterus, in expanding in every direction, approaches the vulva, and the canal of the vagina being shortened, it can be perceived in the pelvic cavity. The same manipulatory manœuvres as were practised in the rectum, may be employed in the vagina at this time, but the results are far from being so satisfactory; the vaginal examination should, therefore, never be preferred to that by the rectum.

Ballottement may be resorted to in the smaller animals, by placing them in a vertical position; but the other signs of pregnancy are usually so manifest in them, that generally there is little difficulty in diagnosing their condition.

Auscultation has not been much employed in the diagnosis of pregnancy in the lower animals, though its value in woman is undeniable; as since its introduction by M. Mayor, of Geneva, in 1818, its utility has been frequently and successfully put to the test, not only to ascertain whether there was a fœtus, but also whether it was alive. In woman, either the uncovered ear or the stethoscope is applied to the abdomen; the latter is generally preferred, as by it the sound is limited, as well as defined.

The *pulsation of the fœtal heart*, or *double battement*, consists of a rapid succession of short, regular, double pulsations, differing from those of the adult heart in rhythm and frequency; the sound being like the muffled ticking of a watch, or the pulsations of the heart of a new-

[1] The *ballottement* or repercussion to ascertain the presence of a fœtus in woman, is produced by the operator placing his patient in the upright position, or if in bed, raising her shoulders. The forefinger is then introduced into the vagina and placed on the cervix uteri, while the other hand is employed to keep the uterine tumour steady; then suddenly but slightly jerking upwards the point of the introduced finger, a sensation is experienced of something having receded from it, and which he will perceive to fall again on the point of his finger in a moment or two. The jerk of the finger upon the head of the fœtus causes it to float upwards a little in the liquor amnii, and its weight makes it descend again. We have seen that a kind of external, or flank *ballottement*, can be practised in the Cow.

born child. In addition to the sounds of the fœtal heart, there is also the *uterine souffle* or *placental bruit*, caused by the blood passing through the greatly enlarged vessels of the uterus, particularly at the part to which the placenta is attached; it is an intermittent whirling sound, heard at an early period of pregnancy, and usually regarded as one of its most unequivocal signs. There is, in addition, the *pulsation of the umbilical cord* or *funic souffle*, heard in certain favourable positions of the fœtus; it is synchronous with the fœtal pulsations.

In the larger animals, auscultation of the abdomen for the purpose of discovering the existence of these sounds is very often unsuccessful, because of the intestinal walls, the rumblings and noises of the intestines, and those of the rumen in the Cow, the large quantity of amniotic fluid, the position of the fœtus, etc., which entirely mask the *bruits* of the fœtal heart; so that it is seldom, if ever, resorted to. Lafosse and others, however, have resorted to it, and apparently with satisfactory results. Lafosse states that, on several occasions, he heard the pulsations of the fœtal heart very distinctly in Cows which were six months pregnant; though he also asserts that they cannot always be perceived on auscultation. Hollmann likewise mentions that he has often heard these fœtal beats, which varied from 113 to 128 per minute, those of the Cow being 64 to 70, and were not markedly influenced by the state of the mother's health; he acknowledges that they cannot be heard in every instance, even towards the end of pregnancy. Saake, using the stethoscope in the right iliac region, in front and a little above the crural arch, recorded the number of beats of the fœtal heart from the twenty-fifth week up to two hours before birth; though he was certain, from their distinctness, that they might have been heard earlier. In number they varied from 126 to 128 per minute, the mother's pulse being 68 to 84.

Rainard, Trasbot, and others, have not succeeded in detecting these sounds; and I have on several occasions practised auscultation on pregnant Mares, but have failed to distinguish the fœtal pulsations.

But there is no reason why, as suggested by M. Trasbot, the uterus should not be auscultated from the cervix, by a long special stethoscope —or rather "metroscope"—introduced by the vagina, its wide end resting on the cervix. The intestinal noises would be evaded in this way, and the fluids surrounding the fœtus being good conductors of sound, the beats of its heart should be distinctly heard, if it is alive. Nauche, so long ago as 1826, and Verardini, in 1871, have spoken strongly in favour of this *intra-vaginal* auscultation in the human species.

From what has been said of the signs of pregnancy, it will be perceived that, in the early period of this condition, there is but little more than supposition to guide us, the presumptions becoming stronger as the physical and other indications are more marked. It is only, however, towards the middle period, when all the rational and physical signs are present, and when the condition of the uterus has been ascertained by the exploratory manœuvres above described, that we can affirm, without the danger of error, the existence of pregnancy. And when a doubt chances to prevail at this stage, it is well to remember that this condition may exist without being accompanied by very evident signs, and that a hasty conclusion must not be drawn. When, for instance, some rational signs present give rise to the presumption

that an animal is pregnant, but no physical indication reveals this state, the examinations must be repeated before a final decision is arrived at. The value of experience and observation, when added to theoretical knowledge, is well displayed in this branch of veterinary science. Not unfrequently the diagnosis of pregnancy is surrounded by great difficulties, and a guarded opinion must therefore always be given.

SECTION IV.—DURATION OF PREGNANCY.

The *duration of pregnancy* varies considerably in different species of domesticated animals; and even in the same species there are individual variations which, though not very great, are yet important; so that the exact term cannot be rigorously fixed. From the doe Rabbit, which carries its young only twenty-eight to thirty days, to the female Elephant, whose period of pregnancy is, according to report, two years, there are a number of intermediate terms; and it is scarcely possible to establish a satisfactory relationship between the duration of pregnancy and the other conditions of organisation—such as size or longevity. In closely allied species, and which may couple and produce hybrids—as the Horse and Ass, Sheep and Goat—the period is pretty nearly the same.

With regard to breeds, Wilhelms has remarked that the Hungarian Cow averages ten days more than the Dutch Cow. With the male fœtus, the duration of gestation is greater than in the case of a female. It has even been remarked that the male parent may have an influence in this direction. For instance, a Mare which has been put to a thoroughbred Horse will be longer pregnant than when impregnated by a common-bred stallion; and the Mare which has been fecundated by a stallion Ass goes longer than when impregnated by a Horse. The duration of pregnancy also depends upon the age of the female, and her strength and condition; a weakly or much-worn animal does not go so long as one which is strong and well fed.

The differences in individuals of the same breed or species may be partly accounted for by the fact, that impregnation is possible at any time during œstrum—a variable period; and if coitus has taken place several times during this condition, it is impossible to predict when conception took place. And even when contact has only occurred once between the male and female, fecundation does not necessarily coincide with this intercourse; as the ovum may meet the spermatozoa in different regions of the uterine system, and may therefore only be fertilised some days after copulation. The time required for the ovum to pass through the Fallopian tube also varies in different animals. In the Rabbit and Guinea-pig, for instance, it takes three days; in Ruminants from four to five days, and in the Bitch from eight to ten days.

And, as has been remarked, various circumstances may retard or accelerate the development of the fœtus; not only this, but with some animals it may apparently remain for a number of days in the uterus after it is ready for birth, without inconvenience to the mother or itself, just as it may be born several days before the ordinary period without compromising its safety.

For these reasons, the period of pregnancy can only be approximately fixed, though there are of course limits beyond which Nature, ever provident and watchful for the preservation of species, cannot go without ceasing to be natural.

Mare.

The usual period of gestation with the Mare is *eleven months*, though it may vary between ten and twelve.

From the observations of Winter, Brugnone, Tessier, and Grille, made on 284 Mares, it results that the shortest period of gestation was 307 days, and the longest 394 days—or a mean duration of 346 days.

Gayot, in 25 instances noted at the Haras of Pin, France, found the average to be 343½ days; the shortest being 324 days, and the longest 367 days.

A writer in the *Journal d'Economie rurale belge* for 1829, cited by Rainard, gives as the minimum 322 days, maximum 419 days, the average being 347 days.

Colin gives the average as 345 days, though birth may occur at 330th to 365th, and sometimes to the 380th day.

Dieterichs gives the shortest period as 307 to 317 days, and the longest as 409 to 419 days—the average being 336 to 342 days. Baumeister and Rueff give a minimum of 330 days, or eleven months, the maximum as 420 days, or fourteen months[1]—the average as 340 days, or 11⅓ months.

A correspondent of the *Field* (May 26th, 1894) alludes to a Mare which foaled twelve months and twenty-five days after the last service.

With regard to the influence of breed on the duration of pregnancy, we have the researches of Baumeister and Rueff; from these it appears that, with pure-bred Persian mares, the gestation period was 341 days—343 for male foals, and 338 for females; in thoroughbred Arab Mares, the average was 338 days—339 for males and 337 for females; in high-bred Russian Mares, some of which belonged to the Orloff race, the average duration was 341½ days—341 for males and 342 for females. With English Mares, they found that in half-breds the average was 339½ days—340 for males, and 339 for females.

Saint-Cyr, referring more particularly to Gayot's observations, arrives at the following conclusions:

1. In the Mare, the normal duration of pregnancy may be fixed between 340 to 350 days—this being the interval in which the majority of Foals are born.

2. Some Foals may be born alive from the 300th to the 310th day, but this is rare.

[1] Hamon (*Recueil de Méd. Vétérinaire*, 1867) alludes to the case of a Mare seven years old, which went beyond her ordinary period of pregnancy, only manifesting at the usual time the customary signs of foaling; though these soon ceased, but recurred again in fifteen days, only to disappear in a short time. After this interval the animal appeared to be quite well, feeding and working as before. At the seventeenth month of pregnancy she was in the same condition; but on the fifteenth day of the eighteenth month, she was seized with serious symptoms which continued during four days, when death ensued. Hamon examined the body in the presence of many people, who were much interested in the case, and discovered a Foal which weighed seventy-five kilogrammes, and was as fat and fresh-looking as if it had been extracted at the normal period. The tongue protruded from the mouth, the eyes were almost gone, the muscles were well developed but somewhat bloodless, and the position of the fœtus was natural. The umbilical cord had the same aspect as in ordinary cases, but there was no blood in its vessels, and it was ruptured at five or six centimetres from the abdominal walls. The fœtal envelopes were hypertrophied, their total thickness being four to five centimetres; otherwise they were healthy. The *cervix uteri* was of a great thickness and very rigid; when dilated it would only allow the passage of the fist. The *liquor amnii* was reddish-coloured.

3. Births are frequent between 325 and 340 days.

4. They are not rare from 350 to 365 days, but they are indeed so after the latter period.

5. We may consider 300 to 400 days as the extreme limits within which normal gestation occurs in the Mare; below or beyond these it ceases to be natural and really physiological.

6. According to the researches of M. Gayot, pregnancy is often a little longer for a Colt than a Filly; and though this conclusion is certainly not founded on a sufficiently large number of observations, it nevertheless acquires a certain degree of probability from being in conformity with what is observed in the Bovine species.

The average duration of pregnancy with thirty-three thoroughbred Mares which foaled at the celebrated Middle Park Stud, Eltham, in 1876, I find on examination to be 335½ days—the shortest periods being 316 days (one instance), and 318 days (one instance); and the longest 354 days (one instance), and 348 days (one instance). Between the 320th and 330th days, there were only 5 instances; between the 330th and 340th days, there were 11 instances; and between the 340th and 348th days there were 15 instances. Owing to some of the Mares having been put to the Horse more than once, and in some cases at intervals of several days, the averages may not be absolutely correct, as the last coitus has been the one which is reckoned from. But with one Mare (Entremet) put only once to the Stallion (Rosicrucian), the period was 324 days; with another (Hilda) put to the same Stallion, the period was 332 days; and with another (Imogene) and this Stallion, it was 342 days.

With regard to sex, there were sixteen Colts and seventeen Fillies: the average gestation period of the former was 336½ days, and the latter 334 days. The shortest periods (316 and 318 days) were with Fillies, and the longest periods were also with Fillies (354 and 348 days). The ages of the Mares ranged from five to nineteen years; there being three at five, two at six, three at seven, two at nine, two at ten, six at twelve, four at fourteen, four at fifteen, two at sixteen, one at seventeen, one at eighteen, and three at nineteen. In the first group, pregnancy averaged 340 days; in the second 350½ days; in the third 328⅔ days; in the fourth 340½ days; in the fifth 336 days; in the sixth 337½ days; in the seventh 336½ days; in the eighth 333 days; in the ninth 340½ days; in the tenth 324 days; in the eleventh 330; in the twelfth 325. These figures would go to prove that the period of gestation decreases with age; and indeed we find that the shortest pregnancies occurred in Mares nineteen years old (316 and 318 days), and the longest in six and nine years old Mares (354 and 348 days).

The animals were of course kept in the most favourable conditions for breeding; and this, with their splendid qualities and precocity, doubtless shortened the period of gestation, which is below the ordinary average.[1]

[1] An extensive horse-breeder in Oregon, U.S.A., has been making some interesting observations on the duration of pregnancy in Mares, as influenced by the season. He writes: "On the 20th of July, 1879, I bred a Mare, and she foaled on the 30th of the following May. The next spring I bred my Mares early, and they carried their Foals about eleven and a half months. The thought occurred to me then that Mares bred early in spring carried their Foals longer than those bred later. For the next two seasons I took charge of a band of Mares, and found that those bred in April carried their Foals longer than those bred in May, and that those bred in May went longer than those bred in June and July. Since then I have had considerable bad luck with my Mares getting

It is also generally admitted that pregnancy is of longer duration in the Ass than the Equine species—from 358 to 385 days.

In a stud-book kept in this country, a record is given of observations, from which it appears that the shortest period of gestation in the Ass in eight carefully-recorded entries was 365 days, and the longest 385 days, of which there were two cases. The mean period was 374 days. The males and females were foreign. When the female Ass has been covered by the horse Stallion, the period of gestation is not so long.

Cow.

It is commonly believed that the Cow is pregnant for the same length of time as woman, and this is to a certain extent correct, so far as the average period is concerned; but there are variations which must be taken into account, and which will be apparent if we look at the published results of various observers. Of 1,062 observations made at the Agricultural School of Saulsaie, and by Blaine, Tessier, Grille, and Fürstenberg, we find that 15 were pregnant for less than 241 days, 52 from 241 to 270 days, 119 from 271 to 280 days, 544 from 271 to 300 days, 230 from 281 to 290 days, 70 from 290 to 300 days, and 32 beyond 301 days. So that it would appear that, with the Cow, parturition is very rare before the 241st day; not so rare after the 300th day; somewhat common from the 240th to the 270th day; and quite common between the 280th and the 290th day; the average duration of pregnancy being about 283 days. Colin gives an average of from 280 to 285 days, though birth may occur at the 250th to the 300th day, and even later.

Dieterichs gives the shortest period as from 210 to 226 days; the longest between 326 and 353 days—average, 286 days; while Baumeister and Rueff give the shortest they observed as 240 days, and the longest 330 days—average, 285 days. The average of the Bernese Simmenthaler breed at Hohenheim was 280½ days: male Calves 283 days, and cow Calves 278 days.

Earl Spencer has furnished notes of 764 observations, which would go to prove that no Calf can be born alive before the 220th, nor after the 313th day, and that it is impossible to rear those born before the 242nd day. Those births which occurred before the 260th day he considered as decidedly premature, while those which took place after 300 days were classed as irregular. In 314 instances, 310 calved after the 285th day, three went on to the 306th day, and one to the 313th. The average given is 284 to 285 days. Among the Calves born between the 290th and 300th day, there was a decided preponderance of males; all those produced after the 300th day were females.

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with foal on the Range by scrub Horses, and have only kept the time of those that I was certain of as to time of breeding. The average number of days of gestation for nineteen Mares bred in April is 348 days; average for twenty-three Mares bred in May is 345 days; average for thirteen Mares bred in June and July is 338 days; longest time of any Mare bred in April is 360 days, shortest time of any Mare bred in April is 332 days; longest time of any Mare bred in May is 360 days, shortest time of any Mare bred in May is 323 days; longest time of any Mare bred in June and July is 354 days, shortest time of any Mare bred in June and July is 314 days. The last Mare referred to was a virgin Mare, and very fat at the time of breeding, and continued so up to the time of foaling. Mares here in Oregon usually get very poor during the winter months, but have an abundance of nutritious grass to run on during the spring and summer months. It is my opinion that Mares which have an abundance of nutritious food for a time previous to foaling, bring the fœtus to maturity sooner than they would were they kept on a small amount of very innutritious food."

In the *American Journal of the Medical Sciences* for 1845, the result of observations on 62 Cows gives the longest period as 336 days, and the shortest as 213 days: the average for the male Calves being 288 days, and females 282 days.

An American breeder, in the *New Live Stock Journal* for July, 1882, gives the following observations. Only Cows were noted which had a single service, the Bull being kept isolated and no other Bulls accessible. With an equal number of male and female Calves, the average with the males was one day longer.

Cows.	No. of days.	Shortest No. of days.	Longest No. of days.
15 in 1877 averaged	287	282	296
14 in 1878 ,, ...	286	279	292
17 in 1879 ,, ...	285	276 (twins)	295
15 in 1880 ,, ...	286	280	291
9 in 1881 ,, ...	286	282	292

Cattle-breeders, we believe, generally entertain the notion, notwithstanding Earl Spencer's observations, that gestation is longer for a male than a female Calf.

It would appear that precocity has a notable influence on the duration of pregnancy in the Cow, in the more improved breeds the period being shortened; though the Calves at birth are not so well developed as those of the common breeds.

Sheep and Goat.

The Sheep and Goat go with young about *five months*. M. Magne carefully noted the pregnancy of 429 Sheep at the Alfort Veterinary School during a period of eight years, with the following result:

2	instances of	143 days	57	instances of	150 days
15	,,	144 ,,	49	,,	151 ,,
22	,,	145 ,,	23	,,	152 ,,
30	,,	146 ,,	13	,,	153 ,,
55	,,	147 ,,	7	,,	154 ,,
68	,,	148 ,,	7	,,	155 ,,
80	,,	149 ,,	3	,,	156 ,,

From this list we observe that the difference between the longest and shortest period was only thirteen days, by far the largest number of births occurring between the 147th and 151st days; the shortest was 143 days and the longest 156 days. The average duration of pregnancy was about 149 days. Gestation was longer with the female than the male Lambs, and this Magne attempts to explain by the greater development and weight of the former, which rendered parturition more difficult and slow.

Colin says the average period in the Sheep is 151 to 152 days, though parturition may take place from the 145th to the 160th day.

Dieterichs gives the shortest period as 146 days, the longest 157—average 151 days; and Baumeister and Rueff state the shortest period in the Sheep and Goat as 135 days, the longest 160—average, 144 days; the male Lambs requiring, as usual, the longest period. With regard to

breed, these authorities found that the period of gestation in Merinos averaged 150·3 days; while with Southdowns it was only 144·2 days, or six days less.

In the Merinos, for the male Lamb the average period was 151·1 days, female Lamb 150·6 days, and twins 149·9 days; and in the Southdowns, for the male Lamb 144·7 days, female Lamb 144·1, and twins 144 days.

Mayne asserts that the Goat goes a little longer than the Sheep—the average being five months and some days; another authority gives it as 148 days.

Pig.

The Pig is usually pregnant *four months*, or according to some authorities *three months, three weeks*, and *three days*. Baumeister and Rueff give the longest period as 130 days, the shortest 110—average, 120; while Dieterichs gives 109 days as the shortest and 133 as the longest—average, 115 to 116 days; and Magne says that it is rarely less than 109 or more than 120 days. Rainard noted the period of gestation in 65 Pigs, and reports it to be as follows:

2	instances	104 days.
10	,,	110 to 115 days.
23	,,	116 to 120 days.
27	,,	121 to 125 days.
2	,,	126 days.
1	,,	127 days.

The average was, therefore, 119 days, the interval between the longest and shortest periods being 23 days.

Bitch.

The Bitch goes with young about *two months*, or from 58 to 65 days; the average being 63 days or nine weeks. Baumeister and Rueff state the shortest period to be 55 days, and the longest 70—the average being 60 days.

Cat.

The Cat is pregnant from 50 to 60, 62, or even 64 days, the average being 55 days or eight weeks.

SECTION V.—GEMELLIPAROUS AND MULTIPAROUS PREGNANCY.

Among the domestic animals there are species which are naturally *uniparous*—produce only one at a birth; and others which, in a normal or physiological manner, bring forth two, three, or more at a time, and are therefore designated *gemelliparous* or *multiparous*, gestation being known as double, triple, quadruple, etc. As examples of *uniparous* animals, we may give the Mare, Ass, Cow, Sheep and Goat; while we may cite the Pig, Bitch, and Cat as *multiparous* creatures. As multiparity is normal with the latter, we shall not specially refer to them, but will allude to those creatures which, naturally uniparous, sometimes bring forth more than one progeny at a time.

It is seldom that twins or triplets are produced by the larger domesticated animals, and particularly by the Mare and Ass, though instances are recorded of these; while in the Cow, Sheep, and Goat

the occurrence of twins, triplets, or even more young creatures at a birth, is not so rare.

The causes of *multiparity* are not well ascertained. It may be due to simultaneous ripening of two or more Graafian vesicles, which, rupturing at the same time, allow the escape of the ova they contain, and which may become impregnated at a single *coitus*. Or a Graafian vesicle may contain two or more ova, as Bischoff has witnessed in woman; and these arriving together in the uterus, may be fecundated at one time. Or it may even happen that the vitelline membrane contains two yolks, as sometimes occurs in the fowl's egg; and as the vitelline mass is the essential part of the egg, it is evident that when this contains two of these masses, they ought, if fecundated, to produce two embryos.

In the first case, each fœtus has ordinarily all its appendages distinct and completely independent; or it may be that the two chorions are fused together, in which circumstance the two fœtuses will then have a common envelope. In the second hypothesis, this fusion of the chorions appears to be the rule, although the envelopes may also be independent; and in the third case—that of the two vitelluses contained in the same vitelline membrane—not only the envelopes, but also the fœtuses may become united more or less closely, and thus give rise to *double monsters*.

Finally, it is also possible that two ova may become detached from the ovarian cluster, though not simultaneously, but successively; and be fecundated, one after another, at two consecutive copulations within a brief period. Occurrences of this kind, by no means rare, have been wrongly adduced as instances of superfœtation.

Mare.

Of all the domestic animals, the Mare is the one which least frequently brings forth more than a single creature at a birth; and Saint-Cyr has only been able to collect fourteen instances, though we have been more fortunate. Rueff admits that one case of gemellar gestation may occur in this animal in every 250 normal cases, but that the young are nearly always born dead or die soon after birth. In the register of a stud, only one instance of twins was found in every 236$\frac{2}{7}$ births.

Demoussy, cited by Saint-Cyr, observed an example of double gestation; but the Foals, though alive when born, perished soon after. Lemaître gives a similar instance; only that one of the fœtuses was expelled at four months, while the other was retained, was foaled alive at the usual time, and survived. Trélut has seen a Mare which, at the tenth month of pregnancy, cast two well-formed Foals. She had been put to the stallion five times—on April 23, May 4, 16, and 25, and June 5; she aborted on March 15. Her abdomen was enormously large, and some time before abortion she had received a kick in the flank.

A fourth example of double gestation is related by Goux. The two Foals—a Colt and a Filly—were alive when born, and continued to thrive. Saint-Cyr's father, an agriculturist, witnessed an analogous occurrence, the progeny also surviving; and Saint-Cyr himself saw a twin birth in a Mare, one of the Foals, which was born dead, weighing 25 kilogrammes; the other, which lived, weighing nearly 26 kilogrammes.

In the *Veterinarian* are found a number of instances of twin Foals in this country. Mr. Millington (vol. iv., p. 424) gives three cases of this kind, the Foals being born alive. In vol. ix. (p. 450) an account is given of a Mare which died of hydrops uteri, in which were twin Foals; in vol. xii. (p. 288) is another account of two born dead, and in vol. xvii. (p. 177) a similar instance.

A most unusual case of twin-birth is related in the *North British Agriculturist* for May 17, 1876:—A Mare, the property of Mr. Chapman, farmer, Halnaby, gave birth to

a Colt and Filly foal on the 2nd March, 1875, both living. On the 16th March, 1876, she brought forth two filly Foals, thus giving birth to four Foals—one Colt and three Fillies—in less than thirteen months.

The *Field* (May 10, 1873) reports a Mare in Devonshire, which produced twin Foals three times within three years. The Mare went full time in each instance, but only one Foal (they were all Colts) lived for any length of time. According to the *Liverpool Mercury* (July 23, 1845) a Mare at Abringhall, fifteen years old, brought forth *four* Colts in the space of fifteen months!

Raabe, in 1852, witnessed a *triple* birth in a five-year-old Mare; the three Foals were born alive, and were completely developed, but they soon died.

Two instances of triple birth are given by Saint-Cyr, the most remarkable being that recorded by Paugoué. This occurred with a Mare which, put to the Horse *only once*, on February 17, 1843, aborted during the night of September 27-28, two Foals being found in one chorion; on the 25th of the following February, it produced a third Foal perfectly formed, and which lived. In the second case, related by Devilliers, the Mare had been put to the Stallion several times in May, June, and July. On March 10 it produced three properly-formed but dead Foals, one having apparently ceased to live some days before.

In the *Veterinarian* for 1875 (p. 334) allusion is made to an agricultural Mare in Norfolk, eight years old, and not known to have been previously bred from, producing three Foals at a birth. The first was dead, and appeared to have been so for several days. The second was born alive immediately after the birth of the first, but only lived about half an hour. The third was born dead seven hours after the second, but its condition showed that at the time parturition commenced it was alive. The Foals were all of the same colour—bay—and were perfectly formed. The Mare made a good recovery. In the same journal for 1867 (p. 595), Mr. Newman, of Havant, reports the birth of three fine, well-developed Foals, two of which were born alive and lived. The Mare, of the cart-breed, had gone the full period of pregnancy.

In the *Veterinary Journal* for March, 1882, Macgillivray reports the case of a Mare twenty-one years old, which produced three Foals at a birth, one of which was dead. Two years previously she had twin Foals.

The most numerous instances of twin or triple gestation in the Mare are, however, to be attributed to two successive fecundations, of which Saint-Cyr has collected eight examples. In all of these, strange to say, the Mares had been put to a Stallion of the Equine and Asinine species in succession, and brought forth each a Foal and a Mule. In the majority of these instances, the two fecundations were within a brief period—the one succeeding the other immediately, or, at any rate, within the same day; though in one instance there was an interval of fifteen days. Which was the elder of the two Foals in these births—the one first born or the one first conceived? Though in the human species such a question might have some importance, with animals it has only a physiological interest; but the order in which they were born would, nevertheless, be the only rational assignment.

The female Ass more frequently brings forth twins than the Mare; but even in this animal such an occurrence is rare. In an average of thirty she-Asses, kept for the production of milk by a man at La Chapelle Saint-Denis, only four had twins in a period of seventeen years.

Cow.

Double and triple births are not so unusual in the Cow, the former being far from uncommon. Indeed, it is so frequent in some breeds, and with individuals, that it has been suggested to produce by selection a breed of Cows which would habitually have twins; while even quadruple, quintuple, and more births have been recorded.

Mr. J. Macgillivray, of Banff, in an excellent little "Manual of Veterinary Science and Practice," published in 1857, writes:—"A neighbour of mine, Mr. Peter Low, had

a Cow, a splendid animal, of the cross breed, which had twin Calves yearly for six successive years. Two of her female progeny have had twin Calves repeatedly. Mr. Low kept one of her male twins, a Bull ; to him two Cows have had twin calves, and there are a number of Cows in calf to him just now. From this and other similar cases, I think there is no doubt but, by proper selection and management, a race of twin-bearing cattle might be established." And again he says :—" From a paper now lying before me, I shall record what I believe to be a unique case of a calf-producing Cow. I am indebted for the particulars to Mr. James Stephen, Balfluig Cottage, Alford. ' Memorandum regarding a small Cow of the black Polled breed, which belonged to the late Mr. Alexander Stephen, Farmton, Alford :—

Year.	Number of Calves at a birth.
1842	1—first Calf.
1843	3—came to maturity.
1843	4—one died ; seven in one year.
1844	2—came to maturity.
1845	3—came to maturity.
1846	6—died prematurely.
1847	2—came to maturity.
1848	4.' "

Rueff says that, with the Simmenthaler breed of cattle at Hohenheim, during an interval of ten years, there were four per cent. twin births.

Triple gestation is of course much more uncommon, but the instances on record are numerous.

Dupuy mentions a very unusual instance of fecundity in a Cow which, at three births in successive years—1817, 1818, and 1819—brought forth nine Calves, only two of which were not reared by the mother ; these Calves afterwards had only one offspring at each birth. Rainard speaks of one of his pupils delivering a Cow of three Calves in the neighbourhood of Lyons ; and Roche-Lubin gives two similar instances. In one of these the first two Calves were born alive and reared by their mother, but the third, which was in a bad position, was removed dead six days later. In the second instance, the Cow, after producing a living and properly-developed Calf, continued to strain and make fruitless efforts to get rid of the other fœtuses, until she died five days afterwards, when two Calves attached to each other by the sternum were found in the uterus. Sperling records the case of a Dutch Cow which produced three Calves ; the first was a male, the second a heifer, and the third a heifer in a wrong position. In England Mr. Snowdon has seen a Cow which brought forth a living Calf some hours after a dead one, and in a few minutes an anidian monster.

In the *Ipswich Journal* for October, 1875, mention is made of a Cow which produced six Calves in twenty months, all living : first three fine Calves, then one, and again two.

The *Liverpool Mercury* (April 9, 1847) mentions a Cow which produced sixteen Calves in eight years—two Calves at six births, three at one birth, and one at another birth. The *Mark Lane Express* (May 11, 1852) alludes to a Cow which brought forth three Calves at a birth—making eleven calves before she was seven years old. A similar instance is reported in the *Hartford Times* of Connecticut for 1881. The Cow was a three-fourths Durham. On April 16, 1877, she gave birth to twins, one male and one female ; March 19, 1878, she gave birth to triplets, two male and one female, making five Calves in eleven months and three days ; July 9, 1879, she gave birth to twins, both males ; October 7, 1880, she gave birth to triplets, two males and one female, making ten Calves in the three years five months and twenty-one days. The Calves were all of good size, healthy and handsome, and were raised on the farm.

In 1888, a Cow at Braceborough, Stamford, gave birth to twins. Her former yearly calvings were twins, a single one, a single one, twins, triplets, and then the above-mentioned twins.

The *Chester Chronicle* (February 18, 1865) reports the birth of three full-sized Calves by a Cow, all of which did well ; and the *Shrewsbury Chronicle* (July 5, 1844) gives a similar instance, but the Calves, born during the night, were found dead in the morning. In the *Field* for June 17, 1876, the birth of three Calves—a Bull and two Cows—is reported. They were alive and doing well.

Quadrigemellar gestation is also sometimes observed in the Cow.

Rainard gives two instances ; and Hamon mentions a little Breton Cow which, in 1858, produced four Calves—two male and two female, the last two dying soon after birth. Gellé gives a remarkable instance of a Cow which, in 1837, had three Calves, in 1838 two, in 1839 two, in 1840 two, and in 1841 four ! One of the last was a heifer ; all were well developed and successfully reared, and the last four, at five weeks old, weighed about forty-five pounds each.

The *Revue Vétérinaire* of Toulouse (February, 1876) gives a case of quadrigemellar parturition in a Durham Cow, aged twenty-two months, near Rochefort. Birth occurred naturally in an hour ; two cow-calves were first born, then two males ; three did not live beyond an hour, the other survived thirty-six hours.

In the *Etat Sanitaire* of the Domestic Animals in Belgium for 1877 (p. 87) mention is made of a Cow, seven months pregnant, which for eighteen days had fallen into such a state of debility that she could not rise, and she had also completely lost her appetite. She was killed, and at the autopsy four fœtuses were found. These weighed respectively 10½, 11½, 12½, and 14 kilogrammes. Three were females.

An instance is given by Saint-Cyr as occurring at Beaujeu in 1881. This was a Cow which had produced one calf at each of three births, three Calves twice, and at last four Calves ; all were strong and lively, and were reared.

The *Veterinarian* (vol. xiii., p. 579) gives an account of a delivery, with assistance, of four dead Calves. This journal also (vol. xiv., p. 15) records a case in which, with assistance, a Cow was delivered of four Calves—two dead at birth and two alive, though these soon expired. They were properly developed, and appeared to have been healthy up to parturition ; they weighed, respectively, 25½, 24, 17¾, and 17¼ lbs. From the structure of the placenta, it was concluded that each fœtus had been contained in a separate membrane and fluid. The birth was premature by two months and nine days. In the same journal (vol. xvii., p. 424) another quadruple birth is described ; the Calves were well developed and all born alive, though they soon after died.

According to the *Chester Chronicle* (March 5, 1847), a Cow brought forth three Calves, and in three days a fourth. All died soon after. The *Field* (December 7, 1872) describes the birth of four Calves by a Cow about four years old, and which had twins at a previous calving. One Calf died, but the others did well. The *Liverpool Mercury* (March 28, 1845) reports a Cow as having produced four Calves—full-sized, but dead. *Eddow's Shrewsbury Journal* (July 29, 1846) alludes to a Cow which gave birth to four bull-calves, three of which lived.

Mr. Cartwright, of Whitchurch, gives an instance of four Calves at a birth. The Cow and Calves died soon after.

In the *Field* for March 29, 1879, mention is made of a shorthorn Cow which produced four Calves at a birth—two male and two female—all alive, and five weeks old when reported. She was six years old, and lost condition very considerably for some time before calving ; she was almost hopelessly weak for weeks after that event, but ultimately did well. All the Calves were white.

A farmer at Netherseal, England, owned a Cow that gave birth to four Calves, two of them bulls, all well developed. The next day one died, but the others lived and did well, as did also their dam.

A Cow in Norfolk, eleven years old, was delivered of four full-grown Calves, but none of them survived.

Quintuple pregnancy is, of course, more rare in the Cow.

In the *Giornale di Veterinaria* for June, 1855, Professor Lessona, of Turin, describes a quintuple birth in a Cow in Piedmont. The animal was twenty days from its full time. The abdomen was very voluminous, but beyond the premature delivery there was nothing unusual attending the birth. The progeny consisted of three females and two males, and each weighed about 37½ pounds. They were healthy and fully developed ; but the mother, either through her premature delivery or from age, was unable to suckle them, and they were put to another Cow whose milk proved unsuitable for them, as they had an attack of indigestion, and in about eight days after birth all were dead. Lessona thinks two were lodged in the same envelope in each horn, and that the fifth fœtus, with a single placenta, occupied the body of the uterus with its proper envelopes. A singular fact was their being all presented for delivery in a normal position—a very extraordinary circumstance. The Cow had produced twin Calves the preceding year.

Schumann, in 1854, reports a quintuple birth—all males, and dead-born. Rueff records another, in which all the Calves lived—and one which occurred at Havingen, in a five-year-old Cow. Baron also refers to a similar instance. Mr. Garrard, of Ticknall, however, has a more favourable report of a birth of this kind. In 1854 a Cow gave birth to

five living healthy Calves, all of which were, when he wrote (a week after birth), alive and vigorous, and likely to continue so. They were nearly all of one size, and larger and stronger than could be supposed. Four were bull-calves. The Cow, by no means a large one, was eleven years old and of a mongrel breed, and had never produced more than one Calf at previous gestations. She did not manifest any unusual symptoms of exhaustion ; the first four Calves presented naturally ; the fifth was a breech presentation.

About sixteen years ago a Cow at Hohenmath, Bavaria, dropped five Calves, ranging in weight from sixteen to twenty pounds. They were all of the same colour and all dead, the dam dying soon after giving birth to them.

In 1878, Professor Freytag, of Halle University, saw a Cow at Zeit, Saxony, which gave birth to four Calves in rapid succession, and very shortly afterwards dropped another. Parturition proceeded normally, and the Cow did not appear to suffer more than usual ; but the Calves, though well developed, were born dead. The case is recorded in the *Deutsche Landwirthschaftliche Presse* for 1878.

But the most wonderful instance of fecundity yet mentioned is that of a Cow which was seen by Ferrari, who reports the case in the *Journal de Méd. Vétérinaire et de Zootechnie* for 1883. She brought forth *fourteen* Calves at *four* births. At her first delivery, in 1879, she had twins, which lived ; in 1880 she had five—two females and three males—only two of which survived and were sold ; in 1881 there were four—two males and two females—only two of which were alive ; at the fourth parturition, in 1882, she gave birth to two males and a female, one of the former dying, but the other two lived and grew well.

Kurds speaks of a Cow which aborted seven fœtuses ; while Kleinschmeid (*Magazin für Thierheilkunde*, 1857) mentions having found fifteen embryos in the uterus of an animal of this species !

In the *Veterinarian* (vol. xxxii., p. 200), Mr. Forbes, of Reigate, mentions a Cow, six years old, which at her third calving produced—three weeks premature—five Calves at a birth—four males and one female. Three of the Calves died in a few hours, the fourth in a day, and the fifth two days after they were born.

The *Chester Chronicle* (February 11, 1854) reports a Cow, between ten and eleven years old, producing five Calves—four males and one female—all of which lived. The Calves were nearly of the ordinary size, and were strong and lively. In *Eddow's Shrewsbury Journal* (September 9, 1874), mention is made of a Cow which had been purchased as barren, but which in due course produced a dead Calf, on the following day another, and so on until four were born. The Cow then died, and on being opened a fifth Calf was found. Mr. Litt, of Shrewsbury, in the same journal gives the particulars of the case of a Cow which died within a fortnight of calving, and on being opened no fewer than five fully-developed Calves were found in the uterus. They were nearly uniform in size, and, with the exception of one, which was rather emaciated, they were in a remarkably well-nourished condition. They consisted of four females and a male, and were very little smaller than ordinary Calves at birth, being about the usual size of twins. Mr. Litt was of opinion that, had they been born at the proper time, they would have lived. The Cow had not thriven so well as its companions for some time, but up to the morning of the day previous to decease, it appeared to be in perfect health. Death was probably due to the excessive drain upon the animal's system produced by so many young.

Sheep.

With the Sheep, twins are a very common occurrence ; and it is a saying that in a good flock there should be as many Lambs as Ewes, the double births compensating for the losses. Instances of extraordinary fecundity are also by no means rare, and would appear to pertain to particular breeds. Daubenton states that in the counties of Julliers and Clèves, every Sheep brings forth two or three Lambs twice a year—five Sheep producing twenty-five Lambs in twelve months. In French Flanders, according to Magne, who cites Corneille as his authority, there is a very prolific breed of Sheep, each ordinarily producing three, sometimes four, five, and six, rarely seven Lambs, at two births during the year. Tessier, speaking of this breed, while admitting that twin Lambs are not an ordinary occurrence with Sheep, assures us that in a flock composed of 371 Ewes there were 22 double births ; and

he mentions having seen a Sheep that was twenty years old, which had bred every year. A Ewe at Hohenheim, in 1845, brought forth one Lamb, the first; in 1846 two; in 1847 five; in 1848 four; 1849 three; 1850 two—in all seventeen Lambs at six births. Four of these were males, and thirteen females.

In our own country such fecundity is not very uncommon.

For instance, in the *Chamber of Agriculture Journal* for March, 1871, there is a notice of extraordinary prolificacy related by Mr. Angus, of Lowthorpe, Hull, who says:—"Last year one of my Ewes, of the Lincoln breed, brought forth six Lambs, all living. I had great difficulty in persuading my neighbours to believe this, although the fact was quite clear and well attested. I gave her a private ear-mark, and last Michaelmas a separate red mark also. As we saw this spring that she was getting heavy, we kept her quite separate from the rest of the Ewes, and last Thursday she produced another six Lambs. Some of these will not survive, as they were a few days before their proper time; but all are complete and well formed, and the Ewe is now suckling one Lamb." "The especial wonder about this woolly mother," adds the editor of the journal, "is that she belongs to a breed in which it is rare for a Ewe to drop more than three Lambs, while good luck among the Lincoln flocks is 'one half pairs,' with occasionally a three."

The *Carmarthen Journal* (March, 1844) alludes to four Ewes in that county, which in one week yeaned fourteen Lambs; one had five Lambs, and these all did well. The *Chester Chronicle* (May 25, 1867) mentions that a little Welsh Ewe at Birkenhead had two Lambs in the spring of 1864; in 1865 three, all alive; 1866, four, all living; and in 1876 five, four of which lived, and were in good health. *Bell's Weekly Messenger* (June 29, 1844) states that a farmer in Kent had a Ewe which dropped the extraordinary number of six Lambs, four of which it reared, and the other two were brought up by hand. The previous season the same Ewe produced four Lambs, all of which were reared and turned out well. According to the *Chester Chronicle* (April 11, 1868), a farmer at Otley, Yorkshire, had a Ewe, five years old, which had produced fifteen Lambs. When one year old it had two, at two years four, at three years two, at four years four, and at five years three. The *Salopian* (April 6, 1872) speaks of a Ewe at Wem, Salop, which gave birth at one time to five Lambs the previous year, and these were all reared, and in this year six were born, five of which lived. The *Chester Chronicle* (April 19, 1873) alludes to a Ewe which produced an annual average of three Lambs for seven years; the animal itself was one of three. The *Shrewsbury Chronicle* (June 26, 1874) reports that a Shropshire Ewe lambed twice in six months, producing twins each time; and the *Field* (May 12, 1873) gives an instance of a Ewe having five Lambs, one of which died in a few days, but the others did well. The *Oswestry Advertiser* (October 2, 1872) instances a Ewe which gave nine Lambs in two seasons—three and six—all fine Lambs, and in perfect health. And in the *Cambrian* newspaper for the same month, it is mentioned that "Mr. J. M. Harding, of the Town-Hill Farm, Swansea, has just had an extraordinary piece of good luck in lambing. From a small flock of seventeen Ewes, he has had no less than thirty-seven Lambs, all alive and doing well. Every Ewe has brought 'doubles,' and three have brought 'triplets.' It is not only the number of Lambs, but they are all strong and healthy. . . . There is no reason to doubt that the remainder of the flock will be equally prolific."

In the *Nottingham Journal* for 1846, it is stated that a Ewe in that locality brought forth five Lambs at a birth, all alive and likely to continue so.

Mr. Litt, already quoted, mentions the case of five Ewes which had been attacked with symptoms of brain disorder shortly before lambing, and soon died. Each, when opened, was found to have four Lambs, making twenty in all.

The *Lynn Advertiser* for February, 1872, states that a Ewe in that locality lambed on the 11th of that month, the Lamb living twenty-four hours; again on June 28, and on January 21, 1872, bringing forth twin Lambs on the last occasion. The Ewe thus lambed three times in a year and ten days.

In 1875 Mr. Robert P. Greenhill, of Elmbridge, near Droitwich, was in possession of a Ewe, seven years old, which had produced no fewer than 20 Lambs—a small flock. In the first year she gave birth to 2; in the second, 1; third, 3; fourth, 3; fifth, 4; sixth, 4; and seventh, 3.

And at Shaftesbury, it is recorded in May, 1876, that a farmer had some Ewes fatting, and a neighbour's ram got with them; consequently, 13 of them proved to be pregnant, and produced no less than 31 Lambs, all born alive (a few dead since), as follows:—

1 single	... ...	1
8 twins	... ...	16
3 threes	... ...	9
1 five	... ...	5
13 ewes.		31 lambs.

The *Field* for March 29, 1879, states that a Ewe at Adderstone Hall, Belford, Northumberland, produced five Lambs, all of which were alive and thriving some time afterwards.

The *Live Stock Journal* for April, 1878, mentions that a Ewe at St. Mary's, Orton, dropped six fine healthy Lambs—four males and two females; two of these were adopted by other Ewes, the others being suckled by the mother, an extraordinary-sized Leicester.

The *London Farmer* tells of a Border-Leicester Ewe that produced six Lambs at a birth, all living and doing well. Another Ewe, of mixed breed, had the same number at Meldon Park, Morpeth—all living. This animal had produced twenty-eight Lambs in six years—4 in 1873, 4 in 1874, 4 in 1875, 4 in 1876, 6 in 1877, and 6 in 1878.

Other similar instances might be quoted.

It may be remarked, that extraordinary fecundity in Sheep is seldom observed in the highest-bred races, which are usually uniparous; it appears to pertain more to the common breeds. Not only this, but certain years are more remarkable than others for double, treble, and quadruple births in this species.

Goat.

The Goat is generally considered a uniparous animal, but it would appear that this is a mistake, as double and triple births may be said to be the rule; not at all infrequently four are produced. But usually with three or four at a birth, one or more are feeble or born dead. It is looked upon as exceptional for only one kid to be produced at a birth.

The question has been much discussed as to whether these multiple births in animals ordinarily uniparous, are the result of one or successive copulations. The majority of the authorities in such matters are certainly of opinion that a single copulation will suffice to fecundate several ova; and they doubt if, after a fruitful copulation, it is possible for the spermatozoa to reach the ovary, supposing a second ovum to be developed, unless the second impregnation takes place very soon after the first, and before the fertilised ovum has descended into the uterus. The well-authenticated instances of superfœtation, though rare, nevertheless rather militate against this opinion; and it would appear to be impossible to explain why one animal among several hundreds, perhaps thousands, should alone bring forth "doubles" or "triplets," while all the others, placed in the same hygienic conditions, have only one offspring. It is a fact, however, that with certain breeds of Sheep an abundance of nourishment and plentiful years dispose to these multiple births.

Cornevin, as the result of inquiry in and beyond France, comes to the conclusion that in the Mare there are twins in every thousand births; in the female Ass twins in every hundred births; and in the Cow twins in every ninety births. He considers it exceptional to have multiple gestations in primiparæ, and that a Cow which has produced twins will frequently continue to do so, or sometimes even to drop three at subsequent pregnancies.

What has been said of uniparous animals does not at all apply to those which are multiparous; for although the latter may be impreg-

nated at a single copulation, and bring forth several young, yet, as a rule, they are fecundated more than once, and in fact do not cease to seek the male until after several copulations. And yet, even in these creatures, there are instances of extraordinary fecundity often recorded. With regard to the Sow, for example, I have notes of a case in which 24 young were produced, but the mother died soon after; another case in which a Sow brought forth 43 in two succeeding litters—22 in the first and 21 in the second; and another case of a Sow that had 21 living Pigs in a litter, she having then produced more than eighty young in less than two years. Then with respect to the Bitch, I have the record of a St. Bernard's that gave birth to 17 Puppies in one litter, and in the succeeding litter there were 23.

In these cases of multiple gestation in creatures naturally uniparous, one of the fœtuses occupies the ordinary situation of single gestation—the head towards the cervix uteri, the larger portion of the trunk in the body of the uterus, and the hind quarters and limbs in one of the cornua. The second fœtus occupies the whole of the other cornu; with the head turned back, or, as occurs not infrequently, in the opposite direction, and so on.

The duration of gestation in these cases is generally shorter than that of single pregnancy in the same animal, probably in consequence of the unusual distention, as well as derangement of the principal functions in the mother. The weight of the young, individually, is usually less than the average; but, collectively, it may be very much greater than that of one young creature produced at a birth. Thus, in the quadruple birth recorded by Magdinier each fœtus weighed ten to eleven kilogrammes; in that by Bouchard they only weighed from eight to nine kilogrammes; in the quintuple birth described by Cassina, each calf weighed seventeen kilogrammes, or eighty-five for the entire birth—an enormous weight. Lignana, another Italian veterinary surgeon, mentions that in a double birth in a Cow, one of the Calves which was born dead, though at full time, weighed twenty kilogrammes; and the other Calf, which was alive, weighed forty-three. In the double birth observed at Saulsaie, in which both Calves were born alive, one was twenty-eight kilogrammes and the other thirty-one.

Free-martins.

A curious fact in connection with this subject in the *Bovine* species, is that when the young are of both sexes, the *female* is in general unproductive. John Hunter drew special attention to this subject,[1] which has since received the notice of many veterinary surgeons and agriculturists. Though the anomaly has been particularly remarked in Bovine animals, yet some authorities assert that it also pertains to Solipeds, but it would seem that the Ovine species is exempt. Even of the

[1] "It is a fact known, and I believe almost universally understood, that when a Cow brings forth two Calves, one of them a Bull-calf and the other to appearance a Cow, that the Cow-calf is unfit for propagation, but the Bull-calf grows into a very proper Bull. Such a Cow-calf is called in this country a Free-martin, and is commonly as well known among the farmers as either Cow or Bull. It has all the external marks of a Cow-calf—namely, the teats, and the external female parts, called by farmers the bearing. It does not show the least inclination for the Bull, nor does the Bull ever take the least notice of it. In form it very much resembles the Ox or spayed Heifer, being considerably larger than either the Bull or the Cow, having the horns very similar to the horns of an Ox. The bellow of the Free-martin is similar to that of an Ox, having more resemblance to that of the Cow than that of the Bull."—*Observations on the Animal Economy.*

human species, it has been asserted that twins are less prolific than those born single at a birth, and their vitality is also diminished.

The fact that twin Calves are sometimes unfruitful is well known in many countries, where the female Calf receives a particular designation: as "Free-martin" in Britain; in Holland, "Queenen"; in Germany, "Zwitter," or "Zwilling"; in Swabia, "Zwicker"; in Piedmont, "Mugne"; in France, "Loures," "Taures," etc. The old Roman agriculturists knew these animals as "Tauræ." It is generally believed that the defect is only present when both Calves are females, and certainly it is very rare indeed that the male is infecund. Baumeister, however, gives an instance in which a Bull—a twin—was put to a hundred Cows, none of which produced a Calf. In Switzerland it is the belief that when the Cow-calf is born first, it will not be sterile; and that when, on the contrary, the male is born before the female, it will be unproductive. The female twin is generally a hermaphrodite, and in form more of a male than a female; the vulva is excessively contracted, and the vagina a *cul-de-sac*. The mammæ are also feebly developed, sometimes appearing as a mere trifling fold of skin, at others as a voluminous sack. The animal is usually long-legged, with muscular hind quarters. Internally, in some instances, the uterus is undeveloped; in others the ovaries are absent, and instead of them there are testicles. With others, again, there is no trace of a uterus, the vagina ending in an infundibulum—a condition which is readily ascertained in the living animal by introducing the finger. The clitoris is sometimes enormously developed, and not unusually the urine is expelled powerfully backwards. Ordinarily, the "free-martin" evinces sexual desire very rarely, if at all.[1]

[1] One of the recorded examinations of these creatures is given in the *Œsterreichische Vierteljahresschrift* for 1875 (p. 78), and was brought to the notice of the Gresnter Land and Forest Society of Austria, the veterinary surgeon to which furnished the anatomical details. The society purchased the Calf three and a half years previously, and it had never exhibited any signs of sexual instinct during that period. It was therefore killed. It was in good condition, and of the Mürzthaler breed. The head and physiognomy had a most singular appearance, resembling that of a Monkey, though the horns were strongly developed. The udder was little and hard, and the vulva small and contracted, although normal; on opening the labia no trace of a clitoris could be found. The vagina was nine to ten centimetres in length, and instead of extending forward to the *cul-de-sac*, which is often very dilated in Cows, it terminated abruptly in a funnel-shaped aperture, and here the genital organs ended, for the cervix uteri was absent, as was the uterus and Fallopian tubes, and it was only in the vicinity of the external angle of the ilium that were found small ovaries closely and curiously enveloped in fat, so that they could scarcely be recognised. The glands of Bartholin in the vagina were almost as large as an egg, and were full of blood; instead of the valve in the vagina there was a small impermeable opening. On incising the mammæ the gland substance was found to be absent, and in its stead was fibrous and adipose tissue. In fine, this twin was destitute of uterus and oviducts, and the vagina was short and constricted.

In the *Œsterreichisches Landwirthschaftliche Wochenblatt* for 1878, the observations of Professor F. Müller are published. These are based on the examination of three twin Calves. The first was a female in an early stage of uterine development, and in it he found testicles in conjunction with external feminine organs. The other two were full-grown, sterile Cow-calves; one was aged three years and two months, the other being more than two years. In both cases the external pudenda were normal, the labia firm, puffy, and well closed, and the clitoris not unduly prominent. The udder and the four teats were small in development. Both animals had in some degree a male appearance generally, and neither of them had ever been observed to be in "rut." Examination of the internal genital apparatus revealed almost exactly the same state of affairs in each case. The female generative organs were not fully developed in either. In both of them two gland-like bodies connected with the sexual apparatus were present, viz., small bodies in place of normal ovaries, and larger bodies further back in the neighbourhood of Gärtner's duct. Whether these latter bodies, which Müller is inclined to consider remnants of

The rule does not always hold good, however, as to the infecundity of twin Calves, as many instances are on record in which they have bred. For instance, in the *Veterinarian* (vol. ix., p. 22) there is an authenticated case in which the female of a twin birth, when five months old, became pregnant, and in due course produced a Calf. The next birth was *twin* Calves. And a few years ago, a Shorthorn Cow belonging to Mr. James Harrison, Water Stratford Grounds, near Buckingham, dropped twin Calves—a Bull and a Cow-calf. As the Cow was well descended, Mr. Harrison decided to keep both Calves for breeding purposes, and the experiment was quite successful, for the Heifer had a strong Cow-calf, and the Bull was the sire of three Calves.

Diagnosis of Multiple Pregnancy.

The *diagnosis* of *multiple pregnancy* in animals ordinarily uniparous, is not very certain. It is usual to say that the signs are only those indicative of a single fœtus, but exaggerated. The belly is more voluminous than when there is but one, especially in the early months; the respiration is more than usually embarrassed; the animal lies frequently, and soon moves lazily and heavily, while the posterior limbs become œdematous. These signs, it will be remarked, are obscure, as a large Foal or Calf, or some morbid condition, may occasion the disproportionate size of the abdomen and alteration in breathing; so that at best they only afford a vague presumption as to the condition of the mother. It is also said that the belly is larger on the side on which it is usually least enlarged—the left; in others, both sides are enlarged at the same time, and there the movements of the young are most evident. But this sign, in addition to being far from constant, depends upon the relative position of the progeny; as when there are two one may occupy the body, the other the cornu, of the uterus. Neither does an examination *per rectum* or *vaginam* afford any certain indication of multiple gestation; as the number of young, supposing there are more than one, cannot be sufficiently distinguished.

Auscultation, if it could be successfully applied to the larger animals —which are usually uniparous—would doubtless greatly aid in diagnosing whether a gestation was single or multiple. The distinct pulsation of the fœtal hearts, especially if at a distance from each other, and if the number of pulsations were different in the respective situations, should be conclusive proof of multiple pregnancy. It would, of course, be important to note the different situations of the pulsations, as the action of the fœtal hearts might be at times synchronous. Care would also have to be observed not to confound the beating of the maternal heart with that of the fœtus.

Wolffian bodies, are to be regarded as rudiments of testicles cannot be determined, but he admits that there is much in favour of such a view. The general result of his examination, which is in great measure corroborative of former observations, Müller gives as follows: (1) From a practical point of view, female twin Calves should never be used for breeding purposes, because they are generally barren in consequence of maldevelopment of the internal genital organs. Exceptions to this rule are few and far between: one such is recorded in *Krafft's Journal* as having been noticed in 1875. (2) The cause of such sterility depends on an arrested development of the genital glands in the earliest stage of their development from the Wolffian bodies, at which period the sex is indifferent. The view that the incomplete female is really a male not fully developed, is not supported by the two cases under notice. Neither can it be assumed with certainty that it is a hermaphrodite, although there are some grounds for justification of the latter opinion.

Position of the Fœtuses in Multiple Pregnancy.

The *relative position* of the young in the uterus in the cases already briefly alluded to, is important to remember. With regard to each other, it may be said that they usually occupy four different positions: 1. Each fœtus may be isolated and enveloped in its own proper membranes; 2. If there are two fœtuses they may have a common envelope in the chorion, and otherwise have a second separate sac; 3. Both may be developed in the same cavity and the same amniotic fluid, their membranes being common, and no partition existing between them; 4. One fœtus may be contained within the other by "inclusion," as in some of the monstrosities of which we will speak hereafter. It may be necessary, however, to state that the included fœtus may be contained in the abdominal cavity of the other individual, constituting *deep* and *abdominal inclusion;* or it may be enveloped in a subcutaneous tumour —when it is *superficial* and *cutaneous*.

In the first variety of gestation, the envelopes, where they are in contact, adhere together by means of fine connective tissue; the placentæ are often confounded (in Ruminants), or united by a kind of membranous connection, though their circulation remains distinct. In such a case the young may be expelled from the uterus together—a frequent occurrence in the Goat, according to Rainard; but more commonly, after the birth of the first fœtus, the uterus contracts on itself, enclosing the remaining progeny, which may not be born until some days after — long enough sometimes to give rise to the belief that it is a case of superfœtation. This apparently prolonged retention of the second fœtus is generally due to the fact that the first is expelled prematurely, because of the excessive distention experienced by the uterus; this organ, having thus got rid of its embarrassment and become relieved, can then maintain the second fœtus until the usual time expires. An illustrative case is given in the *Mémoires de la Société du Calvados* for 1831-32. A Mare gave birth to a dead Foal after four months' gestation, and at the ordinary time a living Foal.

If one of the Foals dies in the uterus, the other, being contained in a separate envelope, may continue to live and grow. In somewhat rare cases, the dead fœtus remains in the uterus, becomes desiccated, and is not expelled until the birth of its companion at the usual period; or, which is more common, it acts in the uterus as a foreign substance, the presence of which is irritating, and by inducing contractions of that organ it is extruded, while the living fœtus is retained and grows until the normal time for delivery.

The fœtus that has died during pregnancy may be kept in the uterus for a long time, through close adhesions existing between that organ and the placenta. A case is on record in which a fœtus was retained in this manner for two years. Rainard gives an instance of a Mare which retained a dead fœtus for a year; the animal was then fecundated again, but having died while pregnant with the second Foal, an examination of the uterus was made, and the two fœtuses were found—the first being mummified.

Death of the fœtus in these multiple cases appears to be due, either (1) to the stronger vitality of the one which lives, and which, by attracting to itself a larger share of nutriment, starves the other; (2) to the too considerable increase in volume of one fœtus, which compresses and atrophies the other; (3) or to the separation of the fœtal from the

maternal placenta, which, of course, causes an interruption to the circulation of the young animal, and a suspension of nourishment and oxygenation of its blood.

In the second variety of gestation, in which the chorion is common to the two fœtuses, but which are yet separated by the amnion, there is only one placenta ; the two having a circulation in common, through their placentæ and the umbilical vessels communicating by their vascular ramifications. In this case the expulsion of one fœtus necessarily brings about that of the other. This also occurs when both are contained in the same envelopes.

I believe only two instances are on record of inclusion : that of the first mentioned variety, in which one fœtus was found in the abdominal

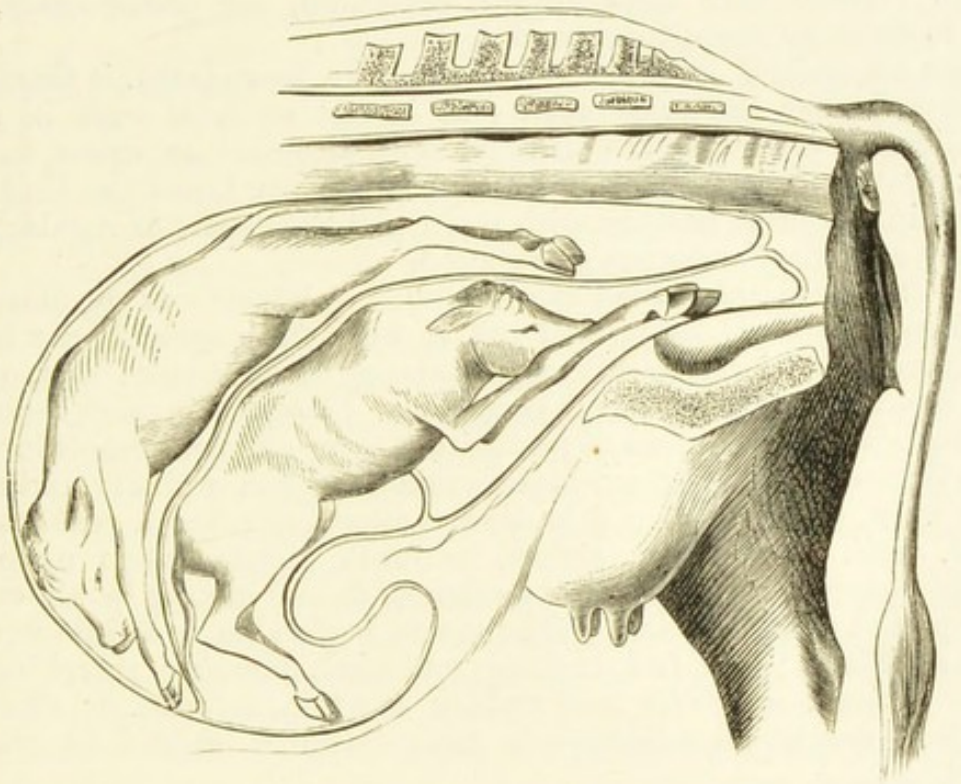

Fig. 66.

Twin Pregnancy : Cow.

cavity of the other. Bartholin, the celebrated anatomist, at the commencement of the seventeenth century described the case of a Mare which brought forth a Mule, in the abdomen of which was found another ; and Gurlt[1] mentions an instance in which one fœtus was developed within the abdominal cavity of a Calf, and consisted of an incomplete left hind leg, a membranous organ representing the uterus, and the skin and some vessels. It may be remarked, however, that Rainard witnessed an instance of this abdominal inclusion in a Goose. The egg was double the ordinary size, and it had another inside of about the ordinary dimensions ; each had a perfectly formed shell.[2] The subcutaneous tumours of young animals, containing either a whole fœtus or portions of a pre-existing one, are common.

[1] *Magazin für Thierheilkunde*, 1860, p. 347.

[2] In the *Veterinary Journal* for 1891 (p. 88), Mahon describes an instance of inclusion in a male Hare.

CHAPTER VI.

Hygiene of Pregnant Animals.

The hygienic measures to be observed in the management of animals during gestation are, in general, those which should prevail always, irrespective of this condition. But beside these there are a few particular precautions to be attended to, in order that this period may be safely and successfully passed through, and these precautions are all the more necessary as the period of birth approaches. Unlike the human female, pregnant animals do not require those careful, numerous, and minute attentions so essential to her health and the welfare of her offspring; indeed, too much nursing and pampering, by removing animals further from their natural condition, are unnecessary, and likely to do more harm than good.

When an animal is believed to have been fecundated, it should not be allowed near the *male* again; as in the artificial state in which domesticated creatures are usually kept, attempts at coitus may do harm; though it must be confessed that among Cows the Bull often remains in the same pasture with them, and they calve as regularly and as safely as if they were not so exposed.

With those animals which are employed in labour—as the Mare, and sometimes the Cow—it is well not to work them severely nor fatigue them much, and particularly as pregnancy is advanced; and, on the other hand, absolute repose is pernicious. *Exercise* is most beneficial, and the most difficult cases of parturition occur among animals to which this is denied. The pregnant Mare will accomplish ordinary and accustomed work, particularly if it be slow, without any harm, perhaps with benefit, until the seventh, eighth, or ninth month, when more care must be observed; but moderate exercise should always be allowed up to the period of parturition. Harness is preferable to saddle work for pregnant Mares; and fast trotting, galloping, jumping, travelling over broken ground, or severe and sudden exertion, injuries, or shocks of any kind, are to be avoided—in fact, extremes should be guarded against.

If the animal must be employed for riding, the use of spurs should be interdicted, because of the sudden contraction of the abdominal muscles which their application induces, and which may lead to abortion.

Should the animal not be usefully employed in this way, then it ought to be regularly exercised in hand, or placed in a paddock provided with shelter from inclement weather.

The Cow, if employed in labour, may be worked moderately until the sixth or seventh month. If kept for milk production, the milking should also cease about this period; though with well-fed Cows it is often prolonged until near parturition. Nevertheless, there can be no doubt that this practice is prejudicial to the fœtus, by arresting or retarding its development, through diverting into the mammary glands the materials which should be disposed of in the uterus.

Exercise at pasture is beneficial to all animals; even the Pig and Bitch are greatly benefited by movement.

The *food* of pregnant animals is an important consideration. Creatures in this condition should be well fed, and especially if they have to accomplish a certain amount of labour or yield milk. The

appetite is generally increased, and there is, as has been already observed, a tendency to fatten. This tendency should be somewhat guarded against, as it may prove troublesome, particularly if it is allowed to proceed to an extreme degree; when it may retard the development of the fœtus, induce abortion, cause difficult parturition, or give rise to serious after-consequences. This precaution is more to be observed in the second than the first half of pregnancy, when the food should be plentiful, but not in excess, and flesh more abundant in the animal than fat. The food should also be of good quality, very nutritious, easy of digestion, and not likely to induce constipation.

Indigestion should be carefully guarded against, and unaccustomed, hard, damp, bulky, fermentable, mouldy, or otherwise hurtfully altered food, should be avoided, as it is likely to prove indigestible, occasion tympanitis, and produce other injurious results.

Grazing on pastures is favourable to the pregnant condition of herbivorous animals, and especially if the land is not too broken, or sloping, and the herbage is good; as they take their own exercise, and breathe a purer atmosphere than that of stables or sheds. But it must be remembered that they should, if possible, be protected from damp, fogs, cold rain, stormy weather, etc. If the herbage is not sufficiently abundant and nutritive, it should be supplemented by an additional allowance of food.

In connection with food, it may be well to observe that, besides the ordinary saline matters which it is beneficial to add to the ration, especially when it is prepared for the animals, in those regions where inflammation of the joints of young creatures, and other morbid conditions due to the deficiency of certain mineral constituents in the economy are noted, it may be necessary to add these constituents to the food of the pregnant animal.

The phosphates so necessary for the formation of certain tissues of the body, for instance, may be deficient in the herbage; and this may be compensated for by giving, in addition to bran, meal, oil-cake, etc., and even properly-prepared bone-dust.

The *water* should be pure, and plentiful at all times; as then the animals will drink only moderate quantities, and when necessary.

A point to be particularly attended to, is not allowing pregnant animals to drink very cold water, nor eat food at a low temperature. We have seen that the fœtus is extremely susceptible to the action of cold, and abortion is by no means unusual through the operation of this susceptibility.

Very cold water, frozen food—such as roots, or herbage covered with white or hoar frost—should therefore be withheld from pregnant animals, as they are likely to induce abortion, metritis, and other serious accidents, either through their direct action upon the fœtus, or indirectly through the derangement they may set up in the digestive apparatus.

With regard to *dwellings*, the hygienic rules which should always be observed in buildings in which animals are kept, ought to be rigorously enforced with regard to those in which pregnant creatures are lodged. Cleanliness is, above all things, necessary to be observed. Near foaling time—three weeks or a month—the Mare should be kept apart in a roomy loose-box, and when convenient, within sight of the other Horses with which it has been accustomed to associate. The Cow is usually allowed to remain in its ordinary stall in the cow-shed; but overcrowd-

ing and want of space should not be allowed, and every Cow, towards the end of gestation, ought to have plenty of room in its stall, if a separate box cannot be allotted. Stables, sheds, and loose-boxes should have wide doors, to prevent injury to the females. With stalls, the floor should slope very little indeed, from before to behind; as if the inclination is at all marked, the weight of the gravid uterus is thrown backwards, and this may lead to abortion, prolapsus of the vagina, and even eversion of the uterus. The cow-shed ought to be kept very clean and free from bad smells, and have plenty of fresh air. The stalls should have plenty of litter, so as to prevent the Cows soiling themselves. Should a case of abortion occur in a stable or shed, among pregnant Cows, the one which has aborted ought to be removed at once, and the place it occupied thoroughly cleansed and disinfected, every trace of the accident being most scrupulously obliterated.

Cows which afford indications of approaching abortion, ought also to be removed from the vicinity of other pregnant animals, and kept apart from them so long as there is any vaginal discharge; the same precautions which must be adopted with regard to thorough disinfection and cleansing, are likewise necessary here. It is not advisable to have Cows bring forth among others whose period of gestation has not arrived.

The *cleanliness* of the animals themselves is not to be overlooked; as neglect of grooming and freeing the skin from dirt must operate perniciously not only on the mother, but also on the fœtus.

Mental and physical *tranquillity* are essential conditions of successful gestation. Harsh or cruel treatment on the part of grooms, cow-keepers, shepherds, and others, should be sternly suppressed; and fear, generally produced by young dogs hunting the animals, and particularly pregnant Sheep, is especially to be averted, if possible. It is advisable not to have animals of other species in the same field or pasture with those that are pregnant, more especially towards the period of parturition.

With an irritable or timid primipara of the larger animals, it is well to be gentle, and to accustom it to manipulation, particularly about the udder, in order that it may the more readily allow its progeny to approach it without danger.

Surgical operations, and medication in general, should be proscribed, as they may be hurtful during this state, unless they are urgently needed for the cure of disease. Above all, it is necessary to guard against the use of drastic purgatives, or even laxatives, for the relief of constipation which may not exist; as with some animals these agents, by increasing the peristaltic action of the bowels, indirectly excite contraction of the uterus. If there is constipation, suitable diet is a safer remedy than purgatives. Powerful narcotic, sedative, and other medicinal agents, if they do not injure the mother, may imperil the life of the fœtus.

We have no sufficiently trustworthy facts to prove that female animals are amenable to those mental influences which, in the human species, and known as "maternal impressions," have such a marked effect on the development or characteristics of the fœtus.

BOOK III.

PATHOLOGY OF PREGNANCY.

THE *pathology* of pregnancy may be said to include those diseases and accidents which constitute deviations from the regular or normal series of physiological phenomena characteristic of this condition. These deviations are somewhat numerous and various, and we will follow Saint-Cyr in classing them under three distinct heads: *anomalies*, *diseases*, and *accidents*. They will be studied in this order.

CHAPTER I.

Anomalies in Pregnancy.

THE anomalies occurring in gestation are *superfœtation*, *extra-uterine pregnancy*, and *spurious pregnancy*.

SECTION I.—SUPERFŒTATION.

The term *superfœtation* (*fœtus super fœtum*—one fœtus on another) has been employed to designate these cases of conception in which an animal, already pregnant, has been supposed to conceive a second time before the termination of the primary gestation. In ordinary double or triple gestation, the same copulation has produced the young at once; but in superfœtation they are supposed to be formed at a more or less wide interval of time, and of course by different copulations.

The belief in the possibility of such an occurrence in woman was common among the old writers, and cases are adduced in support of this view; but its correctness has been much disputed by some recent authorities.

Aristotle admitted the likelihood of superfœtation taking place in woman, because during pregnancy she was always with her husband; but he denied its possibility in the Mare, although he was aware that it might receive the male several times. In all probability, he imagined that the instinct of the Mare would repel the Stallion after impregnation. The naturalists and hippiatrists who succeeded him, have also denied that such an abnormal occurrence could take place in the Mare; because, they declared, after conception the orifice of the uterus is closed, so that the semen of the male cannot be introduced; every double birth, they also maintained, was due to two ova being impregnated at the one copulation.

But numerous facts recorded by competent authorities would go to prove that superfœtation is not only probable, but possible; and that if, generally, there is only one successful copulation possible, on the other hand there are instances well vouched for, in which two successive copulations have been followed by two independent impregnations. In *uniparous* animals such cases have been frequently observed, the most convincing of which is the production of a Mule-foal and a Horse-foal by the same Mare at one birth.

An occurrence of this kind is mentioned in the *Mémoires de l'Académie Royale des Sciences* for 1753; a Mare at Châtillon-sur-Sèvre brought forth a Horse and a Mule-foal.

Demoussy speaks of a M. Maillard, a wealthy farmer and breeder of horses, who had occasion to observe a similar occurrence.

In the *Journal Vétérinaire Pratique* for 1826, there is an account of a Mare which, covered on the same day by a male Ass and Stallion, brought forth in eleven months a well-formed, though weak, Mule-foal, and a full-developed, but dead, Horse-foal. In the same journal for 1836, there is another case of this kind recorded. A Mare had been put to an Ass Stallion at St. Maixent, and was shut up in an enclosed space ; into this, however, a Horse Stallion, two years old, broke, and covered this animal several times in the course of the same day. The Mare obstinately refused to be covered when afterwards put to the Horse, according to custom. At the usual period of parturition it produced two Foals, one evidently belonging to the Equine species, and the other a well-characterized Mule. These two young creatures, when three months old, were presented to M. de Vaublanc ; they were then being suckled by the Mare, and were in perfect health. The fact was verified by the Mayor of the Commune, and communicated to the administration of the Stallion depôt of St. Maixent.

In Moll and Gayot's "Connaissance Général du Cheval," Ayrault states that in Poitou, France, a Mare was put to a Stallion Ass on March 7, 1855, and on the 28th, being still "in season," was put to a Horse. The following year, during the night of April 14-15, this Mare produced a Colt-foal at eight o'clock, and a Filly-mule at eleven o'clock ; so that the oldest fœtus was born three hours after the youngest.

In the *Journal des Vétérinaires du Midi* for 1859, Dr. Chabaud relates that in the Commune of Verniolle (Ariège), a Mare was put to a Stallion Ass. As œstrum continued, it was put to a Stallion fifteen days afterwards. Nothing unusual occurred during gestation, and when parturition took place, a fine healthy Foal was born, and after ten minutes' straining, to the astonishment of the owner, a good well-formed Mule. The Mare suckled the two, and they did well.

In the *Journal des Vétérinaires du Midi* for 1864, M. Gilis gives a similar account of a Mare that had been covered by a Stallion, then some minutes afterwards by an Ass, and in twelve months had two Foals, perfect in their conformation—one, a Mule, died soon after birth, and the other, a Horse-foal, did well.

Lanzillotti-Buonsanti mentions a Mare which, on March 28, 1851, was put to an English Stallion, and on April 5 to a Barb ; on February 28, 1852, it produced two Foals, each resembling one of the Stallions. Lessona speaks of a Mare which was put to a Horse in 1852, and sixteen days afterwards to a Persian Stallion ; at eight months' pregnancy it dropped a Horse-foal, and in two hours after a Mule-foal.[1]

In the *Veterinarian* (vol. xxx., p. 78), Mr. Evans refers to a Mare which was put three times to the Horse, about six weeks intervening between each time. Two months prior to the ordinary period of parturition from the last coitus, two Foals were produced, one alive and full grown, the other so immature that it died immediately. The same journal (vol. xxxix., p. 444) contains another instance, in which a Mare was put to a Cart-Horse on May 20, but showing symptoms of œstrum subsequently, was again put to him on June 19. At the commencement of the following April two fœtuses were born, each being in a different stage of development, and one of them apparently a month older than the other. The same Mare had aborted the previous year.

In the *Mémoires* of the Veterinary Society of Calvados, vol. ii., M. Lemaitre describes the case of a Mare which aborted on December 2, and in the following June brought forth a Foal which continued to live. Trelut, in the *Journal des Vétérinaires du Midi* for 1844, mentions a Mare, eleven years old, which was put to the Horse on April 23, on the 4th, 6th, and 25th of May, and again on June 5, 1845. In December this Mare received some kicks on the belly and flank from a Horse, but this did not impair her health. On March 1 it slipped up, and on the 15th it aborted two Foals without

[1] All these instances are paralleled in the human female, by various authorities. Buffon, quoted by Foderé and Churchill, mentions a woman at Charleston, South Carolina, who, in 1714, was delivered of twins within a very short time of each other, the one being black, the other white. On examination the woman confessed that on a certain day, immediately after her husband had left her, a negro entered her room, and, by threatening to murder her in case of refusal, obtained connection with her. Dr. Moseley alludes to the case of a negro woman who brought forth two children at a birth, both of a size, one of which was a negro and the other a mulatto. On being interrogated upon the cause of their dissimilitude, she said she perfectly well knew the cause of it, which was that a white man belonging to the estate came to her hut one morning before she was up, and she suffered his embraces almost instantly after her black husband had quitted her. Similar illustrations are quoted by De Bouillon, Trotti, Guerarde, Delmas, Dunglison, and others.

suffering any ill effects. The first Foal had the tongue protruding from the mouth, the mucous membranes were very pale, the hair of body and mane and tail were present, the eyes were closed, the skin was colourless and looking as if macerated, and the hair was easily removed; the bloodvessels only contained a few drops of pale blood; and the muscles, pale and flaccid, did not show any signs of decomposition. The second Foal had the skin smooth and shining, but no trace of hair; the eyes were open; the mucous membrane bright red; the muscles firm and red; and the heart and vessels filled with red blood.

Cauzit, in the *Journal de Méd. Vétérinaire de Lyon* for 1859, gives an instance of superfœtation in a Mare, fecundation having occurred at an interval of eight days; and Chabaud, in the *Journal des Vét. du Midi* for 1859, mentions another case, in which fecundation must have occurred at fifteen days' interval.

An instance is reported from the United States of America. On the 20th of February, 1876, a five-year-old Mare belonging to William Driesbach, of Sparta, N.Y., foaled a dead Colt, fully developed and otherwise promising in those points which go to make up a good Horse. The Mare appeared to be well, and to the surprise of her owner, on the 2nd of April following, six weeks after the birth of her Foal, gave birth to another Colt, which was sound, healthy, well developed, and in all respects as promising a colt as could be found in the State.

In the *Journal Vétérinaire Pratique* for 1828, there is an instance given of what was supposed to be superfœtation. A fine-woolled Ewe, impregnated at the usual season in 1823, evinced in the following year, at the period of parturition, the ordinary signs of giving birth; but these subsided without any produce being born, and the animal quite recovered. The fœtus was in the abdomen, and could be easily felt. In 1824, this Ewe was again impregnated; in the early days of March, 1825, the mammæ contained milk, and soon after the symptoms of parturition became manifest; but, as before, they disappeared without any result. The animal then lost condition, became gradually weaker, and was not long in succumbing. On opening it, a perfectly developed Lamb was found in the right horn of the uterus, and in the left another well-formed fœtus of the male sex was discovered. The latter, with its envelopes, as well as the uterine cavity, were normal, except that a portion of the fluid had escaped and the fœtus was dead; the cervix uteri, however, was constricted by the presence of a newly-formed mass of matter, which was so hard that it could scarcely be cut through—a circumstance that appeared to explain the impossibility of delivery.

Hering (*Repert. für Thierheilkunde*, Jahrgang ix., p. 1) alludes to instances of superfœtation in the Cow and Sheep. An English breeder recently reported a remarkable case of superfœtation in the Cow, as follows:—"I have a Cow that on August 9 last had a Heifer Calf, apparently at full time; indeed, so fine a one that I am rearing it. The Cow milked well for about a month, and then suddenly lessened the quantity, and shortly ceased to give any. On September 26 she took the Bull, and from that time I noticed nothing unusual with her, though constantly seeing her, until December 24, when she had another Calf, a Bull, strong and full-sized, and certainly not premature. The Calf is now alive and doing well, and the mother is giving as much milk as after any of her previous calvings. She was running with a Bull during last March and until April 25, when the Bull was castrated, and she could not have had access to any other until September 26, when she was seen to be in season and sent to a neighbour's Bull and served.

From the facts already accumulated it may, then, be concluded that superfœtation in the Mare may occur, and indeed has occurred, several times. It has been argued against these facts that superfœtation is impossible, because a Mare that has once conceived would be exceedingly liable to abortion if submitted to a second service; but it is more than doubtful that abortion should be the inevitable consequence of repeated copulation; and we have the human species to adduce in proof of the comparative innocuousness of sexual intercourse during pregnancy. So far as researches have gone, however, it must be confessed that these double conceptions have only occurred in uniparous animals by successive copulations on the same day, or within a few days; and we are therefore without any indication that this could occur in them at longer intervals. This, it will be evident, is no very strong proof of superfœtation having taken place; for in the case of the Mule and Horse Foal, it only proves that a double conception may occur from

intercourse with two different animals within a very short period. If a longer period—say three or four months—intervened, then superfœtation would be admissible, and would perhaps be undeniable, provided there was nothing abnormal in the uterus—such as a double organ.

Rainard remarks that torsion of the neck of the uterus in the Cow, though preventing the birth of the fœtus, may nevertheless permit new conceptions. With inversion of the uterus and torsion of the cervix, parturition is impossible; so that instead of attempting to deliver by a sanguinary and dangerous operation, the success of which is very doubtful, the animal, if not killed for consumption as food, is generally left to the efforts of nature; should the season be favourable it is allowed to remain at pasture, and frequently after some suffering the creature regains its condition, even becomes fat, and may then be advantageously sold to the butcher. Towards the spring-time, such an animal might conceive again without having been delivered of the first fœtus.

In *multiparous* animals there can scarcely be a doubt that superfœtation may take place, and perhaps of all those which have been domesticated the Rabbit furnishes the most striking example. With this creature a new fecundation may occur in the middle of pregnancy. This, of course, can be accounted for by the anatomical disposition of the generative organs, the two cornua of the uterus opening into the vagina independently; so that a primary fecundation may occur only from one ovary in the corresponding horn, the other remaining open and unoccupied.

In the Sow, many instances are published in favour of superfœtation. One of these is given by Müller, of Hildesheim, in 1887. Twenty-one days after the birth of a litter of six Piglings, the mother Sow became restless and irritable and refused to suckle them. Two days later, that is twenty-three days after birth, a second litter of eleven, all well-formed and healthy, appeared upon the scene. Five of the first and nine of the second litter are still doing well. It is remarked that the mother had access to the Boar for some weeks after the first impregnation, and the authenticity of the account is stated to be beyond dispute.

In the Bitch, many observers have assured themselves that superfœtation is by no means unfrequent. Rainard, Blaine, and others speak of it. Blaine says, "I am disposed to think that Bitches are capable of superfœtation; that is, they conceive more than once. If this is the case, a Bitch may copulate to-day, and become impregnated, and in a day or two she may copulate again, and again become impregnated. This is not frequent, I believe; but it certainly does happen, or we could not account for the different periods at which the progeny sometimes appear. I have known a week, and in one case even ten days, intervene between the puppings; but one or two days is not at all uncommon, As a still more convincing proof, the whelps often appear of different kinds."

It must be remembered that the bitch remains in "heat" for three or four days, and will seek for repeated intercourse with the male during that period. It must, therefore, either be concluded that the last intercourse was the successful one, or that one or more ova were impregnated at each copulation.

So far as our knowledge at present extends, we can neither positively negative nor absolutely admit the possibility of superfœtation in the

larger domesticated animals. The cases recorded have not been sufficiently investigated to convince those who deny the likelihood of two conceptions taking place after a certain interval; and it must be admitted that a true explanation of such a singular occurrence has not yet been offered. A lapse of time occurring between the birth of two animals is no strong proof of a second impregnation during conception; for, as we shall see hereafter, when twins are conceived from the same intercourse, it may and does happen that one ovum does not attain maturity so soon as the other, and is either rejected or retained after a more or less lengthened interval—a circumstance which might mislead. And again, with regard to the size of twins, it is not at all unusual to find one larger and more developed than the other, though both were produced at the same period. Putting aside the question of superfœtation in animals, the anatomical disposition of whose generative organs evidently permits such an occurrence, a little consideration will show that usually there are physical obstacles which would appear to offer an insurmountable barrier to a second impregnation, after conception has been achieved for a short time. Soon after that event has taken place, the entrance to the uterus is closed by the shut sac enveloping the embryo, and which adheres closely to the inner surface of the organ throughout its entire extent—covering the orifices of the os uteri and Fallopian tubes. In addition to this, the canal of the cervix is during gestation rendered still more impervious by the thick viscid mucus secreted by its glands. Such being the case, it will be obvious that a second impregnation cannot occur, if it be necessary for this purpose that the spermatozoa pass into the uterus, or even to the ovaries; for the whole is hermetically sealed after a certain time. For a second impregnation to occur during conception, fecundation must take place before this closing-up of the uterus and Fallopian tubes—an interval too brief after the primary impregnation to make much difference in the respective developments of the young animals. In cases in which there is a double uterus, or in which conception occurs in only one horn, superfœtation is possible, and one parturition may not be followed by another for some considerable time. However this may be, there are certain facts recorded which need explanation if superfœtation be not admitted as possible.

SECTION II.—EXTRA-UTERINE PREGNANCY.

In studying the development and progress of the ovum, after its escape from the ovary and impregnation by the spermatozoa of the male, we saw that a peculiar arrangement existed in the presence of the fringed border at the extremity of the Fallopian tube, which grasped the ovum and permitted it to be conveyed into the canal on its way to the uterus. From certain causes which are not yet clearly understood, it sometimes chances that the ovum, instead of taking this its normal course, either remains in the ovary, is arrested in its progress through the tube, or, escaping the fimbriated extremity of the latter, falls into the peritoneal cavity, or glides between the folds of peritoneum constituting the broad ligament, or between the serous and mucous membrane of the uterus; in all of which situations nature makes an effort to afford space and nutrition for the embryo, and thus supply the place of the uterus. This effort, however, as might be anticipated, is only partially successful, and after attaining a more or less imperfect development, the fœtus perishes from lack of nourishment.

This abnormal deviation from ordinary gestation, happily very rare in the domesticated animals, has received various names—such as *Extra-uterine pregnancy*, *Exfœtation*, *Conceptio vitiosa*, etc. The first is that usually employed; and the different varieties are commonly designated from the situation the ovum occupies. Thus we have (1) *Ovarian fœtation*, when the ovum is detained in the ovary; (2) *Ovario-tubal*, when lodged partly in the Fallopian tube and partly in the ovary; (3) *Tubal*, when the tube is the situation; (4) *Interstitial*, when the ovum enters the parietes of the uterus at the termination of the tube, but is arrested between the fibres before it can reach the cavity of that organ; (5) *Utero-tubal*, a compound of the two, the ovum being partly in the tube and partly in the uterus; (6) *Utero-tubo-abdominal*, when the fœtus is in the peritoneum, the umbilical cord passing through the tube to the uterus; (7) *Tubo-abdominal*, when the fœtal envelopes are fixed in the tube, but the fœtus is developed in the peritoneal cavity; and (8) *Ventral* or *abdominal fœtation*, when the embryo is formed and develops in the abdomen; (9) *Vaginal fœtation*, when the ovum is implanted and becomes developed in the vagina.

Extra-uterine pregnancy is extremely rare in the domesticated animals, and appears to be much more so in them than in woman; several of the varieties just enumerated have never, to my knowledge, been observed in them. This may be fully accounted for by the different arrangement of their generative apparatus, the much less tendency of these to disease, functional disorder, or deformity, and also, doubtless, to their function being only that of reproduction. With regard to anatomical arrangement as averting, to some extent at least, this misplaced gestation, we may point out that of the Mare as typical—though the same indication is applicable to the case of the other large animals. In this creature, the escape of the ovum into the abdominal cavity can only occur through some malformation or anomaly in the conformation of the fimbriated extremity of the tube, which, in the normal condition, is applied to the base of the ovary, and envelops it during the genital excitement. Neither is it likely that its course through the cavity of the tube can be checked, as this is short and direct; and the comparative thinness of the uterine walls almost precludes the probability of the ovum lodging itself in them.

Ovarian fœtation has very seldom been observed, so far as my researches have led me; though its occurrence in the domesticated animals is far from being impossible. It has been divided into two kinds—*internal ovarian*, when the embryo is developed in the Graafian vesicle or interior of the ovary; and *external ovarian*, when the ovum has left the vesicle and grows beneath the envelope of the ovary. The only instances on record are given by Rohlwes, Gurlt and Plot. The first observed this rare form of gestation in a Mare which had been pregnant twenty-one days. The ovary was greatly enlarged, and contained a small embryo in a vesicle. Plot observed it in a Cow, and also in three Sows.

Tubal fœtation, in which the embryo is developed in the Fallopian tube, is also exceedingly rare, if the paucity of cases reported is any criterion. Rohlwes mentions having found the bones of a fœtus in the left Fallopian tube; and Carus says this form has been noted in the Rabbit. Carsten Harms speaks of it as causing fatal internal hæmorrhage, by rupture of the tube, through the incapacity of the latter to distend sufficiently for the development of the fœtus.

Interstitial fœtation is that form in which the embryo is developed between the membranes forming the walls of the uterus; the muscular fibres, at the point where this occurs, are separated, and the cyst containing the embryo is situated between the serous and mucous membrane. This variety has not been noted in the lower animals, I believe; neither have the remaining forms, except the *abdominal*, some very rare cases of which are on record.

Abdominal or *ventral fœtation* may present two varieties: the ovum may graft itself, after escaping from the ovary, directly in the cavity of the abdomen, and there be developed; or it may be developed at some other point—the ovary, Fallopian tube, etc., and fall into the abdomen after rupture of the pouch which contained it. In the first instance it is named *primary*, and in the other *secondary abdominal fœtation*. Extremely rare though both varieties are in animals, yet perhaps the first variety is less frequent than the second.

Vaginal fœtation has been recorded as occurring in animals, and the size and conformation of the vagina lends itself to this kind of abnormal pregnancy, which does not appear to be possible in woman.

Several instances of these different kinds of fœtation are to be found in veterinary literature.

The length of time during which these extra-uterine fœtuses may be retained, varies according to circumstances. In the human species, a case is recorded in which the fœtus remained in the abdomen for fifty-six years; and a great many instances are published in which retention has continued from three months up to the last-named period. In animals this retention of the misplaced fœtus may also continue for a long time; and though death usually occurs if delivery is delayed much beyond the usual period of pregnancy, yet development appears to progress in the ordinary manner, and subject to the laws of normal gestation. It is indeed astonishing to find the ovum fix itself, and become developed into the embryo and fœtus, by drawing nourishment in the strange situation in which it chances to fall—the placenta, cord, and envelopes being present just as if it had found its way into the natural receptacle. It does not appear to be quite decided whether the ovum, in primary abdominal fœtation, receives an additional covering analogous to the decidua; though it is very probable that it does, and that this membrane may perform a similar office in the nutrition of the fœtus. The part of the abdominal or other surface to which the ovum adheres, receives an increased vascular supply for the occasion, its vicarious function being as actively carried on as if it were the lining membrane of the uterus.

Not infrequently retention is brought to a termination by the death of the parent, through the disordered state of health induced by the living fœtus, or through absorption of the septic matter it engenders, if putrefaction sets in after its decease. On other occasions—and these are comparatively not very unusual in the lower animals—an effort is made by nature to get rid of what really in time becomes a foreign body, by artificial openings. In these cases the fœtus may be passed whole or by fragments through the abdominal parietes, the intestines, or the vagina—in almost every case the former, owing to the quadrupedal position of the domesticated animals. Several occurrences of this kind are to be found in the literature of Veterinary Science.

Symptoms, Course, and Terminations.

The symptoms are generally those of conception and gestation. The ovum grafts itself on some part with which it chances to be in contact; an embryo results, the placenta being attached to the neighbouring textures and developing with the increase of the young creature; these changes being accompanied by the ordinary external signs of uterine pregnancy. In the majority of cases, when parturition should occur in the usual course, the premonitory indications of that phenomenon are very slight or altogether absent; though the animal may now and then make expulsive efforts, which continue perhaps for a few days, and then subside gradually, or recur at intervals. In the most favourable cases, when the fœtus perishes, it becomes encysted and mummified; the fluids and soft parts are absorbed, and the remaining portions become dry and parchment-like; or the creature may undergo a process of calcification by the deposition of carbonate and phosphate of lime in its tissues, which preserve its shape, and convert it into a "lithopædion" or "osteopædion." In this condition the fœtus may remain for an indefinite period in the abdomen of the mother, without causing much, if any, inconvenience; indeed, a most perfect state of health may exist, and the animal may become remarkably fat, or it may again conceive and bring forth as favourably as if nothing abnormal existed; the indications of anomalous gestation being only discovered by chance when the animal dies from some disease which has no relation to this accident, or is killed for food.

Such a happy result of the accident is, however, very far from being the rule, and the chances are many that a fatal termination will be the consequence of extra-uterine gestation. Expulsive efforts or other causes, may lead to rupture of the cyst in which the fœtus is contained; and this, with the fluids and *débris* of membranes, falling into the abdominal cavity, may give rise to such a severe form of peritonitis that death will ensue in one or two days. In other instances the kyst inflames, and suppuration is established, with putrefaction and partial solution of the fœtus; and if the mother does not at once succumb to pyæmia or septikæmia, adhesions and communications are formed between the kyst and neighbouring organs, and the remains of the young animal, chiefly the bones, are expelled either directly, as by ulceration of the abdominal walls after the development of an abscess, or indirectly, as through the intestine, etc. After the foreign matters have been completely, or even only partially, eliminated in this way, the fistulous openings by which they escaped cicatrise after a variable period of suppuration, and the female recovers—as has been observed in Sheep and Goats.

More frequently, however, it loses condition, becomes emaciated and feeble, and perishes in a state of marasmus; or it succumbs to hectic fever, septikæmia, or one of the many accidents which the presence of such a body may produce. The course of external ovarian gestation, which has been stated by Gurlt to occur in the domesticated animals, appears to be as follows: the envelopes of the ovary rupture towards the second or third month of the embryo's development, when the latter falls into the abdominal cavity, where it constitutes what we have termed "abdominal" gestation, leaving only a cicatrix on the ovary. With regard to internal ovarian pregnancy, the ordinary termination is rupture of the organ, and fatal hæmorrhage.

Diagnosis and Treatment.

There is absolutely nothing in the early, or even in the later stages of extra-uterine pregnancy—especially ovarian and tubal—to indicate the existence of any deviation from normal gestation: and when at length the animal exhibits indications of approaching parturition, there may be grave doubts as to the actual state of affairs, though the absence of certain signs may give rise to suspicion. The animal is uneasy and strains, yet the vulva is not enlarged, and the flow of mucus observed in the preliminary stage of ordinary parturition is not apparent. Exploration of the cervix uteri by the vagina, will prove the absence of induration or morbid tumefaction, as well as dilatation or contraction of the os, notwithstanding the length of time that has elapsed and the expulsive efforts. Palpation and inspection of the abdomen may also furnish certain information with regard to volume, and the situation of the enlargement. Careful exploration of the abdominal cavity by the rectum will be found advantageous in cases of abdominal gestation uncomplicated with uterine pregnancy. Not only can the condition of the uterus be satisfactorily determined, but perhaps a tumour independent of that organ may be discovered, in which a fœtus, or parts of one, can be felt. In such a case, efforts must be made to check the attempts at parturition, though it must be confessed that they are not likely to be successful. Sedatives, large doses of opium, chloral, hot water applications to the abdomen, and other measures of this kind, are indicated. If the diagnosis is well established, and the animal can be utilized for food, it is generally better to have it destroyed if in fair condition. In cases in which the period of parturition has passed, and when the animal has been unwell for some time, exhibiting loss of appetite, with marked depression, quickened pulse and increased temperature, and nothing else to account for these symptoms, then we may suspect the existence of extra-uterine gestation and putrefaction of the fœtus.

In the smaller animals—such as the Sheep, Goat, Bitch, etc., abdominal palpation can be readily resorted to, and often with most satisfactory results.

When elimination of the fœtus has commenced in any of the modes just described, active interference may or may not be necessary, according to circumstances. The fistulous openings which may be occasioned by the eliminative process, must be dealt with as ordinary fistulæ. Should the fœtus chance to be alive, it is scarcely possible that it can be removed by operation without greatly endangering the life of the mother. If in abdominal gestation a tumour, simulating an abscess, forms on any part of the abdomen, this may be carefully opened, and the fœtus extracted with a successful result. The accessory treatment, such as careful nursing and hygienic measures, must not be neglected.

In vaginal pregnancy, there is of course an absence of the usual signs of abdominal gestation, unless this is going on concurrently. The animal shows symptoms which should lead to exploration of the vagina, when the fœtal tumour will be encountered; this will probably be attached to the floor of the passage, from which it can easily be removed.

SECTION III.—SPURIOUS OR PSEUDO-PREGNANCY.

Spurious pregnancy is a designation applied by veterinary obstetrists to certain accidents, characterised by the development of special pathological productions, which may probably be due to a previous conception, and which more or less simulate normal pregnancy. Such cases are far from common, and the principal of them are described as *moles*, *uterine cysts*, and *hydrometra* or *hydrops uteri*.[1] These we will allude to.

Moles.

Moles, or more correctly speaking perhaps, *anidian monsters*, are more or less voluminous fleshy masses constituted by a blighted embryo, the

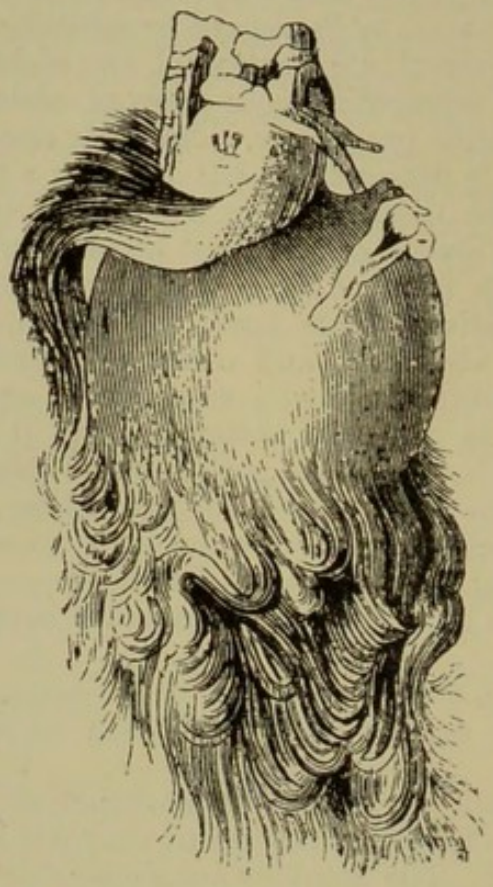

Fig. 67.

A Mole.

membranes of which have continued to perform their function, and to nourish the abnormal growth. They are, as a rule, met with only in Ruminants, and especially the Bovine species, though Roell mentions their occurrence in the Mare; and in nearly every case they appear to be one of twins, the development of which has been arrested at a certain period.

The *mole* (*mola cruenta*) is more particularly characterised by the persistence of an umbilical cord which, though degenerated, yet seems in the majority of cases to maintain relations between the tumour and

[1] I am not aware that the curious and obscure form of pseudo-pregnancy occurring in woman, and designated *pseudo-cyesis* by the late Dr. Simpson, has ever been observed in animals.

the uterus. With regard to the tumour itself, it is generally easy to distinguish the distorted remains of an embryo—such as skin, bones, muscles, and even organs of sense in some cases. These anidian monsters have not attracted much attention; though several instances of their occurrence are published in veterinary literature.

Rainard and others mention having found fibrous moles (*mola racemosa*) in the uterine cornua of the Bitch, Pig, and some other multiparous animals during gestation, and most frequently in the last dilatation of one horn, rarely in both; sometimes they were between two of the dilatations which contained living fœtuses. They are spheroidal, soft, irregular in shape, and look like flesh; they appear to be composed of fibres running in every direction. In the dilatation of the horn containing them, traces of a zonular uterine placenta have been observed.

Fig. 68.

HYDATID CYST OR MOLE: HUMAN.

The Cyst, which filled the Uterus, has been opened, and gives exit to a number of Hydatid Vesicles. The Section shows two Membranous Layers, the first of which, *a*, *a*, *a*, is external, and is analogous to the Epichorion or Decidua; while the second, *b*, *b*, *b*, is a fine transparent Membrane, apparently the remains of the Chorion. *c*, *c*, *c*, Granular Vesicles; *d*, *d*, *d*, White Vessels, some of which appear on the Surface as Granulations, and others act as Pedicles to the Globules at their extremity; *e*, *e*, *e*, Oblong Vesicles which appear to be Constricted or Dilated Vesicles; *f*, *f*, *f*, Budding Vesicles.

Rainard was of opinion that they were embryos whose development was checked by disease.

Demoussy states that the presence of fœtal mole in the Mare gives rise to the same phenomena as real pregnancy—enlargement of the abdomen, sinking of the croup and flanks, sluggish gait, and altered respiration ; and that the diagnosis is the presence or absence of movement in the fœtus.

Uterine Cysts.

Uterine cysts are pathological productions, somewhat analogous to the vesicular degeneration of the human placenta, in which the placental villi are distended with fluid, enlarged, elliptical, transparent, and loosely connected, while their vessels become obliterated and disappear. This constitutes what has been designated a "vesicular mole," of which many cases are recorded in veterinary annals.

Hydatid cysts have been mentioned as occurring in the domesticated animals, and simulating pregnancy ; but the authorities who allude to these instances have not offered any details. They appear to be related to conception and pregnancy, and in some instances they may be a deformed embryo.

The *Veterinarian* (vol. xx., p. 187) gives an interesting account of an immense tumour in the uterus which, in the living animal, led to the belief that the Mare was in foal.

Hydrops Uteri or Hydrometra.

Hydrops uteri, as the designation implies, is a collection of fluid in the uterus ; though it may not be of a serous character in every case, but may sometimes be purulent. There are many instances of this condition recorded in British and foreign veterinary literature, as occuring in the Mare and Cow—the animals which most frequently receive attention, though the Sheep and Bitch sometimes suffer from the disease. This condition appears to be related to gestation ; it is allied to mole pregnancy, and sometimes closely simulates real pregnancy, though it may also be a symptom of metritis. It may also be due to injury to the uterus.

Rainard says : "When this collection is forming, the abdomen gradually enlarges as in ordinary gestation : the animal looks healthy, and there is scarcely any difference between this state and that of pregnancy before the second-third, or even the second-half of gestation. It is rare that these collections persist more than five or six months without being evacuated at least once, and it is usual to see this evacuation take place every month, or at least every two months. The fluid is greyish coloured, and it is often as much as an ordinary bucketful."

Saint-Cyr, in alluding to the cases recorded since Rainard wrote these lines, remarks that it is usually after a copulation which is supposed to be successful that these collections form. They are gradually developed, and are accompanied by all the signs of ordinary gestation, with the exception, of course, of the movements of the fœtus. Then, at a certain time, there appear the precursory indications of parturition or abortion : expulsive efforts—certainly less energetic, painful, or prolonged, as a rule, than those of natural parturition, and rather resembling those of micturition or defecation. The cervix uteri slowly enlarges, though the hand introduced into the vagina discovers the os to be almost impervious, and neither fœtus nor

membranes can be felt; when it is dilated, there is at once a gush of fluid, the aspect and quality of which varies. It is often greyish-coloured, thick, and more or less fœtid; though it may also be clear and serous. Its evacuation may occur at very variable periods—as at one hundred and eighty days, five and a half months, thirty-two weeks, or forty-six weeks, after the supposed successful copulation, according to the various writers who have described these cases.

There are two forms of hydrometra—*œdematous hydrometra* and *ascitic hydrometra.* The former exists when the walls of the uterus are infiltrated with serum, and may acquire a thickness of four or five inches; the latter is an accumulation of fluid in the cavity of the uterus. Hydrometra has been observed in the Mare, Cow, and Bitch; rarely in the Sheep.

Recovery has often followed the evacuation of the fluid, when it has been in the uterine cavity; in some cases the condition has become so aggravated as to cause death, or necessitate the destruction of the animal.

The *diagnosis* is arrived at by manual exploration, and by the absence of some of the most characteristic indications of pregnancy.

When the condition is diagnosed, and there is reason for interference, the indications for *treatment* are plain—carefully dilate the os, evacuate the contents of the uterus, and inject astringent and antiseptic fluids (as carbolic acid 1 to 20) at intervals into its cavity. Give gentle laxatives frequently; guard against distention of the bladder, from which the urine may be removed by means of a catheter, if necessary; and give nourishing food, with tonics.

CHAPTER II.

Diseases incidental to Pregnancy.

Owing to animals being kept in a more natural state, generally, than the human species, when pregnant they are much less exposed to the risks and inconveniences of that condition than woman. The difference in the attitude of the body may also tend much to obviate those serious accidents, and prevent those unpleasant consequences, which so often attend gestation in the human female.

Nevertheless, notwithstanding this immunity, pregnancy in animals brings about certain modifications in the organism which may sometimes call for serious notice, either when it leads to a morbid predisposition, or in its influence on the progress of certain diseases already existing at the time of conception, or which have developed during pregnancy. There are also maladies which are peculiar to this condition, some of them of much importance.

SECTION I.—INFLUENCE OF PREGNANCY ON ORDINARY DISEASES.

The influence of pregnancy on the course of the ordinary diseases of animals has not yet been well ascertained, though it has been long observed that such an influence exists, and has often been productive of marked effects.

And these may have been due, directly or indirectly, in some cases at least, to the condition of the blood in the female, the red globules of

which are greatly diminished, and the proportion of albumin is also notably decreased, while the serum, on the contrary, is much above the normal standard. The amount of fibrine likewise varies, though this variation is neither so constant nor so uniform as in the other constituents; but it generally increases towards the termination of pregnancy.[1] Owing to this decrease in the solid portion of the blood, and particularly in the red globules, the pregnant female is more anæmic than plethoric. It is none the less exposed to inflammatory attacks, however, owing to the excess of fibrine; but, as Saint-Cyr justly remarks, these phlegmasiæ assume a particular physiognomy, and run a very different course to those observed in ordinary conditions, and more especially with regard to depletive measures, which have to be carefully resorted to—or, we might say, abstained from.

The mechanical effects of the fœtus, and the immense volume of the uterus, must also produce disturbance of most essential functions, and more especially those of the abdominal and thoracic organs. Therefore it is, that during pregnancy such affections as indigestion, colic, tympanitis, enteritis, or pneumonia, are so frequently followed by abortion and slow convalescence, or death of the animal.

Chronic diseases have in general but little influence on gestation. It has been imagined that "broken wind" in the Mare is much relieved during pregnancy; but some observations would go to prove that it is rather aggravated—though the troublesome cough does not appear to prevent the fœtus reaching its full period.

Acute diseases are more serious, and especially those of an epizoötic kind, which often cause abortion or induce premature labour. Influenza very often leads to abortion in Mares, and the contagious pleuro-pneumonia of cattle has frequently the same result, death being more frequent as pregnancy is well advanced. Sheep-pox is also more serious and more often fatal in pregnant Sheep, and most frequently followed by abortion.

A number of observers—among them Saint-Cyr, Bouley, Röll, Lafosse, and Reynal—have remarked that the cattle-plague does not appear to have any very particular influence on gestation: and the same has been said of eczema epizoötica ("foot-and-mouth disease"). But this Continental experience does not harmonise with that relating to these two diseases in our own country. Abortion has been a notorious sequel of both maladies, and more especially of "foot-and-mouth disease," in which the losses from this cause have sometimes amounted to twenty, thirty, fifty, and even more, per cent.

Painful and nervous diseases are also more serious during pregnancy than at other times. It would, however, seem to be an error to attribute the non-appearance of certain disorders during pregnancy to the influence of this condition, as Spinola has done with regard to rabies, etc.

SECTION II.—DISEASES INCIDENTAL TO PREGNANCY.

As has been already stated, the diseases peculiar to the pregnant condition are fewer, not so frequent, and usually much less serious in animals than in the human female. The chief maladies or morbid

[1] In woman, it has been noted that the normal proportion of *red* globules is from 125 to 127 per 1,000, and that during pregnancy this proportion falls to 120, 115, 95, 90, and even 87 per 1,000 of the total mass of the blood; while the albumin descends from an average of 70½ to 69, 66, and 62 per 1,000.

conditions which have been noted in animals are *pica* or *malacia*, *rickets* and *osteomalacia*, *constipation*, *vomiting*, *colic*, *œdema*, *hydrops amnii*, *paraplegia*, *cramp*, *eclampsia*, *cerebral congestion*, *amaurosis*, *cough*, *albuminuria*, *mammitis*, and *red colostrum*.

Pica.

We have already noted that the appetite of pregnant animals is sometimes depraved, and that they will ingest foreign matters—such as plaster licked from the walls, wood gnawn from their stable-fittings, earth, etc.

When depending on derangement of the digestive functions—on a neurosis of the stomach—this depraved appetite may be corrected by the careful administration of tonics, antacids, and attention to the quantity and quality of the food. The Herbivora should be allowed common salt in their food, or to lick.

Rickets and Osteomalacia.

Disease of the bones, tending to softening or fragility, has been frequently observed in pregnant animals, and especially those which are young; the two conditions being observed independently or coincident in the same creature. There is considerable increase in the organic matter of the bones, and a corresponding decrease in the inorganic constituents, especially of calcium phosphate; the long bones are more particularly affected, though the whole skeleton may be involved. The bones become softened, are often enlarged, and are friable and brittle; so that in advanced cases fractures occur readily, while deformity is not at all rare. The disease has been witnessed in an enzoötic form on the Continent in large breeding establishments, among Mares and Cows; flocks of Sheep have also been affected, and it is not uncommon in Bitches and Swine. It is generally due to the animals receiving insufficient food, or eating that which is deficient in mineral matters—such as lime and phosphorus—as well as in nitrogenous constituents. When pregnant animals are not well fed, the fœtus makes such demands upon them for growth materials that they must suffer, and that speedily, in their osseous structure.

The early symptoms are often those of pica, the animals instinctively seeking for lime salts. But frequently the first indication of this condition is the occurrence of fracture of one of the limb or pelvic bones from some slight cause—as getting up from the recumbent position, slipping, or a blow. The pelvis appears to be very liable to such fractures, though the long bones, ribs, scapula, and even the sternum, are commonly damaged in this way. Sometimes, before these fractures occur, the animals appear to be stiff, and walk as if suffering from paresis or debility, and the joints begin to swell; then the recumbent position is assumed and maintained, unless strong persuasion is applied. The condition is always more or less serious, though there may be difficulty in diagnosing it, unless careful examination and inquiry is made. Prevention lies in giving pregnant animals good food, keeping them in a healthy state, and not breeding from them when too young. The curative treatment is simple, and is mainly centred in offering nutritious food rich in lime salts—as crushed oats and beans for Mares, and even for Bovines (which may have them scalded or boiled), with green forage or good hay; nerve tonics—as strychnine or nux vomica, and preparations of calcium phosphate, may also be administered in serious

cases. For the smaller animals the same drugs may be prescribed, with the addition of cod-liver oil, and milk-and-oatmeal porridge for food.

Constipation.

Constipation is, of course, due to many causes, some of which have no relation to pregnancy. This condition, however, is not at all rare, particularly in the Carnivora, during gestation; and in all animals it may be largely remedied, or altogether removed, by suitable diet and exercise. Purgatives should be avoided, if possible, and only mild laxatives resorted to if necessary. For the Bitch, which appears to suffer most frequently from constipation, Saint-Cyr recommends the administration, every day for eight or ten days, of five to eight grammes of white mustard; but I have always found castor-oil, with enemas when the constipation was very obstinate, quite satisfactory. Castor or linseed oil, or even boiled linseed, answers well for the larger animals.

Vomiting.

Contrary to what occurs in woman, vomiting in pregnant animals is so unfrequent that I have been able to find mention of only one instance, and that is in the Belgian *Etat Sanitaire des Animaux Domestiques* for 1877.

Colic.

Colic may appear in some instances during the early months of pregnancy in the Mare, the attacks being generally slight, and occurring at intervals. It may be due to indigestion, and only require simple treatment—as warm gruel, friction to the abdomen, enemas of warm water, and laxative food, such as linseed mashes.

Œdema.

The infiltration of serosity into the connective tissue of certain parts of the body of pregnant animals—almost exclusively the Mare—is somewhat allied to the *anasarca serosa* of woman. The period at which it is manifested depends much upon breed, conformation, and individual temperament, as well as upon the season and hygienic conditions. With common-bred, lymphatic Mares deprived of sufficient exercise, it appears at an early period—from the eighth month of gestation, and sometimes earlier—particularly in winter. With better bred animals it is later, and in summer may not appear at all in those which are well bred. It is most marked in primiparæ. It commences usually at the inferior part of the hind limbs, gradually ascending to the hocks, or higher; the fore limbs are also attacked, though not so markedly; and the swelling extends to the lower surface of the abdomen. Here it commences by a soft tumour in front of the udder; this increases in size and spreads over that gland, as high as the vulva, down the inner surface of the thighs, and towards the chest, sternum, and fore-arms. It readily disappears or diminishes with exercise, and is probably due to the pressure exercised by the fœtus on the pelvi-crural vessels, as well as, perhaps, to the anæmic condition of the system. The exemption of the Cow from œdema has been ascribed to the great development of the mammary veins in this animal, and their free communication with others, which permits a ready return of the blood from the hind limbs.

There is nothing serious in this œdema of pregnancy, as in nearly every case it can be counteracted by exercise or hand-rubbing, and it disappears in a day or two after birth.

If it causes inconvenience, frictions with soap or turpentine liniments, bandaging, or even slight scarifications, may be employed; but the occasions for these must be very rare indeed.

Hydramnios, or Hydrops Amnii.

When there is an unusual secretion of the amniotic and allantoic fluids, it constitutes what has been termed "dropsy of the amnion" (*hydrops amnii* or *hydramnios*); though, as Saint-Cyr remarks, as there may also be an increase of the allantoic fluid, it would be more exact to designate it "dropsy of the fœtal envelopes." This condition, when very marked, is serious for the mother as well as the fœtus. A number of cases have been recorded, and Saint-Cyr has enumerated sixteen, thirteen of which occurred in the Bovine, two in the Equine, and one in the Caprine species; one has also been observed in the Bitch. Gierer, who has published an interesting account of several cases, observes that it is most frequently met with in poor, badly-fed animals—and particularly in Cows, in which improper hygiene has produced a morbid excitement of the generative organs; the result of which is that exosmosis and endosmosis do not take place equally through the walls of the placentæ and placentulæ.

Symptoms.—It is not until the fifth or sixth month of pregnancy, or even later, that indications of this condition are evident. Then the abdomen rapidly enlarges, especially to one side—generally the right; and in a short time it has acquired a greater volume than it has towards the end of gestation. At this period the health becomes deranged, and colic, with or without tympanitis, is not unfrequent. General debility is so marked that the animal can scarcely, if at all, stand; the appetite is lost, rumination is suspended, defecation and micturition are irregular, œdematous swelling of the limbs and abdomen ensue, with dyspnœa, which increases so quickly in intensity that asphyxia is often imminent. The muscular parietes of the abdomen have in some cases been ruptured, and the entire mass of the uterus, with its contents, has formed a subcutaneous hernia. The ordinary period of gestation may be completed; or abortion may occur at the seventh or eighth month, when all the indications of such an occurrence are present. The uterine contractions, owing to the relaxed condition of this organ, and its distended and paralysed fibres, are weak, the pains feeble and unsustained, the os does not dilate, and the act of parturition is consequently tedious.

Diagnosis.—The state of the abdomen might lead to the supposition that the case was one of tympanitis or twin pregnancy. Abdominal percussion, and the "touch," as well as auscultation, should aid in diagnosing this condition. Rectal examination will reveal the immense size of the uterus, which forms a great globular mass in the abdominal cavity, and almost completely fills the pelvis, though nothing of a fœtus can be detected; while vaginal exploration discovers the cervix uteri effaced, the os closed, and the posterior part of the uterus projecting more or less into the vagina; pressure on this prominent portion proves that it contains fluid, though usually no fœtus can be felt, as it is beyond the touch, and almost lost in the small ocean of fluid surrounding it. In rare cases the os is partially dilated, and the fœtal membranes protruding more or less into the vagina; usually, however, scarcely one or two fingers can be introduced into it.

Results.—The occurrence of hydrops amnii is nearly always fatal to the fœtus. In none of the cases recorded was it alive; in a certain number it appeared to have lived up to the period of parturition or abortion; in others it had been arrested in its development, and was dead for some time. In a Goat, the two fœtuses were in a state of general anasarca, being completely infiltrated.

The mother may or may not survive. Of the above cases four perished from the disease; one was killed as incurable; another recovered after a long time; one was subsequently sold for food; and seven or eight got well so rapidly and completely as to be bred from again. The results have, as a rule, been more favourable as assistance has been prompt and early.

After death the uterus is found excessively dilated, its walls pale in texture, with ecchymoses on its surface. The fœtal membranes vary, sometimes being thickened and dense, and at other times attenuated and friable. The fluid has been found contained in alveoli or cells, formed by the processes uniting the allantois to the amnion; so that the membranes might be torn in several places without all the fluid escaping—in this respect resembling the vitreous humour of the eye. The *liquor* is usually limpid and transparent, or of a pale citron colour, with a slightly sweetish taste; its quantity, as has been remarked, is always considerable: as much as 50, 70, 100, 120, 150, and even 200 litres having been found.

The digestive organs are nearly empty, even in Bovines.

Etiology.—As in woman, so in animals, the etiology of this condition is not well understood; but it would appear that it may be due to several very diverse causes. Multiparæ are much more frequently affected than primiparæ, and it nearly always occurs during the early months of pregnancy; the fœtus is generally little developed, and in the majority of instances is dead before it is expelled. It has been supposed that obstruction to the fœtal circulation, induced by torsion of the umbilical cord, may act in producing it, or imperfection in function of the heart or liver of the fœtus; the death of the fœtus, deformities, monstrosities, twin pregnancies, ascites, and other causes have been enumerated as concomitant or exciting causes. But until we know how the amniotic and allantoic fluids are formed, and what their normal quantity is, it is not probable much progress will be made in elucidating the etiology of this pathological condition.

Treatment.—The chief indication is to evacuate at least a portion of the fluid, by rupturing the membranes, as medical treatment has always proved inefficacious. It must be remembered that the fœtus is always dead; and even if alive, with the view of saving the life of the mother, it should be sacrificed. Though opening the amniotic sac, and removing a certain quantity of the liquor, need not necessarily compromise the existence of the fœtus; as a case has been published by Lhomme[1] in which a portion of the fœtal membranes, protruding beyond the vulva, was excised without interfering with the ordinary progress of gestation; for when parturition occurred three months afterwards, a well-formed Mule was born and continued to live.

The chances of success are greater as intervention takes place early, and before the abdomen is excessively distended, the respiration not seriously affected, and debility not great.

[1] *Journal de Vétérinaire du Midi*, 1869.

The evacuation should be effected through the vagina, though it has been made through a puncture in the flank. If the fœtal membranes are in the vagina, they may be ruptured by the fingers there; if not, and the os is sufficiently dilated for the admission of the hand, they may be ruptured in the uterus; if it is closed it should be gently dilated, and the envelopes punctured, if necessary, by means of a trocar and cannula. As soon as the membranes are pierced, a gush of fluid takes place, the abdomen diminishes in volume, the uterus becomes retracted, and in this retraction the fœtus and membranes are sometimes expelled. Should this expulsion not take place soon, they must be removed in the ordinary way. Afterwards, the animal is to be carefully attended to and generously fed.

Paraplegia.

What has been termed paralysis of the posterior extremities is not rare in the Cow during gestation, especially when near parturition, and often even when that act has commenced. *Ante-partum paresis* would perhaps be a better designation, as in the great majority of cases the debility which compels the animal to remain in a recumbent position, is merely the effect of pregnancy and the increased weight the creature is called upon to support. It has also been witnessed in the Sheep and Goat, and, though very rarely, in the Mare. Generally, however, it appears six, eight, ten, or twenty days, rarely a month or two, previous to parturition, and attacks animals in the most diverse hygienic conditions—those which are well fed and tended, as well as those which receive the opposite treatment. It is not rare to observe in a cow-shed, two or three cases occurring a short distance from each other, and even in a locality we may, in certain years, meet with a number of cases; then several consecutive years may elapse without any being noted, though it would be a manifest exaggeration to say that it was either an epizoötic or enzoötic malady. It must not be confounded with what has been termed "parturient fever," or "parturient apoplexy," in which we have paralysis, but from which it differs greatly, as the symptoms and results will show.

The paralysis of gestation generally appears suddenly and without any premonitory symptoms, manifesting itself with the same intensity at the outset as at a later period; though in rare cases the animal shows a weakness and unsteadiness of the posterior part of the body and hind limbs for a short time before it drops, and the end of the tail is said to be remarkably flaccid. When paralysis has really set in, the Cow is forced to lie, but it does not appear to suffer; the position is natural, the head carried as usual, the eye bright and clear, the muffle damp and cool, and rumination in the majority of instances is not suspended; the pulse, respiration, and appetite are unaltered, and sensation does not seem to be impaired, even in the hind limbs—it may be exalted. Constipation is frequently present. It is only when the animal attempts to rise that its condition is evident; the fore limbs and neck can be moved to accomplish this, but the hinder extremities are powerless, or can only be raised to a slight extent; though with help it may be lifted up and can then stand, but unsteadily.

Ordinarily, the paralysis persists until parturition, when it disappears; though Saint-Cyr mentions an instance in which a Cow became paralysed twenty-eight days before that event, and lay on the litter for two days after calving, without being able to move its hind extremities; but it arose spontaneously on the third day, and did well. The same

authority, however, states that he has occasionally witnessed the paralysis persist for a longer time after calving, and either cause death or necessitate slaughter. I have seen a Sheep which eventually died from this ante-partum paralysis. When the paresis appears towards the seventh or eighth month the prospect of recovery is not so favourable; though the prognosis must to a large extent depend upon the cause. If the animal is old or debilitated there is less hope for recovery. When it can move the hind limbs after a day or two, and change its position from one side to another, a favourable issue may be predicted.

The cause is somewhat obscure, but is supposed to be due to compression, or rather straining, of the nerves and vessels of the posterior extremities by the heavy uterus. In five or six cases there has been found, on *postmortem* inspection, infiltration of the dorso-lumbar and gluteal muscles, and discoloration of the muscular fibres. The spinal canal has also contained a large quantity of serum, and the membranes of the spinal cord are injected. From the rapidity with which recovery generally takes place, it is obvious that the lesions cannot be serious in many cases. Debility from insufficient or poor quality of food may induce this condition; getting jammed and unable to get up in the stall may also bring it about, as well as slipping or falling down and injuring bones or muscles.

Treatment.—The first thing to be done is to ascertain, if possible, upon what the paresis depends, as upon this treatment must be based. It is advisable in most cases to get the animal up, either with or without help; but if it cannot stand, and slinging is not advisable, then it must be made comfortable in the recumbent position, and turned over frequently; peat-moss makes the best litter. In the majority of cases, and especially before parturition, little treatment is necessary. The principal indication is to avert or get rid of constipation by means of laxatives and enemas, and to pay attention to the diet and cleanliness, while enjoining quietude. If the paralysis is due to debility, then highly nutritious food and tonics should be given. If congestion of the spinal cord is suspected, then stimulating applications to the spine should be resorted to. Should the paralysis persist and the time for parturition be some months distant, it may be necessary to induce abortion, as protracted recumbency generally produces superficial sores of large extent. Should the paralysis continue for any length of time after parturition, then more energetic treatment may be adopted. In these cases, the subcutaneous injection of strychnine is nearly always attended with success.

Cramp.

Cramp—by which is meant a tonic, involuntary, and extremely painful contraction of one or more voluntary muscles—is sometimes observed in the Mare and Cow during the second half of gestation, the muscles of the thigh, and chiefly the principal extensor of the metatarsus, being almost exclusively involved. When affected, the animal either suddenly and rapidly flexes and extends the limb—striking the ground hurriedly and energetically with the foot, as if a fly had settled on the leg, or the whole limb is gradually and rigidly elevated without flexure of the joints, except those of the phalanges, which are half flexed, the anterior aspect of the hoof being directed towards the ground; at the same time the muscles of the leg are hard, tense, and painful to manipulate, and the animal betrays the torture it experiences by its

expression and attitudes. This manifestation is increased if the Mare is compelled to walk, its first steps being extremely difficult; while the limb is maintained in a perfectly rigid condition, and the indications of pain most marked. In a short time these symptoms disappear, and movement is restored. The cramp may pass from one hind limb to another alternately, and appears to be due to the compression exercised on the sciatic nerve in its course over the sacro-sciatic ligament. This cramp has much analogy, in its symptoms, to luxation of the patella; from this it may be distinguished, however, by the latter occurring most frequently in young animals, by the displacement of the patella, and by the total inability to flex the limb until the patella has been replaced.

Cramp is of no moment, and can be relieved by walking the animal for a few paces, or by smart friction. It disappears altogether after parturition.

Eclampsia.

Saint-Cyr speaks of a report by Lafitte, in which three Bitches are stated to have been affected with eclampsia during pregnancy. The symptoms were acute clonic convulsions, which were at times remittent, with unsteadiness of the limbs, but without total loss of sensibility, hearing or vision. The successful treatment was milk diet, ten centigrammes of fucsine morning and evening in milk, and at the same periods enemata of chloral hydrate.

Cerebral Congestion.

Saint-Cyr and Violet speak of cerebral congestion as one of the concomitants of pregnancy, and they, as well as some English and foreign veterinary surgeons, consider it identical with the condition known as "parturient apoplexy." But it would appear that this *ante-partum* cerebral congestion is very rare, and is due to a plethoric condition and lack of exercise; though, as has been observed, and as will be again remarked, this and other affections of the nervous system sometimes witnessed during this period, may be due to uræmia and albuminuria, which are not unfrequently the cause of similar disturbances in woman.

Reference to the symptoms and treatment of this brain congestion will therefore be deferred until *post-partum* congestion or apoplexy is dealt with.

Hysteria.

This would appear to be a very infrequent concomitant of pregnancy, as I can only find one instance recorded.

Olver (*Veterinary Journal*, vol. vii., p. 367) describes the case of a thoroughbred Mare, four months pregnant, which was suddenly attacked with great nervous excitement, accompanied by profuse perspiration, great difficulty in walking, straddling gait, continual micturition, etc. The slightest noise increased the excitement. There was great rigidity of the muscles, particularly those of the gluteal region, and at a later period volition appeared to be abolished, the limbs acting merely as mechanical props; the eyes were turned upwards as if in a trance, and the animal was quite blind; there was frequent neighing, and continual opening and closing of the vulva, with the expulsion of small quantities of urine, and a highly congested condition of the vaginal mucous membrane; the pulse was eighty-two per minute, and the respirations were accelerated. There was every symptom of œstrum. As there was difficulty in swallowing, coniæ was injected subcutaneously, and with the most satisfactory effect. Next day she was still perfectly blind, and even more nervous; but she had gradually recovered consciousness, and took a little food. The pulse in the evening was normal,

and the muscles had lost much of their rigidity, while the nervous excitement had subsided; there was, however, great thirst and obstinate constipation. The latter were relieved by suitable remedies, but some days elapsed before vision was regained. She did well subsequently, and proved to be in foal.

Amaurosis.

The only instances of amaurosis occurring in connection with pregnancy, are two given by Riss.[1]

A Mare, nine years old and in good condition, when advanced in pregnancy became blind. On the eyes being examined by Riss, the humours and lens were found to be quite healthy, but amaurosis was complete. A blister was applied to each cheek, and other treatment adopted, but without success. The day following parturition, which occurred about a month afterwards, vision was perfectly restored.

A seven-year-old Mare, when near parturition, and which had never exhibited anything the matter with its eyes, suddenly became blind from amaurosis. Remembering the other case, Riss abstained from treatment. The Mare foaled in thirteen or fourteen days after loss of sight had been noted, and on the third day after this occurrence it was able to see as well as ever.

Cough.

We have mentioned hydramnios as a cause of disturbance in the respiration, the obstacle to which is often a marked symptom of that condition. But even without the existence of this kind of dropsy, the breathing is not unfrequently impeded in pregnant animals, and this obstruction is sometimes accompanied by a very harassing nervous cough, which, in the larger animals, and particularly in the Mare, may lead to injury. For the relief of this cough, Zundel recommends the cyanide of potassium, but other drugs will also act in allaying it.

Albuminuria.

The existence of albuminuria in pregnant women has long been known, and Zundel gives it as one of the complications or accompaniments of gestation in animals; though he does not look upon it as a pathological condition. Others, on the contrary, think that this is a matter well deserving further investigation; for as, as has been mentioned, various kinds of nervous disturbance—eclampsia, paraplegia, amaurosis, etc.—are probable consequences of albuminuria in the human female, there is no reason why they may not be so in animals.

Mammitis.

Mammitis is another very rare occurrence during pregnancy, and the cases recorded by Saint-Cyr and Violet only number three—two Heifers five or six months pregnant, and a Mare. In the former the udder was much swollen, and from one or two of the teats a reddish serous fluid could be extracted, while it was thick and syrupy in the others; there was also fever, loss of appetite, and sluggishness. By means of appropriate treatment all the symptoms were subdued; but for a considerable time it was necessary to withdraw the fluid from the teats. One Heifer went to the end of her pregnancy, but the other aborted some weeks before. The Mare had already produced Foals, but the udder had regained its natural size before she again became pregnant. The inflammation of the udder was not severe, though a large abscess formed in it; this was opened, and recovery quickly ensued, without permanent damage to the gland.

Red Colostrum.

Saint-Cyr speaks of red colostrum appearing in the Cow during the last two weeks of pregnancy; it may suddenly disappear, or it may con-

[1] *Recueil de Médécine Vétérinaire*, 1831.

tinue until after parturition. It does not demand any attention, unless the udder is very large and hard, when it would be beneficial to draw the teats frequently.

CHAPTER III.

Accidents of Pregnancy.

Though a distinction between the diseases and accidents of pregnancy cannot always be readily drawn, yet for convenience we follow Saint-Cyr in allotting to a separate chapter those conditions or diseases which may be due to accidental causes, operating either externally or internally. These are *prolapsus of the vagina*, *hernia of the uterus*, *rupture of the uterus*, *metrorrhagia*, *abnormal retention of the fœtus* and *abortion*.

Ante-partum Prolapsus of the Vagina.

Prolapsus vaginæ, or *inversio vaginæ*, has been observed, so far as I can ascertain, most frequently in the Cow and Sheep; rarely in the Mare or Bitch. It consists in the protrusion, or pushing backwards, of the vagina by the uterus and its contents during pregnancy, the tumour it forms appearing between (*inversio vaginæ incompleta*), or external to (*inversio vaginæ completa*), the labia of the vulva. It must not be confounded with *post-partum* prolapsus. This accident is peculiar to pregnancy, and may occur in well-shaped Cows, but whose tissues, and especially those of the genital organs, are soft and relaxed—animals of a lymphatic temperament, good milkers, with a wide pelvis, and which are fed on an abundance of bulky but innutritious food. Keeping such Cows on a floor sloping too much to the rear, as well as falls, injuries of different kinds, distention of the rumen, fatigue, etc., are all likely to lead to this accident in such animals, when pregnant. It is observed, though very rarely, in primiparæ, and occurs most frequently after the third or fourth gestation, the period of its appearance during that state varying; in certain Cows manifesting itself so early as the fifth month (though this is rare), and oftenest at the end of the seventh or eighth month, and even so late as twenty or fifteen days before delivery.

The occurrence of the accident is made known by the appearance, at the vulva, of a circular, bright-red tumour, depressed in the centre, and of a variable but gradually increasing size as gestation advances, or the exciting causes remain in operation—from the volume of a fist to that of the head of a child or man, or even larger. At first it is only visible when the animal is lying, and disappears when it gets up; but when of considerable volume it never entirely vanishes in the latter attitude, and even when reduced by the hand the vulva remains larger than usual.

If existing for some time, however, in certain cases infiltration takes place and inflammation may ensue, when a large and somewhat dense tumour projects permanently outside the vulva, the circumference of the latter constricting it and rendering matters worse. The colour now becomes a darker red, and even dark brown; the tumour may be abraded on the surface from the rubbing of the tail and contact with the fæces and urine, while at its upper part can be seen the neck of the uterus. The animal does not seem to be incommoded, unless it be of an irritable disposition, when straining may take place, and this increasing in intensity, the cervix, and even a portion of the body of the uterus,

will follow the everted vagina, and a spontaneous reduction can no longer take place, while manipulation increases the straining. This is in reality now a case of *prolapsus uteri*, and an examination of the voluminous mass may lead to the detection of some portion of the fœtus in its midst. Not only this, but the prolapsus of vagina and uterus will, in all probability, produce displacement of the bladder, and when this is distended with urine it will gravely complicate the case and render reduction more difficult.

According to Cox,[1] Sheep, when heavy in Lamb, frequently evert a double fold of the vaginal mucous membrane. This happens when they are in a recumbent position, and it is in some animals of such frequent occurrence as to cause excoriation and ulceration.

TREATMENT.—This prolapsus, in the majority of cases, does not appear to cause the slightest inconvenience to the animal, and offers no obstacle to parturition—indeed, it has been noted that such Cows calve more easily than others ; neither does it predispose to chronic eversion of the vagina, as has often been supposed. After calving, the vaginal tumour disappears without any treatment being required. But if treatment is necessary, the first thing to be done, should the floor of the stall be lower behind than in front, is to level it, or even raise it a little behind. This may be readily accomplished by means of the litter. The diet may also require attention, giving that which contains sufficient nutriment in small bulk ; constipation should be guarded against or remedied. This treatment will be sufficient in the majority of cases. In others, a bandage, to be hereafter described, may be required, and especially if the tumour is liable to become soiled and irritated when the animal is lying.

In serious cases, when the tumour is large and the Cow strains, and spontaneous reduction does not occur in the standing position, the mass must be returned. This is readily enough accomplished ; but it sometimes happens that reduction does not prevent a continuation of the straining, and even with the bandage the everted vagina again appears. This is due to the mucous membrane, which, not having been properly smoothed down when introduced into the pelvic cavity, is ridged, and these rugæ give rise to an uncomfortable sensation, and induce expulsive efforts.

It is necessary, therefore, in reducing the part, to cleanse it well with tepid water, and to smooth the vaginal mucous membrane by gentle pressure forward as far as the cervix uteri, in order to efface any folds which may excite uneasiness. After this the bandage may be applied with a view to keeping the vulva closed, until its labia have retracted somewhat. Wire sutures through these have been recommended, but they are very rarely required.

In very exceptional instances, we may have not only complete prolapsus vaginæ, but also, as has been said, partial protrusion of the uterus itself. Then the case is very serious, owing to the excessive straining and the weight and bulk of the fœtus, which has to be returned beyond the inlet of the pelvis.

But in the majority of cases reduction may be successful, and apparently desperate cases may be saved by the exercise of patience and tact. The Cow must be made to stand, with the hind quarters as high as possible, and to prevent straining the loins should be pressed upon

[1] *Veterinary Journal*, vol. i., p. 267.

in a forcible manner, as recommended by Saint-Cyr, by means of a stick placed transversely, a man at each end, another pulling out the tongue and pinching the septum of the nose. Attempts at reduction can only be made in the intervals of straining, and during the straining all that can be done is to resist further expulsion. Having returned the displaced organs into the pelvis, the arm and fist must follow them, and by pressing on the cervix of the uterus so act on the mucous membrane of the vagina as to leave no folds or ridges in it; when the straining has ceased, which usually occurs very soon, the arm may be withdrawn, though the practitioner must be on the outlook for its recurrence, and prepared to prevent another extrusion. This may be guarded against by the use of a pessary consisting of a wooden rod from one to two feet long, furnished with a head several inches in diameter and covered with some soft material, or a ring fixed horizontally at the end sufficiently wide to go over the cervix; this end, well greased, is to be inserted in the vagina in such a manner as to keep the uterus in the pelvic cavity, the other end being fixed by a cord at each side to a girth round the body or elsewhere. An ordinary quart bottle with a concave bottom may be employed on an emergency, a round piece of wood driven into the neck making it sufficiently long. So long as this pessary is worn—and it may be allowed to remain in the genital canal for a considerable period—the vagina should be syringed daily with warm water and a mild astringent. Death is often the result of such an accident; and to prevent a fatal termination, it has been suggested that artificial delivery should be effected without delay. Premature delivery has been counselled in those cases in which the Cow continues to strain and evert the vagina, notwithstanding bandages, sutures, and other means, and when grave consequences are likely to follow; more especially is this advice to be adopted when pregnancy has reached the 260th day, and the Calf is alive. Perforation of the membranes may be effected by the fingers after they have dilated the os. There is no difficulty in parturition, as a rule; but care is necessary for some days afterwards to prevent inversion.

With Sheep, according to Cox, it is a common custom to return the partially prolapsed vagina, and to tie the wool across the vulva; on other occasions a truss, similar to that used for cattle, is employed. Both methods frequently fail, and in these cases nothing answers so well as the ring-shaped pessary of a small size.

Hernia of the Uterus (Hysterocele).

Hernia of the uterus is not uncommon in the domesticated animals, and has been observed in the Mare, Cow, Sheep, Goat, and Bitch. In the latter animal the organ is often displaced before conception, and the fœtus is developed in the hernia; but with the larger creatures the empty uterus is too far removed from the abdominal parietes to escape from the cavity; and it is only when its volume is increased as gestation advances, that it may form a hernia, should there exist an *accidental* opening in the muscles which enclose the cavity. In the Bitch the hernia may be inguinal; in the other animals it is always accidental and ventral, and usually towards the inferior part of the abdomen—on the right or left side, or in the pubic region.

Its ordinary cause, when accidental, is due to the natural or spontaneous relaxation of the abdominal aponeuroses; or to traumatism, as

contusions or strains, the viscus being generally only covered by the skin. It is rare in young animals.

In the Cow it is not at all unusual to observe the hernial tumour in front of the pubis, towards the attachment of the rectus muscle, and near the udder; here it may be of a great size, extending as low as the hocks, pushing the mammary gland to one side, reaching as far forward as the floating ribs, and containing, in addition, other of the abdominal viscera than the uterus and its contents. This tumour impedes movement; the hind limbs are kept widely separated, and the animal is much inconvenienced.

With the Bitch, ventral hysterocele has been noted in two regions—above the mammæ, where it might be mistaken for a scirrhus tumour; and in one of the labia of the vulva, beneath the skin.

In the larger animals, the fœtus may sometimes be felt in the tumour, and its movements may be noticed; though, owing to its being so low, it cannot be reached from the rectum.

Very often, excepting the inconvenience to the female, hysterocele does not interfere with gestation, nor give rise to any serious symptoms; though, in some cases, it may render parturition laborious and protracted, if not impossible. In other cases this act may be accomplished without difficulty or extraneous aid; Cows which have been ruptured from the perineum to the ribs have calved easily enough; and Leconte alludes to a Mare which had a uterine hernia nearly as extensive as this, and yet brought forth four living Foals in succession.

Nevertheless, it is somewhat of a risk to attempt to breed from such animals. When treating of difficult parturition, we shall have occasion to return to this subject. In the meantime, it is only necessary to say that in order to obviate serious consequences, the hernia should be supported by a wide bandage until the uterine contents are expelled. Should circumstances render it necessary, abortion may be artificially induced, or hysterotomy may be performed.

It may be observed that care is necessary in diagnosing mammary uterine hernia in the Bitch, so as not to mistake it for a mammary tumour. I have known of one blunder of this kind, and have heard of another in which an operation was performed for the removal of the tumour, in which two fœtuses were found, and the Bitch subsequently died. In my case no operation was attempted, and though the hernia was somewhat large, yet the animal brought forth her Puppies without any apparent difficulty.

Ante-partum Rupture of the Uterus.

Rupture of the uterus may happen before and during parturition, or in attempts to reduce the organ when inversion has occurred during that act. The accident has been observed in the Cow, Sheep, Goat, and Bitch; it is not very common before gestation has terminated, and the symptoms by which it can be diagnosed are not very reliable. Spontaneous rupture of the uterus usually occurs at the anterior part of the organ, between the two cornua, or even in the cornua themselves; the direction of the rupture generally depending on the direction of the muscular fibres—being sometimes diagonal, at other times transversal, and more rarely longitudinal. The size of the rupture also varies considerably; though it must be remembered that in the dead animal ruptures only appear in their original dimensions when the uterus had

ost its contractility before death, and immediately after their production; when the organ has contracted after the accident, the extent of the laceration is much diminished. The lips of the wound are in some cases thin and ragged, in others swollen and inflamed. The texture of the uterus itself, in the vicinity of the rupture, may be quite healthy, or it may be inflamed, softened, or gangrenous; while the peritoneum is normal or inflamed. The blood effused into the abdominal cavity may be in large quantity or scarcely noticeable, and it may or may not be decomposed.

According as the tissue of the uterus is more or less completely torn, the ruptures have been divided into those which are "complete" and "incomplete." In the first, the cavity of the organ communicates freely with that of the abdomen; while in the second, the peritoneum, or sometimes a portion of the muscular layer, is intact.

The foregoing remarks refer to longitudinal rupture of the uterus, but Saint-Cyr alludes to what the Italian veterinarians designate as *semi-mobile uterus*, and which he believes to be allied to rupture. This is a condition in which the uterus has been completely divided across, either at the body or the cornua, and remains floating in the abdominal cavity, being only suspended by the broad ligaments. The most singular fact connected with these cases is, that although the uterus is torn in this manner, its contents—the fœtus and membranes—do not escape; the wound cicatrises, and the organ appears as a large cystoid tumour. Ercolani, Veterinary Professor at the Bologna University, has met with four instances of this extraordinary accident, the pathological specimens being deposited in the museum of that institution. Their history and description are as follows:

1. The uterus of a Cow which contained in one of the cornua a fœtus beyond its term, and in the other horn such a great quantity of mucus that, so far as volume is concerned, it would be difficult to say which cornu was the largest. This uterus is completely divided at the cervix and floats in the abdominal cavity, being attached only by the broad ligaments, which are thin and distended. The detached portion of the uterus has a globular form, and its perfectly smooth surface is everywhere covered by peritoneum; where the separation has taken place, the organ is closed by the cicatricial union of the border of the rupture. The mucous membrane in the left cornu of this portion is loose, and shows numerous radiating cicatrices; the fœtus in the right cornu is indurated, and appears to have lived beyond the ordinary period of gestation, to judge by the hoofs, as well as by the teeth, which are cut. The nose did not correspond to the opening of the cornu, as the head was doubled on the left side of the neck. The vertex and occiput were turned upwards, and closed a vast circular opening resulting from the destruction of the partition separating the two cornua. The head adhered to the entire border of this opening—unequal and ragged as it must have been; and all that portion which projects into the left cornu presents a large *tonsure*, where not only is the skin absent, but even the periosteum itself. Lying flat on one of its sides and curled up, the limbs twined towards the head, and the muffle placed between the thighs, the fœtus represents a kind of great discoid body.

2. Cornu of the uterus of a pregnant Cow, containing a completely developed fœtus, markedly indurated. This cornu, perhaps ruptured during parturition, is detached, and hangs almost free in the abdomen; while the rupture has cicatrised, and there is formed a large kyst, everywhere closed, and containing the fœtus. The walls of the uterus are for the most part fibrous, and the fœtal envelopes coriaceous. Like the preceding case, this specimen was found in a Cow which had been slaughtered by the butcher; the cornu fell on the ground, after some few fibrous bands which attached it to the sub-lumbar region had been cut through.

3. The uterus of a Sheep arrived at the termination of pregnancy; the organ has been torn in the vicinity of the vagina, and remains free in the abdominal cavity. In this instance, also, the uterus forms a completely closed kyst, which contains a very much indurated lamb. In detaching this organ, an irregular cicatrix is seen, which leads to the supposition that the accident was due to torsion of the cervix.

4. Posterior portion of the body of a Guinea-pig, which shows the right cornu of the uterus detached, and cicatrised where separation has occurred. This cornu, which was half free, was filled with fluid blood; the distension caused by the blood has been so great that the cornu is ruptured in the middle, and the fœtus must have died from hæmorrhage.

Other examples of a similar kind have also been recorded.

Causes.—Thinning of the uterine walls, hydramnios, and distention by the gas evolved from a putrefying fœtus, have been said to predispose to longitudinal rupture, as well as contusions of different kinds to the exterior of the abdomen: the latter may cause immediate rupture, or this may only occur after the lapse of days or weeks. Energetic contractions of the muscular tunic may also lead to this result. Transverse rupture, Saint-Cyr presumes, is a consequence of torsion of the uterus on itself, or at a limited point where the circulation is interrupted.

Symptoms.—The symptoms of rupture of the uterus are not well defined. If the accident is due to external violence, the signs will be in accordance with its severity, and the more serious indications may appear very soon after the contusion, or not for a considerable time. After showing symptoms of colic for a short time, the animal appears to be quite well until parturition is due, when after manifesting signs of that act the straining ceases, and those of peritonitis commence—hurried, short and plaintive respiration, quickened pulse, inappetence and suspension of rumination, insensibility to surroundings, coldness of body, looking round to the sides, etc. Examination of the abdomen will detect the presence of fluid in its lower third; while vaginal exploration may reveal an empty uterus, or only a portion of the fœtus in it—the rupture itself may be discovered. Or if the rupture has only ensued when parturition is advanced, the fœtus may be expelled in the usual way, and the symptoms of rupture only recognised when the birth has been accomplished.

Similar symptoms are observed when transverse rupture of the uterus has taken place, except that, owing to the twisting or torsion of the uterus, the hand cannot explore its cavity; the vaginal walls, however, are found very relaxed, and the uterine cervix extremely movable in every direction. If the animal survives, the straining soon passes off, the external genitals resume their ordinary appearance, and every indication of pregnancy disappears except the enlarged abdomen, on the floor of which the fœtus lies, and there it may become mummified, or in the course of time be eliminated by an ulcerative process set up in the abdominal walls; or it may even live and grow for some time after leaving the uterus, but unless removed artificially it must die. The mother may thrive, especially if the fœtus does not cause any inconvenience or is expelled in some way; and if only one uterine cornu was involved in the rupture, she may again become pregnant.

Treatment.—But little can be said as to this. Looking at the serious nature of the accident, it must be a question whether, if pregnancy is about complete and the fœtus is alive, it may not be advisable to kill the mother and preserve the young one. On the chance of the mother surviving, attempts might be made to treat the case as one of peritonitis, and resort had to surgical interference if there are any outward signs of abdominal abscess, for the elimination of the dead fœtus. With regard to the smaller animals, gastro-hysterotomy might be practised with some chance of success in favourable cases.

Though the accident is generally of a most serious character, yet, remembering that recovery does sometimes take place, there need not be undue haste in destroying the animal. When the organ contracts the dimensions of the rupture are reduced, and tears in the upper portions are very much less serious than those in the lower surface, for obvious reasons.

Metrorrhagia.

Accidental hæmorrhage from the uterus during pregnancy, appears to be somewhat rare in animals, judging from the paucity of instances recorded. Carsten Harms[1] has observed this accident in cattle; it was accompanied by a small discharge of blood from the vagina, particularly during micturition, and resulted in the death of the fœtus. Some observers have not noticed this discharge; the blood has always remained in the uterus, where it has been sometimes found, as a clotted mass, to the amount of more than four gallons. In the majority of cases it would seem to be occasioned by a spontaneous separation—more or less extensive—of the placental capillaries from the uterine surface. Zundel has seen it occur in an animal which showed signs of œstrum while pregnant. The following cases may, to some extent, illustrate this accidental uterine hæmorrhage.

1. Egli (*Journal des Vétérinaires du Midi*, 1850, p. 133) was called to see a Cow which staggered about in walking, and did not eat. He found it lying, and had great difficulty in getting it up, when it kept alternately lifting the hind legs. The pulse was slow and very weak, and the heart's beats were loud. There were no other symptoms. It was bled, but during the operation it staggered and trembled; the bleeding was stopped. It then lay down without appearing to suffer, and was dead in a few minutes. At the autopsy the uterus was observed to be considerably distended and of a violet colour, and an enormous quantity of blood was effused between the muscular and serous layers, so that the wall of the organ was about six inches thick; there was no extravasation, either in the abdomen or the cavity of the uterus. No cause was ascribed for the accident.

2. Zundel (*Journal de Méd. Vét. de Lyon*, 1861) describes the case of a Mare which suddenly presented the following symptoms during pregnancy: Anxious countenance, drooping head, rigidity of the loins, staggering gait and lameness of the left hind leg, as if from a sprain; the respiration 36 per minute, and pulse 60 and small. Treatment was of no avail; prostration gradually set in, the animal appeared extremely anxious, soon it could not stand, and when it fell, death ensued almost immediately without much agony. There were never any symptoms of colic or discharge of blood *per vulvam*. On examination, a five-months-old fœtus was discovered in the right cornu, and the placenta was detached nearly throughout. The left horn was the seat of sub-acute inflammation, and its volume exceeded that of the right; an enormous blood-clot, measuring about four gallons, occupied this horn and the body of the uterus. The bloodvessels were nearly empty. Zundel asks whether the lameness, which had already been noted as a symptom of metrorrhagia by some German authorities, may not be explained by the arrangement of the lumbar plexus, which sends nerves to the limbs and the generative organs.

3. In a pregnant Mare, Schmidt (*Annales de Méd. Vét. de Bruxelles*, 1862) witnessed the following symptoms: Sudden inappetence; head low and "beneath the manger"; reeling gait; extreme feebleness, and hind limbs widely separated; looking first towards one flank, then the other; pulse 110, regular but sinking; heart's beats quite audible, and venous pulsation in neck; mucous membranes very pale, and the body temperature low. Dark-coloured blood flowed in a passive manner from the uterus. The Mare died on the same day, and an autopsy revealed all the organs, except the uterus, almost bloodless; that viscus was found to be considerably distended with blood—nearly two pailsful—which was partly coagulated. It contained, in addition, a seven-months fœtus surrounded by the liquor amnii, and entirely separated from the uterine walls.

4. Macgillivray (*Veterinary Journal*, 1881, p. 177) was asked to attend a Mare more than nine months pregnant, because she was discharging much blood. Nothing was done to check the flow, which was arterial blood, and continued rather more than a

[1] *Lehrbuch der Thierärztlichen Geburtshülfe*, p. 60.

day, when it entirely ceased. The Mare subsequently produced a strong healthy Foal at the usual time. The author had no doubt that this was a case of *placenta prævia*, and the result of some distention or looseness about the cervix or os uteri, whereby the parts immediately within these became detached, and allowed a flow of arterial blood at that point.

5. The same observer (*Ibid.*) saw a young Cow within a fortnight of second calving, which for two days had been discharging large quantities of clotted blood. It began with the escape of arterial blood, but changed to venous, and finally became mixed with some of the uterine fluid. The Cow ultimately gave birth to a living Calf soon after, and did well. There was an entire absence of labour pains up to a short time before delivery, the os uteri being only partially dilated. The same animal had suffered from severe *post-partum* hæmorrhage at her first calving the previous year.

6. Kotelmann records the case of a Mare, seven months pregnant, which suddenly lost about half a pound of blood by the vagina; this happened again during three or four days, then the discharge changed to a yellow serum and ceased on the seventh day, when the animal regained its health and brought forth a Foal in due course, but died afterwards of paralysis.

7. Vogel speaks of a Mare which had four regular parturitions, and had reached the thirty-seventh week of her fifth pregnancy, when, without any precursory symptoms, there was an emission of blood from the vulva; this could not be checked, though cold-water compresses were applied to the loins for two hours. The blood continued to flow until the vagina was plugged; after some hours the plugging material was removed, when it was found that the os uteri was dilated. The hæmorrhage having recommenced, it was deemed advisable to induce abortion. The membranes were therefore ruptured and the fœtus extracted. But the Mare died immediately afterwards, and at the autopsy a fibroid tumour was found in the uterus, the pedicle of which was two and a half inches long, and near which the fœtal placenta had become adherent to the mucous membrane. Vogel was of opinion that the hæmorrhage was due to rupture of the placenta caused by movements of the fœtus.

8. Anacker refers to the case of a Cow which, when six months pregnant, exhibited symptoms of severe colic, during which she emitted strange bellowings. Some days afterwards a considerable quantity of blood was expelled from the vulva, and the following day there was another quantity, blood only coming away by drops in the interval. Being treated by bleeding and soothing medicines, and topical astringents, recovery took place in four days. The Cow did not abort.

9. The same authority alludes to the case of another Cow which, in the sixth month of pregnancy, after a severe attack of colic, discharged a large quantity of blood from the vulva, without any lesion being detected in the vagina. The same treatment was pursued, and the animal completely recovered.

10. Violet (Saint-Cyr's *Traité*, p. 222) mentions the case of a Cat which had nearly reached the time for parturition, when it fell from a height of about eighteen feet, expiring soon afterwards. An autopsy was made immediately, and it was noted that the uterus was deeply congested and full of dark blood, which had partially separated the placentas.

11. The same authority alludes to another Cat, also pregnant, which died very suddenly, and the uterus of which showed the same appearances as in the above case.

When there is no escape of blood externally, the diagnosis of this accident is most difficult; but when the hæmorrhage is apparent, then topical remedies might be applied in severe cases, and if these are of no avail, then artificial delivery should be attempted and the same treatment adopted as for *post-partum* hæmorrhage (*which see*).

Abnormal Retention of the Fœtus.

It was remarked, when speaking of the normal period of gestation, that this varied within considerable limits, and that the fœtus might remain in the uterus for a comparatively long period beyond the ordinary time, without any serious inconvenience to itself or its bearer.

But when, from any special cause, delivery cannot take place, then very grave results may, and indeed nearly always, follow.

Cases of abnormal retention of the fœtus were observed in the last

century by Boutrolle,[1] Gervy,[2] and Huzard, senior and junior; the latter exhibited to the Society of the Faculty of Medicine of Paris, in 1815, the uterus of a Sheep containing a fœtus which had been there for three years. Since that period the literature of the subject has become very extensive, more than forty instances being recorded in English veterinary journals alone. All the domesticated animals may suffer from abnormal retention of the fœtus, but the Cow appears to be far more exposed to it than any other — the frequency in this animal being as twelve to one in the Mare, and ten to one in the Sheep. Of the forty-eight instances recorded by Saint-Cyr, 35 occurred in the Cow, 7 in the Ewe, 5 in the Mare, and only 1 in the Bitch.

Symptoms and Terminations.—The symptoms at first are, of course, those of pregnancy, until the period of normal parturition, or even during pregnancy when abortion is about to take place. At this period there are nearly all the signs of parturition: enlarged mammæ, swollen vulva, pendulous abdomen, restlessness and anxiety. Then straining begins, but the os uteri remains closed and no fœtus appears. This condition may persist for only a brief period, and be so little marked as to pass unobserved in some cases; in others it may continue for two, three, or four days, the expulsive efforts gradually diminishing in force and frequency until they altogether disappear. The animal then regains its ordinary state, and, if a Cow, the secretion of milk goes on as if there were nothing the matter. Health may never be impaired from this cause, and the condition of the animal may not be suspected until, if a Cow or a Sheep, it has been fattened and slaughtered by the butcher for food, when the fœtus is discovered. It has been observed that œstrum does not appear in such animals, as a rule. The exceptions are rare, though Rossignol mentions a Cow which retained its fœtus for twenty-seven months, yet gave an abundance of milk, often exhibited œstrum, went to the Bull, and was at last killed because it became too fat! More cases of a similar kind are recorded.

In other instances, after the ordinary period of gestation has been exceeded by several months, signs of parturition are again manifested, and delivery may then be safely accomplished, either without aid, which is rare, or by careful manipulation; the young animal may even be born alive if too long a period has not intervened since the normal time of delivery.[3] Parturition in these cases is generally difficult; and the

[1] *Le Parfait Bouvier*, 1776. He writes: "There are Cows which are not 'open,' that is to say, which have not sufficient passage for the Calf, which remains in the Cow and becomes dried up like a ball. The Cow does not die for all this, if it is well cared for; but many perish when, instead of drying up, the fœtus becomes a mass of corruption. The Cow which carries its dried-up Calf in the uterus does not seek the Bull. . . . It is necessary to take care of these Cows for ten months or a year, and to feed them well, especially when the Calf dries, for they eat little and become extremely emaciated for fifteen days. In about ten months or earlier, if there is any herbage, these Cows are put out to pasture, and they fatten like others; the butchers find the calf dried up in the Calf-bag."

[2] *Instructions Vétérinaire*, vol. iv., p. 256.

[3] In the *Newcastle Journal* for January 18, 1840, there is the description of a Calf which was born on the 365th day (fifty-two weeks and one day). It was alive when dropped, but died soon after. It was of great size, though born without assistance; it was a male.

Strange to relate, in the *Veterinarian* for 1850 (p. 148), a Mr. Tatam, of Horncastle, records a case of abnormal pregnancy in a Cow in his locality, in which not only was the period the same (fifty-two weeks and a day), but the Calf was a male, as extraordinary in size, and excited a similar degree of wonder, as the above. Mr. Tatam saw the Calf; had he seen the other one?

favourable termination of such a condition is due to the membranes of the fœtus remaining intact, and the os sufficiently contracted and close to exclude the atmosphere. Even under these circumstances, the retention of the fœtus may not have so fortunate an ending. Very often, after fruitless straining, the animal continues unwell; it has little or no appetite, languishes, becomes feeble; hectic fever appears; it falls into a state of marasmus, and dies after a more or less prolonged period of misery.

When, at the usual time of parturition, the straining of the animal has ruptured the fœtal membranes and the liquor amnii escapes, air at the same time obtaining access to the uterine cavity, the case is in nearly every instance very serious. The fœtus soon perishes and begins to putrefy, and in a short time the decomposing mass causes inflammation of the uterus (metritis), accompanied by frequent and exceedingly severe straining; low fever supervenes; a foul-smelling putrescent fluid escapes from the vagina, and the creature finally succumbs to metritis and putrid infection. In other instances the termination is not so rapid. The animal remains unhealthy; the secretion of milk is suspended; horribly fœtid discharges are passed *per vaginam*, containing pus, broken-up decomposed tissues, and even bones of the fœtus; these discharges are increased by the straining which sometimes takes place at intervals. In the meantime, the creature loses condition, emaciation becomes extreme, and death ensues from debility and marasmus.

With the Cow we may, nevertheless, have a vaginal discharge, due to the presence of a putrefying fœtus, and for a long time, without any such serious result. Figuier removed from the uterus of a Cow the entire skeleton of a fœtus which had been there for more than *five years*, without giving rise to any other symptoms than a very disgusting intermittent vaginal discharge. The animal quite recovered. Thierry reports the abortion of a Cow at the fifth month of gestation, and the retention of the putrefied fœtus for more than three months afterwards, without any harm ensuing; Gervy also removed the head of a fœtus which had lain in the uterus of a Cow for eighteen months, without the animal suffering much inconvenience during that time. In the *Veterinarian* (vol. ix., p. 454) there is an instance of a Cow carrying a decomposing Calf for two years with impunity; and another (vol. xxix., p. 577) for ten months.

It is not the same with the Mare, as death has been the usual termination; but it would appear, as already remarked, that retention of the fœtus is very unusual indeed in this animal, the best recorded instances being one by Hamon, in which death took place after seventeen months' pregnancy; and another by Hammond, when the same result followed after twenty-two months.

The period during which a fœtus may be retained in the uterus varies from a few months to five years.

We have mentioned that, in these cases of retention, the fœtus may live for a certain time, provided the membranes are not ruptured when the symptoms of parturition first manifest themselves; it may even continue to develop, as is evidenced by its size, its bony framework, hoofs, teeth, etc., which often cause it to look like an animal that has

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I have some instances of 300 days' pregnancy in Cows, the calves being born alive.

In the Mare, prolonged pregnancy is not nearly so frequent, though it sometimes occurs, the fœtus being retained a month, or even a little longer, without prejudice to the Foal's existence.

been born for two, four, or six months. But in other cases there can scarcely be a doubt that the fœtus perishes when the first ineffectual expulsive efforts are made by the mother, or even at a period anterior to the ordinary occurrence of parturition, as is proved by the absence of hair, and the small size and weight of the creature; while, again, it may live for some hours after rupture of the membranes, provided it can breathe, or the placental connections are intact.

In all cases, as a rule, if the air does not obtain access to the uterine cavity, putrefaction does not ensue; and when the uterus is examined after death, it is found to be closely contracted on its contents, its mucous membrane healthy or slightly ecchymosed here and there, with the cotyledons pale, wasted, and separated from the placentulæ. Sometimes between the inner surface of the uterus and the chorion there is a gelatinous mass, which covers the fœtus and conceals the placental cotyledons, these being decayed, spongy, and sometimes completely destroyed. The liquor amnii has also been absorbed; so that the membranes are in close contact with the fœtus, and may even have become adherent to it in places. The fœtus itself is desiccated by absorption, and its skin is hard and dry as if tanned, or it is wrinkled and shrivelled; while the flesh, if any remains, is either perfectly white, or pale and faded-looking in colour, and emits a kind of rancid odour. Other organs are pale and bloodless, and more or less undergoing fatty degeneration. When the retention has continued for a long time, all the soft textures may disappear, and nothing remain but the bones; in other instances the fœtus and its membranes become the seat of calcareous infiltration, and constitute what has been termed a *lithopædian*.

It is sometimes extraordinary how perfectly a fœtus is protected from decay in the uterus. For instance, in the *Veterinary Journal* (July, 1876), Mr. Taylor mentions one which had been retained for seven months beyond the normal period; and yet with the exception of absorption of the eyes, it did not present indications of having passed more than a few days in excess of the usual term in the uterus.

When the envelopes have been ruptured, however, and the liquor amnii has escaped, we have a different pathological condition. Then, through the partially dilated os the air has been admitted, and if immediately before this the fœtus was alive, it may then die and rapidly submit to the putrefactive process, its soft parts decomposing and macerating, and forming a most foul-smelling mass; so that when the uterus is opened, we discover a grey or greyish-red fluid emitting a most disgusting odour, and containing portions of matter resembling adipocere, and perhaps bones which may yet be covered by soft parts and held together by ligaments, or entirely disunited and decaying. The uterus itself shows evidence, in the majority of cases, of chronic metritis; sometimes abscesses have been formed in its texture, or it has become adherent to other organs—as the intestine, or such tissues as the abdominal walls—with which it has established fistulous communications, and through which portions or the whole of the fœtus may be passed.

In the case of twins, it sometimes happens that one of them dies, and this occasions symptoms of abortion; but delivery of the dead fœtus cannot be effected, owing to the obstruction offered by the living one, which is born at the usual time, the parent being in good health. But days, weeks, or even months after, the remains of the dead fœtus may be passed, or have to be extracted from the uterus.

The fœtus may also be retained in the vagina long after being passed from the uterus, the os of which is closed; but then it is of very small size, and does not appear to cause serious inconvenience.

Causes.—Various causes have been assigned for the retention of the fœtus, several of which are no doubt quite sufficient to offer an obstacle to normal parturition. Among these causes may be cited: a diminution or loss of contractile power in the uterus itself to expel its contents, and the absence of assistance when attempts are made; adhesions of an unusual character between the uterus and placenta; malposition of the fœtus; displacement of the uterus; deformed pelvis; fibrous induration or spasmodic contraction of the cervix uteri; torsion of the uterus, or adhesion of its ligaments, etc.

Treatment.—The treatment of fœtal retention must greatly depend upon circumstances. When the owner of an animal that has reached the termination of pregnancy and begins to be in labour perceives that the straining is weak and irregular, and not sustained, so that birth does not take place after twenty-four, thirty-six, or forty-eight hours, and even when the symptoms of colic are slight and the condition of the creature otherwise satisfactory, the attendance of the veterinary surgeon should not be delayed. The latter will inform himself as to the history of the case, and also its present condition by careful external examination and internal exploration. By the latter he will ascertain, in all probability, the character of the obstacle to parturition, and be in a position to decide whether delay is necessary, or if he is to promote immediate delivery. In some instances it will be difficult to arrive at a decision. Some practitioners of note recommend abstention from interference and the adoption of expectant treatment, so long as the os is not sufficiently dilated or the fœtal membranes are not ruptured; and they insist on this course even when there is a material obstacle present—such as torsion of the uterus or degeneration of the cervix—which renders spontaneous or natural delivery impossible.

This treatment is based on the relative innocuousness of the fœtus in the uterus, even for a very long period, so long as the liquor amnii has not escaped and the air has not penetrated. This course is no doubt most judicious in some cases, and is followed by successful results. All that has to be done is to keep the animal very quiet—in a darkened place if possible—and to administer opium or chloral in full doses, both in draught and enema if need be.

But in the majority of cases, if not in all, it is preferable to resort to active measures. The expectant method was all very well when art found itself disarmed in the face of certain accidents, such as torsion of the cervix, which rendered spontaneous delivery impossible; but it cannot be urgently insisted upon now, when we are in possession of methods which enable us to overcome these accidents. Therefore, as a rule, it is the duty of the obstetrist to terminate as soon as possible the act of parturition, when it has once commenced. In compliance with this advice, the veterinarian, after informing himself as to the nature of the obstacle opposed to delivery, should act according to the rules applicable to each particular case, rules which will be alluded to hereafter.

When the membranes are ruptured, then delay may be out of the question, and intervention might require to be prompt, if serious consequences are to be averted. Attempts to effect speedy delivery should

be resorted to at once, in the majority of cases, if not in all. Nevertheless, even here we find excellent practitioners recommending abstention, at least for some hours, according to circumstances. For instance, Dupont,[1] of Bordeaux, a good authority, does not at all agree with the generally received opinion that death of the fœtus must necessarily immediately follow rupture of the membranes, as he has met with many cases in which it has lived for a long interval—twenty-four to thirty-six hours—after the escape of the liquor amnii; and he does not hesitate to affirm that respiration commences with, and is continued after, the evacuation of this fluid, especially if the young creature is in a natural position—the fore-limbs and nose in the os. He will not say so much for all the positions of the fœtus, though he has effected delivery in them fifteen to twenty hours after escape of the "waters," and the creature has respired and lived. He thinks that the popular opinion is due to the fact, that the attention of the obstetrist is solely directed to preserving the life of the mother, and that the fœtus is killed through the violent compression it sustains in a narrow pelvis, from the powerful contractions of the uterus, without the intervention of other causes.

When some time—days, for instance—has elapsed since this stage in parturition was reached, and labour has completely subsided, the case is difficult, and it will again depend upon circumstances whether expectant or active treatment shall be adopted. An exploration should certainly be made, and if it can be ascertained that the membranes are not ruptured, while there is no straining and the condition of the animal is satisfactory, then it will be advisable to wait until indications of labour are once more manifested. If the state of the animal is not so favourable and delivery is decided upon, and should the os be impermeable, or not sufficiently dilated to allow the passage of the fœtus, then it must be opened either by careful manipulation, uterine douches, the uterine dilating bag, or other modes which will be alluded to when treating of dystokia.

When a long period has intervened, and the general and local disturbance in the animal necessitate active interference on the part of the veterinary obstetrist, then of course the first and most urgent indication is to remove the cause—the putrefying fœtus—from the uterus. When the os is not sufficiently open to admit the hand and the withdrawal of the fœtus, then the case is one of difficult labour, complicated by the death of the fœtus and its state of decomposition. If the os should chance to be contracted, it must either be dilated by the means we have named, or if these do not succeed (though they often do), then the cervix must be incised. In very exceptional cases, gastro-hysterotomy has to be performed if the fœtus or its remains are to be got rid of; and in some instances, owing to the emphysematous condition of the fœtus, its shape or size, or deformity of the genital passages of the mother, embryotomy is called for.

When the uterus is emptied of all the matters, solid and fluid, it contains, it should be thoroughly cleansed by repeated injections or washings with tepid water, and finally with some anti-putrescent fluid—weak solutions of chloral, permanganate of potassium (Condy's fluid), or of carbolic or salicylic acids. General treatment may also be necessary, and this must be regulated according to the indications. In all the manipulative operations subsequent to delivery, it will generally be

[1] *Archives Vétérinaire*, June, 1876.

found that care and patience, and, above all things, an absence of undue haste, are commendable, and particularly with regard to the removal of the membranes, especially in primiparæ. The danger of septic infection may be largely averted by intravaginal emollient douches, and serious consequences may often be avoided by abstaining from premature and violent interference.

When portions of the fœtus are expelled through fistulous openings, even then surgical interference might be successfully invoked.

Abortion.

When pregnancy is interrupted by the expulsion of the ovum, or of the fœtus at a stage when this has not attained sufficient development to live external to its parent, *abortion* (*partus immaturus*) is said to occur. But when the fœtus is expelled before the ordinary period of parturition, yet with all its organs sufficiently perfected to enable it to exist for at least some time in the external world, this is designated *premature birth* (*partus præmaturus*). In the first instance, the young creature is either dead when expelled from the uterus, or dies immediately afterwards; and in the second, it may be weakly and immature, and succumb after a variable period; or it may continue to live and thrive. In practice, there is no accurately defined limit between abortion and premature birth, and especially when the latter has been brought about by some of the causes which produce the former.

Abortion may be said to take place in Solipeds, when the fœtus is expelled forty days before the normal period; in the Bovine species, thirty-five days; in the Sheep and Goat, twenty days; in the Pig, fifteen days; and with the Bitch and Cat, seven days. Saint-Cyr says that it may be acknowledged that abortion has taken place, when the fœtus is expelled in the Mare before the 300th day of gestation, in the Cow before the 200th, in the Ewe before the 140th, and in the Sow before the 100th day.

There is not the same tendency or readiness in all the domesticated animals to abort. The Bitch and Cat rarely do so, even after serious injuries; and the Sow retains its fœtuses almost as tenaciously; but the Sheep and Goat are rather liable to this accident. The Cow and Mare, but more especially the former, most frequently lose their fœtus. In what proportion abortions occur is not ascertainable from any documentary evidence. For the Cow, Baumeister and Rueff state that in France, in a dairy containing Durham Cows, and numbering 100 pregnancies, there were 17 abortions; and at Hohenheim, from a register kept for thirty years, it appears that one-fifth of the Cows aborted. Among 5,864 Sheep of various breeds at the same establishment, there were only 26 abortions, or 0·433 per cent.

Abortion may occur at any period of gestation within the limits above named, though it is much more frequent during the first than the second half of pregnancy, and especially with the Mare. When this accident occurs at a very early stage, it may produce no appreciable disturbance of health in the female, and the developing ovum escapes intact, and often unperceived. The accident is more serious when it happens at a late period; as it then not only causes the loss of the young animal, but may compromise the existence or value of the mother.

Abortion may be either *sporadic*, *enzoötic*, or *epizoötic*. When cases occur here and there on farms or breeding establishments over a wide extent of country, without any relationship as to causation, they

are *sporadic* or *accidental* abortions; and though they must be reckoned as losses, yet they rarely attract much attention from the damage they inflict, because of their isolated, and by no means unusual, occurrence. But when, on the contrary, the pregnant animals—say Cows, Ewes, or Mares—on a farm, in a village, or over a large district or country, abort in large numbers, and the mishap is evidently due to the same cause or causes, then it is indeed a grave misfortune, as it entails serious damage—present and prospective—to the interests of agriculture and live stock. This is *enzoötic* or *epizoötic* abortion—an occurrence, unfortunately, far from uncommon, and the etiology of which has attracted the attention of the most distinguished European veterinarians for many years.

Sporadic Abortion.

Causes.—The assignable causes of sporadic abortion are very numerous, but the way in which many of them operate in causing separation of the fœtus from the mother is either unknown or little understood. However, it is considered or presumed that they may act either directly or indirectly, and produce their effects in an evident or an obscure manner. They may be ranged as *external* or *internal*.

1. *External Causes.*—Atmospherical influences, bad weather, or irregular seasons, have been cited as predisposing to or causing abortion. There can be no doubt whatever that cold, and especially when suddenly applied to the skin, may produce this result; and hence it is that the abrupt setting in of cold weather is often marked by miscarriages among animals exposed to it. Many observers have noted that the continued and severe cold of winter is far less frequently productive of abortions than when cold, wet, or frosty nights in autumn succeed fine warm days. Cold rain is sometimes very damaging in this respect.

With regard to food and ingesta in general, there can be no doubt that here we often have an undoubted cause. Food of bad quality, indigestible, or containing injurious ingredients, is well known to be dangerous. After unfavourable seasons, when forage has not been well dried and made, abortions are far from uncommon. Indigestible food, or that which has a tendency to collect or ferment in the stomach, may, by exerting pressure on the uterus, produce this accident.[1] On the other hand, too great an abundance of easily-digested and stimulating food, by inducing plethora, and consequent congestion of the uterus and loosening of the placentæ, has been set down as another cause. Frozen food or water, when taken in immoderate quantity, and especially if the digestive organs are nearly empty, as well as forage or herbage covered with snow or frost, are also injurious in this respect to all the larger animals when pregnant, and abortion often follows

[1] Delwart has given a good illustration of this. "For twenty years all the Cows in a herd of thirty aborted each year, and if by chance one Calf reached its term, it was so puny and deformed that it died in a few days after birth. The cause of these abortions appeared to me to lie in the too large quantity of grains and balls of cereals with which the animals were fed; the rumen and second compartment of the stomach formed a compact mass which weighed on the fœtus, prevented its development, and ended by killing it. These Cows were put under our care, and submitted to a different kind of alimentation; roots replaced the innutritious food previously given, and which gave rise to permanent indigestion. This régime was seconded by the administration of a decoction of linseed, five or six bucketfuls in the day, and a draught of a pound of sodium sulphate to each Cow. . . . Success was complete; the destructive scourge entirely disappeared, and twenty-eight healthy Calves were born at the proper time."

immediately.[1] Filthy putrid water has also very frequently a pernicious influence on gestation. Some plants—such as the horse-tails (*Equisetaceæ*), sedges (*Cyperaceæ*), etc.—and the leaves of beetroot, readily induce abortion, according to several authorities. Rue, savin, ergot of rye, and other ecbolics will, of course, have a tendency to cause expulsion of the fœtus more or less readily; and toxical substances, such as cantharides, which act upon the uterus, will do the same. Purgatives, especially those of a drastic kind, are a fertile cause; and opium, digitalis, and some other drugs have to be administered with caution. Food or herbage altered by the presence of cryptogamic vegetation, especially when damp, has long been known to cause abortions. Ergotised grasses and grains have often produced wide-spread losses from this accident.[2]

Excessive muscular exertion and unusual travelling, and especially if there is a predisposition to abortion, is very likely to produce it; if the exertion is sudden and severe, or even moderate, but coming after a long period of rest, it is all the more certain. Contusions to the abdomen by kicks or falls, or squeezing through a narrow doorway or passage, railway or steam-boat travelling, blows and shocks, keeping the animals in stalls with very inclined floors, are all so many causes. A case came under my observation recently, of a little Bitch, extremely fat, which aborted at a late period of gestation, through frequently ascending and descending a steep staircase.

Access of the male not unfrequently produces a miscarriage; and exploration *per vaginam* by the expert has also been blamed, as well as surgical operations performed on pregnant animals—bleeding, for instance, or throwing an animal down to be operated upon.[3]

[1] Saint-Cyr mentions that Gellé has witnessed nearly one-fifth of a flock of Sheep abort immediately after drinking from a pond, the ice on which had to be broken to water them. Audoy reports an exactly similar occurrence; and Delorme, who has also observed analogous accidents, adds that they are most likely to happen when the Sheep have been deprived of water for several days. Huvellier mentions a rich grazier of Merlerault who owned ten brood Mares, one half of which aborted every year, because they were sent three times a day to drink cold water. Often, after quenching their thirst, they trembled, were seized with colic, and aborted. The régime was changed; the Mares received water at morning and mid-day in the stable, a handful of bran being put in the water; and only in the evening were they allowed to be watered outside, after the stable-doors had been opened for an hour. The abortions ceased. Flandrin relates similar accidents occurring to the Mares belonging to the Prince of Condé, and from the same cause.

[2] The *Veterinary Journal* (vol. i., p. 422) alludes to an occurrence of this kind in New Zealand in 1875. It appears that this accident was comparatively rare in that colony until the introduction of rye-grass on the pastures, after which it was common, and a cause of great loss when the rye became ergotised. The same journal (vol. ii., p. 51) contains an account of serious abortions among Mares in Germany, due to rust (*Trichobasis rubigo*) on the straw on which they were fed. In *Animal Plagues* (London, 1871) many interesting notices are given of similar occurrences.

Haselbach reports that in a cow-shed where maize infested with its parasitic fungus (*Ustilago maïdis*) was given to the cattle, eleven aborted within eight days. The food was changed at once, and the other Cows escaped the accident. A certain quantity was administered to two pregnant Bitches, and they both expelled their young.

With regard to the ergot of rye, its action as an ecbolic does not appear to be so certain in Herbivorous as in Carnivorous animals, large quantities of it having been given to pregnant Cows without abortion resulting.

[3] Professor Bouley performed the operation of castration on three pregnant Cows; they aborted in two days after, and one died. Nevertheless, Chanel has seen a castrator operate on a Sow about two months pregnant. Three fœtuses, the size of the middle finger, were removed, along with the portion of cornu in which they were contained. The poor beast lost much blood, and was very ill for six or seven days; yet in more than two months afterwards it brought forth five young Pigs, which it suckled.

Carrying a rider, in the case of the Mare, and especially if spurs are used, is attended with much risk.

Excitement, fear,[1] sudden surprise, or anger, are also causes. Heavy thunder has sometimes been serious in this way; and the fear produced by Dogs leads sometimes to heavy losses among Sheep—foxhounds running near or among pregnant Cattle or Sheep often cause considerable damage, especially among nervous animals.

Certain odours are said to cause abortion.

2. *Internal Causes.*—Badly-fed and neglected animals sometimes abort, but not nearly so frequently, perhaps, as those in the opposite condition and extremely fat. It is generally admitted that with some animals there is a special predisposition to abort, and that a very trifling cause —especially previous abortions—and sometimes no appreciable cause at all, will induce this accident; while other animals never lose their fœtus, though exposed to the influence of apparently most powerful causes. This predisposition is not manifest externally, and sometimes it disappears as age advances.

A more constant and potent cause, however, is to be found in the presence of grave diseases, and especially those which affect the system generally, producing more or less derangement of all the functions. The various serious epizoötic maladies, enteritis, and all those abdominal disorders which give rise to restlessness, tympanitis, cough, as well as those diseases which induce cough—as bronchitis, pneumonia, asthma, etc.—pleurisy and other affections and injuries accompanied by great pain; as well as nervous or convulsive derangements—such as tetanus, epilepsy, vertigo, etc., are all set down as causes.

In acute febrile diseases of the mother, the fœtus may perish from the abnormal accumulation of heat; or chronic or acute anæmia in the female may prove fatal to the fœtus, by causing asphyxia in it.

Certain virulent disorders affecting the female may likewise cause the death and expulsion of the young creature *in utero*—for example, foot-and-mouth disease and tuberculosis. The fœtus of a Cow affected with contagious pleuro-pneumonia, has been found with its lungs affected in a similar manner;[2] and to prove that the transmission of these diseases can be effected in this way, Sheep which were in the uterus when their dam was affected with variola (sheep-pox) were found to resist inoculation with the virus of that very malignant malady.[3]

Violet has even removed one of the ovaries from a Cow two months pregnant without abortion taking place or the animal suffering in health, and it would probably have gone the full time and reared its Calf if it had not been killed for food.

[1] The Cat rarely aborts, and instances are on record in which they have fallen from a considerable height without this accident occurring. Nevertheless, they are liable to miscarry, and a friend who lives near Chatham had a favourite Cat heavy in Kitten, that aborted immediately after being pursued by a strange Dog, which, however, did not seize it. The accident in this case was evidently due to fear.

[2] Barrier describes an abortion epizoöty among Cows, in which nearly all the Calves were expelled alive at the fifth to the seventh month, but died within eight days afterwards. The principal symptoms were a more or less loud râle, the discharge of rusty-coloured mucus from the nostrils, and constant loud bellowings. At the autopsies the "lungs were tumefied, red, and fleshy, and the bronchi filled with the saffron-tinted fluid that flowed from the nostrils."

[3] In the human female, Klautsch remarks that pregnancy may in such cases be brought to an end either by the death of the fœtus, or less frequently by premature uterine contractions. The fœtus may die owing to (1) deficiency of oxygen; (2) alteration in temperature; or (3) direct transmission of the infection. These conditions may be combined. The inconstancy of the transmission of the infection the author would explain by the circumstance that it can only occur when the normal connection between the maternal and

Hydrocephalus, ascitis, anasarca, and chlorosis, may also lead to the death of the fœtus, which in nearly every case is not only the most frequent predisposing cause of abortion, but is almost a certain determining cause of its expulsion. Hydramnios, and other morbid conditions of the fœtal membranes, or faulty formation or relations between the placentæ, are other causes; and congenital malformations of the fœtus, malposition, or exaggerated volume are also mentioned. The presence of several fœtuses often leads to abortion in uniparous animals.

Disease of the uterus will, of course, be very likely to lead to the premature expulsion of the ovum or fœtus. Metritis, abnormal conditions of the mucous membrane, as well as new formations—such as fibroid and carcinoma, and other alterations by which the enlargement of the organ is hindered—as enormous tumours in the abdomen, ovarian dropsy, etc.—will predispose to or excite abortion, as will also every condition which leads to hyperæmia of this viscus.

Abortion has not unfrequently been ascribed to some defects or other influences in the male, though in what these consist has not been explicitly stated; unless they are to be found in the debility arising from too frequent usage, or other causes related to the animal's state of health. There is strong and abundant evidence that a male enfeebled by too much use, is very likely to be a cause of abortion in the females to which he is put. This accident has also been said to occur frequently when the male was larger and more powerful than the female.

Various injuries to, and diseases of the fœtus or its envelopes, may lead to the same result. External violence may not only injure the uterus itself, so as to produce abortion, but the fœtus even may sustain damage. Cauvet has remarked in a case of abortion in a Mare brought about by kicks on the abdomen, that the fœtal membranes exhibited at the corresponding point an enormous ecchymosis, and behind the shoulder of the fœtus, which was in relation to this extravasation, was a large brown-coloured exudation. Another observer has witnessed an adhesion between the skin on the cranium of a fœtus and the fœtal membranes, as well as depression of the cranial bones—all evidently due to external violence.

The fœtus may be poisoned by food or medicines which do not produce any appreciable effect on the parent.

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fœtal circulation is disturbed. Premature pains may be caused by (1) increased body temperature; (2) altered blood; (3) changes in the uterine mucous membrane, as in endometritis exanthematica; or (4) toxins present in the blood. If the deficiency in oxygen occurs rapidly, the fœtus dies; if more gradually, pains are induced. In typhoid fever abortion occurs in more than half the cases, and the fœtus is generally born dead, the death being most often due to the transmitted infection. Cholera is not transmitted to the fœtus, the death being here due to the altered blood, to an endometritis, to a diseased fœtal placenta, and to temperature variations. In measles the fœtus rarely dies. In severe malaria the fœtus is more often born alive, but soon dies of malarial cachexia. In pneumonia the death of the fœtus is not uncommon, and is due to asphyxia. Variola frequently kills the fœtus, yet many are born alive. As regards the pains, the fœtus may be expelled in variola even during the suppurative stage; in malaria after the paroxysm; in erysipelas most often when the eruption appears; in cholera during the transition stage; in influenza soon after the onset of the febrile symptoms, and in pneumonia on the third or fourth day. In typhoid fever the abortion may be accompanied by much hæmorrhage, or strong contractions and little hæmorrhage. In cholera the hæmorrhage is profuse, and the contractions violent. The fœtus is mostly much more threatened by the altered temperature, disturbed circulation, and pathological changes in the endometrium, than by the transmission of the infection.—*Münchener Med. Wochenschrift*, December 26, 1894.

Symptoms.—The symptomatology of abortion is extremely varied, being in some cases so trifling that, as already said, the accident may be unperceived, so far as the female is concerned; while in others the symptoms indicate a very serious condition. This usually depends on the period of pregnancy at which the accident occurs.

Generally, abortion takes place without any premonitory indications, and the animal may be as well and lively as usual up to the moment when the fœtus is expelled; and the expulsion itself is so sudden, so prompt, and accomplished with so little visible effort or disturbance, that the accident in most cases receives very little, if any notice. It frequently occurs during the night, and wonder is often expressed at finding in the morning the aborted fœtus—generally contained in its intact envelopes—lying behind an animal which, on the previous evening, looked perfectly well, and even now is so cheerful and unaltered, and its functions so unimpaired, that it can scarcely be believed that it has been the subject of such a mishap. Even the sentiment of maternity, which is so strongly developed in animals, as Saint-Cyr justly remarks, is not awakened in favour of the expelled fœtus, and the mother shows the utmost indifference to it, even treading on it as if it were in no way related to her.

When this simple abortion has taken place during the day, it has been noted that the flanks fall in a little, the abdomen descends, the vulva and vagina slightly dilate, and there escapes from them a glutinous, sometimes sanguinolent, fluid, with which the fœtus is passed almost without effort. We have said that the ovum or fœtus is generally expelled in its intact membranes; this more frequently happens at an early stage of pregnancy. Sometimes, however, the amnion ruptures at the commencement of abortion, and the embryo or fœtus escapes with a small quantity of liquor amnii, the envelopes being rejected soon after; or in some instances they may be retained in the uterus, and thus constitute a source of danger, the animal not making any effort to get rid of them. This *complicated* abortion occurs more frequently at the later stages of pregnancy, and more resembles normal birth than *simple* abortion, which is most frequently witnessed in the first half of pregnancy. Nevertheless, we have the latter happen so late sometimes as the seventh or eighth month in the larger animals. It is observed more particularly in those which are debilitated from any cause; but, at the same time, animals which appear in the very best health are often the subjects of simple abortion.

So little disturbance does this kind of abortion cause, that the animal can be treated in every way as if nothing had happened; though it is more judicious to give it a little extra care for some hours at least.

In what has been termed *laborious*, *difficult*, or *complicated* abortion, which is often due to external causes, such as injuries, the precursory symptoms are generally well marked, and vary somewhat, according as the fœtus may be dead or alive. The animal suddenly appears dull and peculiarly dejected; or it is restless, uneasy, and continually moving about; if pregnancy is advanced and the fœtus is alive and strong, its movements are, on watching the abdomen attentively, perceived to be frequent, violent, and disordered, but they soon become feeble and infrequent, and cease altogether when the fœtus has succumbed. The appetite is lost, a plaintive neigh in the Mare, moan in the Cow, or bleat in the Sheep, is emitted every now and again; the pulse is quick, small, and hard as in hæmorrhage; progression is difficult and unsteady;

the physiognomy is anxious, and respiration hurried. When the fœtus is alive there is perhaps less prostration, and—more particularly with the Mare—there appears to be much abdominal pain. The animal often looks anxiously towards the flanks, paws with its fore feet and stamps with its hind ones, moves from side to side, perspires at the flank, breast, and elsewhere, lies down and gets up again, whisks the tail incessantly, and exhibits every indication of increasing restlessness. At the same time the abdomen loses its round shape, and drops; if the animal is in milk, the mammæ become soft and diminish in size more or less rapidly, while the secretion diminishes; but if it is not yielding milk, then, on the contrary, they enlarge and become turgid; the vulva is tumefied, and from it escapes a tenacious mucus, serous, or sero-sanguinolent, and—if the fœtus is dead—more or less fœtid fluid, according to circumstances. Then follow symptoms analogous to those which characterise normal parturition—the uterus begins to contract, and the expiratory muscles act simultaneously with it; the expulsive efforts, or "labour pains," acting more or less energetically and continuously, according to the suddenness of the abortion and the strength and health of the animal. The first result of this straining is the evacuation of the bladder and rectum; the next is the dilatation of the os uteri and protrusion of the membranes into the vagina, then through the vulva, where they appear externally as the "water-bag"; this may rupture and the liquor amnii escape, and the pains becoming more powerful, the fœtus is at last expelled either nude or covered by the membranes. This act occupies a variable period—from a few to many hours, according to the strength of the animal; and it may even require human intervention to bring it to a successful termination. In other instances, however, the fœtus is not expelled immediately after it is dead, but after many of the premonitory symptoms just described have been manifested; with the cessation of the movements in the fœtus the animal regains its ordinary tranquillity, appetite, and liveliness, and all the symptoms disappear for one or more days, when they again set in, and the fœtus may be rejected without any apparent effort, or after much straining.

In the case of two or several fœtuses, it may happen that the one or two nearest the os are dead, and are expelled, the others being alive are retained until pregnancy is complete; or the contrary may occur, the living fœtuses being in proximity to the os, prevent the escape of the dead ones, and these being kept in the uterus until delivery of the others takes place, become mummified.

And in some cases of what might be termed "violent" or "acute abortion," when it suddenly sets in, and nothing is prepared for its being carried to a successful termination, either on the part of the fœtus or of the mother, the latter is exhausted by ineffectual efforts, and soon passes into a critical condition.

Abortion differs from normal parturition chiefly in the state of the cervix uteri. Towards the termination of pregnancy, this part of the uterus becomes gradually shortened and softer; but in abortion we do not have these progressive changes which are so favourable to the passage of the fœtus from the uterine cavity outwards. The cervix is long and rigid as in the non-pregnant condition, and its dilatation is therefore slower, more difficult, and more incomplete than when gestation has reached its termination; and especially as the muscular fibres of the uterus have not acquired either their full development or contrac-

tile force. To counterbalance this, there is the small size of the fœtus, which does not require so much space for its passage as if it were full grown; so that the difficulty in removing it is less on this account, though the other difficulties the obstetrist has so often to encounter in parturition may all be present.

Results.—Abortion is always a serious accident, if only from the loss of the fœtus. It is frequently complicated by hæmorrhage, which may primarily have been the cause of uterine action; it may also result in rupture of the organ, from the efforts the animal makes to overcome the resistance offered by the cervix; indeed, we may have the usual complications that attend parturition. But in many cases the complications are few and trifling, the animals scarcely experiencing any inconvenience, and retaining all their useful qualities unimpaired. When the accident occurs in the Cow at an early period—before the fifth month—the secretion of milk is generally interrupted, often for a year, as the mammæ have not had time to experience the reflex or sympathetic influence which stimulates them into activity; when, however, it takes place in the last half of pregnancy the secretion may be established, though the yield is usually diminished, and the glands do not furnish their ordinary quantity until the next pregnancy.

Abortion may produce prolapsus of the uterus and vagina, and sometimes even of the rectum.

At an early period of pregnancy, as we have mentioned, when the fœtal and uterine attachments are not very close, the ovum or fœtus may be expelled with the whole of the membranes; but as the process has advanced this result is less probable, and particularly with the Cow. The membranes are frequently retained, wholly or partially, when the fœtus comes away; and owing to the condition of the cervix and its rapid contraction, they are included in the uterine cavity and constitute what is termed "retention of the placenta"—often a serious complication of abortion in the Cow after the first third of pregnancy, the membranes decomposing and giving rise to putrid infection and other alarming pathological conditions.

In the simplest cases, œstrum appears in the Cow in from one to two weeks after the miscarriage, as after parturition, and conception may occur then; but not infrequently impregnation does not take place until after several returns of this condition, and often a whole year elapses. In other instances, œstrum does not appear until the full interval of regular pregnancy has elapsed, and then the animal conceives almost as readily as before the mishap. Another very common result is a more marked disturbance in the generative functions, in which there is a tendency to abortion after every conception; and with other animals there remains an excitability of the generative organs, which is manifested by an almost persistent state of œstrum, giving rise to nymphomania, accompanied by sterility.

Pathological Anatomy.—The lesions occasioned by abortion are varied, according to circumstances. In the majority of cases, and especially when pregnancy has been well advanced, the maternal organs are in a similar condition to that observed after normal parturition. The os is dilated or closed, but in general the cervix is a little softer than in the unimpregnated state. The uterus is more or less contracted on itself and looks congested, its vessels being voluminous varicose,

and filled with blood; its cavity contains a certain quantity of blood-coloured mucus, and often all the characteristic indications of placental retention and decomposition; its mucous membrane is red and thickened, and there may be traces of inflammation in it and the cotyledons, as well as evidence of the cause which produced the accident, if due to injury.

The appearance of the fœtus varies also, according to the period at which it is expelled, the cause or causes which led to its expulsion or death, as well as the period of its decease. At p. 116 we have enumerated everything known that is likely to lead to a knowledge of its age. Whether it is expelled, or is found in the uterus on examining the carcase of an animal that has died or been destroyed, the body of the fœtus may be in a more or less perfect state of preservation. If it has perished recently, it is little if at all altered; its skin is firm, white, elastic, and even; the mucous membranes are pale; and its flesh white, rather soft or firm, and odourless. But when death has taken place some days previously, and the air has had access to the uterine cavity, then there are indications of putrefaction—all the more marked as the interval is prolonged since death occurred. The fœtus is swollen, infiltrated, and emphysematous, and exhales a putrescent odour, while the hairs, and even the hoofs, are easily removed. When the air has not entered the uterus, the fœtus may present a withered, wrinkled and mummified appearance. If abortion has been due to hydramnois, then the fœtus is sodden and wasted.

The fœtal envelopes have been found, in some instances, intensely congested, and the fluids reddish tinted; in others the latter were turbid, whitish, and not so fluid as usual; while in others, again, the envelopes were softened, fragile, and colourless.

Saint-Cyr draws attention to a fact which we have referred to on several occasions, but which is worth alluding to again. It is that, as a general rule, the death of a fœtus brings about its expulsion in a short time; and not its own expulsion alone, but also, in multiparous animals, that of all the uterus may contain. This rule, however, is far from being absolute. We have already seen that a dead fœtus may be retained for a very long time; and at the autopsy of such multiparous creatures as the Bitch, Cat, and Sow, which have died or been killed while pregnant, it is not rare to find, between two perfectly healthy and well-developed fœtuses, one which has been arrested in its growth, and has evidently been dead for a long time, and yet its presence has occasioned no disturbance. Besides, Bitches and Sows, and even the uniparous Mare and Cow, at the usual period of parturition will bring forth, along with well-developed and living young, one or more dead fœtuses whose general appearance testifies that they had ceased to live for a long time. These facts prove that the diseased condition, or even the death, of one or more of the fœtuses in an animal does not always prevent gestation from following its regular course.

Diagnosis.—The diagnosis of abortion, easy in some cases, is in others difficult and complicated; and as an error in distinguishing this accident may result in serious consequences to the veterinary obstetrist, no less than to the animals confided to his care, as Saint-Cyr properly remarks, it is well that it should receive attention. This excellent authority judiciously presents the problem in three different aspects: 1. Prognosticate a possible, but not yet imminent abortion; 2. Distin-

guish an abortion taking place from other accidents or diseases with which it might be confounded; 3. Recognise that an abortion has taken place.

1. *Prognosticate an Abortion.*—Suppose the owner of a pregnant animal asks such a question as, "Will this creature carry its young the full time?" this must be answered by another question, "What leads you to think it will not?" For there can be no doubt that, as has been already asserted, there is a special predisposition in certain animals to abort from the most trifling cause, and indeed without any evident cause at all; and yet they offer no visible indication of this tendency. In this aspect of the question, it is always judicious to remember certain maxims, the most important of which is that relating to several previous miscarriages, before giving an opinion as to the probability of such an accident; and this opinion should be based on exact knowledge of the causes capable of compromising the issue of pregnancy to which the animal has been or is then exposed. The inquiry should be as complete as possible, and then an opinion ought to be carefully given; as many of the causes of abortion are so very imperfectly known, and so many circumstances may modify the predicted result, that in the majority of cases it is only permissible to hazard presumptions which, after all, are more or less uncertain.

2. *Recognise an Actual Abortion.*—Here we have to distinguish an abortion in process of accomplishment; and at first sight nothing would appear more easy, and, in fact, nothing is so easy if time be allowed until all the characteristic symptoms attending the expulsion of the fœtus are plainly developed. But when the obstetrist is consulted at the commencement—during the premonitory period, it may be very embarrassing to give a decided opinion. In many cases, indeed, impending abortion is only announced—even for some days—by such vague signs as an indefinable *malaise*, a peculiar dulness, inappetence, laziness, perhaps a little fever, with pawing now and again, agitation of the tail, and symptoms which might be taken for those of slight colic. Saint-Cyr has known many good practitioners deceived by these signs, and who have diagnosed either indigestion, gastro-enteritis, or some other malady which disappeared—after the expulsion of the fœtus! Such a mistake is unfortunate for the reputation of the veterinarian, as well as for the owner of the animal, whose interests suffer; as if a miscarriage had been diagnosed in proper time it might have been prevented, and pregnancy allowed to run its normal course.

To prevent such an error, it is well to know that a mistake is possible; so that if called in to attend an animal offering some of the above-enumerated symptoms, the first inquiry should be as to whether it is pregnant; then the external organs of generation—the vulva and mammæ—ought to be examined with the greatest care, and the actual symptoms thoughtfully analysed. This being done, it will often be found that this is a case of threatened abortion; and that, when taken in time, the accident can be averted by rational treatment.

3. *Recognise that an Abortion has taken place.*—It may happen that information is required as to whether abortion has occurred in an animal; though this information is far less likely to be sought from the veterinarian than from the human obstetrist. In the absence of the fœtus or its envelopes, such a question is not easily answered with regard to animals; and the difficulty is increased if the fœtus is undeveloped, and a long interval has elapsed since the presumed date of the suspected abortion. Saint-Cyr is of opinion that, as a rule, it is

impossible after fifteen days to assert with absolute certainty that such an accident has occurred, the generative organs having at that date resumed their ordinary physiological condition. For it is only by an early inspection of these that we can enlighten ourselves as to what may have taken place. In this inspection is included that of the *mammæ*, which are always a little tumid, hard, and painful, and often yield a small quantity of milk after a recent abortion; the *tail*, the hair of which is soiled and matted by blood, mucus, and the liquor amnii; the *vulva*, which is swollen and dilated, and its mucous membrane often presents, in addition to its uniform and more or less deep-red colour, ecchymoses due to the rubbing or bruising it experiences during the passage of the fœtus. On careful vaginal exploration, if the cervix is found to be softer than usual and the os partially open, and, better still, if the hand can be introduced without much difficulty into the uterine cavity, and a quantity of sanguinolent or sanious fluid, or remains of membranes, is discovered in it, it may be concluded that a fœtus has been recently expelled.

Treatment.—The treatment is *preventive* and *remedial*. With regard to preventive treatment, this must mainly depend upon a knowledge of the causes which produce abortion—which we have seen are numerous, and care in avoiding or modifying these. This pertains to the chapter on the hygiene of pregnancy (p. 166). With regard to animals which have a predisposition to abortion, they should not, if possible, be bred from. Should it be desired to breed from them, if they are Bovines, they must not be put frequently to the male, and certainly not before eighteen months or two years have elapsed since the last abortion. If the accident has been due to irritation of the generative organs, then these should receive appropriate treatment. When pregnancy has again occurred, every precaution should be observed to continue it to a successful termination, by avoiding or removing those causes which previously induced the accident, and attending to the general health—combating plethora on the one hand, or anæmia on the other; guarding against constipation by giving proper food and administering mild laxatives, and against irritation, whether general or uterine, by doses of chloral or opium given by mouth or by rectum; and allowing only gentle exercise towards the end of gestation.

When abortion appears to be imminent, active intervention generally becomes necessary in order to avert it; and therefore it must be accurately diagnosed. We have already alluded to the symptoms and means by which this accident may be distinguished. If the veterinarian is fortunately called upon in good time, and he is able to assure himself that the fœtus is still alive, that the membranes are not ruptured, and labour pains have been few and not severe, the accident may be checked or prevented by the administration of narcotics, and keeping the animal in the most perfect quiet possible—alone in a darkened place, with doors and windows closed, if convenient. The narcotic may be opium (in the form of tincture if desirable), chloral hydrate, or chloroform. Saint-Cyr recommends laudanum (one to two and a half drachms for large animals) administered every half-hour or hour, in very small enemata (not more than a wine-glassful at once), which he thinks preferable to draughts, but which may, nevertheless, be employed concurrently. Zundel prefers chloroform, which, he asserts, has yielded extraordinary results in his hands in these cases, by suddenly arresting

the straining. He gives it in doses of about three drachms to the Cow, in the form of draught in oil or mucilage, repeating them every hour. Carsten Harms recommends camphor, or camphor and opium, and Rueff assafœtida.

Enemas are objectionable, as they have a tendency to increase the straining.

The abdomen should be gently rubbed for some time, and the stall well littered; and if the animal will eat and drink, easily-digested food in small quantity, and gruel, may be given until all danger has passed —generally for one or two days—when it may be gradually put upon ordinary diet, and allowed to resume its usual occupation.

When abortion is inevitable—indicated by rupture of the membranes and escape of the "waters"—and there are no means of preventing the expulsion of the fœtus, the object must then be to favour the latter in some cases as speedily as possible, and remove the envelopes, should there be any likelihood of their being retained in the uterus. In the majority of cases, active intervention is of little value here, and is only to be recommended when the labour is tedious, and the animal is becoming exhausted by fruitless straining, or when labour is altogether suspended after rupture of the membranes. Then, having emptied the rectum, the oiled hand is to be cautiously introduced into the vagina, and if the os is contracted or not sufficiently open, it must be gently dilated by the index and other fingers, until the interior of the uterus can be reached, when the fœtus is to be seized and removed in the usual way; should it be in a wrong position, or should there be any obstacle to its egress, then we must proceed according to the directions given for overcoming such obstacles when they occur at the normal period of parturition. In abortion or premature labour, however, the fœtus being smaller, the difficulties are less.

If it should happen that the cervix is contracted, and shows no sign of yielding to gentle manipulation, then after a sufficient time has been allowed measures should be adopted to relax it. Belladonna ointment (one part to four of lard), introduced into the vagina and applied around the cervix by the hand or any suitable instrument, may be used with advantage. Mr. Cox also recommends rugs dipped in hot water and applied over the pelvic region. Injections of mucilaginous fluids or glycerine into the vagina may be resorted to if the passage has become dry after the escape of the amniotic fluid; and, internally, extract of belladonna, chloral, or ether or alcohol draughts should be administered, particularly if the animal is exhausted. Gruel, beef-tea, milk, or other strengthening fluids may likewise be required. The ergot of rye is of little value in cases occurring in the larger animals, and its use is rarely to be prescribed.

If the membranes come away with the fœtus, there is little more to be done; though in the contrary case, which is by no means infrequent in abortion or premature birth, the membranes are strongly adherent to the uterine placentæ, and their retention, particularly in Cattle, is often troublesome. Some practitioners in these instances prefer to remove them immediately and mechanically by the hand, carefully separating the placentulæ one after another; and though this is easily enough accomplished so long as the os is dilated—which it usually is for three days after delivery—yet others are content with some simple precautions, and prefer to wait. When they find the membranes firmly adherent, and their separation from the uterus likely to be attended with incon-

venience, they only partially detach them, then collect and twist them into a rope-like form, and leave this mass in the vagina; so that should the cervix contract, it may not be imprisoned in the uterus. Others tie them together with a piece of tape, which is allowed to hang out of the vagina. In a short time the placenta becomes loosened, and can then be wholly removed. A few experienced obstetrists rely on internal medication for the separation of the fœtal placenta. Zundel, for instance, has long and successfully administered powdered laurel berries in an infusion of fennel, giving $1\frac{3}{4}$ ounces three times a day, with an ounce of sodium bicarbonate in half a pint of fennel infusion. The membranes always come away on the second or third day, particularly if plenty of mucilaginous fluid has been given in the interval. Rychner employs a decoction of the meal of linseed-cake in doses of about twelve pints a day, when this result ensues about the ninth day.

An animal which has aborted requires attention after the delivery of the fœtus. It should be kept clean, fed on gruel and easily-digested food, though not in excess, kept from draughts of air, particularly in cold weather, and otherwise nursed for some days. The complications which sometimes accompany this accident will be alluded to hereafter, as they are usually those of ordinary parturition. The animal should not be allowed to become impregnated at the next œstrum, nor yet perhaps at the succeeding period.

Relaxation of the genital passages in the Bitch generally follows immersion in a warm bath (112° to 114° Fahr.) for a few minutes; it must not be prolonged after the respiration becomes hurried or the animal looks distressed; and the creature should be well dried and kept comfortable.

Epizoötic, Enzoötic, or Infectious Abortion.

What has been named *epizoötic* or *enzoötic abortion*, but which we have designated "infectious," differs in its etiology and some other features from abortion occurring in isolated or sporadic cases, but more particularly from its attacking all, or nearly all, the pregnant Cattle (for it is more particularly observed in Cows, seldom in Sheep, and more rarely among Mares) on a farm or pasture, in a village, over a wide district, or even throughout an entire country, for perhaps a succession of years—thus constituting itself a veritable scourge to agriculture; and more especially as it only too frequently appears to defy all precautions to prevent its occurrence, and eludes the most careful search for its exciting cause.

Epizoöties of abortion have been recorded from the earliest times;[1] but it was only towards the end of the last century, when Flandrin, Barrier, Pelé, and other French veterinary authorities undertook their investigation, that we discover the damage they inflicted. The observers in this century are very numerous, but space forbids our alluding to them; it may be sufficient to state that Continental authorities are agreed as to the destructiveness of this accident or disease, and, until recently, as to the obscurity which attends its development. For instance, Heuzé mentions that in the Nievre (France) in 1869, the loss to certain agriculturists amounted to 30,000, 40,000. and even 50,000 francs;

[1] Those occurring up to A.D. 800 are described in my work on *Animal Plagues*. We need only allude in this place to the human "abortus epidemicus" of B.C. 278; to that observed in Germany in 1777, in which Cows and Pigs were involved; and that at Chalons in 1784, in which nearly all the Cows and Mares aborted.

in South Germany, in 1851-52, according to Rueff, it was very serious; Zundel mentions that it is frequent in North Germany; and, according to Harms, it is very prevalent in Hanover.

Indeed, there is scarcely a country in which there are competent observers, that has not been reported as suffering from visitations of infectious or epizoötic abortion. Some of these outbreaks have been most destructive. In the United States of America, for example, it has proved a veritable scourge in some of the horse-producing regions, where it seems to have made its appearance in recent years. It is only since 1866 that it has attracted attention in the Mississippi Valley, and gradually increasing in severity, in 1889 and 1890 it caused great havoc —the losses through Mares aborting amounting to as many as 75 per cent. in some regions; in others, one-half of the Mares aborted. The Horse-breeding areas in Illinois and adjoining States suffered most. In Kentucky in 1892, it was reported that 75 per cent. of the brood Mares—trotting and thoroughbred—were either barren or had lost their Foals that spring. Bourbon County sustained a loss equal to £10,000 by Mares slipping their Foals. Fayette County suffered an even greater loss; while Madison and other counties experienced the same misfortune. In Montana it inflicted much damage in the Horse ranches in 1892, when it first appeared there. In 1891 the disease was observed in South America—in the State of Buenos Ayres, Argentine Republic —where the outbreak was described as the most extensive of any that had hitherto been observed in any part of the world, and the epizoöty as entirely a novelty in that region. The losses were very great. In Australia an outbreak of epizoötic abortion in Cows was reported from Warrnambool, Victoria, in 1892. In 1889, Labat reports an outbreak among Ewes in France.[1]

Causes.—If we attempt to study the causes which have been alleged as operating in the production of epizoötic abortion, we are baffled by conflicting statements and opinions. Many authorities have adduced those causes which have been already enumerated as producing sporadic or accidental abortion; while others have taken into consideration other influences which may give rise to the accident, as well as those which may propagate the disorder. Among the latter is Zundel, who has made a conscientious study of this important subject, and throws considerable light upon it.

With regard to *general causes*, it is remarked that the disease is most frequent—enzoötic—in wet years, as it was in South Germany in 1852, when inundations were common (Rueff), and in Haute-Saône frequently (Trelut), and in other countries; then it is probably due to anæmia, as well as to forage damaged by moisture, ergotized, or otherwise altered. This adynamic condition of animals, brought about by the weather and food, is, in the opinion of Zundel, particularly favourable for the multiplication of microphytes, micrococci, and bacteria in the genito-urinary mucous membrane, and these have been spoken of as the principal local cause of this kind of abortion. He also adds that it is possible that, among the fungus or parasitic elements which infest forage in wet seasons, there may be some which act, like the ergot of rye, directly on the uterus. But in addition to the influence of seasons, there has also

[1] For particulars of these outbreaks in North and South America, Australia, and France, see the *Veterinary Journal*, vols. xxviii., p. 402; xxxiv., pp. 275, 337; xxxv., p. 332; xxxvi., p. 16.

been a supposed influence of locality—the disease fixing itself in particular places and sparing others. For instance, Heuzé remarks that in the department of the Nievre, France, abortions are very few in the arrondissement of Clamecy, while in other arrondissements there is scarcely a calf.

With regard to local conditions or causes, it is certain that the régime to which animals are subjected cannot be adduced as in operation; for the abortions occur under every kind of management, and as frequently, perhaps, with poor as with fat stock, and irrespective of age, breed, or constitution.

Malarial poisoning is a cause of abortion in domestic animals as well as in the human species; and in the malarial districts in Africa, Florida, and India, Weatherly asserts that the natives of these parts are so well aware of this, that they send their Cattle and Sheep inland to breed, only bringing them back to fatten.[1]

The influence of inclement seasons may, as has been remarked, operate in inducing wide-spread abortion, but this cannot always be adduced; as the malady—speaking of it as we would do of a disease—occurs at all seasons and in all kinds of weather, and perhaps much more frequently among animals which are housed than among those living in the open air without shelter of any kind.

Neither can the influence of food be adduced as an exciting cause in many outbreaks, for animals fed with the greatest care both as to quality and quantity do not escape; and as for ergotised grasses or seeds, admitting that these may induce abortion—though it has never been possible to produce this effect on Mares or Cows experimentally, no matter what dose of the ergot of rye was administered, nor how it was given — yet the most serious visitations have appeared where the herbage was free from this condition, and where the animals were stabled.

Strebel, for instance, informs us that in 1878 and 1879-80, from 20 to 60 per cent. of the pregnant Cows in the Canton of Freiburg aborted, though they were in very good cowsheds; and Bruin mentions that in November and December, 1884, and January, 1885, 60 per cent. of the pregnant Mares in his locality aborted, the majority of the fœtuses being in their envelopes, or these were expelled in from two to eight hours after birth, though in some instances they were retained from one to four days.

All the causes that have been adduced as operating in the production of sporadic abortion, and even extensive outbreaks, will not account for every mishap of this kind; consequently, there has always been something mysterious, something inscrutable and baffling, to the pathologist who sought to account for their appearance and extension.

So long ago as the end of the last century, contagion or infection was believed to play the principal, if not the sole part in many outbreaks; for it was observed that when a Cow aborted in a place where other pregnant Cows were kept, these would abort in succession until all, or nearly all, had miscarried. Not only this, but it has often happened that a newly-purchased Cow-in-calf has been introduced into a farm where the Cows had always calved favourably at the proper time; and when the stranger has aborted, first one, then another, then a third, and so on, of the others have experienced the same misfortune, and the malady has persisted in the place for con-

[1] *British Medical Journal*, February 2, 1895, p. 278.

secutive years. It is not always the pregnant Cows next to the one which has aborted that are first seized, but rather animals some distance from it.

Again, when pregnant Cows which were living in a place where the disease had not existed, have been introduced into a stable where it prevails, those that are at the end of gestation calve regularly and normally soon after arrival; but if they are a certain time in the infected stable before this period is reached, they abort like the others.

So that the presence of an infecting element, if not absolutely proved, is at least admissible, after the very numerous observations of the most competent veterinarians—especially of Darreau, Cruzel, Félizet, Bouley, Lafosse, Nocard, and others, in France; and Rueff, Haubner, Franck, Roloff, and many more, in Germany. The insalubrity and bad hygiene of cowsheds and stables appear to have no influence in the pathogenesis of the accident, as it appears quite as severely and readily in those which are well ventilated and cleansed as in those in the opposite conditions; in fact, nothing can so well explain the occurrence of particular outbreaks of epizoötic or enzoötic abortion as the presence of a *contagium* or a *miasmatic infection.*

The existence of a contagium would appear to have been proved by the result of an experiment performed by Franck, of the Munich Veterinary School, some years ago. It had been established by microscopical investigation, that on the lining membrane of the vagina and vulva, there is constantly found — as on the buccal mucous membrane — a minute fungus mixed with the mucus, in every respect similar to the *Leptothrix buccalis*, which, according to Hallier, is only an allotropic condition of the ordinary moulds—such as the *Penicillium glaucum* or *Aspergillus* —being, in fact, a kind of bacillus. Towards the period of parturition these bodies become extraordinarily abundant, and they appear to concur in the decomposition of the fœtal membranes and their expulsion; when the membranes are retained and putrefy in the uterus, they are extremely numerous, as are the micrococci. Franck showed that, by smearing the vaginal canal of a pregnant animal to a certain depth with the matter from the expelled membranes of one which had been delivered, abortion can be induced.

So that, as Zundel asserted, it is sufficient to introduce into the vagina micrococci or bacteria, which will multiply there, and, penetrating to the uterus, commence their work of decomposition, to produce abortion.

Roloff had also ascertained that abortion is due to something which finds admission to the uterus by the vagina; that a certain amount of redness and tumefaction of the lining membrane of the latter always precedes this accident; and that this viruliferous or miasmatic matter is found on the articles soiled by the delivery of a Cow which has aborted, as well as in the drains of the stable, on the litter, etc.

Brauer inoculated Cows which were pregnant from five to seven months with this infective material, and in twelve, fourteen, fifteen, and twenty-one days after the operation they aborted.

It must be remarked, however, that such views were not accepted for a considerable time by a large portion of the veterinary profession, who endeavoured to explain the occurrence of this kind of abortion by asserting that when one animal got rid of its fœtus prematurely others did so through *sympathy* or *imitation*—a very old notion indeed, and one which will not bear examination. Cows do not abort when

others calve beside them, and why should they do so when abortion takes place? Sympathy should be shown as much, if not more, in the first instance as in the second.

Then, again, others attributed this kind of abortion to the fact of pregnant Cows being brought into contact with putrescent materials or odours, no matter what they were derived from; this was another old notion, and so firmly was it believed in by farmers, that, in order to ensure their pregnant Cow against this accident, they were accustomed to smear the animals' noses with tar when any bad smells were evident. But for this belief also there is no better foundation than for the supposed sympathy; as it frequently happens that Cows go their full time amid foul odours, and it even happens that in a shed a Cow will calve, and the placenta will be retained until it evolves an almost insupportable stench of putrescence, and yet other pregnant Cows will remain unaffected; while not unfrequently abortions occur in a large cowshed in which cleanliness is well attended to, and no bad smell can be perceived.

The evidence in favour of the presence of an infecting agent in these outbreaks of abortion which cannot otherwise be explained, is strong from a clinical point of view, and still stronger from an experimental one; for in addition to the investigations of the authorities already named, we have those of Nocard, carried out ten years ago, which should definitely settle the question, as they were almost exhaustive on every point, while his experiments were conducted with that scrupulous care which marks all his pathological inquiries. He ascertained that there was nothing in the living animal to indicate that this abortion was a general disease of the Cow; as all the functions are normally performed, the temperature does not rise above the tenth of a degree; the urine contains neither sugar nor albumin, and the blood, milk, and various tissues are unaltered. The histological examination and cultivations of solids and fluids did not reveal the presence of pathogenic organisms. He examined the bodies of Cows which had just aborted, of those about to abort—especially primiparæ, and of those which had aborted the previous year and were afterwards sterile. In Cows which had aborted but still retained the fœtal envelopes, he removed, with all due precautions, fibrinous mucopurulent flakes of a bright yellow colour he found in the latter; difficulty was experienced in separating the maternal and fœtal placentæ, and the placental villi were of a dirty white colour, looking as if infiltrated with pus or macerated; around the base of the cotyledons there was a great quantity of the same yellow flakes, similar to those frequently recorded as passing from the vulva after abortion. The cotyledons, after their placental covering was removed, were firm, rosy, and penetrated by deep wide follicles; pressure caused the exudation of some drops of purulent-looking matter, softer than the flakes. Scraping of the cut surface gave a milky juice, white and homogeneous, analogous to cancer juice. He also obtained a quantity of cotyledonary pulp, and this, with the other matters, he sowed in broths and in peptone-gelatine tubes. When stained and examined microscopically, the puriform matter was found to consist of a mass of epithelial cells and leucocytes mixed up in a mucus and fibrinous network, together with a number of micrococci—isolated, double, and in short chains—consisting of three, four, and five cocci; here and there were also a few short thick bacilli, isolated or associated two by two.

In the cotyledonary juice these bacilli were found almost to the entire exclusion of the micrococci, and in the juice scraped from the mucous surface these organisms existed in about equal numbers. After forty-eight hours the sown tubes exhibited an abundant cultivation. Those sown with the cotyledonary juice, cultivated in a state of purity, showed the short, thick geminated bacillus just referred to; while those sown with purulent matter had, on the contrary, a mixed culture of micrococci and bacilli, the former being most abundant. The tubes sown with blood and milk preserved their limpidity.

Similar results were obtained in all the experiments; but in a Cow which had aborted the previous year, and was afterwards sterile, a mixed variety of organisms was found, while the matter obtained by scraping the uterine mucous membrane gave a slightly acid reaction that was probably the cause of the animal being incapable of impregnation; as spermatozoa cannot retain their vitality in other than an alkaline medium.

It was observed that Cows—primiparæ and pluriparæ—from a district where this abortion did not exist, had no micro-organisms between the uterine mucous membrane and the fœtal envelopes.

In his observations on the Calves, Nocard found that neither the blood, bile, pulp of the spleen, liver, kidneys, nor mesenteric glands, nor yet the serum from the pericardium, pleura, or peritoneum, yielded cultivations; but from the fluid in the stomach and the intestines, as well as the medulla oblongata, he obtained cultures of the same micrococcus that he had found in the liquor amnii and flaky muco-purulent matter.

It was, of course, necessary in these investigations to select fœtuses which had been aborted dead, and had therefore never breathed; for as soon as respiration begins, micro-organisms are always found in the alimentary canal of all animals.

From his inquiries, Nocard was of opinion that the peculiar bellow of the Calf, like the altered voice of the rabid Dog, is due to cerebral derangement, caused by the presence of these micrococci. He also believed that many cases of death from diarrhœa in newly-born Calves are due to this cause; he has examined the medulla oblongata of those which succumbed, and found a microbe in all respects identical; so that he questions whether it is not one and the same disease, developing at different periods in the life of the young animal. The existence of micro-organisms in the alimentary canal of aborted fœtuses, previous to expulsion from the uterus (though none are in the healthy fœtus during intra-uterine life), was also demonstrated; thus showing the microbic nature of this infectious abortion.

In the outbreak of infectious abortion among Mares in Montana, United States, inoculation experiments were made with cultures from the membranes and blood of an aborted fœtus, and these were successful not only in inducing abortion, but the Foal of one which lived for a short time had disease of the knee and hock joints.

It has not yet been absolutely demonstrated how the infection is conveyed to the uterus, but as the Cow is individually seldom affected, it is extremely probable that the vaginal discharges, as well as the fœtus and its envelopes, contain the organisms which occasion the accident, and that putrefaction does not destroy their vitality. It has been remarked that, in general, the fœtal membranes are liable to be retained in Cows which abort, and that when not removed artificially

they only come away when decomposition sets in. The influence of these putrefying membranes has been noted by several veterinarians—Pelé, Barrier, Cruzel, Bouley, Rychner, Haubner, and others—who imagined that the putrescent emanations infected the economy of the animals breathing them; but Zundel thinks it more probable that direct infection takes place by the genital mucous membrane. In support of this opinion, he quotes the observations of Roloff, who asserts that he always saw the disease or accident developed in stables or sheds where the distance between the mangers and drains was small, or where the drains did not have sufficient fall, whereby the hind quarters of the animals were readily soiled by the excreta in them.

The micro-organism may obtain introduction to the genital passage of pregnant Cows through actual contact with these matters, or the air may carry it to them when the discharges have become dried.

There is evidence, then, which leads to the belief that, beside the other causes which have been cited as giving rise to abortion, there is a specific germ that, when transmitted from an animal that has aborted, or from the aborted fœtus or its envelopes, to another pregnant animal of these same species, will cause it to abort. Clinical, experimental, and hygienic observation are in favour of this opinion, which if it cannot be accepted as absolutely confirmed in every respect, yet affords at any rate a good working hypothesis that satisfies the exigencies of everyday practice.

Whether the abortion germ is identical in every species of animal is a question still to be solved—though it probably is not, as Mares have aborted among pregnant Cows, Ewes have done the same, and *vice versâ*, without abortion going beyond the one species.

Symptoms.—It is rare that this kind of abortion occurs before the third or fourth month of gestation; more frequently it is at the fifth, sixth, or seventh month, or even later. There are no premonitory symptoms, except perhaps a trifling uneasiness for a few hours previously, with sinking of the flanks and descent of the abdomen; the animal generally looks well and hearty, and yields its supply of milk as usual; and soon after the fœtus is expelled, apparently without any effort or inconvenience, and along with its membranes, if these are not ruptured, with or without them when they are. It is rare, however, that the ruptured membranes are rejected immediately after the fœtus; as a rule they are nearly always retained, particularly when pregnancy is advanced; and they putrefy in the uterus, being got rid of only in shreds at intervals. When attempts are made to remove them by hand, this is found much more difficult than after ordinary parturition; owing to the membranes being very adherent, the cotyledons have to be enucleated separately, and even then the membranes come away in fragments. Then the animal generally loses its appetite and condition, goes off its milk, and sometimes perishes, probably as a consequence of this placental retention. If it recovers, œstrum appears unnaturally frequent, though conception is infrequent and sterility common; and on the other hand, there are some animals which expel the membranes quickly, conceive soon after, but again abort as readily—perhaps three times in the course of a year.

The fœtus is usually dead, though when it is expelled (in the Cow) after the fifth month it may be alive; but it is weakly and soon dies, even when born near the termination of pregnancy. These Calves make

a rattling noise when breathing, accompanied by the discharge of a rusty-coloured mucilaginous fluid from the nostrils; they are attacked by diarrhœa; they bellow continually, and are always emaciated and flabby, the gums and palate being pale, and the umbilical vessels livid and withered-looking. The dyspnœa and great weakness evinced by them shows that they are not properly organised. Nocard believes that such Calves die from the same cause as those which are aborted dead. Those which are dead when expelled exhibit indications of having ceased to live a short time previously.

As has been stated, all the animals on a pasture or in a shed where the disease prevails, do not abort at the same time, but at intervals. When one aborts, another—its neighbour perhaps—appears to prepare for the event, which may occur in about eight days; then some days after this it is the turn of another, and so on until two-thirds, or perhaps even all, of the pregnant Cows beyond three months' gestation have aborted.

It has also been mentioned that it is only after being some time in sheds in which the disease is present, that newly purchased pregnant Cows are attacked; those which have passed their eighth month and are near calving escape abortion.

Darreau alludes to instances in which a pregnant Cow, leaving a shed in which abortions prevailed, and transferred to another where the accident had not been seen, would remain all right for some time, then suddenly miscarry, and in the course of about fifteen days other abortions would occur in this shed—testifying to the danger of keeping pregnant Cows in contact with or in proximity to those which have miscarried in this way. It has also been stated that an animal which aborts either remains sterile, or has always a tendency to abort again. But it has been observed that if Cows are well fed, the period that elapses after each abortion is often longer; so that if a Cow aborts the first time at six months, it will do so again at the seventh month, and the third time a little before the ninth month, reaching its full period in three pregnancies.

The symptoms of infectious abortion in the Mare do not differ much from those observed in the Cow. Very often nothing at all is noticed, the animal appearing in as good health as usual; in other instances there is uneasiness, which might pass without attracting much attention. In the American outbreaks, very often the first indication observed was the return of œstrum in Mares supposed to be some months pregnant; and the animals being at pasture, the expelled fœtuses escaped detection, until in some of the Mares pregnancy had considerably advanced, when the size of the abortions led to the discovery that the disease was rife. The Foals that lived for a short time had inflammation of the joints, which often ran on to suppuration, and this was ascribed to the same organism which had caused the abortion.

Pathological Anatomy.—The appearances observed in the uterus and its contents in infectious abortion have already been briefly alluded to when describing Nocard's investigations, and there is not much to be added. The fœtal envelopes are generally much altered in Bovines—looking as if macerated, and covered with pus or lymph-like flakes; while the liquor amnii is turbid, and sometimes flocculent. The mucous membrane of the uterus it often very congested. In America, in the case of the Mares, the fœtal membranes in one outbreak were

always found abnormal in appearance. In one instance the portion of the envelopes in the cornua was undergoing decomposition, having a deep-red, congested appearance, followed later by a leaden-gray hue, and exhaling a very fœtid odour. Patches of the membranes were destroyed, and small quantities of a muco-purulent matter were found.

TREATMENT.—If the malady is suspected to be due to any one particular cause, or if there exist predisposing causes, then the indications for the prevention or cure of this accident are obvious. The atonic state which seems to favour the occurrence of infectious abortion in or after certain rainy seasons, should be remedied by good food and tonics—and especially preparations of iron. Tonics have been particularly serviceable when abortion was supposed to be due to ergotised food; though Zundel recommends the internal administration of carbolic acid. In cattle-sheds where Cows aborted year after year, Brauer has employed carbolic acid with the most marked success. He gave it to Cows which were from five to seven months pregnant, by subcutaneous injection in the neighbourhood of the flank, the dose being two Pravaz syringefuls of a two per cent. solution.[1]

If, however, we admit the most common and efficient cause to be infection or contagion—that abortion is due to the presence of a micro-organism transmissible from an affected animal, or from something which has belonged to it, to another in health—then the first and fundamental indication is to remove or isolate the source of the mischief.

When, therefore, abortion occurs, and there is reason to believe that this accident is in its nature infectious, the fœtus and all pertaining to it should be removed as promptly and completely as possible from the shed or place in which the animal is located. The Cow itself should also be removed—or, better still, the other pregnant animals in the same shed should be moved away to another building — and either kept altogether isolated, or at least away from all other pregnant cattle, with a special attendant employed to look after it; this attendant should not go near the unaffected pregnant cattle, and the excreta from the Cow should also be carefully kept out of their way.

The shed in which the accident has occurred, and especially if it contain more pregnant cattle, ought to be immediately cleared of all manure and other matters of an objectionable kind, the drains and the floor—particularly that of the stall which has been occupied by the Cow—being thoroughly swilled with water, and sprinkled with some good disinfectant; the walls should also be lime-washed; a good layer of straw may then be laid down, and the cattle replaced.

The shed should be kept clean and well ventilated for a number of days, and the drains well flushed and disinfected.

The animal which has aborted must also be at once attended to. If

[1] *Wochenschrift für Thierheilkunde und Viehzucht*, 1884, p. 429. The administration of this medicament has quite recently been brought forward again, and its successful employment is reported in the *North British Agriculturist* for January 19 of the present year. In this case a valuable herd was so haunted with the abortion plague that it was about to be destroyed. Crude carbolic acid, in quarter-ounce doses, was dissolved in sufficient warm water to make a mash, then the bran was added. The dose was increased gradually to half an ounce. The mashes were given three times a week.

It has also been recommended to give the acid (Calvert's No. 4) in quarter-ounce doses, as above, carefully dissolved in one quart of warm, sweetened water, or in a bran mash once or twice a week.

This medication might be combined with Nocard's external treatment, mentioned above.

the membranes have not been discharged—which is most frequently the case—they should be removed as early as possible, and not allowed to putrefy; their removal should be effected by the hand, and a weak solution of carbolic acid, corrosive sublimate, permanganate of potassium, or salicylic acid ought to be injected into the vagina and uterus, a 5 per cent. solution of carbolic acid being employed to sponge about the vulva, over the tail and down the back part of the thighs. The membranes themselves must be destroyed or buried, and the Cow should not be allowed to go near others which are pregnant so long as there is any discharge *per vulvam:* for safety, the period of isolation should extend at least to from eight to fifteen days. The animal may require good nursing in the meantime; and it should not be put to the male until every trace of irritation in the generative organs has disappeared.

If Cows show any symptoms of impending abortion, they ought to be promptly removed from the vicinity of others which are in calf.

When this accident continues in a stable or shed, Saint-Cyr thinks it necessary to recommend disposal of all the Cows therein; and before introducing others into it, to thoroughly cleanse and disinfect it by removing all excreta; renewing the soil or flooring, washing and scraping the mangers, racks, and walls and woodwork, making more air-apertures if necessary, and leaving it empty, with the doors and windows open, for a month or six weeks.

In sheds where abortion among Cows is frequent, Nocard recommends the following preventive measures: 1. Once a week the cow-sheds are to be well cleansed, particularly behind the Cows, and then sprinkled with a strong solution of sulphate of copper, or of carbolic acid—one part to fifty of water. 2. The tail, anus, vulva, and thence downwards to the hoofs of the hind limbs of every Cow inhabiting these infected sheds, to be sponged daily with the following preparation—

Distilled or rain water - -	2 gallons.
Hydrochloric acid - - -	2½ ounces.
Corrosive sublimate - -	2½ drachms.

These ingredients to be thoroughly mixed; and as the preparation is poisonous to man and beast, care must be taken.

This precautionary treatment, wherever adopted, has been found successful—another proof of the infectious nature of this kind of abortion; though, as Nocard remarks, in some instances the accident does not wholly cease during the first calving season, but it always does so in the second season.

With regard to infectious abortion in the Mare, similar measures to those recommended for this accident in the Bovine species should be enforced. In Montana, U.S.A., those prescribed were as follows: 1. If the Mare aborted in an open paddock or pasture, the fœtus and fœtal membranes were to be burned, and the animal taken to a stable or small lot, where she could be easily treated. 2. If she was removed to a stable, this had to be apart from any other stable containing pregnant animals, and not on high ground from which the urine would run on to other parts frequented by pregnant Mares; if removed to a small lot, this had to be low, or situated so that the drainage from it might not be a source of danger. 3. When Mares have aborted and are not doing well, their external genitals should be thoroughly cleansed with a solution of corrosive sublimate (1 to 1,000 of water); the tail itself was to be thoroughly washed with the same, and, if in fly-time,

a solution of carbolic acid (1 to 100 of water) was to be added. The vagina and uterus were also to be cleansed by injections of clean tepid water, and the solution just mentioned injected. These injections were to be made once a day for two or three days. 4. The attendant on these Mares was to thoroughly disinfect his hands, and, if possible, change his clothing before he went near other pregnant Mares. 5. After two or three weeks of treatment, the Mares might be allowed to be put to the Stallions. 6. Foals affected with joint-disease (this being considered of the same nature as that which led to abortion, and capable of producing that accident) were to be destroyed and their bodies burnt. 7. If, however, the foal were suffered to live, it was to be separated from pregnant Mares before the swellings had suppurated or become sores. 8. All Mares dams of Foals with affected joints, were to undergo the same antiseptic treatment as if they had aborted, if not doing well. 9. Mares that had aborted and done well, were not to be allowed to the Stallion earlier than two or three weeks after the accident.

With regard to Ewes, similar curative and preventive measures are to be adopted. Those recommended by Labat at the outbreak of abortion among these animals in France in 1888, were perfectly successful. There had never been such an occurrence among the flock until this one, when a large number aborted without any assignable cause. The following precautions were recommended by him: 1. Evacuate the sheepfold. 2. Separate the pregnant Ewes from those which have aborted. 3. Place the pregnant Ewes in a clean, well-ventilated place. 4. Every week remove the dung, clean the floor, walls, and racks with boiling potash-water. 5. Every Ewe which aborts is to be immediately removed from the healthy to the second group (those which had already aborted), and complete delivery if it is incomplete; replace soiled litter, the fœtus and membranes to be covered with lime and then buried in an out-of-the-way place. 6. Every morning sponge the vulva, anus, perinæum, and tail of the Ewes with a solution of corrosive sublimate (1 gramme to 100 grammes of alcohol and 2 litres of water). 7. Feed on good food and avoid chills.

Vaginal injections were not recommended for the pregnant Ewes, for fear of causing abortion if badly given. Only four abortions occurred within four days after these measures were adopted. The treatment was continued for eighteen days, and the pregnant Ewes subsequently gave birth to their Lambs at the usual time. The expense of the measures was trifling, and carrying them out caused little trouble, two men only having been employed for an hour every morning.

Should abortion be traced to the food—ergotised or otherwise damaged fodder, or water, of course the use of this must, if possible, be prohibited, and a change resorted to. If the pasture grasses are ergotised, then the pregnant animals, as a matter of precaution, should be removed from them, and placed in more favourable conditions with regard to food. It may be remarked that ergotised or mouldy dry forage may be rendered safe for consumption by scalding it with boiling water or steam, or pickling it in salt.

It should not be forgotten that, whether abortion be due to casual causes or to a virulent micro-organism, and whenever or wherever the accident occurs—whether at pasture, in strawyard, or in shed—the greatest possible care should be taken to isolate the animal, if it is with pregnant creatures of the same species, and to bury everything—fœtus, membranes, etc., as well as to destroy all traces of discharges.

BOOK IV.

NORMAL PARTURITION.

Normal, *natural*, *physiological*, or *spontaneous parturition* or *birth*, is the expulsion of the fœtus from the uterus through the maternal passages, by natural forces, when it is sufficiently developed to live external to its parent. This act is designated "foaling," when occurring in the Mare, "calving" in the Cow, "lambing" in the Sheep, "pupping" in the Bitch, etc. It receives the designation of "normal," "natural," etc., when it is accomplished in a manner favourable to the parent and offspring without extraneous assistance, and by natural forces alone; and "abnormal," "pathological," or "difficult," when it cannot be so accomplished, and when the aid of man is required to relieve the parent and release the progeny. Though eminently a physiological act, it is nevertheless one of the most difficult; the interval between normal and pathological parturition is sometimes extremely brief, the one being often transformed into the other in a remarkably short time. It is also said to be "premature" when it occurs before the usual period, and the young creature is born in a viable condition; while it is "prolonged" birth when pregnancy extends beyond the ordinary term. We have already spoken of these terms, and alluded to their diversity; and we have only now to note that these variations do not appear to have any influence on the physiological act of parturition.

CHAPTER I.

Physiology of Parturition.

The act of parturition, notwithstanding its special object, is distinguished from all other physiological acts or functions by certain peculiarities; for while the latter are normally accomplished without disturbing in any way the well-being of the individual, parturition, on the contrary, even when natural, is accompanied by pain, general disturbance and uneasiness, and violent efforts. And during birth nature does not appear to obey those immutable laws so strictly as in the accomplishment of other physiological acts, but makes frequent and wide deviations; though these do not often compromise the final result. We never find two births exactly alike, but each offers something peculiar when attentively observed. We need only refer to the duration of the act as a whole, as well as to each of its periods or stages. Sometimes it only occupies a few minutes, in other instances days are required to complete it; in some cases the first stage is long and the second short, and in others it is the reverse. The "labour pains," or utero-abdominal contractions, present as notable differences with regard to intensity, duration, and frequency, as well as in the pain they cause and the influence they exercise on the other parts of the body; while the amount of allantoid or amniotic fluid is as variable, though no ill effects may result from this. And, finally, the fœtus may present itself for expulsion in a variety of positions, which, though they may not impede birth, yet prove that parturition is an extremely variable act, while its phenomena are highly complex.

SECTION I.—CAUSES OF PARTURITION.

Though parturition only occurs at the end of pregnancy, nevertheless this act is being prepared for from an early period in the development of the ovum, as we have shown when speaking of the anatomy and physiology of the generative organs. During the evolution and development of the ovum, the uterus increases in a corresponding manner, and its muscular structure is proportionately augmented. When, towards the termination of gestation, the ovum has reached maturity, and the organs necessary for the independent existence of the fœtus are completely developed, certain alterations occur, both in the uterus and the fœtal connections with it, which bring about the expulsion of the young creature.

These alterations would appear to consist in a gradually increasing fatty degeneration of the decidua, by which the organic connection that had existed between the peripheral portions of the ovum and the uterus is gradually destroyed, by a regressive process in the cells lying between them; while the blood which was sent to the organ is now diverted towards the mammæ, for the secretion of milk. The exchange of materials between the uterus and fœtus is lessened, and the latter—always more or less of a parasite—becomes like a foreign body in the cavity of the former, its greatly augmented weight and volume also aiding in the change. At all the places where the cell degeneration has reached a certain stage, the terminations of the nerves are irritated. But to obtain a reflex action, and consequent contraction of the uterine muscles, as Schrœder observes, a certain amount of continuous irritation is necessary. This sum once obtained, a reflex action takes place in the form of a contraction, which, however, is slight at the beginning. Then a pause follows, until the sum of the irritation is again sufficient to cause a contraction. By the increase in intensity of the contractions the uterine wall is removed from the envelopes, and this separation becomes a new source of irritation to the uterine nerve-fibres. The reflex action, in the form of labour-pains, becomes more and more powerful, until these follow at last in rapid succession and complete the expulsion of the ovum. This irritability of the uterine nerves progressively increases with the advance of pregnancy, and explains the regular setting in of labour, as well as the not infrequent retardation of the pains in cases where the separation of the membranes has been premature.

The sympathetic nerve is in all probability that which is most concerned in the uterine contractions, as it is the motor nerve of the organ; and its influence is called forth by the irritation just mentioned as being produced on the terminations of the nerves on the inner surface of the uterus by reflex action, the irritation being transformed into involuntary motor activity. It is surmised that the sacral nerves are merely inhibitory.

SECTION II.—THE EXPELLING POWERS.

The expulsive force by which parturition is effected resides in the unstriped muscular fibres of the uterus; these cause the organ to contract in a rhythmical and somewhat peristaltic manner, the contractions of the abdominal muscles and diaphragm being merely auxiliary. The contractions of the uterus may take place although the organ

does not contain a fœtus, and have been noted in extra-uterine pregnancy, when they probably occur through sympathy. They have been observed in the false gestation of the Bitch which has not really conceived, but whose mammæ enlarge, and which makes its bed and exhibits other indications of approaching labour; as well as in pregnancies prolonged beyond their ordinary limit.

As the uterine contractions which lead to expulsion are usually accompanied by a painful sensation (due to the pressure exercised on the terminations of the nerves within the muscular fibres), they are in common parlance designated "labour pains" (*dolores ad partum*); while the resistance they have to overcome is centred in the fœtus and its envelopes, as well as in the passages these have to traverse in order to reach the external world.

Expulsion is not effected by one contraction, but by a series of contractions; between each of these there is an interval of apparent repose, during which the organ seems to be gathering strength for a new effort. As in almost all unstriped muscular fibres, the reflex action following upon an irritation is slow and gradual, and, according to the degree of irritation, of varying intensity and duration. At the commencement, corresponding to the slight irritation, the contraction is feeble and short, and the time required to obtain the necessary sum of the persistent irritation for a new reflex action is comparatively long; though the uterine walls are not relaxed on their contents, but are maintained in a certain state of contraction by the tonicity of their muscles.

When the pains are regular, there is also a certain gradation in each individual contraction. Feeble at its commencement, it gradually increases, the uterus becoming harder until the maximum of contraction has been reached; this persists for some time, and then as gradually subsides.

As parturition progresses, and the separation between the uterus and fœtus increases, the irritation becomes stronger, and the intervals between the contractions shorter, while these latter augment progressively in intensity and duration. The necessity for these intermissions, particularly in the early stage of parturition, is obvious. They allow the animal time to recover, to some extent, from the exhaustion they occasion, and permit the genital passages to become gradually prepared for the exit of the fœtus through them; while the latter can also recover from the inconvenience it may suffer from the interruption between it and the uterus during the pain, and especially towards the termination of the act.

During each regular pain the whole of the uterus contracts, though the fundus does so most energetically; and the longitudinal fibres of the organ are more particularly brought into play at the initial and middle stage of parturition. The cornua likewise contract; they are twisted on themselves anteriorly, are shortened through the action of the longitudinal fibres, and are brought nearer the body of the uterus, which is also shortened; and as this shortening is always taking place in the direction of the cervix, it is here that the sum total of the expelling force is centred; and it is this force, commencing to operate at the fundus of the organ, and exerted on the incompressible liquor amnii, which gradually opens the os for the extrusion of the fœtus. The latter, with its envelopes, first acts as a stimulus to the uterus, but they soon begin to play quite a mechanical part in the dilatation of the already greatly shortened cervix. The latter becomes thinner as the

contractions force the bag of waters against it; so that the os is gradually widened, and the cervix really becomes a part of the uterine cavity. As soon as the os is slightly opened, the bag of waters enters it and acts as a mechanical dilator; then the lower parts of the fore limbs, succeeded by the head of the fœtus, are introduced, and from their combined shape act like a wedge, until, by the eccentric pressure, the chest is passed in, and the cervix being drawn over the presenting parts, the os is of the same diameter as the vagina, which then, with the uterus, constitutes one common cavity. Every part of the cervix being acted on by the longitudinal fibres, the aperture of the os is perfectly circular at this stage—as is observed in the Cow and Goat when the uterus is pushed back, and its orifice is visible at the vulva. Irregularity in the contractions, however, and particularly when they are rendered so from a transverse position of the fœtus, delays the dilatation, which is otherwise rapid according to their force and frequency. At first the dilatation occurs very slowly, especially in primiparæ; and when the fœtus presents by the croup, or when the body of the uterus inclines too much downwards, causing the cervix to bend up towards the sacrum, it is also very tardy. As soon, however, as the mechanical action of the water-bag and fœtus comes into operation, it makes rapid progress in natural parturition.

If the uterus of animals usually uniparous contain two fœtuses, the two cornua are about the same size, each having a fœtus in the same position as if there were only one in the uterine cavity. In general, the two fœtuses present anteriorly, although it sometimes happens that the second, or the first, or even both, present posteriorly; not infrequently the second makes a mal-presentation. When there are twins, parturition is more difficult and slower than when there is only one: possibly because the great distention of the uterus diminishes its contractile power. Another feature in twin pregnancies is that parturition often occurs before the ordinary time; and even when this has been reached, one or both fœtuses are smaller and weaker than when there is only a single fœtus.

When twin parturition sets in, the uterine contractions commence almost simultaneously in both cornua, which are much less apart than in the non-pregnant state; but as the two fœtuses cannot be born together, that which is most advanced is delivered first, the other, which is behind it, mechanically aiding in its expulsion. In the Mare, the interval between the birth of twins is rarely more than ten minutes; with the Cow it may be one or two hours; and with the Ewe half an hour. When the position of the second fœtus is favourable, it is usually expelled more rapidly and easily than the first; and when they are of a different size, the largest is ordinarily born before the other. When the number of fœtuses is greater, they are also expelled successively at intervals of some hours.

In cases of superfœtation, if such an occurrence can take place in animals other than in those the cornua of whose uterus open into the vagina, the uterine contractions must be limited to the cornu containing the fœtus whose period for birth has arrived; otherwise, the other fœtus would be expelled at the same time, and there would then be a birth and an abortion.

With the small multiparous animals, in which the fœtuses are expelled one after the other, it may be admitted that each fraction of the uterus corresponding to a fœtus contracts in its turn—at first the

segment of one of the cornua nearest the cervix, then the next segment, and so on until the one in proximity to the ovary is reached, so as to get rid of all successively—one cornu expelling a fœtus alternately with the other; the uterine contractions, although general, being most energetic at the portions intermediate to the fœtuses.

The uterine contractions are very powerful, as anyone can testify who has had occasion to introduce his hand into the uterus of one of the larger animals during parturition; and their force is not always related to the general physical power of the animal—though they are always more energetic in the Mare than the Cow, as well as more continuous. Not infrequently they are more powerful in weak-looking animals than in those which are robust and vigorous; and their energy depends evidently upon the development of the muscular structure of the uterus, and the potency of the sympathetic ganglia which stimulate it. Their energy and frequency also often depend upon the duration of the pains, and the existence of mechanical obstacles to the birth of the fœtus.

After the complete dilatation of the os, the third stage of delivery begins, and the manner in which the uterus contracts is modified. The resistance is no longer at the cervix, but in the uterus itself, being due to the presence of the fœtus; and now the circular as well as the longitudinal fibres come into action simultaneously, in order to diminish the uterine cavity and quite expel its contents. In this they are greatly aided by the abdominal muscles and the diaphragm, which until now could assist but little; though the participation of these does not appear to be absolutely indispensable, for birth may take place without it. Nevertheless, it is a fact that, in diminishing the abdominal cavity and pressing on its contents, these muscles concur in pushing the fœtus in the direction in which least resistance is offered — towards the pelvic cavity; and as their contractions are effective, so do those of the uterus, which are coincident with them, become increased in power and frequency. The animal "strains," as in defecation or micturition, but with all its force; and these throes, which are involuntary to a great extent, and in which nearly all the muscles of the trunk share, soon bring the act to a termination.

The fœtus itself has been sometimes regarded as the chief agent in parturition, from the fact that this act is longer and more difficult when the creature is dead, and that it has been expelled after the mother has ceased to live. But it must be remembered that the movements of the fœtus are very trifling, and of little importance when compared with the resistance to be overcome at birth; so that the young creature must remain almost, if not quite, passive during the act. And if this act is tardily accomplished when the fœtus is dead, the delay may be due to the absence of stimulation or irritation in the organ, to the uterus not having a fixed point to act upon, or perhaps even to a local septosis or paralysis from the decomposition of the fœtus.

With regard to expulsion of the fœtus after the death of the mother, it must also be remembered that all the organs do not cease to live at once, and that many continue to contract for some time after the mother's heart has ceased to pulsate. Leroux has felt this organ contracting a quarter of an hour after death, and after gastro-hysterotomy on the dead human body it has been seen to contract as in the living woman; Haller has witnessed the contraction of the cornua of the Cat's uterus, even when the organ was detached from the body; and

Colin states that he has observed the uterus of Sheep to contract for forty and fifty minutes after death.

As we have said, the resistance which the expelling forces have to overcome is constituted by the fœtus and its membranes, and the genital passages—the os uteri, vagina, vulva, as well as the pelvis and soft parts covering and lining it. The fœtus participates in the resistance by its volume, its form, its manner of presentation, its position, the conformation and texture of the tissues which unite it to the mother, etc.; while the genital passages offer resistance from their form, width, extensibility, and rigidity or softness. The fæces accumulated in the rectum, or urine in the bladder, sometimes increase the resistance to be overcome.

In order that birth may be possible, the expelling force must be greater than the resistance, and it is upon the relation between these that the manner in which the fœtus is expelled will more particularly depend, as well as the difficulty attending its expulsion and the time required for the act of parturition.

We have only now to allude to the influence of the expelling force on the fœtal membranes. We have seen that these, which we may now, with their contents, designate the "water bag," assist in dilating the os, and that the uterine contractions propel them further into the vagina in the form of an elongated bladder partly filled with fluid. This soon appears between the labia of the vulva as a round distended tumour at the moment a pain occurs, but flaccid in the interval; and not long afterwards as a somewhat voluminous pediculated tumour, to which each pain adds a little more fluid, until at last the membranes cannot resist the strain, and rupture; when the allantoic, and then the amniotic fluids escape from them, leaving a variable quantity in the uterus; some of this is discharged into the vagina at the termination of each pain, and assists in lubrifying the mucous membrane and aiding in the passage of the fœtus.

It may be remarked that numerous causes influence the period when this rupture occurs. In the Mare the membranes are thicker, more resisting, and much less adherent to the uterus than in the Cow; so that rupture is later in taking place, and it not unfrequently happens that the Foal is born in them; though the Calf, I believe, never is. But there are individual differences in this respect even, and in some instances it will be found that rupture takes place at the commencement of parturition, in others towards the end; though when this takes place late it is more favourable than when it occurs early, as the amniotic fluid preserves the fœtus from undue compression by the uterus, while it powerfully aids in the progressive and regular dilatation of the os and vulva, and lubrifies the passages, thus diminishing friction and protecting the maternal organs from injury. When rupture occurs too early, and before the fœtus has been sufficiently expelled, the parts become dry, and labour is always longer and more painful and difficult for the mother, while it is often fatal to the fœtus.

SECTION III.—SIGNS AND COURSE OF PARTURITION.

The physiological phenomena just alluded to, and by which the fœtus is born, are collectively designated as "labour." The entire period of labour is, for facility of description and study, divided into a certain number of stages or periods—usually three or four. These are:

1. *Preliminary stage;* 2. *Dilatation of the os uteri;* 3. *Expulsion of the fœtus;* 4. *Expulsion of the membranes.*

1. *Preliminary Stage.* — Various precursory signs announce the approaching termination of pregnancy and the advent of labour. These may be observed some hours, sometimes even for days, before that event occurs.

One of the most important signs is the enlargement and increased sensibility of the mammæ, to which the excess of blood no longer required in the uterus is directed. These glands become voluminous, hard and tender; and this phenomenon is more particularly remarkable in those animals whose milk is not utilised after the young have been weaned. The mammary glands then become soft, flaccid, and small, and cease to secrete. In such animals as the Mare and Ewe, these glands, ordinarily small and scarcely perceptible, before parturition become so remarkably developed as to cause alarm in people who do not understand the cause. With the Mare especially, the development of the mammæ is sometimes so considerable, that the engorgement extends along the inferior surface of the abdomen and simulates œdema; or it ascends between the thighs as high as the vulva as a prominent ridge, while the skin in this region, if white, looks reddened. At a later period, the teat yields a serous fluid on pressure, or this constitutes a crust around it; the fluid afterwards becomes somewhat lactescent, and finally appears as the "colostrum" or first milk.

Another premonitory sign is the tumefaction of the vulva, increase of the space between the labia, which become soft and flabby, while their lining membrane is reddened, and a viscid glairy mucus covers it. This mucus, derived from the vaginal lining membrane, soon becomes so abundant that it is discharged in long filamentous streams, particularly in the Cow, and soils the tail and hocks; it is destined to lubricate the genital passages, and facilitate the extrusion of the fœtus.

With these changes the abdomen falls, or rather becomes more pendent; the croup looks hollow, as do the flanks, due to the relaxation of the broad ligaments. The spine, particularly in the lumbar region, becomes more horizontal and rather inclines downwards, as if yielding to the weight of the abdomen. The haunches appear to be wider apart, and the gluteal muscles to subside, owing to the falling in or modification of the sacro-sciatic, as well as the sub-sciatic, ligaments, from serous infiltration.

The animal walks sluggishly and unwillingly, and if grazing with others does not appear to care about following them. Sometimes, as has been mentioned, there is swelling of the limbs, particularly the hind ones.

If very careful vaginal exploration be made at this time, it will be found that the cervix uteri has become a part of the uterine cavity and is almost completely effaced, being reduced to merely a thin circular ring; its tissue is soft, and the os is slightly open in those animals which have previously had young.

As parturition draws nearer, these phenomena are more marked. The animal also begins to be restless, and continually agitated; if feeding, it stops for some moments, as if listening to some sound only audible to itself, or as if experiencing some strange internal sensation for the first time, and which may certainly be the preparatory or commencing contractions of the uterus. Not unfrequently the animal lies down and gets up again, as if suffering from colic. Some are quite

mute, though anxious and uneasy; while others, in addition to exhibiting restlessness and distress, utter a half-stifled cry of pain. The Mare whisks its tail, the Cow bellows, the Ewe bleats, the Bitch often whines, and the Cat emits a low cry as if in suffering. If the animal is at liberty, it seeks a remote quiet place in which to bring forth its young; while some—such as the Bitch, Cat, Sow, and Rabbit—prepare a special nest.

2. *Dilatation of the Os Uteri.*—The limit between this stage and the former is not so well marked as our division would indicate. Nevertheless, it is meant to imply that the stage of dilatation of the os terminates pregnancy and ends with complete extension in width of that uterine passage. It is marked by increasing uneasiness of the animal: pawing, lying down and rising frequently in a kind of aimless fashion, while the expression of the physiognomy betrays suffering. When the uterine contractions really commence, the creature suddenly stops, as if surprised by the pain; its eye looks animated and expresses anguish; the skin is hot, pulse quickened, visible mucous membranes injected; the abdominal walls are rigid and contracted, the flank is tense, and very frequently fæces or urine are voided. During this pain, if the cervix uteri is explored, it will be found that its attenuated border has a tendency to become hard and prominent. When the pain has passed, calm succeeds; the cervix becomes thick and elastic, and the os is markedly enlarged. Each pain lasts for some seconds to two or three minutes, the interval of quiet continuing to about fifteen minutes at first; though it diminishes when the contractions become more frequent, more energetic, and more prolonged, and dilatation of the os progresses. Then the fœtal membranes begin to be detached from the inner surface of the uterus and enter the os, whence they pass into the vagina and between the labia of the vulva, where they appear externally as the "water-bag." In the meantime, the fore limbs and the nose and head of the fœtus enter the os, and dilate it to its fullest extent, when the cavity of the uterus forms a canal continuous with the vagina.

3. *Expulsion of the Fœtus.*—The pains become more severe, frequent, and sustained, and to the uterine contractions are added those of the diaphragm, and abdominal and other muscles. If the animal is standing, it brings all its limbs under the body, arches the back, elevates the tail, slightly flexes the hocks, makes a deep inspiration, closes the glottis to imprison the air in the chest, and by a powerful contraction of all the muscles of the trunk, it brings such an amount of pressure to bear on the fœtus as to propel it into the pelvic cavity and rupture the chorion. At each contraction the "water-bag"—formed by the allantois and amnion—protruded beyond the vulva, increases in volume. It varies in different animals; being in the Cow about as large as the bladder of a Pig, and in the Bitch the size of the carp's swimming bladder. When it is very large in advanced parturition, it is reckoned a good sign; though it may not indicate a good presentation of the fœtus, nor yet an easy birth.

The water-bag soon ruptures, and its contents partly escape—that behind the thorax of the fœtus being retained, and voided only in small quantity as the uterus contracts. When the membranes are thinner and weaker than usual, they may rupture before the os is completely dilated, and then the fluid escapes in a small quantity at a time; this frequently happens with primiparæ, though it is sometimes observed in protracted labour, which is the most painful. In general, however, no harm results from this premature rupture if parturition is not too long

delayed; indeed, in some cases it may be useful, as when the uterus is over-distended with fluid—in hydramnios, for example—when its discharge allows the organ to contract more freely. In other instances the membranes are remarkably strong and resisting, and withstand the contractions for a long time after they have been extruded beyond the vulva; their artificial rupture may even be required. Sometimes they do not rupture at all, and the fœtus is born in them, or even after them, as has occurred in the Cow. The rupture usually occurs at the most dependent part of the bag—at the uterine orifice, towards the os, or in front of it. Then succeeds a brief interval of quiet—the fœtus being meanwhile retained in the uterus—during which the organ is closely applied to the body of the fœtus, and is preparing itself for a final effort, which is soon made. The contractions are most energetic and rapid, and every time they are made the waters flow in small quantity, moistening and relaxing the parts; the fœtus passes on until the fore feet and muzzle, forming a kind of cone, appear at the vulva, the orifice of which is opened by them. When the head has cleared the vulva, there is usually a short pause, as if to allow the tissues of this region to become accustomed to the distention, and to prepare them for the still greater strain which is yet to be imposed on them. The thorax and shoulders of the fœtus have now arrived at the inlet of the pelvis, and as they form the deepest and most difficult part of the young creature's body, the contractions which ensue for its complete expulsion, though most powerful and continuous, only impel it slowly towards the outlet, on arriving at which a more energetic and painful effort than all the others pushes it through. The act may now be said to have terminated; as to expel the croup requires only a few comparatively weak throes, and the weight of the anterior part of the body of the fœtus, hanging beyond the vulva, greatly aids them. It is rare indeed that the croup offers a serious obstacle to expulsion.

During this act the creature betrays evidence of pain, especially if it be a primipara: and this is particularly marked when the head of the fœtus passes through the, as yet, incompletely dilated os, and still more so when the chest and shoulders strain the textures of the vulva and perinæum to the utmost. Then the pulse is hard and frequent, and the skin hot—sometimes covered with perspiration—or the body is rigid. The Bitch and Cat often utter a cry of pain as the head and chest pass through the vulva.

After the young animal is expelled, the umbilical cord is torn, and the liquor amnii remaining in the uterus escapes, accompanied or followed by a little blood resulting from the sudden separation of the placentæ.

The *position* assumed by animals during parturition is somewhat variable. The larger animals which usually only bring forth one at a birth, such as the Mare, Cow, and Sheep, ordinarily do so standing; and this position has the following advantage: The vertebro-sacral angle is effaced, and the obstacle that its projection might offer to the passage of the fœtus into the pelvis is diminished; the auxiliary muscles—abdominal and diaphragmatic—can act more energetically; the young creature, being sustained by the umbilical cord when it has cleared the vulva, glides gently on the half-flexed hocks of the parent, and so reaches the ground without injury (Fig. 69).

Such an attitude, however, is far from being constant with these

animals; and very often, especially with the Cow, they bring forth in a reclining position—maintained from the very commencement of the act, and only rising when birth is completed (Fig. 70). These cases, which are quite natural, though debility may be present, offer nothing particular in the position of the female—it being merely that assumed on ordinary occasions, though, of course, parturition is more difficult.

The animal rests on the sternum, the body inclined to the right or left side, the fore limbs flexed beneath the chest, and the hind ones beneath the abdomen. In this attitude labour is carried on somewhat as when standing. The creature, reclining on the breast and partially on the quarter, arches the back in straining, slightly raises itself on the hind feet, and drops again when the pain has subsided.

It is rare indeed that these animals lie full length on one side of the body during parturition, and when it does occur it nearly always indicates a long, difficult, and exhausting labour.

Multiparous animals—as the Bitch, Cat, and Sow—always assume the recumbent position, and lie reclining on one side, with the body

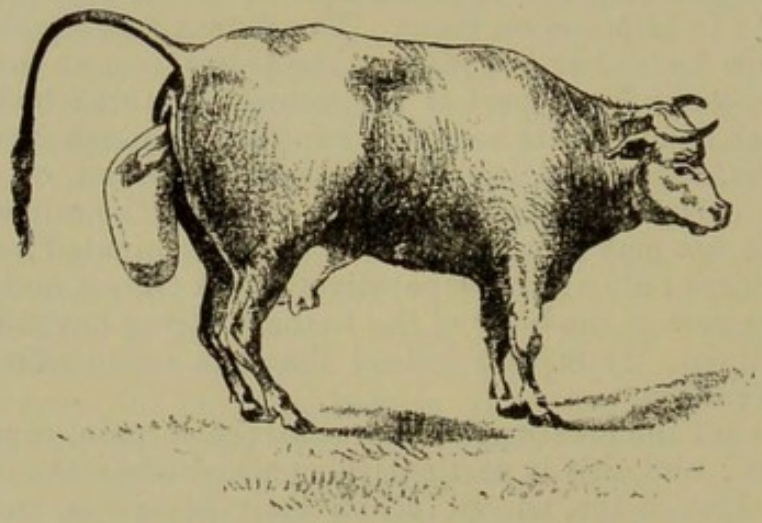


Fig. 69.

Cow in the Act of Parturition: Standing Position.

disposed in a semicircular fashion, the head towards the tail. This position appears to be very favourable to birth, the sacro-vertebral angle being effaced, and the young being spared the risk of falling; in addition, each fœtus as it issues from the vulva is within reach of the mother's mouth; so that it can, without disturbing itself, remove the membranes from it, divide the umbilical cord, clean it with its tongue, put it in a proper position, and even direct its head towards the teat, in order to soothe it while another is born. It may be remarked that, with the Sow, the young creature is expelled with such force from the vulva that it often turns a somersault. It may also be observed that, with the small multiparous animals the "water-bag" usually only appears with the first of the litter, the others being preceded or followed by their ruptured membranes.

The total *duration* of parturition is, of course, extremely variable, not only according to accidental circumstances, individual peculiarities, and species, but even in the same animal at different births. With the

Mare it is usually brief, and is ordinarily accomplished in about ten minutes, sometimes in five—though it may extend to a quarter or half an hour, rarely more. This rapidity appears to be due to the fact that the placenta is detached from the uterus during the early pains, and consequently the fœtus cannot live long after this occurs—three hours being supposed to be the limit—unless it can breathe by the lungs. The duration in the Cow is, on the average, one to two hours; though it may only be a few minutes to half an hour, or be extended, without injury to the Calf, to one or two days. With Cows at pasture or which do no work, it is sometimes only fifteen minutes. With the Sheep the period is also brief, being about fifteen minutes. If there are several Lambs, there is usually an interval of fifteen minutes to two hours between them—the second and succeeding births being always quicker than the first.

With multiparous animals—Sow, Bitch, and Cat—there is ordinarily a period of ten or fifteen minutes, and sometimes half an hour, an hour

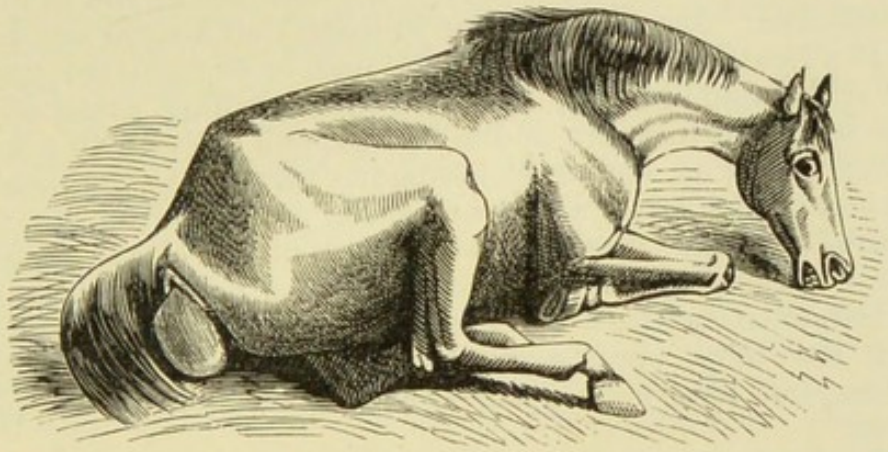


Fig. 70.

MARE IN THE ACT OF PARTURITION: RECUMBENT POSITION.

or even more, between each birth. Not unfrequently the Sow will bring forth ten young ones within the course of an hour.

We have mentioned that with those animals which are delivered in a standing position, the *umbilical cord is ruptured* when the young creature reaches the ground, and usually close to its abdomen. If the mother is recumbent when the offspring is born, the cord is torn as she gets up, which is usually immediately after parturition. The circulation in and by the cord being incomplete shortly before and during labour, its texture appears to undergo a kind of softening that favours rupture; while owing to the vessels being reduced in size, and also the way in which their rupture occurs, hæmorrhage is trifling. Sometimes, however, the cord is sufficiently strong and elastic to resist spontaneous rupture, and the young creature is born with the membranes attached to it by means of this bond of union. The mother then, by a remarkable instinct, in cleansing the young creature with its tongue, gnaws through the cord and sets free its progeny. The Mare and Cow have been known to do this at times; otherwise it is usual with the Carnivora.

Whether the cord be ruptured spontaneously or gnawn through by

the parent, there is nothing to be feared from hæmorrhage from either the fœtal or placental end; for, contrary to what is observed in the human species, the blood has very little tendency to flow from the umbilical vessels, and the laceration and cold soon check any slight escape. But it may sometimes happen that it is necessary to divide the cord at a short distance from the umbilicus, and this is usually effected either by scraping, torsion, or cutting directly through it by the bistoury or scissors. Even then there is little to apprehend from bleeding. Rainard, in thirty years' experience, and other authorities, has never observed any harm to result; and the cases in which there was danger are certainly very few. Rainard quotes from Brugnone, that Béranger of Carpi has seen Horse and Ass Foals perish from hæmorrhage, through the cord having been cut and no ligature applied; and Peuch has witnessed a case of umbilical hæmorrhage in a new-born Calf from which, notwithstanding a thread tied round the cord, the blood escaped in drops; another ligature placed above the other did not check this escape, and it was necessary to fix a compress, steeped in perchloride of iron, along the course of the cord before the hæmorrhage could be checked. It must be borne in mind that similar accidents are possible, if a ligature is not applied an inch or so from the umbilicus. Whether it be tied or not, the portion remaining attached to the umbilicus soon becomes dry and withered, and falls off in a few days after birth; the other end most frequently hanging to the fœtal membranes, which immediately after parturition protrude from the vagina.

4. *Expulsion of the Membranes.*—The expulsion of the fœtal membranes, or "afterbirth," as they are sometimes designated, may occur at birth, immediately after, or be delayed for a variable period—this depending not only upon accidental circumstances and individual peculiarities, but also upon species, and, consequently, the placental connections.

Immediately after the fœtus is expelled, the uterus contracts and retracts energetically on itself, and its internal capacity rapidly diminishes; consequently, the placental villosities are detached from their alveoli, the uterine and chorionic surfaces become wider apart, and the placenta is ultimately separated from the uterus. The same contractions which loosened them are also instrumental in forcing the membranes through the gaping flaccid os into the vagina; and the auxiliary muscles, being again stimulated by their presence here, as they were by the head of the fœtus in the same passage, add their powerful contractions; so that these new pains, aided by the physical weight of the extruded portion with its appended umbilical cord, soon bring the whole mass away. The contractions of the vagina have probably little, if anything, to do with this expulsion, which is rarely followed by hæmorrhage in animals; though in woman, owing to the *inertia* of the uterus, this accident is not at all uncommon. Sometimes the expulsion of the membranes is expedited by the young creature as it descends from the vulva.

With the Mare, owing to the disseminated placenta and the slight adherence of the placental villi, the separation of the membranes takes place rapidly; indeed, the Foal is not infrequently born in the intact envelopes. But generally only a few minutes elapse before the afterbirth is detached. Retention of the placenta is therefore exceedingly rare in the Mare, though it is very dangerous; as in attempting to remove it there is great risk of hæmorrhage.

With the Cow, because of the multiple placentulæ, the number of which may be over a hundred, the adhesion between the uterus and fœtal membranes is very intimate; while the small volume of the cotyledons offers but little surface for the uterine contractions to act upon. So that while it happens that the Calf is never born in its intact envelopes, it is also the case that the afterbirth is only slowly and tardily extruded—two, four, or more hours, or even days, being required; and, indeed, it is not at all rare for retention to occur in this animal, and the envelopes require to be removed artificially.

Multiparous animals get rid of the envelopes as they expel the fœtuses, the birth of the first being followed in a very brief space by its membranes; after which comes the second fœtus, then its envelopes, and so on; so that only those of the last fœtus may be retained—an accident which sometimes occurs. In these animals, the membranes appear to be expelled without any difficulty; the Bitch, for instance, runs into a corner, and assuming a position as if about to micturate, expels the secundines of the last puppy, devours them, and returns to the other puppies.

With animals usually uniparous, but which sometimes bring forth two or more young, the envelopes of each fœtus are expelled immediately after it is born, so long as they do not offer an obstacle to the passage of the next fœtus; so that in a double birth in the Cow or Ewe, a fœtus being lodged in each horn, the second may be born without the envelopes of the first having been discharged.

We may here note the strange instinct which impels not only carnivorous and omnivorous, but also herbivorous animals—Bitch, Cat, Sow, Cow, and even sometimes the Mare—to devour the membranes as soon as they are expelled, if they are not quickly removed from beyond their reach; at times they even devour them as they are being extruded, and the work of delivery is thus hastened. However unnatural and disgusting this propensity may appear, and though the cause for it is unknown, it does not occasion any visible inconvenience to the animal.

It has been already remarked, that when the young creature is expelled in its intact envelopes, the mother, if at large, frees it from them by gnawing them through; more rarely does the progeny release itself by its own efforts. If the mother should chance to be tied up, as in a stall, assistance may be required to cut the umbilical cord and extract the young animal from its imprisoning membranes, else it may become asphyxiated. This peculiarity is most frequently observed in the Mare, with which birth is always rapid, and the chorion strong and easily detached from the uterus. Rueff states that it is not unusual in the Sow.

CHAPTER II.

Presentations of the Fœtus and Mechanism of Parturition.

In addition to, and to a certain extent independent of, the physiological phenomena of gestation and parturition, there are in the latter certain physical and mechanical acts which have been, as Saint-Cyr remarks, hitherto very imperfectly studied in veterinary medicine, but the con-

sideration of which is, nevertheless, very important from a practical point of view.

These acts are related to the manner in which the fœtus presents at the pelvic inlet for passage through the outlet, and the way in which this passage is effected ; they belong, in fact, to the presentations and positions of the fœtus, and the mechanism of parturition.

The presentations and positions of the fœtus during parturition, as well as the mechanism of that act, are of much practical importance to the veterinary obstetrist, and demand careful consideration. Allusion has been repeatedly made to the position of the fœtus in the uterus during gestation, and to the fact that this position is changed as parturition draws near. What the agency or influence may be which induces this change, has not been ascertained ; but it has been surmised that it is due to an instinctive tendency of the fœtus to assume, towards

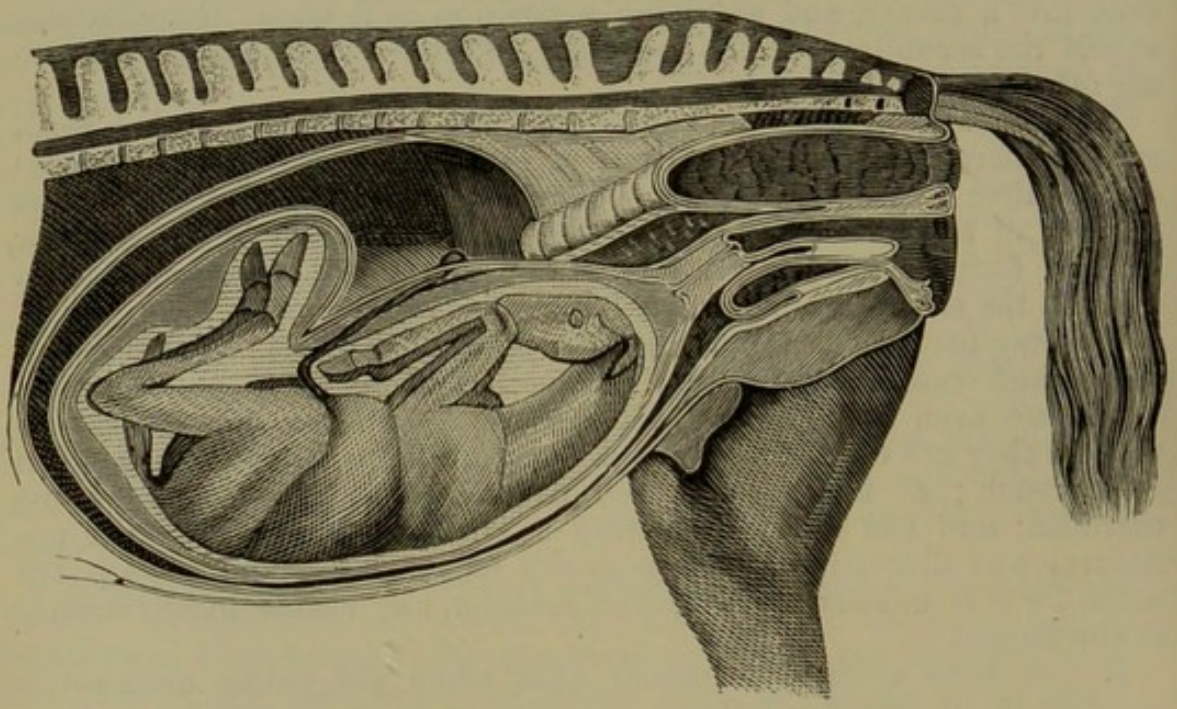


Fig. 71.

Normal Position of the Fœtus in the Mare at Parturition (First Stage).

the termination of pregnancy, the position most favourable for its exit through the pelvic cavity ; though it is indeed very questionable whether the instinctive faculties of the young creature are already sufficiently developed to bring about this result, which may, after all, be due to some reflex action. However this may be, it is certain that the fœtus is very far from being always in this favourable situation, and that the resources of art are often needed to remedy the false positions the young creature may have assumed at the termination of pregnancy.

In studying the various positions and attitudes the fœtus assumes at birth, and the consequent presentations it offers towards the anterior opening of the pelvis, there are to be considered : (1) the region of its body which is first presented to the pelvic inlet, and (2) the relations of, or correspondence between, this region and the shape and dimensions of the pelvic cavity itself.

The first has been designated the *presentation*, and the second the *position* of the fœtus ; and the *inlet*, instead of the *outlet*, of the pelvis

is considered in this respect, because it is the most important in practice, and the position may be altered either spontaneously or artificially during labour; indeed, this alteration has often to be effected by the obstetrist in order to render birth possible.

SECTION I.—PRESENTATIONS.

The *presentation* results from the part of the fœtus which first offers itself at the pelvic inlet—that region of the young creature which the hand of the obstetrist immediately meets on being passed into the os, and which is directly opposite the inlet. In this sense the head, fore feet, hind feet, croup, etc., are said to be presented, according as one or other of them first offers itself on exploration.

These presentations are extremely varied, as any part of the fœtus

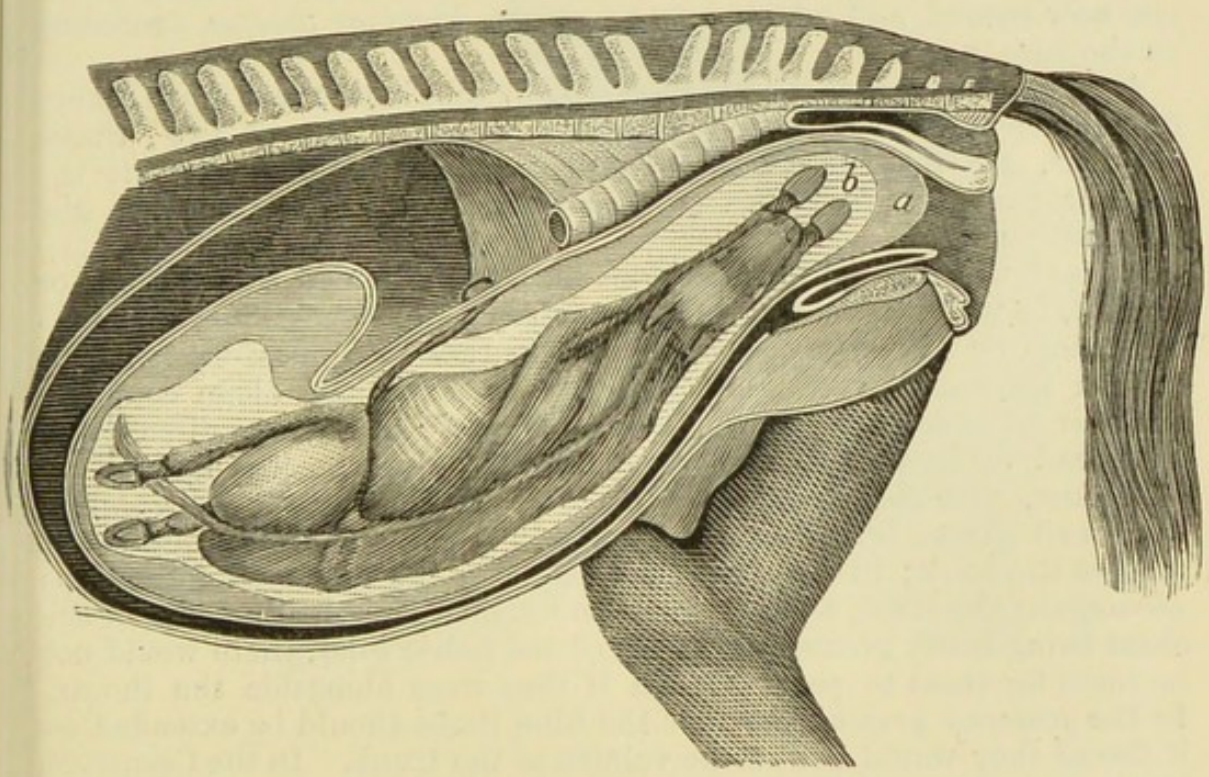


Fig. 72.

Normal Position of the Fœtus in the Mare at Parturition (Second Stage).

a, Allantois; *b*, Amnion.

may occupy this situation; though so far as description and comprehensibility are concerned, their study can be greatly simplified. As Rainard says: "The fœtus, when covered by its envelopes, is oval shaped, or like an olive which it is desired to pass down the neck of a bottle, and which may be presented to this in three ways—either by one of its two ends or by its middle." These ends are the anterior part of the chest in front, and the croup behind; and it is these parts on which the classification of the presentations is based. This classification gives two *longitudinal*, or an *anterior* and *posterior* presentation; and as the fœtus may also offer itself across the long axis of the uterine cavity, we have a *transverse presentation*, which may again be *dorso-lumbar* or *sterno-abdominal*, according to the side of the fœtus which presents. These four fundamental presentations are, therefore:

1. *Anterior Presentation.*—The chest of the fœtus presents towards

the inlet, and is preceded, accompanied, or followed by the head and fore limbs: the situation and direction of which may vary without altering the essential features of the presentation.

2. *Posterior Presentation.*—The croup or breech is facing the inlet, and the presence or absence of the limbs there only constitutes a variety of the presentation.

3. *Dorso-lumbar Presentation.*—Any portion of the *upper* part of the body opposite the inlet. Lecoq and Rainard admit presentations of the withers, back, loins, shoulder or haunch, as distinct presentations; but I agree with Saint-Cyr in declaring the distinction to be practically useless. On exploring the pelvic cavity, no matter what part of the back is first touched, the hand always encounters the spine of the fœtus, either directly in the axis of the pelvis, or obliquely and at some distance from it. All these varieties may, therefore, be reduced to the one now named, and which may be either *direct* or *oblique*, according as the case may be.

4. *Sterno-abdominal Presentation.*—The limbs in this case are in reality first touched, and we may have all four, or only three or two; these, however, are not the fixed point of the presentation, which is the inferior part of the body—or sterno-abdominal region — hence the designation.

These four principal presentations have been divided into *natural* or *normal*, in which spontaneous or unaided birth is possible; and into *unnatural* or *abnormal*, in which parturition is impossible without human intervention. The longitudinal presentations alone comprise the first, although they are not always *normal;* as a wrong direction of the head or limbs may prove an obstacle more or less difficult to overcome, and requires the aid of art. In the *anterior presentation* the head passes before the body, but in the *posterior presentation* it follows the body; in the former presentation the extended fore limbs accompany the head, as there is space for them, for the diameter of the chest being really greater than that of the pelvic inlet, there would not be room for them to pass through if they were alongside the thorax. In the *posterior presentation* also the hind limbs should be extended, as if flexed they would add to the volume of the trunk. In the Carnivora the head is generally larger than the chest, so it does not matter so much if the fore legs are thrown back. Taking this view into consideration, the presentations may either be *simple*, or more or less *complicated*, according to circumstances.

SECTION II.—POSITIONS.

The presentation being determined by the part of the fœtus which offers at the pelvic inlet, it must be evident that this part, whichever it chance to be, may vary considerably in its relations to the circumference of that passage. If the chest of the fœtus first enters it, the *attitude* of this region may be very different in different cases; in one the withers may correspond to the sacrum of the mother, and the sternum to the pubis, or the reverse may happen; in another the fœtus may be lying on the right side, the sternum corresponding to the right branch of the mother's ilium, and the withers to the left ilium, or *vice versâ*. So that here are four different positions in the same presentation—the *anterior;* and it will readily be understood that it should be the same, or nearly the same, for the other presentations.

The *position* has accordingly been defined to be the relation of a determinate point on the surface of the fœtus, to an equally determinate point of the pelvic circumference. The points, so far as the mother is concerned, may be determined once for all, and they will always remain the same for every presentation; they may be, for instance, the sacral region above, the pubic below, and the two ascending branches of the ilium at the sides. If with the fœtus we select any region—say the withers—and put this part in relation with any of these four points of the pelvic circumference, we shall have four successive and easily recognised positions. If, therefore, we first give the name of the region in the fœtus, and next that of the pelvic circumference with which it is in relation, we have a ready means of designating the positions—de-

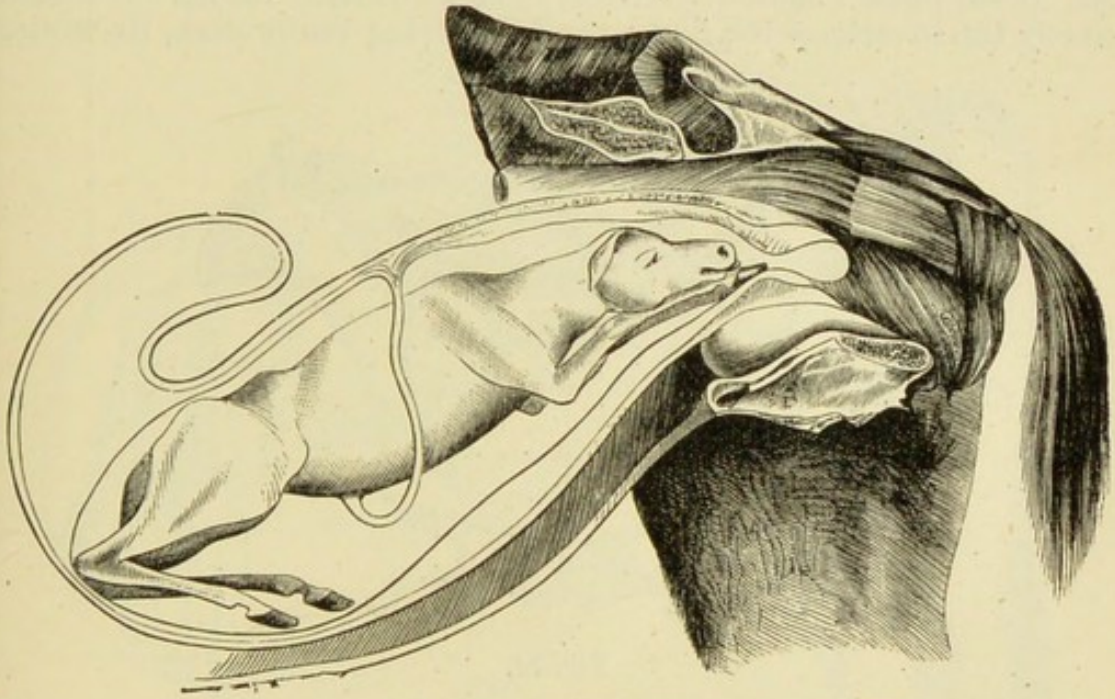


Fig. 73.

Normal Position of the Fœtus in the Mare (Third Stage). Dorso-sacral Position.

scribing the fœtus to be in a *vertebro-sacral position*, for instance, when its *vertebral region* is in relation with the *sacrum* of the mother. The fixed points may be invariable in the latter; but they cannot be so with the fœtus, as they will vary with each presentation.

With regard to the anterior and posterior presentations, Rainard has selected the fixed points as follows in the *longitudinal presentations*: for the first, he has taken the spinous processes of the dorsal vertebræ in the region of the withers; for the second, the lumbar vertebræ. For the positions in the other two presentations, he has not been so fortunate in a designation, in the opinion of Saint-Cyr, who has very judiciously proposed others which are more explicit and comprehensible. The latter gives the various positions which should be recognised in each presentation, as follows:—

A. Anterior Position.—The chest of the fœtus is at the pelvic inlet, and it is desired to make known what relation this part has to

the pelvic circumference. The determinate point on the fœtus is the vertebræ of the withers; and these may be in relation with the sacrum above, the pubis below, the right ascending branch of the ilium on the right side, and the left *ditto* on the left. From this we have four positions, named by Saint-Cyr as follows:

1. *Dorso-sacral Position* (*Vertebro-sacral Position of Rainard, Fig.* 73).—This is the most favourable and the most frequent of all, and is said to be the only natural position. The vertebræ of the fœtus correspond to those of the mother, its withers touching the sacrum of the latter, the belly corresponding to the abdominal parietes, and its sternum to the pubis. This is sometimes named the *first anterior position*, while its sterno-dorsal diameter corresponds to the sacro-pubic diameter of the parent (Fig. 74 *a b*).

2. *Dorso-pubic Position* (*Vertebro-pubic Position of Rainard*).—This is exactly the inverse of the first: the fœtus lying on its back, its withers

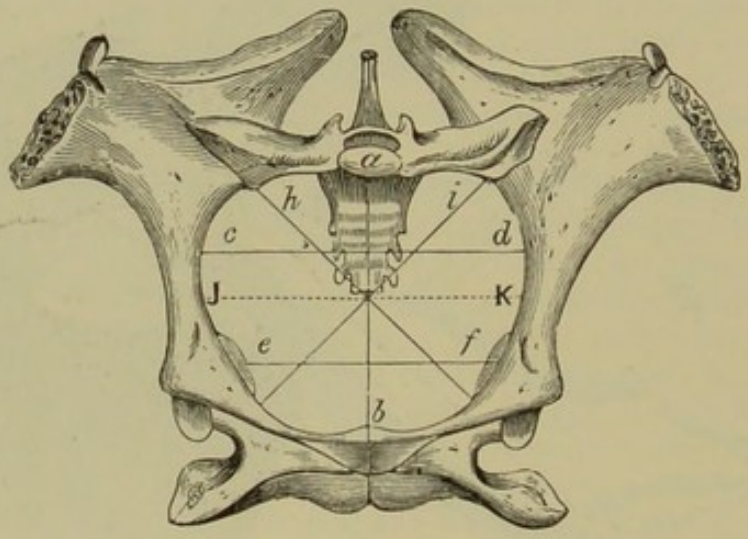


Fig. 74.

DIAMETERS OF THE PELVIS.

a b, Supero-inferior, or Sacro-pubic Diameter; *c d*, Superior Bis-iliac Diameter; *e f*, Inferior Bis-iliac Diameter; *e i*, *f h*, Oblique, Ilio-sacral, or Sacro-iliac Diameters; J K, Middle Diameter.

towards the pubis, and the sternum opposed to the sacrum of the female. This is also named the *second anterior position.*

3. *Right Dorso-ilial Position* (*Right Vertebro-ilial Position of Rainard*).—The fœtus lies in the left flank, its head to the right side of the mother, the neck being in the same direction, and when passing through the pelvic cavity, touching the ascending branch of the left ilium; then the sterno-dorsal diameter of the fœtus corresponds to the bis-iliac diameter passing through the centre of the pelvis (Fig. 74, *j k*), the extent of which is slightly less than the superior bis-iliac diameter. The feet, when they are not in the pelvis, must, of course, be sought for on the opposite side, towards the right flank of the mother.

4. *Left Dorso-ilial Position* (*Left Vertebro-ilial Position of Rainard*).—This is exactly the reverse of the last-described position, the withers corresponding to the right ilium.

The two last are sometimes named the *anterior lateral positions.* They are less frequent, as primary positions, than the first two, and

are sometimes met with as secondary positions after the reduction of a mal-presentation—chiefly the dorsal or ventral.

In addition to these anterior positions, Saint-Cyr gives other four intermediate ones which may be observed when the sterno-dorsal diameter of the fœtus corresponds to the oblique diameters of the pelvis (Fig. 74, *e i*, *f h*). These are as follows:

5. *Right Dorso-ilio-sacral Position.*—This is the intermediate position between the dorso-sacral and right dorso-ilial, the withers being in relation with the right ilio-sacral articulation.

6. *Left Dorso-supra-cotyloid Position.*—This, again, is intermediate between the dorso-pubic and left dorso-ilial position, and quite the reverse of the preceding; the withers are inclined downwards and to

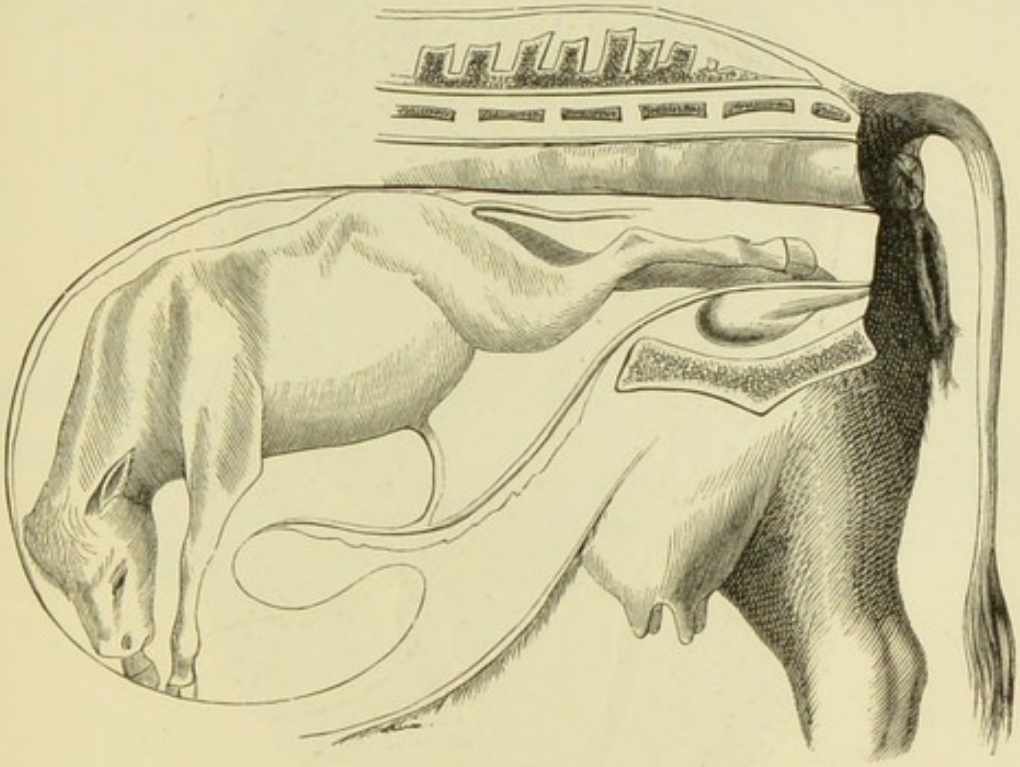


Fig. 75.

LUMBO-SACRAL POSITION.

the left, above the cotyloid cavity, while the sternum lies towards the sacro-iliac articulation.

7. *Left Dorso-ilio-sacral Position.*—Here the position is intermediate between the dorso-sacral and left dorso-ilial.

8. *Right Dorso-supra-cotyloid Position.*—This is the reverse of the preceding.

The *dorso-sacral* and the two *dorso-ilio-sacral* positions are quite natural, as during parturition the curving of the body of the fœtus corresponds to that of the mother's body, while the superior diameters of the first—the *cervico-biscapulo-humeral* and *bicoxo-femoral*—which are the greatest, are related to the superior bis-iliac diameter of the pelvis. The two *dorso-supra-cotyloid* positions are, on the contrary, reversed and abnormal, like the *dorso-pubic*, because the curved condition of the body of the fœtus is the reverse of that of the body of the parent, as well as opposed to the direction of the axis of the pelvis;

so that the fœtus experiences much difficulty in moving along. The relations are still more reversed between the transverse diameters of the fœtus and those of the pelvis when the first correspond to the inferior bis-iliac diameter of the mother.

Positions in the Posterior Presentation.—In this the croup or breech first presents at the pelvic inlet. The lumbar region of the fœtus, which is the determinate point, may be directed towards the sacrum, the pubis, or the right or left branch of the ilium of the

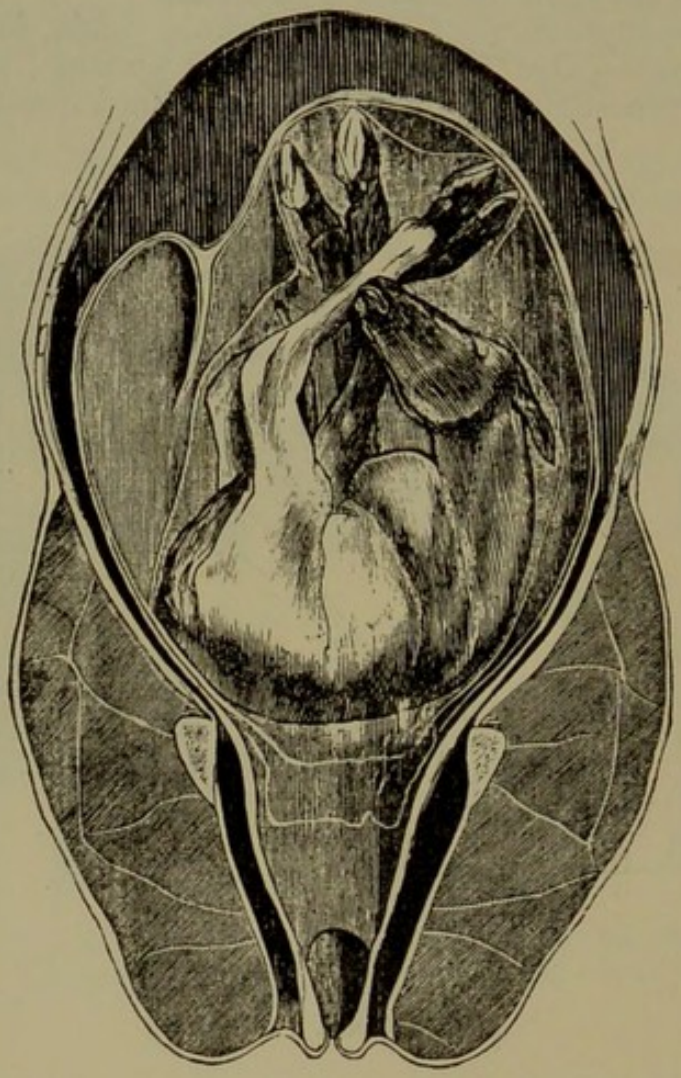


Fig. 76.

Right Cephalo-ilial Position in the Dorso-lumbar Presentation.

female towards the oblique diameters of the pelvic cavity. Hence we have eight positions, as in the preceding presentation. These are:

1. *Lumbo-sacral Position.*—The fœtus is in what some authorities have called a "natural" position (Fig. 75), but which is asserted by others to be unnatural. The loins are towards the sacrum of the mother, the right coxo-femoral articulation towards the right ilium, and the left articulation towards the left ilium. This is sometimes named the *first posterior position.*

2. *Lumbo-pubic Position.* — Some practitioners designate this the posterior reversed position. The fœtus is lying on its back, its croup and loins corresponding to the pubis of the mother, while the limbs

are towards the sacrum, against which they are more or less pressed. This is sometimes termed the *second posterior position.*

3. *Right Lumbo-ilial Position.*—The fœtus is lying on the right flank, its croup and *loins* opposite the ascending branch of the right ilium of the female, and the limbs towards the left flank of the mother, where they must be sought for if they do not present in the pelvis.

4. *Left Lumbo-ilial Position.*—This is exactly the reverse of the preceding position.

5. *Right Lumbo-ilio-sacral Position.*—This is intermediate between the lumbo-sacral and the right lumbo-ilial positions, the lumbar region being towards the right ilio-sacral articulation.

6. *Left Lumbo-supra-cotyloid Position.*—This is also intermediate between the lumbo-pubic and left lumbo-ilial position, being the reverse of the preceding, as the withers are at the other extremity of the same oblique diameter.

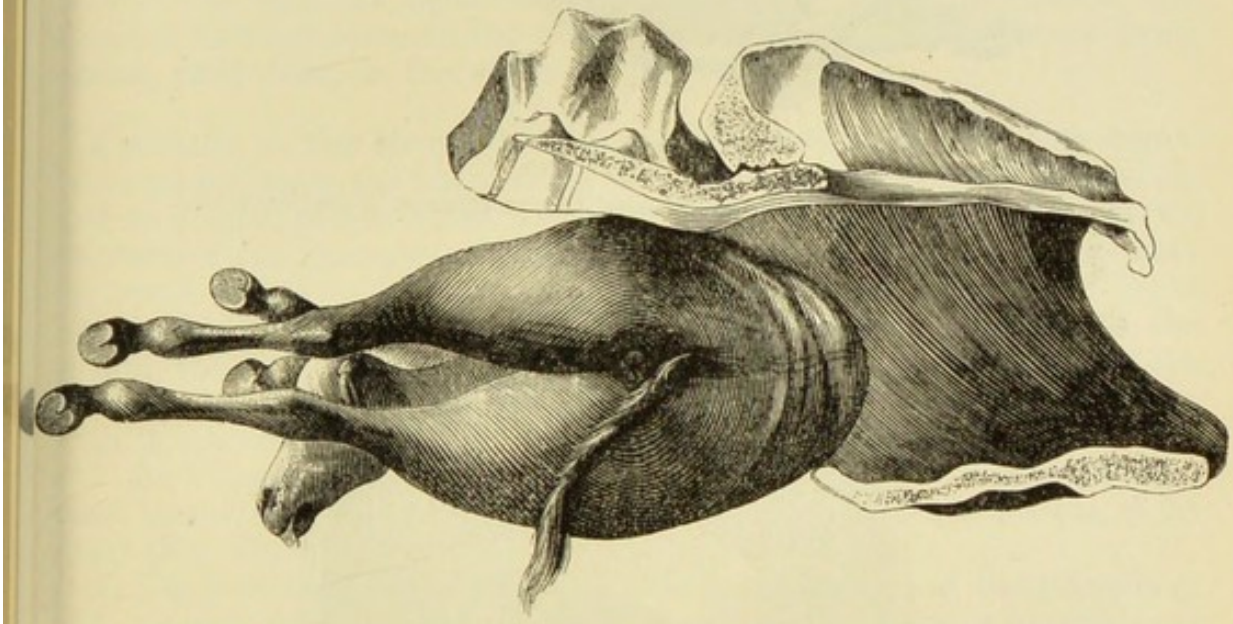


Fig. 77.

CEPHALO-SACRAL POSITION IN THE DORSO-LUMBAR PRESENTATION.

7. *Left Lumbo-ilio-sacral Position* is intermediate between the lumbo-sacral and left lumbo-ilial positions.

8. *Right Lumbo-supra-cotyloid Position* is the opposite of the preceding.

The *lumbo-sacral* and *lumbo-ilio-sacral* positions are the same as their corresponding anterior positions, and therefore *natural;* but the *lumbo-pubic* and *lumbo-supra-cotyloid* are, on the contrary, the reverse of these, and are accordingly abnormal, while the *lumbo-ilial*, like the dorso-ilial, hold the middle place with regard to facilities and difficulties in parturition.

POSITIONS IN THE DORSO-LUMBAR PRESENTATION.—Here the fœtus is presented across or *transverse*, and it may lie on one or other of its sides, its head towards one of the maternal flanks, and the body curved like that of a Dog asleep. In this we have two distinct positions, according as the fœtus lies on one side or the other. But it may also assume a third and almost vertical position—the croup on the floor of

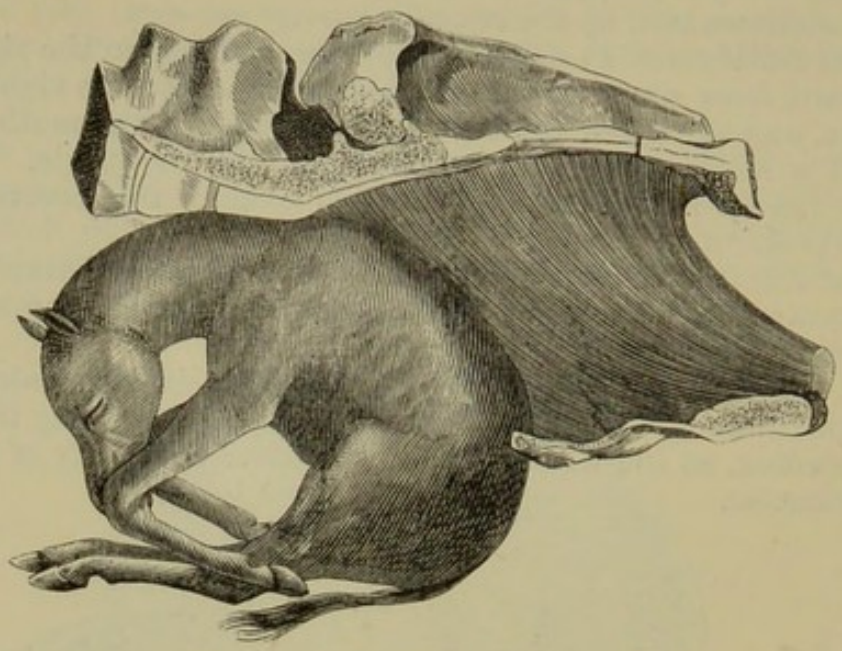


Fig. 78.

CEPHALO-SACRAL POSITION IN THE DORSO-LUMBAR PRESENTATION.

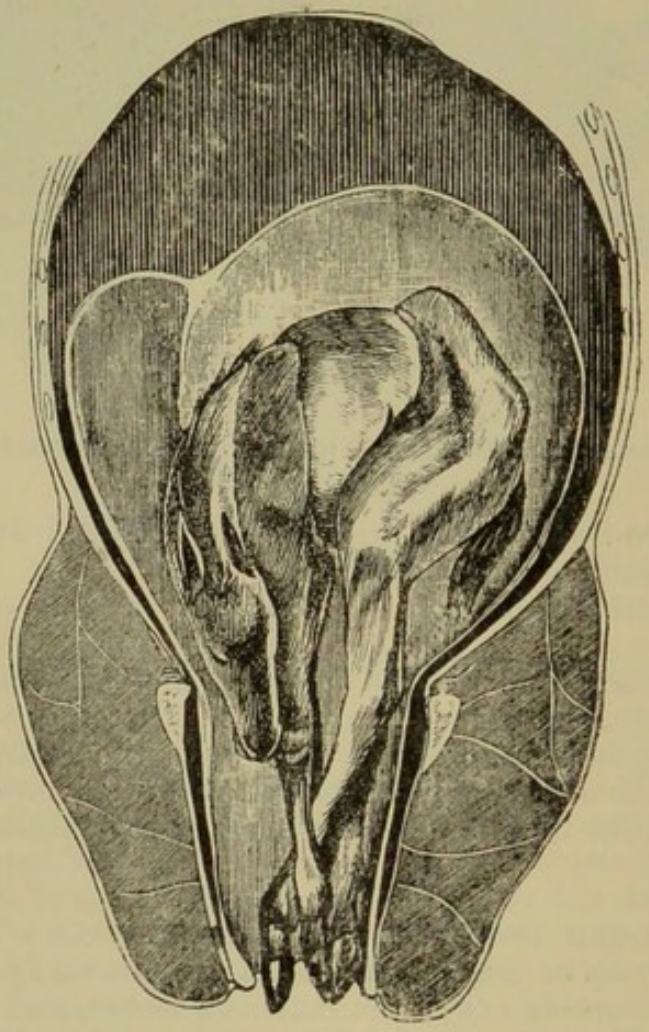


Fig. 79.

LEFT CEPHALO-ILIAL POSITION IN THE STERNO-ABDOMINAL PRESENTATION.

the abdomen of the mother, and the creature in the attitude of a Dog sitting.

The important consideration in these three positions is related to the situation or direction of the head; if this is known, it is easy to infer that of the other parts of its body, and thus appreciate the indications for delivery to be followed in this presentation. According to the direction of the head, the three following positions are described:

1. *Right Cephalo-ilial Position.*—The fœtus is on its right side, which rests more or less directly on the abdominal walls of the mother, the head in the right flank, the croup towards the left flank, the body more or less curved, and the dorso-lumbar region towards the pelvis, in which it presents (Figs. 76, 77).

2. *Left Cephalo-ilial Position.*—This is the reverse of the preceding.

3. *Cephalo-sacral Position.*—In this position the fœtus presents by the back, and in an almost vertical attitude—the croup resting on the floor of the mother's abdomen, the head more or less depressed, and directed forward towards the sacro-lumbar region—the creature being seated, as it were, on the udder of its parent (Fig. 78).

Positions in the Sterno-abdominal Presentation.—In this transverse presentation the fœtus offers the abdomen to the inlet of the pelvis, and on deep exploration the hand first meets this part, and perhaps two or more of the limbs, generally a hind and a fore one. The head may be found (Fig. 79), or it may be out of reach; or the head and limbs may be doubled back, so that no part of the creature has entered the vagina, though the sternum and other parts on the lower surface of the body can be felt.

In this presentation there are three principal positions:—

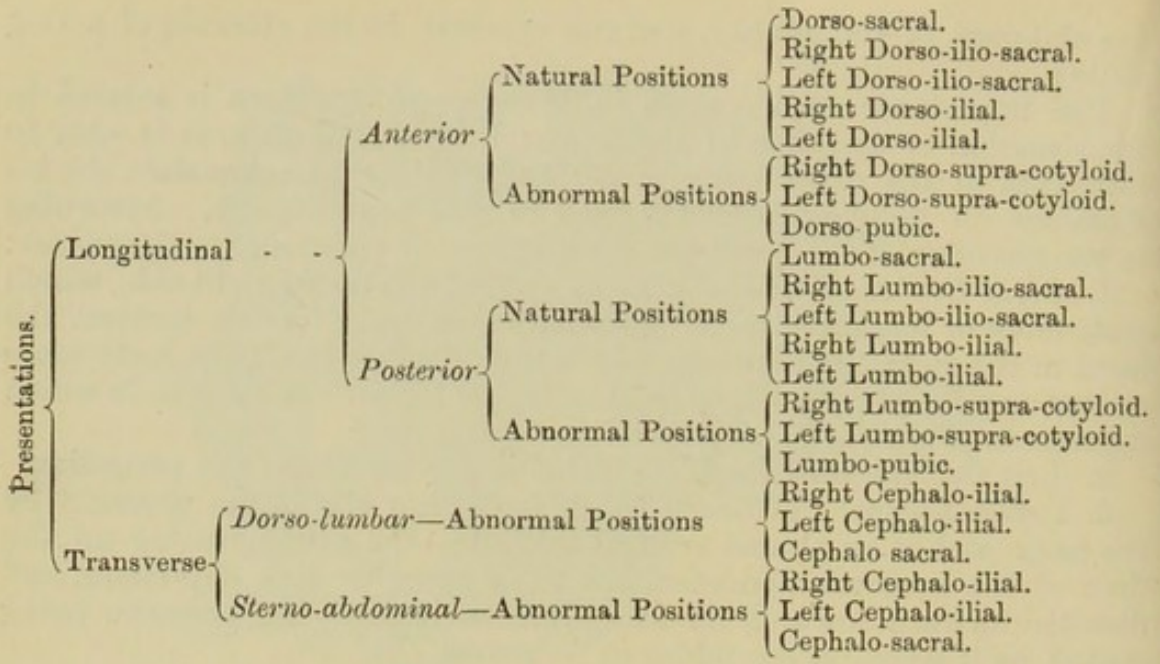
1. *Left Cephalo-ilial Position.*—The fœtus lies on the right side, the head towards the left ilium of the mother, and the croup to the right ilium (Fig. 79).

2. *Right Cephalo-ilial Position.*—This is the reverse of the preceding.

3. *Cephalo-sacral Position.*—In this position the fœtus is vertical, the croup being downward; but the abdomen and sternum are towards the pelvic inlet, all the limbs being directed towards the os uteri, while the withers correspond to the sacro-lumbar region, and the head is turned to the back or sides of the fœtus.

All these transverse positions are abnormal and dystokial.

Saint-Cyr, who has mainly followed Rainard in the definition of these presentations and positions of the fœtus, insists on the necessity for studying them carefully, as by so doing those who commence the practice of obstetricy will be greatly enlightened as to the difficulties they may encounter, and the readiest and most scientific way of overcoming them; while this study will enable the skilled practitioner to describe his interesting cases with more clearness and precision. To render what has just been stated more convenient, the following table is given, in order to show at a glance the different presentations and positions:



The longitudinal presentations, with *natural positions of the trunk* of the fœtus, do not necessarily imply an easy birth, as, independently of disproportion between the dimensions of the passage and those of the fœtus, there may be a misdirection of the head or limbs, which would constitute dystokial presentations.

SECTION III.—MECHANISM OF PARTURITION.

Under normal conditions, it may be said that the pelvis itself does not offer any obstacle to the passage of the fœtus, and that it is the soft parts alone which oppose its exit.

Of the different presentations enumerated, the anterior—in which the fore feet, head, and chest present simultaneously—is the only one we may designate as "natural," especially with the larger animals and primiparæ.

Fromage de Feugré was the first to point this out, though Rainard was of opinion that the posterior presentation should also be looked upon as normal; while Desplas gave three natural positions—head and fore limbs, head only, and hind limbs only; and Delwart gives four normal positions. But experience abundantly proves that the first we have described is that which alone merits the designation, as it is the one in which birth can take place without artificial aid. It is true that birth is possible when the Foal or the Calf presents posteriorly at the pelvic inlet; but this is a rare presentation, and under the most auspicious circumstances it is much less favourable, and more difficult for the mother, while it is very often death to the young animal (especially in the Mare). In the majority of cases, without assistance expulsion proceeds no further than the hocks, and the fœtus dies; and even sometimes with assistance much force is necessary to deliver. Whereas, in the anterior presentation, the cases are exceptional (and these chiefly in primiparæ) in which even slight traction is necessary.

We will follow Saint-Cyr in first studying the mechanism of parturition in this presentation, in which, of the eight positions pertaining to it, the *vertebro-sacral* is by far the most frequent and favourable. This we will now notice.

Mare.

Anterior Presentation.

1. *Mechanism of Parturition in the Dorso-sacral Position.*—In this position it has been stated that the fœtus presents simultaneously with the head and fore limbs, the back directed to that of the mother and the withers towards the sacrum. When perfectly natural, the head and fore legs first enter the inlet; the head is extended, forehead looking upwards to the sacrum, chin towards the pubis, nose forward, the lower jaw resting on the outstretched limbs, the feet of which extend a little beyond the nose. Then comes the neck, and after it the chest and shoulders, which arrive at the inlet when the nose and feet show themselves at the vulva.

In this course it will be observed that, so far as the head and limbs are concerned, there is no difficulty, as the pelvic diameter readily admits them when the soft parts are sufficiently relaxed. With the chest, however, there is difficulty, as its diameter is greater than that of the pelvis; and the question is, therefore, how it is got through the canal. In 1870, Saint-Cyr saw four well-bred harness and saddle Mares give birth to Foals at the Lyons Veterinary School. Gestation had been regular, and parturition, which was easy and favourable, did not exceed the ordinary duration. In taking the diameters of the maternal pelvis by the method already described, and those of the fœtus (dorso-sternal, biscapulo-humeral, and bicoxo-femoral), it was found that in these four instances the biscapulo-humeral diameter—the largest in the chest—was easily accommodated in the bis-iliac diameter of the female pelvis, which was greater by 42, 45, 48, and even 52 millimetres (from $1\frac{1}{2}$ to 2 inches); while the sterno-dorsal diameter of the young creatures exceeded that of the sacro-pubic region in the mothers by 28, 85, 87, 88 millimetres (from 1 to $3\frac{1}{2}$ inches). This part of the body of the fœtus had, therefore, to undergo a corresponding reduction in a vertical direction before it could clear the inlet; and even if we take into account the excess of the lateral diameter of the pelvis, it will be found that the thorax and withers of the fœtus still notably exceed in size the opening through which they must pass. That they do pass through it, and with ease in the majority of cases, without injury to the mother or the young creature, is a matter of daily experience; but the mechanism by which the reduction is effected has been much discussed.

Lafosse endeavoured, in the last century, to describe it, and came to the conclusion that the head once through the inlet, the shoulders of the Foal, which exceed the withers, pass by their upper part in front of the neck, thus forming a kind of channel which glides along the maternal sacrum; also that the spinous processes of the withers, which are almost cartilaginous, bend back on each other, and to right and left of the spine, thus preventing too great compression of the chest. Altogether, he concluded that the Foal in its passage becomes moulded in such a manner that the chest has the form of the keel of a ship gliding on the stocks, and in every way corresponds to the mother's pelvis, the internal contour of which it assumes.

Rainard, however, takes a slightly different view of this matter; for while admitting, with Lafosse, the inclination backward of the dorsal spines as a first cause in diminishing the vertebro-sternal or perpendicular diameter of the thorax, he cannot admit that the upper border of the scapulæ lie against the neck, but states that the shoulders, on arriv-

ing at the pelvic entrance, come in contact with the ascending branches of the ilium, and are thrown back somewhat, leaving the front part of the chest free, and thus diminishing its diameter. He also adds that the withers first enter beneath the sacrum; that the sternum below is pushed back by the anterior border of the pubis, and the chest in this way submits to a process of elongation which notably diminishes its vertical diameter.

Saint-Cyr agrees with Rainard in this interpretation of the real mechanism of parturition in the Mare. The sternum, in being carried backwards, also pulls back the ribs attached to it, and this not only diminishes the chest in a vertical, but also in a horizontal direction, as is witnessed in studying the mechanism of respiration in the living animal, in which, during expiration, the chest decreases in width and depth. When the chest is so altered during parturition, the fœtus becomes, as it were, elongated by this part being depressed; an alteration which occurs all the more readily, from the bones composing the thorax being soft and supple, and the organs they enclose (the lungs) not being so developed as they are immediately afterwards; so that a moderate amount of pressure, provided it is not too long continued, may be borne with comparative impunity.

In the larger animals, the pelvis cannot undergo any sensible increase in size during the passage of the deepest portion of the fœtal body through the inlet, which is, in the Mare, an absolute inextensible bony girdle. Lafosse has sawn through the pubes of Mares about to foal, and he found that during parturition there was only a space of two lines between the sawn margins. So that it is the body of the fœtus which has to accommodate itself to this part of the passage at this stage of delivery.

When, however, it has passed through the inlet, extensibility of the maternal tissues can, and does, take place, and permits an enlargement of the canal. The wide sacro-sciatic ligaments which enclose the pelvis laterally, are softened and more elastic during birth; the sacro-iliac and sacro-lumbar articulations are increased in mobility; and even the posterior part of the ischio-pubic symphysis may become slightly relaxed. So that when once approaching the outlet the progress of birth is more rapid, and this progress may be aided if, as is pointed out by Lafosse, the tail of the mother is well elevated.

A slight check to expulsion is observed when the croup arrives at the inlet, as this part nearly corresponds in diameter to this opening, being, if anything, slightly less. However, notwithstanding this, in consequence of the croup being less susceptible of diminution than the chest, and although the bones may yield to some extent, friction will occur, more particularly if the croup is largely developed, which is the case in some Foals. One haunch may pass into the inlet before the other, however, and thus facilitate the passage.

2. *Mechanism of Parturition in the Dorso-ilio-sacral Positions.*—These positions are two in number and symmetrical, and probably are frequent at the commencement of birth in the anterior presentation, when the width of the pelvis exceeds its depth—the oblique diameters being then greater than the vertical—so that the fœtal thorax enters even more easily, and it is only when the croup reaches the inlet that the fœtus is compelled to rotate slightly on itself to assume the first position on its passage outwards; when the depth of the pelvis is

greater than its width this rotation is effected spontaneously at the commencement of birth. So that these oblique positions are as favourable as the dorso-sacral position.

3. *Mechanism of Parturition in the Dorso-ilial Positions.*—These lateral positions—also two in number and symmetrical—are, according to Saint-Cyr, rarely primary, but, as Rainard remarks, are sometimes found as *secondary positions*, due to the reduction of some lateral-presentations. The latter authority asserts that spontaneous birth is impossible in these positions, because the chest of the fœtus presents its greatest diameter to the smallest diameter of the pelvis of the mother. This, however, is an exaggeration, as the bis-iliac diameter is sometimes equal, or even superior, to the sacro-pubic diameter; so that it is not always absolutely impossible for delivery to occur spontaneously in these positions; though it is very true that it is *always* more difficult, and *sometimes* impossible, if the position is not altered. Independently of the disproportion between the diameters of the pelvis and the corresponding diameters of the fœtus, here also we find the two salient parts of the latter—the sternum and dorsal spines clamming against the two resisting parts of the pelvic circumference—the ascending branch of each ilium, and it will be readily seen that in some cases these will prove an insurmountable obstacle. Nevertheless, as a general rule, this obstacle may be easily turned, if the pelvis is sufficiently wide, by merely causing the body of the fœtus to rotate in such a manner that its greatest diameter will be brought opposite the oblique diameter of the inlet, which extends from the ilio-pectineal ridge to the sacro-iliac articulation on the opposite side. Then its entrance into the pelvic cavity, and complete expulsion, is rendered possible.

But if the pelvis is narrow, the faulty position must be modified at the commencement of birth so as to make it oblique or dorso-sacral, and if the fœtus is not large the croup will probably follow without difficulty. If, however, the fœtus is large, it should be placed in the dorso-ilial position in order to accommodate it to the larger diameter of the pelvis.

It will be seen that the dorso-ilial positions may sometimes admit of spontaneous birth, but that it will also happen that aid will be necessary to effect delivery.

Posterior Presentation.

Mechanism of Parturition in the Lumbo-sacral Position.—Of the positions in which we may have a breech or posterior presentation, only one is compatible with spontaneous delivery—the *lumbo-sacral;* though even this is denied by other authorities. The fœtus is presented by the breech, the loins towards the sacrum of the mother, the hind limbs in complete extension and entering the inlet, so as to open the passage for the body; and though this position may appear to be favourable for the expulsion of the young creature, yet it is far less so than the first anterior position. The croup of the fœtus is a rounded voluminous mass which does not admit of much compression, and the diameters of which—particularly the transverse—are nearly equal to those of the pelvis; it is, therefore, not well disposed for passing through the latter, and, in addition, its upper part presses against the sacro-vertebral angle; while the stifles, which are salient, press against the edge of the pubis, and the hip-joints

against the branches of the ilium. Entrance into the inlet must therefore be slow, difficult, and painful for the mother, and when this first obstacle is overcome and the croup is in the pelvic cavity, the chest has to follow, and to submit to the same compression at the inlet as in the anterior presentation. But this part of the fœtus is much less favourably disposed for such a reduction of dimensions in this position; as the resistance offered by the walls of the maternal pelvis has a tendency to erect the dorsal spines, and to carry the ribs and sternum forward—all this going to increase the diameter of the fœtus in every direction. It is only, then, by direct compression or squeezing, that the necessary diminution in the diameters of the young creature can be effected, and not by a kind of physiological decrease, as in the anterior presentation.

There is also the obstacle offered by the hair of the fœtus, the "set" of which is against the direction of movement; and this obstacle will be greatly increased if the fluids have escaped for some time, and the parts are more or less dry.

Taking all these considerations into account, it will be seen that in this position, even when birth is possible with extraneous assistance, labour must be long and exhausting, and that the young creature incurs the greatest danger. Labour, however, is more likely to be successful and less tedious if the haunches of the fœtus present one after the other at the inlet; so that a slight obliquity in the presentation makes a great difference; and it is just possible that when birth takes place in this position without aid, this obliquity may have been present.

Cow.

Anterior Presentation.

Mechanism of Parturition in the Dorso-sacral Position.—In the Cow, the mechanism of parturition in this presentation is similar to that in the Mare. Saint-Cyr shows, from actual measurements of Cow and fœtus, that the head of the Calf can easily pass into the inlet, owing to its less diameter, and that the principal difficulty is encountered by the fœtal thorax, which is slightly larger in every sense than the inlet.[1]

The bicoxo-femoral diameter of the croup slightly exceeds the bisiliac diameter of the pelvis; but it is possible that the pelvis of the Calf, being more cartilaginous and supple than that of the Foal, may be submitted to a slight temporary compression. It is to be remarked, however, that the progress of the Calf through the pelvis must be more protracted than that of the Foal, owing to the greater length of the maternal pubic symphysis, and the more considerable extent of the pelvic walls, as well as the peculiar curve in the floor of the pelvis; though these disadvantages are somewhat compensated for by the greater mobility of the sacrum. And, as we have seen, such is really the case, the duration of parturition being shorter in the Mare than in the Cow.[2]

The other positions in this presentation do not differ much from

[1] Saint-Cyr in these observations measured the thorax after the birth of the young creatures, and when the lungs had become expanded. He does not appear to have made any allowance for this expansion, which of course makes a difference in the size of the thorax after birth.

[2] The fact that parturition is more quickly performed in the Mare than any other quadruped was well known to Aristotle: *Equa, omnium quadrupedem, facillimè, parit.*

those in the Mare with a narrow pelvis, to which that of the Cow bears considerable resemblance.

The same may be said of the positions in the POSTERIOR PRESENTATION. In the lumbo-sacral position, the stifles of the Calf, being more oblique than those of the Foal, are not so liable to be held by the anterior border of the pubis, while another advantage is to be found in the smaller disproportion between the length of femurs of the Calf and the sacro-pubic diameter of the Cow; so that the Calf is more frequently born alive in this position than the Foal, while the Cow is more rarely subject to injury, though extraneous aid may be necessary at times.

OTHER ANIMALS.

With regard to the smaller female animals, the same remarks are applicable to presentations and positions, as in the case of the Mare and Cow, and more especially with reference to the Sheep and Goat. In these latter, when there is only one fœtus, birth is effected by the same mechanism, and when there are more than one it is no less easy, as the fœtuses are smaller. This is nearly always the case, also, with the Sow, and still more frequently with the Bitch and Cat.

It may be noted that with the common-bred Bitch, which has a more or less elongated muzzle, when fecundated by a Dog of the same conformation and size, and which in due course brings forth from five to eight young, there is usually no difficulty in delivery. The conical form of the muzzle of the puppies, and the softness of their tissues, permits their entering the inlet in this presentation, and passing easily through it under the influence of the uterine and abdominal contractions. But when the Bitch is of small size, and is fecundated by a young, vigorous, and larger Dog, and especially if the muzzle of either or both parents is short, then the head of the puppies is usually large and round, with the forehead high, and the presentation offers grave, and frequently insurmountable difficulties. This is more especially the case if the puppies are few in number, when they are usually larger. This will be alluded to again when we come to treat of difficult parturition.

It may also be observed that in the Anterior Presentation, the fore limbs of the fœtus—contrary to what takes place in the Mare and Cow—do not accompany the head, but are placed alongside the chest, owing to this disproportionate size of the head, which is as voluminous—if not more so—than the chest in some instances; but then the latter, even with the legs alongside it, is easily reducible, while the head is very slightly so.

The Posterior Presentation is frequent in Carnivorous animals, but birth is effected under the same conditions as in the other species.

CHAPTER III.

Necessary Aid in Normal Parturition.

ALTHOUGH, as a rule, parturition is generally effected in animals in what we have designated a "spontaneous" manner (without the intervention of man), and without danger or prejudice to the mother or offspring; and although these do not require that minute and scrupulous

attention bestowed on woman and infant, even when birth has been easy; yet, from the nature of this act and the unfavourable consequences which are sometimes noted, certain precautions should be observed by the owner of the animals at this period, and especially if these should happen to be valuable and very artificially kept. These attentions and precautions should be entrusted for their carrying out to competent persons selected by the owner; as it is seldom that the veterinarian is called in unless something serious has occurred. The mother as well as the offspring require watching, and more or less nursing.

SECTION I.—ATTENTION TO THE MOTHER.

With the smaller animals, except, perhaps, the Bitch, little preparation is needed, and the act of parturition is accomplished without any trouble. But with the larger and more valuable creatures—such as the Mare and Cow, and even the Sheep—certain precautions should be adopted. With the Mare and Cow particularly, this function is accompanied by pain, restlessness, and a certain amount of excitement, which necessitate attention. For instance, an animal tied up in a stall among other animals of the same or different species, is more exposed to accidents than one which is in a place by itself, or which is at liberty in a pasture or meadow. Therefore, the Mare about to foal should be allowed a roomy loose-box, well supplied with soft litter; and the Cow should, if possible, be similarly provided. If either animal must be kept tied, then the fastening should be of such a kind that it can readily be undone when required. The Sow should have a separate sty, and even the Sheep may need a separate allotment. If kept in a dwelling, the temperature should be comfortable and the ventilation good.

A. During Labour.—When parturition commences, it is rare indeed that anything requires to be done during at least the two first stages—those of preparation and dilatation of the os. Therefore, the animal should be allowed perfect quietude; and if the light in the stable is too bright, it may be partially excluded. A trustworthy person may remain with it, in order to avert accidents; but he should keep himself out of sight, and meddle with the animal as little as possible. Some creatures, and particularly primiparæ, are rendered peevish and fidgety if they see anyone present during parturition.

Unless something irregular or abnormal occurs during this act, all should be left to nature. In the case of the Mare, however, it has been recommended to empty the rectum either manually or by means of oily enemas, if the fæces are hard, in order to avert rupture of the intestine. The irregularities are few in number, the principal being *hurried* and *protracted parturition*, they being only modifications of natural labour; the difficult cases coming under the head of *dystokia* will be treated of in another division of this volume.

Whether called in to a case of irregular or abnormal parturition, the first care of the veterinary surgeon will be to assure himself as to the state of the animal and the progress made in the act. In this direction, it must be remembered that for the accomplishment of this function in a physiological manner—*i.e.*, by the forces of nature only—and without prejudice to the mother or offspring, there is required a definite action—proportionate to the constitution of the former—of the forces destined

for the expulsion of the latter. The labour-pains should be normal, and the act should neither be hurried nor abrupt, nor yet too slow; and the mother should not exhibit any constitutional weakness or physical debility. In addition, the fœtus should be normal, as well as its membranes; and the genital passages of the mother ought to be in a properly formed and healthy condition. The fœtus should be alive and natural in form and size, particularly with regard to the volume of the head and thorax; and it ought to be in such a position that it can be expelled without assistance. The fœtal envelopes should possess a certain degree of thickness and resistance, so that they may not rupture too soon, nor yet resist the action of the uterus too long. The pelvis of the mother should have a convenient shape and capacity; the genital passages soft and elastic; the os, vagina, and vulva properly formed and extensible; and the other pelvic organs in a normal state.

If the act of parturition is not sufficiently advanced, and the soft parts through which the fœtus has to pass are not enough dilated, time ought to be allowed for this to take place. As a rule, there should be no hurry to interfere with the progress of the case, as a somewhat long period is often required for preparation; and if this is accelerated by the intervention of art, accidents are more likely to occur than if the labour had been long and protracted.

Vitulary or parturient collapse has been remarked as more common in Cows which have calved quickly or abruptly; and in such instances it has also been noticed that the uterine contractions do not sufficiently detach the fœtal membranes.

In parturition, there is as much wisdom shown in remaining a spectator sometimes, as in interfering at other times when circumstances require it. It is only when obstacles, insurmountable by the natural efforts of the animal, offer themselves that aid must be rendered. So long as the course of parturition remains normal, nothing should be done, under ordinary circumstances.

With the Mare, however, delay should not be pushed too far, as the fœtal placenta is very easily detached from the uterine surface, and the fœtus may perish of asphyxia or inanition.

The intelligent owner of, or attendant on, an animal which is about to bring forth, should be able to ascertain the position of the fœtus, and decide as to whether parturition may terminate in a natural manner, or if the existing obstacles are easy to overcome. If they are not, he certainly should not venture to attempt delivering the animal himself, or to pull about the mother or fœtus; as this may only tend to aggravate the accident, and render relief more difficult. The veterinary surgeon should be sent for, as his knowledge and practised manipulative skill will, in the majority of cases, bring the most complicated labour to a prompt and happy termination—preserving the mother, and often the progeny.

This appeal to the veterinarian is not always made, however, until great damage has been done by the owner, his servants and neighbours, or the empiric, and the loss of valuable time caused; then he is sent for, but now the case may be one of extreme difficulty or hopelessness, from exhaustion or injury.

We shall only notice in this place what has been designated *abrupt, tumultuous, disordered*, or *false labour* (*partus præcipitatus*), and *protracted labour*, both due to anomalies in the expelling forces.

1. *Tumultuous Labour.*—In this kind of labour the act of parturition

is irregular and precipitate; and though the pains are excessive and frequent, yet no progress appears to be made, the parts not being prepared, while the cervix is often in a state of spasmodic contraction, rigid, and painful. Otherwise the maternal organs may be well formed, the passage roomy enough, and the fœtus in a good position.

Sometimes the uterus itself is in a state of contraction, the contractions assuming the opposite direction of those occurring in healthy labour,—commencing at the cervix, they pass towards the fundus of the uterus.

This condition, in which the phenomena are at first alarming, is most frequently observed in young, well-fed, vigorous, irritable animals, and especially primiparæ, which are excited and troubled at the first pains, and give themselves up to violent expulsive efforts that hinder the natural course of parturition.

In the majority of cases, amendment is ensured by diverting the animal's attention, walking it about for a short time, wisping the abdomen gently, and keeping it in a quiet and dark place. If, however, the pains are violent, and the agitation great and persistent, other measures must be resorted to. Some authorities recommend bleeding, but this should, if possible, be dispensed with. Blankets steeped in hot water should be applied to the loins and abdomen, warm enemas administered, and, if deemed necessary, chloroform, ether, opium, or chloral given in draught or in enema—the latter being generally preferable. Not infrequently good results are produced by injecting tepid water into the vagina, and raising the animal's hind quarters; and at other times, when the cervix is in a state of spasm, relief is soon obtained by applying a little extract of belladonna to it. With small animals, a few drops of laudanum, either in draught or enema, and a warm bath, are usually sufficient.

Quiet, soothing, and simple treatment will generally bring about a normal state of affairs; the agitation and irregular straining subside, and easy parturition occurs in six, twelve, or twenty-four hours.

2. *Protracted Labour.*—Protracted labour, due solely to the inability of the uterus to expel its contents, or to pathological weakness of the expelling forces, is rare, except in those cases in which exhaustion results from violent and long-continued attempts to overcome some material obstacle to birth. Then, most commonly, the membranes have ruptured, the waters have entirely escaped, and the uterus, in a state of general tonic contraction—*tetanus uteri*—is closely applied to the fœtus, but makes no effort to expel it. This usually, if not always, happens when the fœtus is dead. But primary inertia, due to constitutional weakness, and in the absence of any material obstacle to the expulsion of the fœtus, is not common.

It is observed, nevertheless, in emaciated, puny, and frequently old animals, which are debilitated from lack of sufficient and good food, prolonged lactation, overwork, or worn by chronic wasting diseases. It may also be due to congenitally feeble development of the uterine muscular fibres, and to diminished contractility of these by over-distention of the uterus during pregnancy, or by disease.

The symptoms in the Mare and Cow are: comparatively shallow and repeated inspirations, feeble and unfrequent straining, weak pulse, restlessness and symptoms of suffering, extremely slow progress in birth,—parturition in the Cow being extended to twenty-four, and even forty-eight hours, though the fœtus may be in a good position, of ordi-

nary size, and the passage clear. If the hand is introduced into the vagina, it will be discovered that the uterine contractions are weak.

There is no urgent danger to the mother in this condition; though the life of the fœtus is often imperilled; as the placenta may be detached more or less from the uterus, and this may lead to fatal consequences.

An examination is of course necessary, in order to ascertain whether there is any obstacle to parturition. Should such not be found, then stimulants may be given; such ecbolics as rue, saffron, savine, and particularly ergot of rye, have been recommended by various writers. These may be useful, but it will generally be found that active intervention is preferable, and more especially as there is little, if anything, to prevent the fœtus being easily reached; for should the os be insufficiently dilated, it may readily be made wide enough for the hand to pass into the uterus. Moderate and judicious traction on the parts which present, when the mother makes expulsive efforts, will bring the fœtus into the pelvic cavity and through the vulva.

Death of the Fœtus.—When parturition is retarded, it is often a question whether the fœtus is dead or alive, and to answer it correctly is sometimes difficult. Auscultation in the larger animals cannot, as it may in the human species, furnish any certain evidence in this respect. The fœtor of the liquor amnii has been held to prove the death of the fœtus; but though it is a good sign, yet it is not infallible. When decomposition has, however, well advanced, and the fœtus is emphysematous and its hair easily removed, then there can be no doubt as to its being dead. The coldness of the parts external to the vulva of the mother, when well marked, is also a sign of death. Of course, so long as the fœtus displays active movements, it is alive; but the absence of these is not an absolute proof that it no longer lives; for sometimes when it is partly in the pelvis and the waters have escaped, so that the uterus encloses it firmly, though still living it remains passive, and cannot be stimulated to movement. Should the presentation be anterior, then passing the fingers into its mouth and titillating the tongue will prove a test of its vitality, as the jaws and tongue are almost certain to move if it lives; but the absence of movement will not be decisive, though it will constitute very probable evidence of death. If the umbilical cord can be reached and seized between the thumb and index finger, slight compression will discover whether or not the arteries pulsate. The absence of pulsation affords a strong, but not in every case a sure, presumption that the fœtus is dead.

Gellé, many years ago, gave an empirical test which, he asserted, was constantly successful; though it is difficult to say why it should be. This method consists in passing a blanket or sheet under the belly of the Cow, and lifting it up by assistants at each side. If the fœtus is not dead, the Cow exhibits dislike of the pressure; but if dead, then it rests on the sheet.

Another authority states that, with the Mare, the expulsive efforts cease for the time being as soon as the Foal is dead, and if it has not entered the pelvic inlet; if it has passed into this, the pains continue as usual.

In the Cow the fœtus may be alive though the labour-pains have ceased for some hours, or only occur at long intervals. With the

Bitch, it has been remarked that when the pains are weak, the first puppy that presents is usually dead.

The causes of death of the fœtus during parturition are not numerous, and may be enumerated as follows:—1. *Knots* on the umbilical cord, which, though not unfrequent in the human fœtus, appear to be very rare in animals; 2. *Twists* of the cord around the body, neck, or limbs of the fœtus, and which may be sufficiently tight to interrupt the circulation in the umbilical vessels; 3. *Prolonged compression of the umbilical cord*, due to the fœtus remaining a long time in the passage, whereby the circulation of blood is checked; 4. *Premature rupture of the membranes* and escape of the whole of the liquor amnii, which, if parturition is not soon completed, exposes the fœtus to great danger from immediate pressure of the uterus upon it; 5. *Disunion*, more or less complete and extensive, between the uterus and fœtal envelopes, by which the vital connection between the mother and fœtus is interrupted, and if the latter is not quickly expelled it must die from asphyxia. Owing to the difference in the placentation of the various animals, it happens that this fœtal asphyxia is not equally common in all—a fact which experience and clinical observation have abundantly demonstrated.

Many veterinarians, and among them Saint-Cyr, have been struck by the fact, that no matter how soon they were called in to a case of difficult parturition in the Mare, nor how trifling the difficulty might be and rapid the delivery, the *living* foal was never produced; while in cases in Cows, though incomparably more difficult, and requiring manipulation for more than an hour, living Calves were the rule. So common is this experience, that a very distinguished French veterinary surgeon—Donnarieix—has laid it down as a maxim that the Foal does not live more than three hours, often less, in the uterus after the first expulsive efforts; while the Calf in the same conditions can live much longer—sometimes for several days—after the commencement of labour. The explanation he gives, and which we think is correct, is based on the manner in which the fœtal placenta is inserted into the uterus. In the Cow, the placentulæ, multiple and independent of each other, adhere firmly and closely to the uterine cotyledons, so that the placental circulation may persist for a long time, notwithstanding the energy of the uterine contractions; while in the Mare, the placental apparatus, being everywhere distributed over the chorion, adheres but feebly to the uterine mucous membrane, and gives way as soon as labour commences, so that fœtal asphyxia is imminent if birth be not prompt. There are exceptions, of course, to this rule, and another practitioner asserts that he has delivered four living Foals three and a half hours after the parturient straining began; one of them was even four hours in the uterus before it was born, and underwent this straining without injury.

The fœtus may also perish when it is in a wrong position, or is of unusual size, and force has to be employed in delivering it, in which case undue compression of the chest may impede the action of the heart.

It was, and still is, believed by many that the fœtus plays an active part in delivery, and particularly in rupturing its membranes; while others consider that its death increases to a marked degree the difficulties of parturition, because it does not then stimulate the contractions of the uterus, and its flaccid tissues do not afford that resistance to the uterine muscles which they do when it is alive. But Saint-Cyr

denies that the death of the fœtus renders parturition slower or more difficult; though he admits that if, at the commencement of this act, there may chance to be any trifling irregularities in presentation or position, these may be rectified to a certain extent by the automatic or more or less instinctive movements of the living fœtus. He concludes that though the death of the fœtus has certainly a great importance, so far as the interests of the breeder are involved, as well as with regard to obstetrical operations in difficult cases; yet it has little or none so far as parturition itself and its results to the mother are concerned.

In the expulsive period, or third stage in parturition, it is usual to consider such matters as when to rupture the water-bag, and when to use traction on the fœtus. This custom will be followed, and these points noticed.

Rupture of the Water-bag.—This should not be artificially ruptured too early; indeed, in the Cow it should never, as a rule, be opened artificially, as it is always spontaneously ruptured at the proper time, and not infrequently sooner than it should be. Besides, the want of tenacity in the membranes, their thinness, and the firmness of their adhesion to the uterus, render this non-interference all the more necessary.

With the Mare, however, matters are different. In this animal the fœtal membranes are thick, firm, and feebly adherent to the uterus; so that the Foal is sometimes born completely enveloped in them. It is, therefore, well to incise them when the water-bag appears as a large tumour beyond the vulva; until this happens nothing should be done, unless the os is completely dilated, and the head and feet of the fœtus are well in it. The membranes may be torn by the fingers, or cut by scissors or a knife, care being taken not to injure the Foal.

When the water-bag is ruptured too early, the uterus contracts on the fœtus, as has been said, and becomes moulded on it; this is opposed to birth. Besides, the genital passage becomes dry and adherent, and this is an additional obstacle. To remedy this, recourse must be had to injections into the vagina of mucilaginous fluids, milk, glycerine and water, oil, lard, bran and water, or even simple tepid water, which may be introduced by a funnel, the Cow's hind quarters being slightly raised.

Traction of the Fœtus.—When the membranes are once ruptured, the natural expulsion of the fœtus should be waited for. In some instances, however, this expulsion may be conveniently assisted by judicious traction on the fœtus. If it is in the *dorso-sacral* position, gentle traction may be made on the pastern of each fore leg when these and the head have cleared the vulva, the tractions coinciding with the throes of the mother, which they should supplement, but must not supplant. They ought to be made in a slightly oblique direction downwards, towards the hocks of the mother, so as to allow the body of the fœtus to follow the curve of the pelvis; inclining the traction a little to the right and left, will also aid in passing the shoulders and afterwards the haunches. The head and neck, when they are clear of the vulva, should be supported. If the fœtus is in the *dorso-ilio-sacral* position, the direction of the feet must be watched and directed, as they have a tendency to press against the sacrum, and may seriously injure the passage. They should therefore be seized while they are yet in the vagina, and brought gently outside the vulva along with the head,

when traction may be employed. This should at first be made upwards, so as to clear the withers from the brim of the pelvis, against which they sometimes jam. When this is effected, the same procedure as in the other case is to be adopted.

In the *dorso-ilial* positions, it is always useful, when they are recognised in time, and before the chest has entered the pelvis, or even when it is in the vagina, to attempt to modify them by converting them into one of the preceding positions, and particularly the dorso-sacral, or dorso-ilio-sacral—though this modification requires the manipulative skill of an experienced veterinary surgeon. If the fœtus is already in the canal, delivery must be attempted according to the principles already indicated: directing the feet towards the centre of the passage and outside the vulva, and by seizing the fore-arms using them to turn the withers towards the sacrum of the mother, then employing moderate traction on the limbs.

If the fœtus presents posteriorly, in the *lumbo-sacral* position, with the croup towards the maternal sacrum, the only way in which birth can be effected naturally is when the feet of the hinder extremities lead and dilate the os. This position is recognised by the coronary and pastern joints being bent upwards, and by the hocks, which are deeper situated, are flexed in the opposite direction, and are distinguished by their broad flat sides and the blunt point of the calcis, which points in a contrary direction to the flexure of the joint. In this position, the two limbs are to be seized at the pastern, and traction exercised at first slightly upwards, in order to carry the stifles over the brim of the pubis, which sometimes checks them; then downwards, to bring the croup below the sacrum; and lastly, an alternate movement from right to left and left to right, to free the haunches, one after the other. It is well to see that the tail of the fœtus is in a right direction before traction has been much practised.

In the *lumbo-ilio-sacral* and *lumbo-ilial positions*, the fœtal croup passes along easily when the pelvis is deeper than it is wide—as in the Cow, for instance. The limbs only need careful direction through the vagina, and when the croup has entered the pelvic cavity the body should be so rotated as to bring the large diameter of the chest to correspond with the vertical diameter of the inlet. If the Mare has a wide pelvis, it would be preferable to place the fœtus in the lumbo-sacral position.

We may remark, however, with regard to gemellar parturition, that this kind of pregnancy is not usually recognised in uniparous animals until birth takes place. The escape of only a small quantity of liquor amnii, and the small size of the creature first delivered, when compared with the size of the mother's abdomen, are not infallible indications that more young will be produced. Soon, however, another water-bag appears, and another fœtus presents at the vulva. Not unfrequently, when the position of the two fœtuses is natural, they present one after the other successively, and without any assistance being required. This is the case more particularly with the Sheep and Goat—animals which so often produce twins. But sometimes, and especially with the larger animals, the two fœtuses present themselves simultaneously at the pelvic inlet, and neither can pass through. In such a case, which it must be confessed is rare, it is necessary to push back the one least favourably presenting, and to keep it away until the fore limbs of the other are engaged in the passage. If the two fœtuses chance to be in

an unfavourable position, the anterior extremities of one should be sought for (recognised by the knees, and to a certain extent by the pasterns), or the hind limbs (recognised by the pasterns and hocks) if they are convenient for the purpose, and traction exercised as in the case of a single fœtus, and according to the directions given above, taking care to keep the other fœtus out of the way. Should it not be possible to extract this fœtus, it may be that certain parts of the other stop its progress, or that the expulsive forces are expended on the latter, although it is farthest from the os. It is then necessary to push back and turn the former, and endeavour to extract it by the extremity opposite to that which was first tried. But if the fore limbs have been got into the passage, as well as the head, the position need not be changed, the procedure being then the same as for a fœtus disproportionately large.

Another remark is with reference to the operator. In exploring the genital passages, gentleness and tact should be scrupulously observed, and the hand and arm ought to be well oiled, the nails of the fingers being cut at least moderately short. It requires some experience to be able to ascertain, by the sense of touch, what parts of the fœtus present, and those which are an obstacle to birth; as well as knowledge to guide one in placing the parts in a favourable position, and particularly in one which approaches what we have designated the "natural" presentation. The time chosen for exploration should be the interval between the labour pains, and care must be taken not to rupture the membranes, if they are still intact. The exploration may be made while the animal is standing or lying; both positions have certain advantages, though the first is generally preferable, and is certainly less fatiguing.

It must not be forgotten that, when traction is required, this should be slow and moderate, and only applied when the animal itself makes expulsive efforts. In many cases the resistance to be overcome is often very slightly superior to the forces exerted by the parturient animal. Violent and sudden traction is to be deprecated, as it may inflict serious injury, while doing little, if anything, in aiding delivery; and even should this be effected, it must be remembered that the contractile power of the uterus is deranged when the contents of the organ are attempted to be suddenly and forcibly removed. The simplest and safest traction is that made by the hands of the operator—for both hands may, in some cases, be introduced into the vagina. Should he not have sufficient strength or purchase, an assistant may clasp him around the chest and pull at and with him—gradually and steadily during the throes. But we shall recur to this subject again.

B. After Labour.—The attention to be paid to the mother after parturition will differ not only according to the species to which it belongs, but also according to its temperament, strength, and the kind of labour which it has undergone. When this has been natural, and the animal is vigorous and not much fatigued, simple hygienic measures are all that is necessary. It should be kept comfortable, with plenty of pure air, but away from draughts. If it has been perspiring, the body, and particularly the belly, should be well wisped if it is a large animal; indeed this friction is always to be recommended, as it often allays the restlessness which sometimes persists after delivery; it also regulates the circulation, and appears to hasten the retraction of the uterus. It may be necessary to cover the body with a blanket, as the animal is very sus-

ceptible to cold at this period. A gallon or so of nourishing, tepid gruel, or even soup, may be given; after which the diet should be moderate and easily digested. Clean dry litter should be plentifully supplied, and the animal left alone for half an hour or so, after which it may be visited, offered more gruel, and the offspring assisted to the teat, if it has not already found it. From three to eight, or even fifteen days' rest should be allowed, according to circumstances, and in order to permit lactation to be fully established, and the animal quite recovered.

When parturition has been protracted, and the animal has suffered much, and especially if the generative organs have been bruised and lacerated, nursing should be continued longer, and greater precautions adopted. Every care ought to be taken to prevent metritis or metro-peritonitis; and with this object in view tepid vaginal injections, to which may be added a little permanganate of potassium or chloral, may be employed: warm cloths being applied to the loins, the animal allowed light diet, with small doses of sulphate of magnesia, and kept clean in a good stable, and in a pure atmosphere.

When the animals are old, weak, or exhausted by protracted labour, or if there has been hæmorrhage, stimulants should be administered, and strengthening food allowed. Sometimes the debility is so extreme that the animal scarcely gives any indication of life. There is then all the more need for careful nursing and quietude. Friction to the surface of the body, clothing, and a good bed are particularly necessary; and as lactation is established with difficulty in these cases, this must be attended to. It must be borne in mind that cold and damp are dangerous immediately, and indeed for some time after, parturition. Therefore, when turned out to pasture care should be taken to afford protection in bad weather, and damp cold localities should be avoided.

With regard to Ewes, if the weather is mild and the situation favourable, protection is not required; but if cold winds and wet prevail, then shelter is necessary. When more than one Lamb is likely to be produced, the first should be kept warm and receive a little Cow's milk diluted with water, until the Ewe has finished lambing. Twin Lambs may easily be reared by a strong mother, if supplied with a sufficiency of suitable food; but, as a rule, if there are more than two, they should be put to another Ewe or reared artificially. In order to overcome the repugnance so often manifested by the Ewe to a strange Lamb, if its own has died, the foster-Lamb may be rubbed with the skin of the dead creature, or the two may be placed together during the night, or even put into a dark shed along with a Dog, which will induce the Ewe to protect and take to the Lamb.

The Goat is more exposed to long and difficult parturition than the Sheep, and not unfrequently requires assistance. The same care is necessary as for the Sheep.

The Sow generally suffers from weakness and prostration after parturition, and requires plenty of nourishing and easily-digested food. When this is given there is less likelihood of the animal devouring its young, and all the more so if it is not irritated by the presence of people.

The Bitch should not be allowed to rear too many Puppies, and warmth, a dry abode, and good food must not be withheld. The Bitch does not readily take to strange puppies; sprinkling these with some of its milk has been sometimes successful. Constipation is not unfrequent after parturition, and this may be removed by castor-oil or manna.

SECTION II.—ATTENTION TO THE OFFSPRING.

No special rules can be laid down for the management of new-born animals, as this must vary more or less according to the species. However, there are some general rules which it may be well to observe, and these we will refer to.

With regard to the Foal or other creature which may be born in the fœtal membranes, it is evident that it must be freed from them immediately, or it will perish from suffocation; for having no longer any communication with the mother by means of the umbilical cord, the blood cannot be oxygenated. If the umbilical cord is not ruptured, it may be double-ligatured about two inches from the umbilicus, and then divided between the ligatures; or it may be severed by scraping it through with a jagged knife.

Immediately after delivery, and having removed the mucus which sometimes clogs the mouth and nostrils and hinders respiration, the young animal should be examined to ascertain whether it be strong or weak, whether all the natural apertures exist—such as the eyes, mouth, anus, vulva, urethra—and if any of them chance to be absent, to make artificial ones soon, if possible, by a kind of puncture, enlarging afterwards by the knife and sound, and preventing union by pledgets of lint, etc.

Suspended Animation.—Whenever the connection with the mother is interrupted by rupture or occlusion of the umbilical cord, the young creature must breathe, respiration being now carried on by the lungs, through the nostrils.

The establishment of respiration is a purely reflex act. The fœtus, hitherto maintained at a certain and always uniform degree of warmth in its liquid bed in the uterus, is suddenly ushered into the cold and dry air of the outer world; and this transition operates chiefly on the skin, producing a peculiar impression—such as we ourselves experience in being suddenly immersed in cold water; this impression is at once transmitted to the cerebro-spinal centre, whence the reflex influence of the spinal cord is called into play, and the respiratory muscles are excited to movement by the centrifugal nerves issuing therefrom. All these muscles contract simultaneously, the chest is dilated, and the air rushes into the air-passages and lungs, distending the air-cells in the latter, and instituting the process of respiration, which is only to cease with the death of the creature. This reflex act may also be produced by pressure on the umbilical cord, or anything which hinders the oxygenation of the blood in the fœtus; hence it has been inferred that the excess of carbonic acid in the circulating fluid acts as a stimulus to the medulla oblongata.

It sometimes happens that the young creature is in a state of syncope when born, or very soon after, and gives no sign of life. Observers have distinguished syncope from weakness, in which the animal is cold and does not breathe, the mucous membranes being pale and the body flaccid; and syncope from plethora or cyanosis, when the mucous membranes are of a livid blue tint, the lips and tongue swollen, and the eyes injected.

In the first form, resuscitation is to be attempted by pouring cold water on the head, beating the body with a cloth dipped in cold water—particularly about the face and chest—dry-rubbing the limbs, titillating the nostrils with a feather, puffing tobacco-smoke into them,

imitating the respiratory movements, as in a case of asphyxia, and inflating the lungs by means of a pair of bellows, acting through the nostrils. So long as the heart pulsates there is a probability of restoration to life.

In the second form, allowing a little blood to flow from the umbilical cord, and even cutting this or fomenting it with hot water to induce hæmorrhage, is very useful, in conjunction with cold water to the head and cold water enemas. But, as a rule, death is always imminent in these cases of syncope.

General Care.—With the larger animals, the newly-born creature should be placed before the mother, if it is not near her; and it generally follows that she instinctively licks off the viscid matter which covers its skin; and in doing this the cutaneous circulation is excited, and, by sympathy, the other organs of the young animal. Consequently, it becomes revived, soon endeavours to get up, and though it may fall several times, yet it generally quickly succeeds in maintaining itself on its limbs, and instinctively seeks the maternal teat. It is very rare that the mother does not voluntarily, and at once, commence to cleanse its progeny; nevertheless, there are exceptions, chiefly among the primiparæ, and especially when the labour has been long and painful. But it will generally be found that sprinkling the young animal with a little flour, bran, or salt will excite the attention of the mother and induce the cleaning process. Should it not do so, then the creature must be well dried and rubbed with a sponge, hay-wisp, or a cloth, and kept warm. This is more particularly necessary when the mother is indifferent to it, which sometimes happens with primiparæ when people are present. Indeed, some Mares become quite savage after parturition, and will not allow their Foal to come near them, and will even kill it; though this most frequently happens when they are tormented by spectators. Other Mares, vicious before parturition, sometimes become remarkably quiet when they have a Foal by their side. When they exhibit any aversion to their progeny, it is well to leave them quietly together for some time.

If the Foal or Calf is weak, and cannot reach the teat within half an hour or so after birth (for in uniparous animals the mammæ are inguinal, so that the young are always suckled in a standing posture), it will be found necessary to assist it by bringing it to the mother, and applying the teat to its mouth, at the same time caressing and soothing the parent if disinclined to it by temper or by painfulness of the udder. This coaxing and handling should be performed by someone accustomed to the animal. It may be necessary to have a second person at hand to hold the Mare by the head or to lift up its fore foot.

Sometimes from weakness or inexperience of the Foal, and temper of the Mare, the former runs the risk of perishing from starvation. The Mare should be safely secured, and two persons ought then to push and support the young animal behind by joining a hand of each, while the other hands are employed in directing it towards the teat, which it should be allowed to use for two or three minutes. After one or two attempts of this kind, the Foal begins to find its way to the udder by itself, while the Mare becomes reconciled to it. When the Foal exhibits great debility, it may be preferable to feed it for a day or two with the milk of the Mare, which has been drawn by hand.

With the Cow, these difficulties are seldom present, and if an animal

will not take to its Calf this is generally transferred to another Cow, or it may be artificially reared. The Foal may even be reared in this manner, though not so easily as the Calf. The milk of the Cow or Goat will suffice, and there is generally little difficulty in teaching it to drink it by at first pouring a little into its mouth while the finger is inserted therein; or a piece of cloth steeped in milk, or even a bottle and tube, may be used.

Calves are often harshly treated after birth; they are not allowed to suck, even for a number of days, for fear of damaging the Cow, but are kept apart and fed on drawn milk. Calves intended for slaughter may be artificially fed, and especially if nutritive substances are added to the milk; but for those intended to be reared, it is a mistake to separate them from the Cow during the early days of their existence.

Lambs, when able to stand, and if they do not readily find their way to the teat, should have a little milk from it pressed into their mouth. With twin Lambs, if the Ewe is in good condition, the udder well filled, and the weather and pasture favourable, both may be suckled; in the opposite conditions it may be necessary to remove one. If the Ewe does not yield sufficient milk, this may be largely remedied by giving a liberal supply of good food.

Multiparous animals, such as the Bitch and Sow, usually lie when suckling their young; so that there is seldom any difficulty with them. The only care generally required in the case of young Pigs, is to prevent their being crushed by the Sow in the act of lying down or moving. If the litter is large, plenty of good food is necessary.

It is well to remember that if a Sow has more young in the litter than teats, unless watched the weakest will die of starvation. Each young Pig has its own particular teat, to which it is persistently attached; and if the creature is ill and does not suck, or if there is not a claimant for the teat, the gland there will cease secreting milk. The pectoral teats and glands are the largest and most active, and the weakest of the litter should be put to them. In general, a Sow should not be allowed to rear more than ten in a litter. Cleanliness and warmth are required for young Pigs.

Puppies do not require any special care beyond a warm, clean, and dry abode.

After the first milk has been taken, there is usually an abundant evacuation of black resinous matter—meconium—from the intestines of the young animal, caused by the 'colostrum,' as this milk is named; and it is well to notice if this evacuation occurs, as when it does not, serious constipation may ensue. With new-born animals which, for some reason or another, are deprived of this colostrum, a mild laxative —such as castor-oil, or honey or liquorice powder and water—should be administered to obviate this condition.

At birth the feet of hoofed animals are covered with a soft yellow horn, which in some countries it is the custom to remove, from a belief that this removal hardens the succeeding horn. It is unnecessary to state that this is a popular fallacy, and that it is really injurious to deprive the foot of this temporary protection.

The young, with their parents, should be kept apart from others—for some time at least, and especially the Equine species; and it must not be forgotten that a mild dry temperature is most favourable for all young creatures.

Gentle exercise is as necessary for the Foal and Calf, as it is for their

parents, a few days after birth. Therefore it is that a meadow is preferable to a stable, as, in addition to the more favourable nature of the food, sufficient exercise is afforded. Indeed, with the Mare light and regular work may be imposed a short time after foaling, and with much benefit to it and the Foal. The latter will follow its dam, provided the pace is not too fast, and a halt be frequently allowed for it to get to the teat. It is astonishing sometimes to observe how well Foals travel soon after birth, even over bad roads and during inclement weather, and for great distances, provided the journey is short each day. Huzard has seen Buffalo Calves, born during the night, follow their mother next day, and make a daily journey of six or eight leagues without appearing fatigued.

It is not rare to find newly-born animals, particularly when parturition has been laborious, injured more or less, from the manipulation of the obstetrist during birth, the lesions being more or less serious. The most frequent injuries are those due to obstetrical instruments and appliances. The wounds may be dressed with cold water, with slightly alcoholised water, or some dilute tincture—such as that of arnica; but salts of lead, or other poisonous salts, should not be employed. Abrasions, which are generally superficial, may be treated with glycerine and water, to which a very little carbolic acid has been added; or by lard, or any mucilaginous substance. Sprains should have cold water irrigation if possible, refrigerant lotions, or friction with soap liniment. Wounds and lacerations, if very severe, must have appropriate surgical treatment.

CHAPTER IV.

Sequelæ of Parturition.

We have stated that gestation and parturition are physiological processes, and we may now add to these the *puerperal state*. But though in one respect eminently physiological, the puerperal condition is marked by special features, which distinguish it from other physiological states, and which, occurring under other circumstances, would be more allied to pathological changes. We refer now more particularly to the functional and organic alterations which take place after delivery. True, we do not have in animals such important, nor so many, sequelæ as are noted in women at this period, some of which are really pathological. Nevertheless, we have certain phenomena occurring during the return of the economy and the generative organs to the condition they were in previous to pregnancy, which are not only very characteristic, but are worthy of serious attention. These phenomena have been divided into *functional* and *organic*.

SECTION I.—FUNCTIONAL MODIFICATIONS.

The functional modifications include the *after-pains*, *lochia*, *milk-fever*, and *lactation*.

1. After-pains.—These are the painful sensations in the abdomen, indications of which are frequently observed in animals, and which persist after the expulsion of the fœtus and the secundines. They are due to the contractions of the uterus, that go on for some time, and

eventually reduce the organ to its ordinary volume and so diminish its cavity. After an easy labour, there are generally few or no symptoms of these pains; and when they are present the only indications are whisking of the tail, at which time the walls of the abdomen appear to be harder. They seldom continue longer than twelve or twenty-four hours in these cases, and do not require special treatment.

In other cases, however, and particularly when birth has been very sudden and rapid, they persist longer and are more severe. The animal paws and exhibits suffering; it also stretches as if trying to micturate, arches the back, contracts the abdominal muscles, and strains. The access of these attacks is not regular; and when they are frequent, severe, and continue beyond twenty-four hours, we may apprehend the retention of a portion of the fœtal membranes in the uterus, or commencing inversion of that organ. This will necessitate an exploration, in order to discover the cause; which, when ascertained, should receive appropriate treatment, to be hereafter described.

2. Lochia.—The term *lochia* has been given to the sanguinolent, sero-sanguinolent, muco-purulent, and, finally, mucus evacuations from the vagina occurring after parturition, and generally persisting until the uterus has regained its ante-pregnant condition. The existence of this evacuation, so marked in woman, has often been denied in animals; but there can be no doubt whatever as to the fact of its presence. It has been witnessed by several veterinarians in the Mare, Cow, Sheep, and Bitch, and we have noted it repeatedly in the Sow and Cat. But it is considerably less in these animals than in woman, and does not flow continuously as in her, but at irregular periods; the discharge accumulates in the uterus, and only escapes when the animal undergoes exertion, and in defecation or micturition. In the Cat, however, we have witnessed this discharge—very slight—flowing constantly for four days after parturition; and with the Bitch we have a sanguinolent, then a mucus discharge persisting almost continuously for several days subsequent to that event.

In the larger animals, this discharge can be seen about the inferior commissure of the vulva; it sometimes accumulates about the thighs and tail in flakes and patches, as well as on the litter; and when the animal has been lying it forms small pools on the ground.

When we remember that the uterus has for a long period nourished one or more fœtuses, we can scarcely wonder that it cannot all at once cease its secretory function, and that its mucous membrane should continue in a hyperæmic condition until the lacteal secretion in the mammæ is fully established. As much as seven to eight quarts of sero-sanguinolent fluid have been removed from the uterine cavity of a Mare which had foaled three days previously.

When not mixed with blood, this discharge is albuminous and chylous-looking; it is rarely purulent, and then probably only from traumatic causes; neither does it have a bad odour, unless the uterus or vagina is the seat of some pathological process, or a portion of the placenta is retained. According to some authorities, the average duration of the discharge is from two to three weeks; but Saint-Cyr believes that when it is prolonged beyond five to eight days, it is no longer a physiological, but a pathological process. This is about the period which is necessary, in the larger animals, for the return of the vulva to its normal dimensions and ordinary form.

Of the importance of the lochia there can be no doubt. By them the uterus is relieved from its physiological hypertrophied condition, and of the excitement of which it was the seat during pregnancy and parturition. But it cannot have the same importance as in woman, in whom the lining membrane of the uterus is thrown off after every delivery, and renewed. It is not so with animals, as we shall see hereafter.

One or two veterinary authorities have attached so much importance to the lochia in animals, that to their suspension or suppression they attribute such serious results as sanguine plethora, articular rheumatism in the Cow, laminitis in the Mare, metro-vaginitis, cystitis, nephritis, peritonitis, mammitis, inflammation of the intestines or spinal cord, coryza, vitulary collapse, etc. But there is evidently exaggeration in this; and we are inclined to think that, at the most, the untimely cessation of this discharge can only cause, as has been stated, dulness, indifference of the mother to its progeny and surroundings, inappetence, suppression of milk, slight fever, with dry erect coat, and constipation.

To avoid this untimely cessation of the lochia, it has been recommended that, with the larger animals, before and after parturition the food should be sound and nutritive, but moderate in quantity, and such as will not predispose to plethora or congestion; not to travel or fatigue animals towards the end of pregnancy; to shelter them at this period; not to hurry labour, and only to render assistance when necessary; and after delivery to attend to the removal of the secundines, which are sometimes retained in the Cow for an abnormal period, but should not be allowed to remain longer than four or five days.

3. Milk-fever.—In woman the establishing of the lacteal secretion after delivery—generally forty-eight hours—is usually accompanied by a general febrile condition, in which this fluid changes from colostrum to ordinary milk. This is the so-called "milk-fever," a pathological condition said by some authorities to be present in animals, and denied by others. The latter assert that, when parturition has been quite normal, there is only observed a little dulness, lassitude, the pulse fuller and quicker than usual, and less appetite for the first day—all consequences of the suffering undergone during even the easiest parturition. In a day or two, however, all this has disappeared, except perhaps a little weakness, which soon vanishes also. But when parturition has not been altogether natural, and complications arise, then there may certainly be fever, though this has nothing to do with the change of the colostrum to milk—a gradual process; indeed, when traumatic fever sets in this secretion is diminished or suspended.

Saint-Cyr is disposed to deny the existence of this so-called "milk fever" in animals, and he quotes eminent *accoucheurs*, who are inclined to doubt the existence of this fever in woman as related to the lacteal secretion, but as due rather to traumatism from injury to the genital organs during child-birth. His own observations on Cows are certainly not favourable to the existence of a fully developed fever in these animals; and even among those who believe in it, there are many who admit that it is scarcely perceptible.

Rainard, for instance, accounts for its being so little marked in animals, by observing that in woman the uterus receives its blood from the abdominal (inferior) aorta, but the mammæ from the pectoral (or anterior) aorta; while in animals the uterus and mammæ are supplied by the posterior aorta. In woman, when lactation is established, there

is an alteration in the circulation, and consequently a general disturbance which has been hitherto designated "inflammatory" or "angiotenic fever"; but in animals this change in the circulation does not occur. Therefore, this "angiotenic fever" should not be present.

4. LACTATION.—Before parturition, preparation for the secretion of milk is already being made in the mammary glands, and immediately preceding that event a thin serous or milky fluid can often be expressed from the teat; while immediately after delivery, the œdematous tumefaction which had been observed in these glands for some time begins to disappear as they increase in volume, become firmer, tenser, and more sensitive, and receive a larger quantity of blood. Then their activity is suddenly brought into full operation, and their secretion reaches its maximum. At the same time this fluid is modified in quality in a notable but gradual manner, so that it is very different three or four days after parturition from what it was on the first or second day —being colostrum at the early period, and milk subsequently.

Colostrum.—The first milk, or "colostrum," secreted after delivery is a viscid, dirty-white, or yellowish fluid, sweet, though unpleasant to the taste, and of a greater density than that of ordinary milk, being in the Cow 1·056. When allowed to stand for some time it has a thick layer of tough cream; it coagulates at a comparatively low temperature into a semi-solid mass. It is very rich in solid elements, these varying according to individuals, and even breeds. The fat globules are present only in comparatively large number, and are less in size than in milk at a later period; but there are numerous colostrum corpuscles—bodies of a large size, spherical or ovoid in shape—often agglomerated in masses by a tenacious viscid matter, and among them many leucocytes endowed with movement, as well as pus cells.

The colostrum corpuscles appear to be only leucocytes or epithelium from the walls of the milk ducts, and undergoing degeneration.

Boussingault gives its composition in the Cow as follows:—

Water - - - -	75·8
Albumin and casein - -	15·0
Butter - - - -	2·6
Milk-sugar - - - -	3·6
Salts - - - -	3·0

But a more recent analysis by Chapelle, shows it to be composed of:

Albumin - - - -	15·997
Casein - - - -	2·552
Butter - - - -	5·390
Lactose - - - -	1·361
Salts - - - -	5·300
Water - - - -	69·700

Dumas gives the colostrum of various animals as below:—

	Cow.	Ass.	Goat.
Water	803·3	828·4	641·0
Fat	26·0	5·6	52·0
Albumin	150·7	116·0	245·0
Mucus	20·0	7·0	30·0
Sugar	traces	43·0	32·0

It is admitted that milk is due to a fatty degeneration of the epithelial cells of the gland follicles, in which they are greatly multiplied and developed during lactation. These cells rupture, and nothing remains but the fat globules of the milk.

But in the colostrum the epithelial cells have not undergone this change; their wall is intact, and they still contain their oil granules, and consequently constitute the colostrum corpuscles. Colostrum, as has been mentioned, is coagulable at a low temperature, and it may be said that the albumin takes the place of casein; but soon after parturition the former disappears and the latter is present. Towards the end of lactation, however, if the animal is pregnant, the milk again loses its casein, and becomes very albuminous; consequently, coagulable by heat. Its sugar also diminishes or disappears altogether. The leucocytes seem to be increased in number in the colostrum, when the animal is disturbed or its health deranged; and as the young creatures are often attacked by diarrhœa, this is ascribed to the presence of these particles.

Milk.—Towards the fifth or sixth day, or even longer, after par-

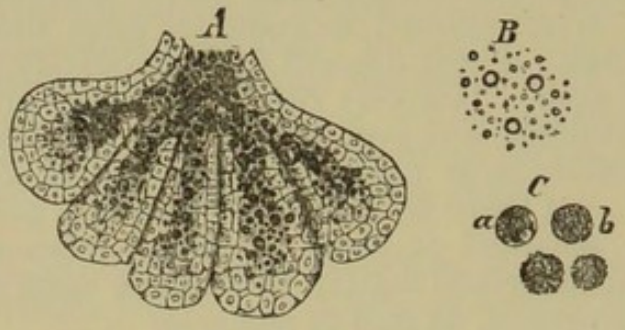


Fig. 80.

MAMMARY GLAND DURING LACTATION.

A, Lobule of the Mammary Gland filled with Cells; B, Milk or Fat Globules; C, Colostrum. *a*, Cell filled with Fat Granules and with a visible Nucleus; *b*, Cells from which the Nucleus has disappeared.

turition in the Cow and Mare, earlier with some of the other animals, the colostrum disappears, and then we have the ordinary milk. This is an opaque, pure white, or slightly yellowish fluid, possessing a sweet taste, and a faint odour somewhat resembling that of the animal from which it is obtained; it is unctuous to the touch, has an average density of 1032 to 1041, according to the species and other circumstances;[1] and is composed of three essential parts—water, butter, and casein. We have in addition albumin, milk-sugar, and mineral matters.

The three principal constituents are easily separated—the fat or cream by allowing the fluid to stand at rest for some time; by pressure the casein is separated in a solid mass; and the remaining portion contains the water.

The milk varies considerably, as has been said, according to species, breed, age, food, the period of lactation and milking, climate, state of health, etc. In Herbivorous animals it is generally alkaline; in Carnivorous, acid.

[1] Cow's milk of good quality, according to Voelcker, has a specific gravity of about 1030; Woman's milk, 1020; Goat's and Ewe's milk, 1035; Ass's milk, 1019.

Vernois and Becquerel give a comparative table of the composition of the milk of various animals, as below :

	Woman.	Cow.	Goat.	Sheep.	Camel.	Mare.	Ass.	Sow.	Bitch.
Specific Gravity -	1032·67	1033·38	1033·53	1040·98	—	1033·74	1034·57	—	1041·62
Weight of Water -	889·08	864·06	844·90	832·32	—	904·30	890·12	854·90	772·08
Weight of Solid Parts - -	110·92	135·94	155·10	167·68	134·00	95·70	109·88	145·10	227·92
Fat - - -	26·66	36·12	56·87	51·31	36·00	24·36	18·53	19·50	87·95
Casein and Extractive Matters -	39·24	55·15	55·14	69·78	40·00	33·35	35·65	84·50	116·88
Milk-sugar - -	43·64	38·03	36·91	39·43	58·00	32·76	50·46	30·30	15·29
Salts (by incineration) - - -	1·38	6·64	6·18	7·16	—	5·23	5·24	10·90	7·80

Doyère furnishes us with another interesting analysis, which we cannot omit publishing here :

Constituents.	Woman.	Cow.	Goat.	Sheep.	Llama.	Ass.	Mare.
Water - -	87·38	87·60	87·30	81·60	86·60	89·63	91·37
Fat - - -	3·80	2·20	4·40	7·50	3·10	1·50	0·55
Casein - -	0·34	3·00	3·50	4·00	3·00	0·60	0·78
Albumin - -	1·30	1·20	1·35	1·70	0·90	1·35	1·40
Sugar - -	7·00	4·70	3·10	4·30	5·60	6·40	5·50
Salts - - -	0·18	0·70	0·35	0·90	0·80	0·32	0·40

The salts contained in the milk vary with the character of the food, and also according to the time that has elapsed since parturition ; this fluid being particularly rich in inorganic elements during the first third of the period of lactation. According to the analyses of Haidlen and Furstenberg, there are in it 1,000 parts of ash ; 475 phosphate of lime, magnesia, iron, etc. ; 219 carbonate of lime and salts, which are more especially combined with the casein ; 343 of sodium salts, with traces of sulphur and fluoride of calcium. Milk also contains such gases as carbonic acid, oxygen, and nitrogen, in solution.

In the Cow the flow of milk becomes very plentiful in about a week after calving, but after a month or so it gradually diminishes in quantity for about ten months, when the animal, as a rule, "runs dry." In the first and second months after calving, when the yield is abundant, it is generally more watery than after the fourth or fifth month ; and the further the diminution in quantity proceeds the better it becomes in quality, other circumstances being equal.

It will be seen from the above table, that the milk of the Cow closely approaches that of woman, and this accounts for the readiness with which it can be substituted for the latter without injury to the child. It is, when compared with that of Solipeds, more rich is casein and fat. The milk of the Goat is the most nutritive, and contains more casein ; but it is viscid and has a peculiar odour, something like that of the cutaneous transpiration of this animal, and particularly during the rutting season ; this odour is not so powerful in white Goats, nor in those without horns, if they are properly kept. The milk of the Sheep contains more fat than that of the Cow and Goat, while the casein is in larger quantity, but is also viscid. It has less water than that of the

Cow, and altogether is particularly rich, especially soon after lambing. This is well seen in the subjoined analysis, and it will explain the difficulty which is experienced in bringing up a Lamb when the Ewe has died soon after parturition :

	Ewe's Milk Three Weeks after Lambing.	Ewe's Milk Six Weeks after Lambing.
Water - - - - -	75·00	86·70
Fat - - - - - -	12·78	3·67
Casein - - - - -	6·58	4·44
Milk-sugar - - - -	4·66	4·00
Mineral Matters (Ash) -	·98	1·19
	100·00	100·00

The milk of the Mare appears to contain the largest proportion of water and the smallest quantity of fat, the milk of the Ass coming next to it in these constituents. This contains little casein, scarcely any fat, and a small quantity of ash. On the other hand, it is comparatively rich in milk-sugar, which is, according to Voelcker, a very digestible material and a good aperient, particularly for children. But of all animals, the Carnivora have the richest milk ; the casein and fat being particularly abundant, and no other food will at all compare with it in these constituents. Solid butcher's meat contains less real nutriment and more water than this description of milk. This explains at once the extreme difficulty of bringing up a Puppy by hand. No kind of food is sufficiently concentrated adequately to provide for the nourishment of a Puppy, strong beef-tea being perhaps the best substitute for that purpose. The milk of Carnivorous animals has another peculiarity, in the very small proportion or entire absence of milk-sugar. This substance is very abundant in the milk of Herbivorous animals ; and when Carnivorous creatures are put on more or less of a vegetable diet, it appears in their milk, and increases as this diet is increased ; whereas, by feeding them entirely on flesh, the sugar vanishes. The proportion of salts is also comparatively large.[1]

According to the richness of milk in fixed constituents, Colin classes that of animals in the following decreasing order :

Bitch	Sow	Woman
Ewe	Cow	Ass
Goat	Camel	Mare

Milk is a typical food, and when healthy and in sufficient quantity, contains all the constituents for the maintenance and growth of the young creature.[2] This is particularly noted immediately after birth,

[1] According to a French medical journal, Montbrun-les-Bains, in the Drome, is celebrated for nurses, who continue to give the breast for two years and more. When one of these women loses her nursling, she takes a puppy-dog instead, which then becomes one of the family. But it has been observed that all these dogs become affected with rickets, and this has led a medical man to conclude that woman's milk is deficient in some principle contained in dog's mik, and that consequently the latter might be a cure for rickets. An observation published by him would seem to confirm this view.

[2] The mammary secretion may be present in animals without their being in the pregnant or parturient state, or ever having been so. We have already alluded to Bitches yielding milk without having Puppies. Rabbits have done the same without having been fecundated, and have reared the young of other Rabbits ; Bitches have done the same. Virgin or barren Ewes have also yielded milk, as have likewise Mares—Mule and Horse—and Fillies.

and before it begins to seek for other food. It is at this period, also, that growth is most rapid; and it has been observed that Puppies double their initial weight in six days only. Colin has stated that, in thirty days, ten Puppies—reduced to nine on the twenty-fifth day—living on the milk of the mother alone, except for the last ten days, showed a total increase of 35½ lbs., the entire weight having been trebled since birth. A similar increase may be observed in other young creatures while being suckled. When, from some cause or another, the progeny cannot obtain milk sufficient in quantity or proper in quality, it is necessary that this be remedied. A Calf can be readily artificially reared in an ordinary establishment, if it has had one or two days' colostrum; or a substitute for the mother in another Cow may be procured. It is not so with the Foal, which is much more difficult to rear, and another Mare, even if procured, will not always readily play the part of nurse. Nevertheless, many animals can be reared by judicious and patient management, and if artificial food must be resorted to, this should come as near as possible, in chemical composition, to that furnished by Nature.

In some instances, the mammary secretion may become a source of embarrassment, or even of danger, when it is too abundant or is not withdrawn when secreted. This happens more particularly with the Bitch, Cat, Mare, or other animal which is suddenly deprived of its young by death, or for special reasons; and the retention of the milk is often a cause of discomfort and disturbance, culminating not unfrequently in inflammation of the gland. In such cases the milk should be withdrawn until its secretion is diminished or altogether ceases, the diet limited and modified, and mild diuretics or purgatives may be administered to hasten this end. Camphor, in small and frequent doses, has been recommended with this object, as well as an effusion of walnut-leaves and powdered white agaric.

Whatever general treatment may be adopted in such instances, local treatment must not be overlooked; and in addition to removing as much of the contents of the mammary glands as possible, these may be kept healthy, or cured when congested or inflamed, by suitable treatment. Soothing liniments or embrocation should be timeously applied by friction to the skin covering them.

SECTION II.—ORGANIC MODIFICATIONS.

Gestation and parturition being completed, it is necessary that the genital organs should return to their non-puerperal state. Indeed, this return to their ordinary physiological condition is commenced in the uterus even during labour, and remarkable modifications occur more particularly in the uterus and its membranes then, and for some time afterwards. These changes are connected with the diminution of the uterus in volume, alterations in its mucous membrane, and the reforming of its cervix.

The powerful contractions of the uterus during parturition, indubitably tend to use up the contents of the cells of the non-striped muscular fibre composing its middle coat; the simultaneous compression of the capillaries and afferent vessels preventing the expended protoplasm from being replaced. After the expulsion of the fœtus and its membranes, this wasting or degeneration of these fibres continues: the uterus still contracting at intervals, and producing those sensations

known as "after-pains"—the contractions being slow, gradual, and continuous, and lasting until the whole of its inner surface is more or less in contact, and its cavity has regained its ordinary dimensions. In this process the muscular fibres continue to undergo alteration, the contractions of the organ diminishing in force as this change goes on; and this change is essentially related to the conversion into fat of the albuminous substance of the protoplasm of which their cells are composed. The fibres become degenerated and absorbed, and it is some time before they are replaced by others which have much smaller cells. The bloodvessels of the organ also undergo similar alterations, after the uterine contractions have more or less suspended the flow of blood in their interior. They become wrinkled and sinuous and gradually less permeable to the circulating fluid, the walls of the veins and capillaries are attacked by fatty degeneration, and are absorbed in large numbers.

This gradual interstitial absorption occurring after parturition, brings about a considerable reduction in the weight and volume of the organ. Thus the uterus of the Cow, which, immediately after delivery, will weigh from thirteen to fifteen pounds, will be no more than seventeen to twenty-one ounces when this process is completed; and the uterus of a Ewe will be found reduced to a twelfth or thirteenth of its weight at parturition.

At the same time, the mucous membrane lining the organ is undergoing corresponding, but perhaps less profound, modifications to those observed in woman after the uterus has got rid of its contents. When treating of the physiology of pregnancy, we described the manner in which this membrane became enormously thickened, either wholly or partially, to constitute a most important glandular and vascular structure for the development of the young creature. But after parturition, fatty degeneration attacks this structure and completely destroys it in Solipeds and Ruminants, and this destruction takes place in a remarkably brief period in some animals. With the Bitch, Cat, and Rabbit, as with woman, the whole of the glandular layer of the membrane corresponding to the insertion of the fœtal placenta—the *decidua vera*—is completely detached and eliminated.

In the former two, this exfoliation of the maternal placenta leaves a depressed surface of equal extent, around which the thicker mucous membrane forms a border like that seen in a cutaneous wound after removal of the scab. On the surface of this exposed part, the mucous membrane, being deprived of its epithelium, is very thin, and so transparent that the muscular coat shines through it. The uterus soon retracts and the placental wounds diminish in size, becoming covered with granulations like other wounds. In a Bitch which had only one puppy, five weeks afterwards the wound was not quite healed, and its width was then about one centimetre; there were also observed other small annular surfaces, narrower than the preceding, separated from each other by nearly equal intervals, and having the mucous membrane very smooth, slightly thickened and pigmented, and which, being found in all the pluriparous Bitches and Cats examined, were believed to be old placentular cicatrices.

In Ruminants the cotyledons, which had gradually acquired such large dimensions during pregnancy, shrink, their follicular receptacles contract so as to be scarcely visible to the naked eye, and many of these maternal placentæ even appear to subside altogether, or to be

reduced to exceedingly small porportions. With Solipeds and the Sow, which have a diffused placenta, the follicles which received the placental papillæ of the chorion also disappear; and the membrane, greatly thinned, assumes its ordinary ridged appearance, though the ridges or folds are larger and more numerous than before conception. In a Mare killed eighteen or twenty hours after parturition, Ercolani found the maternal portion of the placenta reduced to one-half its thickness; its colour, instead of being a dull red, had become yellowish; the follicles, from being one to two millimetres in length, were reduced to one and half a millimetre, and the capillary network around them was no longer visible.

The evacuation of the detached elements is accompanied by an apparently large mucous secretion, which, often sanguinolent, constitutes what we have described as the "lochia."

Finally, a new epithelium is formed in the place of that which has been shed, and the uterine interior presents the appearance it had before impregnation. According to Friedlander, the formation of the new mucous membrane takes place in the following manner: All that has remained behind of the cellular layer richly infiltrated with blood, as well as the upper portions of the glandular layer, gradually exfoliates and is discharged in the lochia. The flatly compressed glandular tubes situated close to the muscular coat are opened up, and their cylindrical epithelium forms the new mucous epithelium of the internal surface of the uterus. The connective tissue situated between the tubular glands accordingly proliferates, and becomes reorganised. In consequence of the increase in thickness of the mucous membrane, the previous shallow depressions of the epithelium are deepened, and in that way the uterine glands are also reformed in the new mucous membrane.

Coincidently with this return to small proportions, the uterine cervix also regains its former shape. During the passage of the fœtus, in process of dilatation the os and vagina form a continuous canal without any interruption, and the cervix is effaced. Immediately after the fœtus has passed through, however, the latter reappears, the os is closed, and the uterus and vagina are again separated by the sphincter-like ring which the uterine neck exhibits in the cavity of the latter. The cervix is at this time soft and flabby, and the os, not entirely closed, is readily dilated by the fingers. But it gradually contracts and closes, as its texture becomes firmer, and in doing so it elongates towards the vagina, into which it projects, until it has regained its natural form and consistence; though it is always shorter and less regular in shape, particularly at the os, in animals which have had several young, than in those which have never been pregnant. The uterus itself does not completely assume the dimensions it had in non-pregnant animals, but is always larger after it has contained one or more fœtuses.

It may be noted that the broad ligaments of the uterus become shortened after parturition, and consequently raise the organ towards the lumbar region, and in the direction of the pelvis; while their muscular fasciculi undergo fatty degeneration and absorption.

Such are the organic modifications the genital organs undergo after labour, when everything occurs regularly. But it sometimes happens that the muscular layer of the uterus appears to be struck with paralysis soon, or even immediately after birth; so that it remains

distended, and its cavity is so large that the arm can easily be introduced into it. This inertia is not so much to be dreaded in animals as in woman, though it is often troublesome and sometimes serious in them. The *débris* of the decidua vera, and other effete matters, accumulate in its cavity, and the os being always more or less patent, the air obtains admission, putrefaction commences, and grave results may follow. An exploration will discover a variable quantity of sanious, and more or less foul-smelling, matter in the cavity of the organ; and until this is removed, and the organ made to contract on itself, danger may be apprehended.

The gradual and steady involution of the uterus is therefore of much importance after expulsion of the fœtus.

PART SECOND.

DYSTOKIA.

GENERAL CONSIDERATIONS.

In studying the physiology of parturition, we saw that a favourable termination of labour depended on two factors, one of which was a proper degree of activity of the expelling powers, and the other a normal condition of the obstacles to be overcome by these powers. When these are out of proportion to each other, then we have difficult parturition, or Dystokia (δύς, *difficult*; τοκος, *birth*). Difficult parturition may be due to too feeble pains, or to an obstacle which the unaided efforts of the animal cannot surmount except after an unusual period of labour, or not at all.

We have already alluded to the nature of and variations in the expelling forces, and also to the causes of protracted labour. We have now to treat of the difficulties attending parturition, with their consequences—proximate or remote, and the means to be adopted for overcoming, preventing, or remedying these. This involves a study of the necessary obstetrical operations, the accidents attending or following parturition, and the diseased conditions more or less related to the puerperal state—all of which may be included under the head of "pathology of parturition."

The difficulties attending parturition depend upon the resistance opposed to the expelling powers, and this is determined by the relation of the object to be expelled—the presenting part of the fœtus, to the maternal genital passages. Consequently, an exaggerated resistance may be due to abnormal conditions of the parturient passages, or to some unnatural condition of the young animal. In the first we have *Maternal Dystokia*, and in the second *Fœtal Dystokia*. These necessitate particular operations, some of which demand much study, address, and manipulative power on the part of the obstetrist. In addition, we have dangerous accidents sometimes occurring during parturition, which, if they do not happen to interfere with the mechanism of that act, may nevertheless require the highest degree of surgical skill to remedy. And, finally, there are the maladies which accompany the parturient state, some of them being serious, and needing great clinical and therapeutical knowledge for their successful treatment.

These difficulties, accidents, and diseases do not occur with the same gravity, nor with the same frequency, in all the domesticated animals; indeed, with regard to the latter, some species appear to be altogether exempt from at least one or more of them.

Cases of dystokia are much more frequent in the Bovine species than in any other;[1] and least so, perhaps, in the Equine species. These two

[1] The Camel—and particularly the Bactrian variety which is characteristic of Mongolia—appears generally to require assistance during parturition. At least we may infer this from the statement of Colonel Prejevalsky, who, in speaking of the Mongolian Camel, says:—"The males become vicious during the rutting season, which is in February, and they will then fight with one another, and sometimes attack mankind. The interference of man is needed to bring the sexes together. The period of gestation is thirteen months, at the expiration of which the dam gives birth to one, or, as an exception, to two Foals.

species are those which the obstetrist is generally called upon to attend during protracted or difficult parturition; and every practitioner who has had any experience in this matter, will testify that for one case in the Mare or other animal there will be at least ten in the Cow. Two Danish veterinarians, Nielsen and Tallich, have estimated, that while they have had ten cases in the Mare, the first has had 190, and the second 159 in the Cow; and yet these writers practised in a district where more Horses than Cows were reared.

We have already said that the Mare is, of all quadrupeds, the one which brings forth its young most easily—a fact noted by Aristotle. But this remark only applies to normal parturition in that animal; in abnormal cases there is, as a rule, more urgency and danger than in the Cow, as well as more difficulty in affording relief. Indeed, a very able veterinarian, Donnarieix, who has had an extensive experience in obstetricy, declares that obstetrical operations in the Mare are a labour of Hercules; while in the Cow they are, comparatively, child's play. This experience will not quite accord with that of every practitioner; as in both animals difficulties in parturition will be sometimes encountered, which baffle the skill of the most competent obstetrist, and often prove insurmountable. One of these difficulties in the Mare is related to the difference in the vitality of the Foal and Calf when parturition has commenced—a difference which we have before pointed out as due to the particular arrangement of the maternal and fœtal placentæ in each species, and which it is of great importance to remember in choosing the means to be employed in overcoming obstacles to parturition in either the Mare or Cow. The following comparison has been drawn by Donnarieix, between parturition in the Mare and Cow, and fairly accounts for the differences in each animal:—

Mare.	Cow.
1. Delivery is often followed by insuccess.	1. Delivery always terminates favourably.
2. A wound inflicted on the genital organs is generally fatal.	2. A wound of these organs rarely causes death.
3. Inversion of the uterus is nearly always irremediable.	3. Inversion of the uterus is often curable.
4. Mares nearly always succumb to penetrating wounds of the abdomen during parturition.	4. This accident is not generally fatal in Cows.
5. Delivery of the most simple kind is occasionally followed by bad results. In abnormal and laborious parturitions not unfrequently Mare and Foal succumb.	5. Delivery, even in the most complicated cases, generally proves comparatively easy, and obstetrical operations successful.
6. Difficult parturition proves a Herculean task to the operator.	6. Such parturitions are not of much account to a practitioner skilled in the necessary operations.

Human assistance is also required at the time of parturition. The new-born Camel is the most helpless creature imaginable; it must be lifted by hand and placed under the mother's teats; but as soon as it can walk, it follows her about everywhere, and the latter is so attached to her offspring, that she cannot bear to be separated from it. The female Camel is granted its liberty for a whole year after parturition; so that it only foals every other year."—*Mongolia, the Tangut Country, and the Solitudes of Northern Tibet*, vol. i., p. 124. London, 1876.

Mare—*continued.*	Cow—*continued.*
7. The duration of the life of the fœtus, in a case of abnormal labour, does not extend beyond the fourth hour, on account of the young animal having to maintain its independent existence, as if already born.	7. Under the same circumstances the calf may live four or five days *in utero*, as life is maintained by the placental connections. These differences are explained by the mechanism of fœtal life in the two species of animals, as well as by the anatomy of the uterus and fœtal membranes.
8. The neck of the Foal being very long, the head is usually found deeply buried in the flank whenever it is turned backwards. The operator has very great difficulty in reaching the head with his hand; indeed, it is often impossible to bring it into its natural position. The loop slips off the neck of the lower jaw, and has constantly to be replaced; it is scarcely possible to fix a cord there, this portion of the jaw being so short and the fœtus having no teeth.	8. The neck of the fœtus being shorter and thicker, the head is less twisted, and the operator can with greater ease bring it back into its normal position. In addition, there are teeth in the lower jaw, the neck of which is narrow; so that the slipknot does not leave it, and straightening of the head and neck becomes an easier affair.
9. When once the amniotic fluid has escaped, the introduction of the hand is difficult, owing to the genital organs becoming dry; this dryness causes an efflux of blood to the mucous membranes. The resistance made by the fœtal membranes to manipulation, when made to ascertain either the position of the fœtus or for correcting the position, together with the struggles and violence of the Mare, which now and then drops as if dead, are all difficulties to be overcome.	9. The genital organs are continually lubricated by a mucus fluid which, while it facilitates the introduction of the hand, renders easy any necessary correction of position, and favours parturient operations. Besides, any movement made is not, in general, of much consequence.

Presentations which, in the Cow—owing to its phlegmatic temperament, intervals of quietude, and more gentle and tractable nature—are common, and as a rule adjustable, are yet most difficult in the Mare, and if not quickly attended to, rapidly lead to a fatal termination. With regard to difficult parturition in the other domesticated animals, the Goat and Ewe come next to the Cow in the order of frequency; though cases of dystokia are not so often noted in them as in that animal. It is to be remarked, however, that assistance is not so easily rendered them, owing to the introduction of the hand into the uterus not being always possible. In the Goat the act is sometimes very prolonged, though on account of the multiple placentæ the fœtus may live as long as in the Cow. With the Ewe the same occurrence is observed, but in this creature it is sometimes possible to introduce

the hand into the genital passages. It is rare indeed that the obstetrist is required to attend upon the healthy Sow, this animal appearing to be almost exempt from difficulties in parturition. In cases of rachitism, however, there is sometimes so much deformity of the pelvis, that aid is required. Notwithstanding the narrowness of the passages, the hand or fingers may be passed into them.

Cases of dystokia are not infrequent in the Bitch, and particularly if it is of small size, or belongs to a breed with a large round head and short nose. Numbers of Bitches perish every year from non-delivery of their Puppies; these latter may also succumb before the decease of their parent, as it often happens that the death of one entails destruction on the others. Cats are sometimes subjects of difficult parturition, and from the same causes as Bitches.

A very great disadvantage under which the veterinary obstetrist labours in cases of dystokia, is the late period at which his services are generally called into request, and often after serious, and even irreparable, injury has been done by unskilful hands; and this in instances in which a little scientific manipulation and some surgical knowledge would have, perhaps, made all right and safe in a few minutes. Saint-Cyr justly says, in commenting on some remarks made with regard to the services a veterinary surgeon may render in difficult parturition, that these can be beneficial only on the *absolute* condition that he is present in good time. Called upon too late, when the "waters" have escaped for a long period, and the neighbouring empiric has exhausted his science, aggravated a bad presentation, irritated the generative organs by manipulations, tractions, and violent means; then all the ability of the most experienced practitioner may be useless. He will find the passages dry, burning, swollen by inflammation, the fœtus more or less advanced into the pelvic cavity, where it is, it may be said, "wedged," or like a nail driven into wood; with the uterus spasmodically contracted on itself, and so closely applied to the body of the fœtus that it is almost impossible to pass the hand between them. How is it possible to manipulate in such a place—how change the vicious position of a fœtus which the greatest efforts cannot make advance or retire? How can a sharp instrument be carried into the uterine cavity and used with safety, when the hand alone can scarcely be made to enter it?

It is in these circumstances that a practical knowledge of obstetricy is most valuable, and renders he who possesses it a very great acquisition to an agricultural or pastoral district. And this knowledge may be said to be special; for obstetricy is not like the other branches of veterinary surgery, in forming a portion of every veterinarian's practice. On the contrary, it is rarely practised in towns or cities, but is almost exclusively limited to animal-rearing localities; there alone is to be found the school in which the practitioner may be initiated into all the difficulties of this complex art, and the best and readiest means of surmounting them. And it must be confessed that the practice of this art is not particularly alluring, and is attended with many more inconveniences, hardships, and difficulties than fall to the lot of the human obstetrist: indeed, we know of no more arduous and anxious occupation than that of the country practitioner in a cattle-breeding district, and he requires physical endowments which are certainly not needed by the attendant on woman.

Veterinary accouchments are generally difficult and perplexing, as

well as fatiguing. Long and powerful arms are necessary, as well as much address in using them and the fingers; bodily activity is above all essential, in order to go about an animal, to place one's self in the most favourable position for exploring and operating, and to avoid injury from the creature. The veterinary obstetrist should also be gifted with presence of mind, coolness, and fertility of resource; so as to take into consideration all the circumstances of the case, devise his method of procedure, and carry it out promptly.

The conditions under which the veterinarian has to perform his task are not favourable or encouraging. It is anything but easy to practise the necessary manipulations in the larger animals—such as the Mare or Cow—in such a great cavity as the abdomen, and in the uterus which lies deep in it, and contains a voluminous fœtus. In practising these manipulations, the operator has to contend with the struggles and disordered movements of the animal, which sometimes, in the midst of its sufferings, does not hesitate to use its feet, horns, or teeth as weapons of offence, or to crush its medical attendant against the adjacent wall. In addition, the violent contractions of the uterus, and especially of the cervix, fatigue the operator extremely. Sometimes these manipulations have to be continued for hours, until the various obstacles to delivery are successively overcome, or the creature is doomed to perish.

Add to this, that Cows and Mares during parturition often inhabit close, foul stables, with an almost poisonous atmosphere, destitute of light, and perhaps also cold and damp. Here the veterinarian must do his duty—cold, wet, and dirty, exposed to draughts and every kind of discomfort. Most frequently, too, he is left to his own resources; for it is rare that intelligent and obedient assistants can be found in such places. And all this after driving long distances, often at night and in bad weather. How different to the accoucheur of woman!

All the inconveniences, risks, and hardships of the veterinary obstetrist do not end here. After manipulations, sometimes long continued, in a uterus containing infective matter resulting from retention of a dead fœtus, or fœtal membranes in process of decomposition, he is exposed to the most serious septic diseases, and may even lose his life. A cutaneous eruption, indeed, often appears on the arms of the operator, merely through having manipulated for some time in genital organs, the mucous membrane of which was only irritated and inflamed, or simply swollen and bruised—no putrefaction or suppuration being present. Most frequently the disease is only local, and is sometimes a simple, limited, erythematous redness which disappears in twenty-four hours; at other times it is a trifling eczema without pustules, but with intense itching; frequently it is a pustular, sometimes confluent, ecthyma, the crusts on which are occasionally not detached for months; in other cases there are furuncles, abscesses on the arm, or even over the body. In the majority of cases, the affection is accompanied by fever, anorexia, great uneasiness, and pains so acute that sleep is impossible; there may also be tumefaction of the axillary glands. The course of the disease is generally irregular, relapses are common, and it is a long time before its effects pass off. Death sometimes occurs, and amputation of a portion of the arm has been necessary.[1] Such are the difficulties and risks of the veterinary accoucheur. We will now refer more particularly to his line of conduct in practice.

[1] *Veterinary Journal*, vol. ii., p. 218.

Proprietors of animals should, in their own interests, suffer no delay to occur in sending for the veterinary surgeon as soon as they perceive that parturition is not progressing regularly; and they should carefully abstain from any violent handling of, or traction on, the fœtus which might render irremediable a difficulty often easy to surmount at the commencement, by anyone sufficiently acquainted with obstetrics.

On his part, the veterinarian should not lose time in giving his services; as every minute's delay may render the case more difficult, and tend to compromise the life of not only the young animal, but also that of the mother, as well as the interests of the owner and his own reputation. It is essential that he should be provided with certain instruments, as obstetrical operations are partly performed by means of these, as well as by the unarmed hand, which is, after all, the most perfect instrument, and should always be preferred to instruments when possible. Some operations, however, can only be undertaken with instruments, and it is therefore necessary that the obstetrist be provided with at least those which are most useful and indispensable: such as one or two knives, cords, hooks, Schaack's head-collar or some other pattern, etc., and these should be so portable as to be carried in a leather or canvas bag, or a small box.

On reaching the patient, all information concerning it should be gathered at once and an examination immediately made into its condition. The period when labour commenced; if the "water-bag" has ruptured, and when; if the animal has gone its full time, or exceeded it; if it is a primipara, or, if not, if its previous parturitions were favourable—all these and other useful points in its history should be obtained.

The examination should comprise: the general appearance of the animal; whether weak or strong; the character of the pulse; and the nature, frequency, and intensity of the expulsive efforts; as well as the condition of the mammæ, and external genital organs. After this, if further examination is necessary, direct exploration of the internal genital organs should be made. We have already described the mode of procedure to be adopted in this exploration; but because of its importance, we will again notice it.

If possible, the Mare and Cow should be examined in a standing attitude, as this is the best. If, however, the animal is lying, and from exhaustion or paralysis it cannot get up, then of course the examination must be made in this position; indeed, it may be advantageous to examine in both positions.

When standing, it should be approached gently and coaxingly, and rigorous restraint is seldom necessary; for the pains of labour usually render the most vicious animals tractable. With the Mare it generally suffices to have one of the fore-feet held up by an assistant, while the examination is made; if young and dangerous, it may be necessary to employ a side-line on a hind pastern, or hobbles on both hind pasterns, and perhaps a twitch on the nose. With the Cow, a strong man holding the animal's head is sufficient to make it stand quiet.

Lateral movements may be prevented by placing the animal against a wall or partition on one side, and a powerful man at the other side; or a man at each side. The operator must be on his guard against the animal suddenly dropping, which would expose him to serious injury. When the floor inclines from the tail towards the head of the animal it is most favourable for an exploration, as the mass of intestines is thrown forward against the diaphragm; so that they do not press on the uterus,

which is then more free and better adapted for manœuvres in its interior.

When the operator has to explore in the lying position, he finds it much more fatiguing and difficult, as he has then to kneel, and to accommodate himself to the animal. In the decubitus, it is still more necessary that the croup should be higher than the front part of the body, in order to get the digestive organs out of the way; the lateral pressure of the viscera should also be diminished by having the spine higher than the limbs; and it must be borne in mind that the more an animal is raised above the ground when it is lying, the easier is the manipulation. For the same reason, the smaller animals should be raised as high as the operator's hand: the Sheep, Sow, and Goat on several bundles of straw; the Bitch and Cat on a table covered with straw or a cloth. The two latter animals must be so secured that they will not bite or scratch the operator.

To compel a Cow to get up, Schaack recommends that a small Dog be introduced into the stable, and made to bark at and excite the animal.

The coat must be removed, and the shirt-sleeve rolled as high as the shoulder; indeed, with large animals, when there is a likelihood of much manipulation being required with the cavity of the uterus, it has been recommended to remove the shirt and underclothing from the arm and shoulder altogether.

My friend, Mr. Cartwright, of Whitchurch, employed a large, thick, and long woollen sleeveless vest that buttoned close up around the neck; this is very suitable for such cases, as it not only admits of the shirt being removed, but besides keeping the operator's clothes clean, it prevents him catching cold. Other operators wear a long gown, like a dissecting-room gown.

The back of the hand and arm should be well smeared with oil, grease, or even butter, not only to render their introduction into the genital passages more easy, and less irritating to the lining membrane, but also to some extent to protect the operator against infection. It is scarcely necessary to add that rings should not be worn on the fingers. The right hand is usually introduced, but it is well to be able to use both hands—certain manipulations being more easily executed with the left than the right hand; and, besides, in protracted operations one hand relieves the other.

Before commencing the examination of the genital passages, it is well to empty the rectum, and if possible the bladder. While emptying the former viscus, useful information may be gleaned as to the condition of the uterus, as well as of the pelvis and pelvic cavity.

The fingers being gathered together in a cone-like form, the hand—which should not be cold—is inserted carefully and steadily into the vagina at a moment when the animal is not straining—the outer margin (little finger) being downwards, thumb towards the rectum, and pushed gently inwards by a slight rotatory movement; but the advance of the hand must be momentarily checked if the straining is at all severe, or until the animal, if irritable, has become reconciled to it. When once through the vulva, more room is found in the vagina, and the hand and fore-arm can then penetrate with ease as far as the cervix uteri.

The object of exploration being to ascertain, in the first place, the condition of the genital passages, as well as the state of the pelvic cavity in general, the operator has to satisfy himself whether the vagina

is empty, or if it already contains some portion of the fœtus or its membranes, and what these are; if there is any normal condition or contraction of the vagina, or any tumours either within or external to that canal, as well as the seat of these, and if possible their nature. He has also to satisfy himself that the pelvis is wide, regular in form, or more or less deformed and diminished in size from exostoses, fractures, or other causes.

The state of the soft parts will likewise engage his attention, and he must learn whether the vulvo-uterine canal is dry, or contains sufficient mucus to facilitate manipulation or delivery, as well as its temperature. Having satisfied himself on these points, the fingers are again brought together, and their extremity pushed as far as the cervix uteri, the condition of which is carefully studied. The chief points to be noted are: whether it still projects into the vagina, or if it is completely effaced; whether the uterus has descended on the floor of the abdomen, or is yet in its ordinary position; whether the os is closed or open, and the extent of its dilatation; whether the texture of the cervix is hard or soft, healthy or altered by morbid degeneration, and if it lies in the axis of the vagina or deviates therefrom, or is more or less twisted. Passing the hand into the uterine cavity, if necessary and possible, and with all care and gentleness, the explorer will meet with the "water-bag," if it is not already ruptured, and the fœtus, if he has not already encountered it; at the same time the energy and frequency of the labour pains can be ascertained. If the membranes are ruptured, the hand must be passed into them in order to discover the situation of the fœtus—the kind of presentation and position, the manner in which the limbs are disposed, and any complications which may be present. If the membranes are not ruptured, and it is deemed necessary to open them—which not unfrequently happens when an exploration has to be made, and labour is advanced, the pains being well marked, the os dilated, and the water-bag in the vagina—the hand may be passed between them and the uterus, the palm being towards the fœtus; or it may not be required to pass so deeply.

When the membranes are tense, pressure against them with the end of the index-finger during a throe is usually sufficient to open them: if, however, they are flaccid, a portion is seized between the thumb and middle finger and torn by their nails, or by the nail of the first finger against that of the thumb. Sometimes the fingers alone are not sufficient, as when the envelopes contain but little fluid; then a pair of scissors, a small trocar, or even an ordinary pen, will effect this object.

In examining for presentation and position, each region of the body of the fœtus should be familiar to the touch, as it can be distinguished by its own proper characters. Under ordinary circumstances, the hand of the operator first meets with the limbs of the fœtus; if they are the anterior limbs, and the plantar surface of the feet is turned downwards, then the fœtus is in the natural or vertebro-sacral position, anterior presentation; but if the plantar surface of the feet is inclined upwards, and they really belong to the fore limbs, then it is in the vertebro-pubic position. To distinguish the fore from the hind limb, the shape of the joints and their mode of flexion must be taken into account—the fetlock and knee of the former bend in the same direction, while in the latter the fetlock and hock flex in opposite directions; the knee, in addition, is large, round, and rather flattened in front, while the hock is flattened

on each side, and offers the calcis as an unmistakable guide. There is also a difference in the shape of the feet.

The explorer should take time to assure himself of the real state of affairs, and conduct his examination with all the care, attention, and gentleness possible. The fœtus may present in a variety of positions, in which hind and fore limbs may offer first, either alone or together; and in the case of twins or monstrosities, the limbs of different creatures may be encountered at the same time. If the presentation is anterior, the head will be met with, and this is distinguished by the presence of the mouth, eyes, and ears; if it is a posterior presentation, then we have the rounded croup, tail, hocks, and external genital organs. In other presentations, the neck is recognised by the mane, if it be a Foal, in addition to its shape, whether Foal or Calf; the shoulders by the acromion processes and withers; the chest, by the ribs and intercostal spaces; and so on. In addition to all this, the obstetrist should judge at the same time of the volume of the fœtus, and its proportions. This is particularly necessary in the case of monstrosities; and in some instances it is most difficult to decide what the hand may alight upon in such an examination. Kopp alludes to the case of a Mare which he examined during parturition, when he found a fœtus affected with hydrocephalus to such a degree, that for a long time he thought the head was the thorax.

It cannot be too strongly impressed upon the minds of those who are commencing obstetric practice, that such an examination should be so complete as to furnish all the requirements of a sound diagnosis, on which the indications for affording assistance can be readily based; and this exploration can only be said to be complete when the obstetrist is as well acquainted with the position of the fœtus and the obstacles to its birth, as if he had scrutinized the whole with his eyes.

Then he can decide as to the measures which are indicated by his diagnosis, in order to bring the young creature into one of the best positions for delivery—either natural or artificial—so that this may be effected with certainty and rapidity.

These measures being decided upon, a methodical procedure is as necessary in carrying them out, as in exploring the vagina and uterus. The required assistants should be selected, and to each should be allotted his share in the operation, in which he ought to be instructed briefly and clearly; the instruments, cords, and other apparatus ought next to be placed in readiness; and then the task may be begun. When this is once commenced, it should be conducted with prudence, and yet with decision, all irrational and unnecessary manœuvres being avoided; while every precaution being at the same time observed, there should be no fear of irritating the organs or textures by manipulation, as they appear to be endowed with a greater amount of tolerance at this than at any other time.

In such cases, the operator should bear in mind that his task is to remove or overcome everything which suspends, hinders, or interferes with the natural course of parturition, and to bring this as near as possible to a normal termination. He should understand and appreciate the part Nature plays in this act; only seeking to second her efforts so long as she is competent to attain the desired end, by removing any obstacles in the way. When Nature's efforts cease to be effective, they should be imitated as closely as possible; and no more ought to be attempted than Nature herself would have accomplished under

more favourable circumstances. Art should never undertake what Nature can effect; and remembering this, the obstetrist will not only seek to learn and appreciate the powers of Nature, but will be in a better position to calculate how far he should himself interfere.

Whatever is necessary to be done should be accomplished without delay, so as to spare the animal pain and exhaustion. Sometimes parturition is difficult because of the insufficiency of the expelling forces, as we have already noticed, and this may be remedied by hygienic and therapeutic means; but more frequently, while the expulsive efforts are normal, there is undue resistance. To increase the expelling forces in the latter instances would evidently be unwarrantable and injurious, and we must attack the resistance by various means, according to its character. Obstacles in the genital passages must be overcome either by altering the position of the fœtus by manipulation, in changing the position of the mother, or by other means; and it often happens that we must combine extraneous force with the expulsive efforts of the mother, in order to extract the fœtus artificially. At other times the size of the fœtus must be reduced by embryotomy, and in extreme cases an artificial passage has to be made for it by hysterotomy; though these dangerous operations may be occasionally averted by causing artificial abortion, at a period when the fœtus is sufficiently small to be safely expelled through a contracted pelvis.

There is no occasion, in veterinary obstetrics, to hesitate in sacrificing the life of the fœtus in serious cases; and in this respect the practitioner is in a different position to the accoucheur of woman-kind. With animals there is only a material loss to be looked at, and the fœtus must always be greatly inferior in value to the mother; therefore, in order to save the latter, it is more profitable to sacrifice the former.

Such are the general principles which we believe to be applicable to all cases of dystokia. These cases are numerous and various—more varied even in animals than in woman; and in order to study them beneficially, it is advisable to classify them in a methodical manner. We will follow Saint-Cyr in arranging and studying them in the order given below.

SYNOPTIC TABLE OF THE CAUSES OF DYSTOKIA IN THE PRINCIPAL DOMESTICATED ANIMALS.

- Dystokia
  - Maternal
    - Pelvic Constriction.
    - Displacement and altered relations of the Uterus.
    - Morbid alterations of the Maternal Organs.
    - Umbilical Cord.
  - Fœtal ...
    - Independent of the Presentations, by:
      - Excess in Volume
      - Excess in Growth of Hair
      - Diseases
      - Monstrosities
      - Multiparity

      } of the Fœtus.
    - Dependent on the Presentations:
      - Anterior.
      - Posterior.
      - Dorso-lumbar.
      - Sterno-abdominal.

BOOK I.

MATERNAL DYSTOKIA.

The pathology of parturition, as has been mentioned, includes disturbances produced by excessive or tumultuous pains and too feeble pains, and derangement caused by too great an obstacle to birth. We have sufficiently described the first; and we have now to deal with the second, in so far as the mother is concerned. The maternal obstacles to parturition are related to the too great resistance offered by the parturient passages, either in their hard or soft parts. These obstacles have been grouped in the preceding table under the heading of *pelvic constriction, displacement or change in relations of the uterus*, and *morbid alterations of the maternal organs.*

CHAPTER I.

Dystokia from Pelvic Constriction.

Dystokia from constriction of the pelvis is sometimes observed in animals;[1] though less frequently, perhaps, than in woman, in whom constitutional causes and the different position (vertical) of this region, operate largely in producing diminished dimensions of its cavity. Any alteration in the dimensions or shape of the pelvis, whether general or partial, is a more or less serious cause of dystokia, and in some cases may render delivery absolutely impossible. A pelvis generally reduced in all its dimensions is sometimes noticed in the large, as well as the small domesticated animals.

On the Continent of Europe, this has been observed more particularly among some of the small common breeds of Cattle—such as the *Bretonne*, and certain of the grey Swiss breeds, as the *Fribourgeoise.* These have the ischia pointed and the tail attached high above them. Leconte has observed this conformation in animals the produce of a cross between large Norman Mares and pure-bred Horses, which have a sharp croup. There is often a relative narrowness of the pelvis in animals of small size that have been put to larger males. This has been witnessed in the Mare and Bitch; and as the young are proportionately larger than the pelvis can accommodate in parturition, we have here a cause of dystokia.

An abnormal inclination of the pelvis has been supposed by some writers to exercise an unfavourable influence on parturition, but this has been denied by others. Provided the other conditions of normal parturition are present, no difficulty should be experienced in delivery; but if, added to this state, there is a narrow pelvis, then obstetrical operations would certainly be rendered more serious.

Deformities which occasion irregular constriction of the pelvic cavity

[1] A naturally wide pelvis—or rather an excess in width—observed more particularly in animals of a lymphatic temperament, and especially in Cows, along with an extraordinary suppleness and laxity of the soft parts in this region, has the inconvenience of rendering parturition too easy, it would appear. For this facility is supposed, and not without reason, to bring about such complications as inversion of the vagina and uterus, placental retention, and even predisposes, according to some authorities, to vitulary apoplexy in the Cow, and metritis in the other animals.

are various. They may belong to the bones of this region, or to its connective tissue ; and they always more or less diminish one or more of the dimensions of the parturient canal, and offer an obstacle to the passage of the fœtus. These cases, however, are somewhat rare ; they are generally found to be due to *complete deformity of the pelvis*, *exostoses*, *fractures*, or *tumours*.

Complete Deformity of the Pelvis.

As has been observed, complete deformity of the pelvis is very rare among animals. When due to rachitism, it is most frequently noted in the Pig. In this animal the pelvis is sometimes greatly distorted, and not unfrequently there is accompanying deviation in the vertebral spine. This condition is seldom seen in other creatures.

Saint-Cyr informs us that in the Museum of the Lyons Veterinary School, there is the pelvis of a Mare and another of a Female-Ass, which

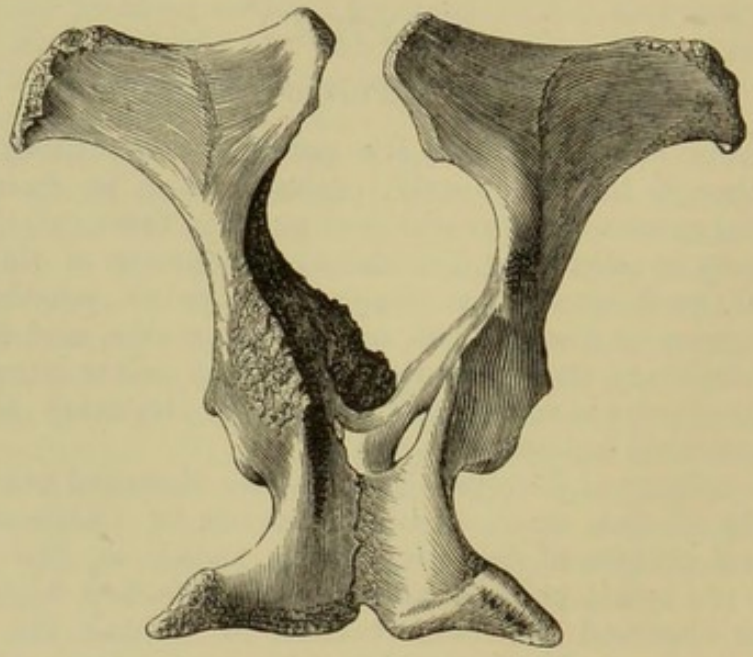


Fig. 81.

Completely Deformed Pelvis : Mare.

present a very remarkable degree of general constriction, and which must have offered a very serious obstacle to parturition if the animals had ever been pregnant. That of the Mare (Fig. 81) is singularly depressed on both sides, the ischia, and especially the pubis, being atrophied with respect to size. The oval foramina and cotyloid cavities are close together, the floor of the pelvis is extremely contracted and angular, and the pubic arch is hypertrophied. In this specimen there is a very notable diminution in the different diameters of the pelvic cavity ; the supero-inferior, instead of being about $8\frac{1}{2}$ inches is only about 6, and the bis-iliac diameter is but $4\frac{1}{4}$, instead of being $7\frac{1}{2}$ to 8 inches.

The diagnosis of this deformity ought not to be difficult, especially when it is so marked as in this instance. Vaginal exploration should soon discover it, and the diminution in size may be approximately determined by spreading the fingers, and in this way measuring the

two diameters. The diagnosis may not be so easy, however, when the canal is partly or wholly occupied by the fœtus.

Another kind of deformity described by several authorities, consists in a depression of the sacrum (*lordosis*), which is recognised externally by an abrupt hollow existing towards the posterior third of the croup. By rectal exploration the sacrum is found to constitute a projection in the roof of the pelvis, at the lower face of the bone, and this diminishes the supero-inferior diameter of the cavity to an extent corresponding to the protuberance.

Exostoses.

Exostoses on the pelvic bones, and particularly when they project into the pelvic cavity or encroach on its openings, may become a more or less serious obstacle to the passage of the fœtus (Fig. 82).

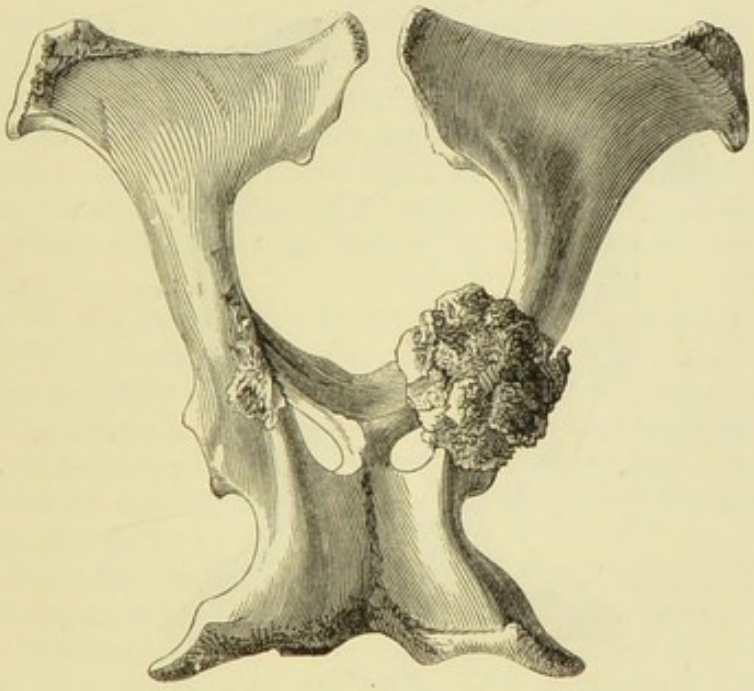


Fig. 82.

Pelvic Exostosis.

Favre, of Geneva, states that bony tumours situated beneath the croup, at the inner and upper surface of the pelvis, render parturition difficult, even if they are not large and near the root of the tail. He adds that such cases are not rare in old Mares.

Fractures.

Like the exostoses, more or less completely consolidated fractures of the sacrum or coxæ, which have been united by an irregular callus, may, for the same reason, prove an obstacle to birth. As animals suffering from a fracture of any of the bones of this region are often destroyed, laborious parturition from such a deformity is not so frequent as from some other causes ; nevertheless, it does occur now and again.

It must be remembered that fractures of the pelvic bones are somewhat frequent in animals, and may occur at any part. The most common seat of fracture is perhaps the external angle of the ilium ;

and the least frequent, the posterior part of the ischium and the pubis. Fracture of the sacrum and the internal angle of the ilium is also very rare. Simultaneous compound fracture of the two coxæ has been observed in two cases by Lafosse; in one case by Crepin, and in another by Philippe.

D'Arboval has witnessed a fracture of the pubis in a Dog; and Carsten Harms alludes to fractures of the ischium occurring in the Mare and Cow. The latter authority has likewise found the two iliums of a Goat united at their posterior angle by a mass of bone as thick as a finger. Professor Ercolani has well described twelve important cases of pelvic fracture exhibited in the Pathological Museum of the Bologna University.[1] The first of these is a compound fracture of the ossa innominata, the solution of continuity involving all the border of the foramina ovale in the pelvis of a Mare; the second is a fracture of the left ilium near its neck, and extending to the cotyloid cavity, also

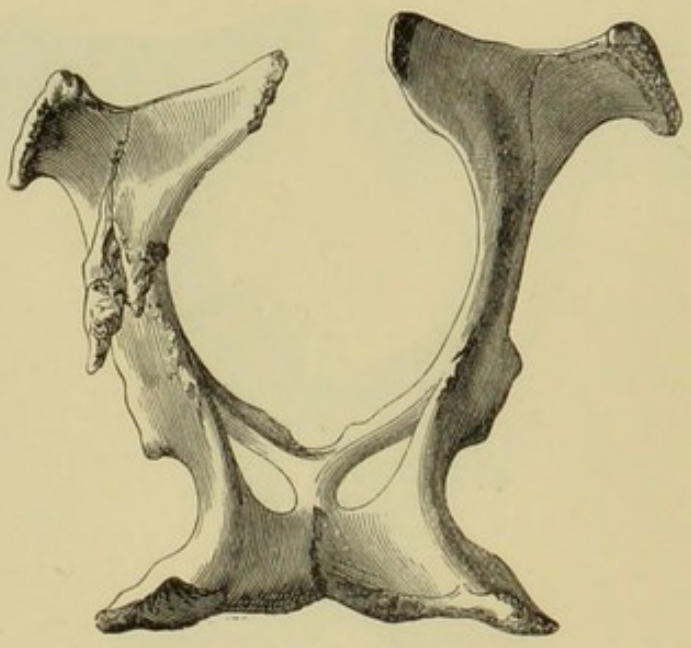


Fig. 83.

Fracture of the Pelvis.

in the pelvis of a Mare; the third is a compound comminuted fracture of the left innominate bone in a Mare, the piece being divided into six principal portions; the fourth is a compound fracture of the right ilium of a Mare, extending to the arch of the pubis on the left side; the fifth is a longitudinal fracture of the right ilium of a Filly; the sixth, a fracture of the external angle of the right ilium and the left ischiatic tuberosity of a Mare; the seventh is a slightly oblique fracture of the ilium extending to the cotyloid cavity of a Mare; the eighth is a compound fracture of the pelvis of a Mare, involving the internal angle of the ilium, the external part of the ischial tuberosity, the arch of the pubis, and the union of the pubis with the ischium; the ninth is a fracture of the superior and posterior crest of the ilium of a Mare; the tenth is an oblique fracture of the neck of the left ilium of a Mare; the eleventh is a compound fracture of the right coxa of a Mare, the

[1] Descrizione Metodica dei Preparati del Museo di Anatomia Patologica Comparata della R. Università di Bologna. Memoria I. Bologna, 1867, p. 38:—*Fratture della Pelvi.*

cotyloid portion being completely isolated from the ischium, ilium, and pubis; the twelfth is a fracture of the external angle of the ilium. Lanzillotti-Buonsanti states that the Pathological Museum of the Milan Veterinary School contains a coxa which shows a fracture of the neck of the ilium, with overlapping of the disunited portions; and also a pelvis in which the pubic portion of the symphysis has sustained a comminuted fracture.

Much will depend, of course, upon the nature and the seat of the fracture. When it is only the outer angle of the ilium (point of haunch), and even when the fractured bone is displaced by the action of the small oblique muscles of the abdomen and the fascia lata, producing much external deformity, no great effect can be produced on the act of parturition, as this part has nothing to do with the pelvic cavity. But when the whole of one side of the haunch is lower than the other, delivery is then undoubtedly interfered with, and perhaps to a most serious extent; inasmuch as some one of the parts which concur in forming the pelvic cavity is implicated in the fracture, and consequently the external deformity corresponds to an internal diminution and irregularity in its diameters, from displaced fragments of bone, overlapping of fractured ends, the approach of the sacrum to the pubis, and consequent lessening of the inlet of this cavity, as well as to the more or less voluminous deposit of bone around the fractured portions (Fig. 83). Many cases are on record of difficulty in parturition from this deformity.

Fractures of the pelvis are by no means infrequent in animals, and are due to falls, crushing, blows, or other causes; and, as the above instances testify, they may prove insurmountable obstacles in parturition. Female animals which have sustained an injury of this kind should not be employed for breeding purposes, unless a careful examination has shown that it has not altered the pelvic diameters in such a way as to render delivery difficult.

Such an alteration may be diagnosed by depression of the haunch or croup, and lameness to a more or less appreciable extent; while rectal or vaginal exploration will discover the presence of a variable-sized hard tumour forming part of the bone, and projecting into the cavity. The previous history of the animal may also aid in confirming the diagnosis.

Fractures of the pelvis may also take place during parturition, and Rueff mentions two instances in which they have occurred spontaneously during very violent labour pains.

In the latter instances, there may have existed a predisposition due to a diseased condition of the bones—a predisposition not uncommon in breeding animals.

Tumours in the Pelvic Cavity.

Tumours of various kinds—such as fibromata, melanotic and cancerous tumours, in addition to those of a bony character due to injury—may prove a cause of dystokia; abscess may also co-exist with pregnancy, and be a source of difficulty in parturition. But that form of melanosis which appears in grey animals, and particularly manifests itself in the form of tumours at the root of the tail, around the anus, and in the connective tissue of the pelvis, should offer the most frequent obstacle to delivery.

A case has occurred in my own experience, in which an aged Mare, nearly white, belonging to a friend, was, on my recommendation, taken by a farmer, who attempted to breed from it; but at the termination of pregnancy, and during parturition, it died without giving birth to the Foal.

When opened, it was found that delivery could not take place owing to great masses of melanotic deposit in the pelvic cavity. When given to the farmer there were only a few small nodular masses observed about the tail and vulva.

Leconte (*Mém. de la Société Centrale de Méd. Vétérinaire*, vol. v., p. 180) was consulted with regard to a Mare, about twelve years old and about five months pregnant, which had such a large melanotic deposit around the anus that defecation was impossible without assistance. Rectal exploration discovered a very voluminous tumour situated at the left side of the pelvis, in the centre of which a slight fluctuation could be perceived. With a view to accelerate the maturation of the tumour, vesicatory agents were applied to the left flank and croup; five days later the tumour was larger and more fluctuating, and it was punctured, when about two pints of a dark, purulent, but almost odourless fluid escaped. On the hand being introduced into the softening mass, a portion was found about the size of two fists, and partially detached; this was removed, and weighed nearly seven pounds. In twelve days the wound had cicatrised; and in five and a half months, gestation being nearly completed, another melanotic tumour, situated somewhat deeply towards the right side of the pelvic cavity, was also removed. Cicatrisation took place rapidly, and delivery occurred without any difficulty.

Cases have been recorded in which a large quantity of hardened fæces in the rectum was a cause of dystokia.

Indications for Surgical Treatment.

The surgical treatment of those cases in which dystokia is due to any of the causes just enumerated, will greatly depend upon circumstances, not only with regard to the kind of treatment, but also as to its expediency.

For instance, if total or partial deformity of the pelvis is present to such a degree as to endanger the life of the animal during parturition, or if there exist obstacles due to fractures or tumours, and which cannot be removed, then it may be advisable, if the animal be fit for food and in good condition, to send it to the butcher; or if it be pregnant and in inferior condition, to produce abortion at a sufficiently early period. But if parturition has already commenced, then, of course, surgical or obstetrical treatment must be had recourse to; and the nature of this will depend upon the constriction of the pelvic cavity, and the kind of obstacle which causes the diminished space. The indications are: *to forcibly extract the fœtus through the narrowed passage; to widen the passage; to diminish the size of the fœtus; or to make an artificial passage.* But as *artificial abortion* may be necessary during pregnancy, should the veterinarian be consulted, and from examination be led to conclude that parturition will be dangerous or impossible, we shall include this as one of the indications, and commence with it.

1. Artificial Abortion. — Artificial abortion may be rendered necessary not only during pregnancy, when the condition of the pelvic cavity leads to the supposition that delivery at full term is dangerous or impossible, but also in metrorrhagia, serious inversion of the vagina, hydramnios, debility, or exhaustion, etc.

Artificial abortion may be produced in several ways, and is generally more successful with the Mare than the Cow, because of the greater excitability of the cervix uteri, and the readiness with which it can be dilated in that animal. Three modes of procedure have been adopted with the domesticated animals, each being attended with success, and each offering special advantages in particular cases. These are: *irrita-*

tion of the cervix uteri by the hand; puncture of the envelopes; and *vaginal irrigations.*

Digital Irritation of the Cervix Uteri.—This is accomplished in the following manner: The hand is introduced into the vagina, and first one finger, then two are insinuated into the os by a semi-rotatory movement, and finally the whole hand is inserted, as the part dilates. If the operation is repeated several times, labour pains soon ensue. As the manual exertion is rather fatiguing, the sponge tent, elastic bags, or other dilators of the os uteri may be employed. A better and more successful mode is the introduction of a long elastic catheter, strong pieces of catgut, or even a quill, between the fœtal membranes and the uterus. Labour may be promoted by passing the hand through the os, and separating the membranes from the uterus.

This procedure is to be recommended for Mares, the uterus of which is so irritable that abortion sometimes takes place after manipulations in the rectum for some time. In ordinary cases, the expulsion of the fœtus occurs in from six to twelve hours. It is not applicable to Cattle, Harms having once manipulated a Cow in this manner for a whole night without producing any result; neither is it to be recommended for smaller animals.

Puncture of the Fœtal Envelopes.—The envelopes are punctured by pushing a long, and more or less pointed, sound through the os uteri, into the "water-bag"; the liquor amnii soon escapes, and the uterine contractions begin. Expulsion of the fœtus follows in from twelve to forty-eight hours. This method is particularly efficacious with Cattle.

Vaginal Irrigations.—Irrigation of the vagina with cold water (or water at a temperature of about 90° Fahr.), made by means of a syringe or injection-tube, and continued for a quarter of an hour every three hours, will induce labour pains about the fourth injection, and effect the expulsion of the fœtus towards the second, third, or fourth day. This method is more particularly adapted for the smaller animals; though it will also succeed with the larger. The only danger to be apprehended from it is an attack of metro-peritonitis.

2. Forcible Extraction.—The first impulse which presents itself when the fœtus meets with any obstacle to its passage through the pelvis, is to "force it through"; and it is this impulse which is carried into execution by unscientific people. Too frequently, however, it happens that by this procedure some portion of the fœtus is so tightly wedged in the pelvis that no amount of force is capable of moving it farther, and renders absolutely impossible those other operations which might be the means of saving at least the mother or offspring, or perhaps both. For this reason it is, that the owner of an animal in this condition should not himself, nor suffer others to, pull at the fœtus, or attempt any similar manœuvre, until the arrival of the veterinarian. And the latter has a difficult task before him in solving the problem as to whether he ought to extract the fœtus forcibly, or resort immediately to the other measures prescribed. This will render a careful examination necessary, in order to ascertain the nature, seat, and degree of constriction.

The animal is making excessive, nay violent efforts, and the fœtus may be in a favourable position, but it does not advance through the pelvis. The parent is restless and sighs deeply; the flanks are covered with perspiration, and sometimes, through sheer exhaustion, it

falls, utterly prostrated by its efforts. As the uterine contractions generally increase in violence in the presence of obstacles to birth, there is the gravest danger to mother and offspring.

In such a case, the veterinarian, having introduced his hand into the pelvis in the ordinary way, endeavours to discover if the obstacle is there. With this object in view, he closes his hand to try if he can move his shut fist about in every direction, and with ease. Then stretching out the thumb, he can approximately judge the distance which intervenes between opposite points of the pelvic circumference, and in this way appreciate to a certain degree whether a moderate-sized fœtus could pass through. For if the pelvis is so contracted that the closed hand can scarcely move about in it, it will be needless to attempt forcible extraction, as the fœtus cannot be brought through.

Saint-Cyr has calculated that the closed hand of an adult man represents an irregular mass measuring between three and four and a half inches in diameter; but the head of a Calf, in its supero-inferior diameter, measures from seven to ten inches, and four to five inches in transverse diameter. It is therefore obvious that the head of a Calf could not pass through an aperture in which the hand cannot move freely; and much less the chest of a Foal, which is at least twelve to thirteen inches in depth.

It is also necessary to take into consideration the cause of dystokia. If this is due to a complete deformity of the pelvis, then the case is serious, and there is little hope of traction alone overcoming the difficulty. If it is due to a tumour, and localised, then it must be ascertained if this is of a bony character, arising from an exostosis or fracture; or if it is movable and independent. If the latter, the case is not so serious, and especially if the tumour is connected with the sacro-sciatic ligament; as it may be pushed out of the way of the fœtus, and birth take place.

As Saint-Cyr insists, all these considerations should be weighed before deciding to terminate parturition by mechanical traction; for if the impossibility of accomplishing it by this means is discovered when too late, the other operations are rendered more difficult and dangerous, in consequence of the ineffectual attempts at forced extraction.

If extraction of the entire fœtus is discovered to be practicable and the position is favourable, then there should not be much difficulty in effecting delivery, which may be achieved as in ordinary circumstances. It will be much facilitated, should the fœtus and the passage be dry and tenacious, if these are lubricated with oil or soapy fluid.

If, however, the fœtus has become wedged in the passage and cannot be pulled through, it may be useful to push it back a little into the uterine cavity, and then lubricate it and the vagina with some oily matter to assist movement, before another attempt is made.

3. Enlargement of the Passage.—This is nearly always impossible in practice, unless the cause be a tumour which can either be excised or moved temporarily out of the way, so as to permit delivery.

4. Diminution of the Size of the Fœtus.—With the domestic animals, as we have repeatedly said, there are no moral considerations to oppose us when it comes to a question of sacrificing the fœtus to save the life of the parent. And with the Mare there should be no hesitation in this direction, when a careful examination has proved delivery of the

living or entire fœtus to be impossible, particularly when we remember that the young creature soon perishes.

With the Cow, however, the case is somewhat different, as when delivery is unsuccessful this animal may be killed and utilised as food. Embryotomy is, nevertheless, often resorted to before the case is considered hopeless; and not at all infrequently with good results, so far as the Cow is concerned.

We shall treat of embryotomy hereafter; but it may be useful to mention here that, in an anterior presentation, removal of one or both of the fore limbs at the scapula of the fœtus, will often allow the remaining portions to be removed by traction. With a posterior presentation, excision of one hind leg is frequently sufficient to permit the body of the fœtus to be drawn through the passage.

5. Establish an Artificial Passage for the Fœtus.—When all the preceding means have been recognised as impracticable or too dangerous, there yet remains another which, though it may place the life of the mother in great jeopardy, and should be considered only as a last and a most serious expedient, may be resorted to: this is the Cæsarian section, or gastro-hysterotomy—an operation to be described hereafter. It may only be noted in this place, that a formidable operation, such as this is, should be resorted to early, and before the female is much exhausted by inefficacious manipulations and impotent labour pains.

CHAPTER II.

Dystokia from Displacement or Changed Relations of the Uterus.

Delivery may be rendered difficult by displacement or altered relations of the organ containing the fœtus—the uterus, either from *hernia* of that organ through a natural or accidental opening in the abdominal parietes; from *deviations* in its direction, whereby the os is no longer in the axis of the pelvis; or *torsion* of the organ, due to its having made a revolution or become twisted on its own axis—a singular displacement that well merits attention.

Hernia of the Uterus—Hysterocele.

Every kind of ventral hernia may be viewed as more or less tending to dystokia, from the important share the abdominal muscles assume in the act of parturition; and when there is a tendency to hernia of any of the organs in this cavity, or when a hernia really exists, this is likely to be increased during labour, and may complicate delivery. But the case is generally all the more serious if the displaced organ is the gravid uterus itself.

Hernia of the uterus is certainly not a very common accident; nevertheless, it is far from being rare, if we are to judge by the instances recorded in veterinary literature, and it has been observed in the Mare, Cow, Sheep, Sow, Goat, and Bitch—in all the more important domesticated animals, in fact, and has often proved a very serious obstacle to parturition.

Origin and Symptoms in Uniparous Animals.

The *symptoms* and other features of this accident rather differ in uniparous and multiparous animals. In such uniparous creatures as the Mare and Cow, hernia of the uterus is generally not observed until pregnancy is pretty well advanced—towards the eighth or ninth month, or even later in the Mare, and the seventh or eighth month in the Cow. This delay is evidently due to the circumstance that, in the non-pregnant animal, the uterus is small, and closely fixed by its ligaments to the sub-lumbar region; so that if there is a breach in the abdominal walls, it is either the intestine or omentum which passes through it. When, however, pregnancy is advanced, the great size of the organ,

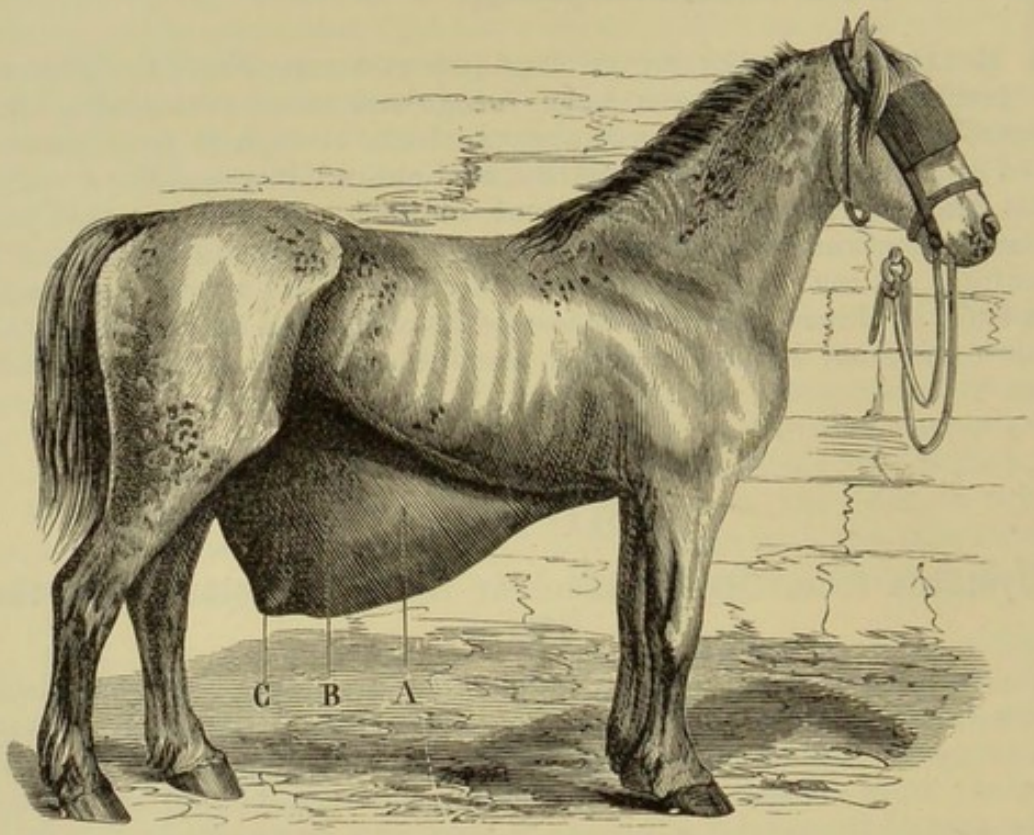


Fig. 84.

Uterine Hernia: Mare.

A, B, Hernial Tumour; C, Teat carried down by the Tumour.

together with its weight, brings it in contact with the parietes of the peritoneal cavity, and if there happens to be a weak part or a rupture, no matter how slight, the heavy uterus gradually forces itself through, and may in time escape altogether from the abdomen, along with other viscera.

It would seem that laceration of the abdominal walls may occur in other ways than through external traumatic influences, or any appreciable occasional cause; and it would also appear that, in some animals, there is a kind of predisposing relaxation or softening of the abdominal muscles, which leads to their being unable to support the gradually increasing strain thrown upon them by the heavy uterus, and its oftentimes very lively and energetic inmate. The muscles are stretched

and attenuated, their fibres are separated and some of them rupture, and in this way is formed a rent which gradually enlarges from the increasing pressure. Then a tumour appears externally and towards the lower part of the abdomen, though always a little to one side—usually the left in the Mare, the right in the Cow, and not infrequently in front of the pubis, in the mammary region. This tumour, when first noticed, is about the size of a child's head, and not clearly defined; but it rapidly enlarges, and in a few days may acquire prodigious dimensions—descending as low as the hocks, or even nearly to the ground, pushing the mammæ to one side or carrying them with it, extending as high as the vulva and almost as far forward as the sternum, giving to the abdomen a singular appearance (Fig. 84).

These extraordinary herniæ are most frequently witnessed in Cows (Fig. 85), though several veterinarians—among others, Lecoq, Binz, Leconte, Serres, Lafosse—have seen them in Mares. In very many

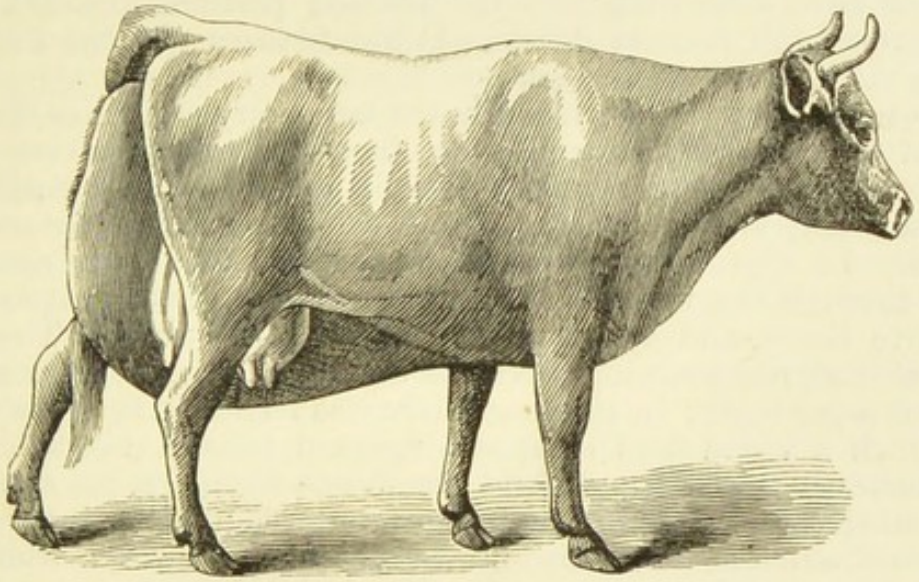


Fig. 85.

Uterine Hernia: Cow.

instances they are due to violent efforts, kicks, blows, and other external injuries.

When the hernia is recent, and especially if it occurs in the mammary region, it is generally surrounded by a considerable œdematous swelling. This swelling disappears after parturition, though the hernial tumour itself does not diminish in volume, the digestive organs having occupied the space previously held by the fœtus. Then the animal has a still more singular appearance, perhaps; for owing to this emptying of the abdominal cavity, the belly is wonderfully retracted and the flanks are so drawn together that the fingers may be made almost to touch through them on each side.

Before parturition, palpation of the tumour enables the fœtus to be distinguished—the head, limbs, and body being felt, while its movements are perceptible by the eye or hand.

As a rule, and contrary to what might be surmised, this uterine hernia does not appear to cause any loss of condition or inconvenience except in progression, which it interferes with, and causes the animal to move

with the hind legs wide apart. Aptitude for labour is also somewhat impaired, as may be imagined.

Origin and Symptoms in Multiparous Animals.

As has been mentioned, uterine hernia is observed in multiparous animals, but its manner of production would appear to be different to what it is in uniparous creatures, this taking place in the interval between gestations. The length and mobility of the cornua in such an animal as the Bitch, together with their close proximity to the abdominal walls, sufficiently explain how they may pass into an opening in these walls. There is formed, at first, a small tumour the size of a pigeon's or hen's egg; this tumour is soft, indolent, more or less easily reduced, and attracting perhaps little or no attention while the animal is unimpregnated, it remains stationary. After impregnation, however, it daily acquires larger dimensions; one or more ova have descended into the hernied portion, localised themselves there, and become developed into fœtuses without the Bitch showing much, if any disturbance.

The usual seat of the hernia is in the mammary region, to the right or left of the *linea alba*, though it may be also inguinal, or even vulvar.

An example of inguinal uterine hernia will be given hereafter; we will now briefly allude to a case of vulvar uterine hernia described by Rainard. In this instance the uterus, which had been apparently carried through the inguinal ring, was pushed backwards through the connective tissue, and appeared as a tumour at the vulva. The owner of the animal, not knowing what the swelling contained, opened it by means of a penknife; in this way there was formed a fistulous wound, from which a viscid fluid escaped. Rainard incised this fistula, and found beneath the skin a second membrane having some analogy to it, and which afterwards proved to be the uterus; to the inner face of this there adhered a reddish-brown vascular network, which was the placenta, and which was easily detached by the finger; within it appeared a transparent bladder—the amnion—already slightly perforated, and looking like the envelope of a cyst. Having opened this, there escaped a quantity of fluid, and a fœtus apparently three or four weeks old. The Bitch died next day.

When the hernia occurs in the abdominal region, it usually appears as an indolent tumour, the skin covering it being destitute of redness, and not attenuated in any way; the tumour itself is soft and fluctuating at different points where the *liquor amnii* is, but firm and resisting at others where the fœtus chances to be.

It may be noted here, that there may be other herniæ of the uterus besides ventral. For instance, Gellé describes a case of hernia of one of the uterine cornua which contained a Calf, and which had passed through a rent in the mesentery. And Rainard has observed several cases of this kind in the Bitch.

Pathological Anatomy.

The pathological anatomy of uterine hernia is not without interest to the obstetrist; and as it has been studied in animals which had died during attempts at parturition, or were slaughtered after that act, the evidence is as plentiful as it is reliable.

The chief and essential lesion is, of course, to be found in the abdominal parietes. The fleshy or tendinous fibres of the oblique muscles may be merely separated, especially at the commencement; though most frequently some of them are ruptured. The great rectus muscle always shows a solution of continuity, the rupture being sometimes as clean and sharp as if it had been made by a knife; though at other times it is irregular and lacerated. In every case there results a variable-sized opening, more or less circular, oval, or triangular, its larger diameter corresponding to the axis of the animal's body; Rodet has seen an opening of this kind measure nearly twenty inches.

The seat of the rupture varies; sometimes the rectus muscle is perforated at its pubic insertion, as Favre has seen it; in other cases it is elsewhere, but in every instance it is inferior—posterior to the umbilicus, and to the right or left of the *linea alba*. The latter structure is at first never involved; but when the hernia increases largely in size, it may in its turn give way; so long as it remains intact it forms a kind of cord extending from the pubis to the sternum, and by partially dividing the tumour, gives it a bi-lobular appearance.

In a few cases the *tunica abdominalis* resists the strain imposed on it, being only extended, and in this way the hernia has another covering in addition to the skin; but in many instances it tears, like the muscles. Delplanque has shown that the peritoneum may escape rupture, stretch and, accompanying the descending viscera, constitute a serous tunic to the hernia; most frequently, however, it gives way, the uterus passes through it, and then there is no hernial sac.

In a recent hernia, the connective tissue surrounding it is greatly ecchymosed and infiltrated, and the muscular fibres broken up and separated; the tendinous fibres are also disassociated and torn, and numerous red and partly decolorised blood-clots lie among their interstices. At a later period no extravasated blood is found between the skin and the uterus, but the parts are uniformly red; and, later still, attempts at repair are evidenced by cicatrisation of the borders of the rupture, which have then a rounded, thickened, and fibro-tendinous aspect, and are dense and resisting. The connective tissue beneath the skin is condensed into a kind of smooth membrane, continuous with the margin of the rent, and forms a second tunic to the hernia.

Before parturition the hernia is occupied exclusively, or nearly so, by the gravid uterus, which is wholly or in part lodged in this accidental diverticulum. After delivery, however, the uterus often, though not always, ascends into the abdominal cavity; but whether it does so or not, other viscera—such as the rumen with the Cow, and the colon and small intestine with the Mare—find their way into the pouch; Rodet has even found the uterus and the entire intestinal mass included in it.

Diagnosis.

The *diagnosis* of uterine hernia in the larger animals is not difficult in the great majority of instances, and especially if labour has commenced. In the first place, it is usually known to the owner that the animal is pregnant; and in the second place, if parturition has begun there can scarcely be any mistake made as to the nature of the expulsive efforts. Besides, there is the abdominal tumour with its peculiar characteristics, and by manipulating it the fœtus can be detected.

It will also be discovered that the tumour does not adhere to the abdominal parietes, and that it may be reduced by taxis.

But it may be necessary to ascertain the presentation and position of the fœtus, and if it cannot be born, what the nature of the obstacle is which prevents delivery. In such a case vaginal exploration must be resorted to; by it we may learn that the os is not dilated from one of several causes to be hereafter discussed; or the non-dilatation may be due to the uterine contractions not pressing the fœtal mass directly against the cervix, in consequence of the altered direction of the uterus, or the margin of the hernial opening strangulating the fœtus and hindering its advance. These obstacles must be combated by appropriate measures.

In consequence of the fœtus lying so far below the pubis, the hand introduced through the os cannot feel it, even when the whole length of the arm is inserted; in which case, if the animal is standing, the abdomen may be raised by means of a sheet or blanket, so as to bring the fœtus within reach. If the animal is recumbent and cannot rise, then it should be placed on its back and secured in that position, the croup being raised by bundles of straw. The tumour may then be examined by external palpation, as well as by rectal and vaginal exploration, and the position of the fœtus determined.

As a rule, the position is never quite normal. In the most favourable cases, the head is found to be directed backwards and near to the pubis—sometimes partly in the pelvis, with the face upwards and slightly forwards; the fore feet being more or less doubled back against the body, which lies deep in the tumour, and the buttocks resting on the mammæ of the mother—the fœtus being altogether, in the recumbent female, in the position of a sitting dog.

The state of the borders of the hernial orifice should be carefully ascertained, and their rigidity and tension, together with the degree of constriction they exercise on the body of the fœtus, noted. This important examination should be made before any traction is exercised on the fœtus; for on the information so obtained will depend the choice of means to effect delivery.

With the Bitch uterine hernia is frequently most difficult to diagnose, and errors are far from infrequent; the most common mistake is fixing on the tumour as a cancerous mass. But mammary tumours are very different to that of hernia; they are generally nodulated, very hard, and the skin is closely adherent to them; whereas the uterine hernia has not the fluctuation of a cyst or abscess, neither has it the resistance of a carcinoma, fibroma, or adenoma, while the skin covering it is smooth, supple, perfectly natural, without ulceration, discoloration, and other signs which mark the presence of mammary enlargements. The uterine tumour can also be reduced by taxis or manipulation, while the fissure in the abdominal wall can be felt. This, together with the fact that it is only developed rapidly after impregnation, and without any local or general inflammatory symptoms, or disturbance of the general health, should settle the question.

However, should any doubt yet remain, or if it is desired to ascertain the exact state of affairs, a more careful examination will be necessary, it being always borne in mind that this hernia in the Bitch appears in different regions. Vaginal exploration cannot be resorted to with this animal, because of the smallness of the pelvis—unless the Bitch is a large one, and then the fingers are too short to explore to any depth.

An external examination must, therefore, be relied upon, and this is easier and more certain than with the larger creatures. By it the size of the abdominal rent will be ascertained, and also whether the fœtus can be passed through it into the abdomen; though this is rarely possible, owing to the hernia occurring when the uterus was empty, and when it could pass through an opening which would not be sufficient for a fœtus when fully developed.

All manipulatory operations on the Bitch should be practised with as much tact and gentleness as possible, as the young are readily killed, while the female itself is very liable to metritis.

Indications.

Animals suffering from uterine hernia sometimes bring forth their young spontaneously, and without any bad results to themselves or their progeny; thus proving that the uterine contractions alone will expel the fœtus, and that the aid of the abdominal muscles is not absolutely necessary. More especially is this the case with the larger animals. Leconte mentions a Mare whose career he traced for five years, and which, notwithstanding the existence of this condition, brought forth four living foals—three without assistance, the fourth being in a wrong position. Cows which had most alarming herniæ have even brought forth twin Calves spontaneously.

But, as a rule, with these larger uniparous animals parturition is always more protracted and difficult than in ordinary circumstances, and the assistance of the veterinary obstetrist is needed to effect delivery; and this, after all, is in some instances impossible, and the mother and offspring are lost. This is more particularly the case with multiparous animals, and especially the Bitch, in which it is generally all but impossible to reduce the hernia or remove the fœtuses by the natural passage. Röll has, nevertheless, described the case of a Bitch suffering from uterine hernia, which brought forth its progeny in a natural manner; and Prange, in 1844, published the history of another Bitch that, unaided, gave birth to three Puppies which had been lodged in a hernia of this kind. A case occurred in my own experience of a small terrier Bitch, which, when I saw her, had what the owner and others thought was a very large mammary tumour. Soon after she brought forth two Puppies—one dead, the other, the largest, alive—and without help, when the supposed tumour completely disappeared. Sheather[1] describes a case of this kind, in which five Puppies were expelled without assistance.

When there are several fœtuses, some of them may be contained in a non-herniæd cornu, and so can readily be born; while those in the extruded horn may experience difficulty, and if the hernial sac is constricted at its neck birth may be impossible. So that if the Bitch lives and no operation is performed, the imprisoned fœtuses may be ultimately expelled by a process of ulceration of the abdominal walls.

At a meeting of the Medical Society of Strasburg, M. Kopp (*Gazette Médicale de Strasbourg*, 1875) exhibited the uterus and its appendages belonging to a Bitch upon which he had operated in order to extract a fœtus which was lodged in one of the uterine cornua. The animal had been restless for some twenty-four hours, when Kopp was called in to examine it. He found every indication of approaching parturition; but notwithstanding this, and the considerable volume of the abdomen, the os uteri was almost closed—a circumstance which decided him to wait. During the night the Bitch

[1] *Veterinary Journal*, 1887, p. 234.

gave birth to a dead Puppy, and on the following day the diminished distention of the abdomen enabled him to discover, beneath the skin, the presence of three fœtuses. On inquiry, he ascertained that for some time the animal had been suffering from an inguinal hernia on the left side, and this information led him to adopt active measures. The skin was incised over the isolated hernial sac, as far as the inguinal canal; then, after largely opening the tumour, as well as the uterine cornu it contained, he was able to remove the three dead fœtuses and their membranes. The prolapsed uterine portion, having been carefully cleansed, was closed by suture and returned to the abdominal cavity, and a strong ligature placed round the sac. The inguinal canal had been widely incised; but notwithstanding this, the reduction of the uterus and its appendages offered some difficulties, in consequence of the great mass of fat in and upon the broad ligaments surrounding them. Everything appeared to be going on favourably until the ninth day, when the animal suddenly succumbed. Death was attributed to purulent absorption, produced through the agency of a small abscess on the broad ligament, which had been abraded during the operation of reduction. There were no traces of metro-peritonitis, and the wound in the uterus, as well as in that portion of the sac which had been ligatured, was cicatrising most satisfactorily. According to Kopp, this was an instance of intra- and extra-abdominal pregnancy at the same time; and in proof of this, he pointed to the narrowness of the inguinal canal, and the presence of the uterine hernia previous to impregnation.

Three of the fœtuses were developed in the cornual hernia, and the fourth in the body of the uterus.

Chanel reports that a Sow brought forth young after a portion of one of the uterine cornua containing two fœtuses, and which had been hernied, was amputated.

Notwithstanding these instances, however, the assistance of the obstetrist is necessary to effect delivery, for which a careful examination, as in diagnosis, will indicate the means.

Previous to parturition the hernia should be supported, when possible, by a truss or retaining bandage, and care should be taken to prevent over-exertion or straining.

With the *larger animals*, delivery by the natural passage is, of course, the chief object to be attained. In certain cases, the simplest measure, and which is sometimes all that is necessary, is to elevate the hernia by means of a sheet or blanket passed under it, and raised by an assistant at each side of the animal. Manipulation *per vaginam* may supplement this support, and in the majority of such cases may even be absolutely necessary to complete delivery.

In other instances, however, the fœtus cannot be removed from the hernial sac without placing the female in a recumbent posture. Either lateral or dorsal decubitus may be resorted to, according to circumstances, but the preference is usually given to the latter position; though when lateral decubitus is tried, the animal should be placed on the side opposite to that in which the hernia exists.

In the dorsal position, the weight of the fœtus and uterus is removed from the floor of the abdomen; consequently, the abdominal muscles are relaxed, and the borders of the hernial opening are not so tense; while the uterus and its contents, by their own weight, have a tendency to escape from the hernia and fall into the abdomen; at the same time the fœtus is more accessible to the hand of the obstetrist.

Should the os be contracted, it must be dilated by the hand; if the membranes are intact, they are to be ruptured; should the fœtus make an unfavourable presentation, which is not very frequent in these cases, this can be rectified; and if the creature is dead, which is nearly always the case when assistance has not been rendered sufficiently early, and the membranes are ruptured, it can be all the more easily removed.

When the fœtus presents anteriorly and the head can be seized, this

should be brought into the pelvic inlet, and cords attached to the lower jaw, or Schaack's head-collar forceps (to be hereafter described) may be employed; then having secured the head, the fore limbs are sought for, and brought into the passage one after the other, where they are also secured by cords around the pasterns. Sometimes these limbs cannot be found, owing to their being bent back against the body of the fœtus, and this will certainly render delivery more difficult.

Should the fœtus present posteriorly, the case is more unfavourable; although if the hind limbs can be found and brought into the vagina, delivery may soon be effected if there are no other complications.

Cords being fastened to the pasterns, sufficient and well-directed traction should be employed on them, the hand of the operator remaining in the pelvis if necessary, in order to guide the passage of the fœtus. Saint-Cyr suggests that an intelligent assistant may at the same time be directed to make methodical pressure on the hernia, in order to complete its reduction, which is effected when the contents of the sac are returned to the abdomen.

At times this reduction is easy, and at other times it is extremely difficult. In the latter instances, all the more care is necessary that the external manipulations are not too forcible, if it is desired to have a living fœtus. Should the resistance prove greater than the means which may safely be employed to overcome it, then a surgical operation must be determined on. When the muscles of the abdomen prove an obstacle to the escape of the fœtus from the hernial sac, and produce a kind of strangulation, an incision may be made through them in the most convenient part, as in the operation for strangulated hernia of the intestine.

In other cases the Cæsarian operation may have to be resorted to, and speedily, if the mother or progeny, or even both are to be saved. Recourse to this formidable measure will only be had in particular instances: as when the mother or fœtus is valuable, and other means have failed or are not likely to succeed.

And in uterine hernia this operation is undertaken in far more favourable conditions than in some other circumstances which necessitate its adoption. In this accident only the skin, and perhaps also occasionally the *tunica abdominalis*, has to be cut through to expose the uterus, which has not to be sought for among the mass of intestines and laboriously withdrawn from their midst; indeed, it generally occupies the whole of the hernial tumour, and so closely, that there is no danger of the intestines escaping during the operation. A simple incision—no larger than is necessary—through the organ, a larger one through the fœtal membranes, and the prompt extraction of the fœtus therefrom, pretty nearly complete the task.

If the Cæsarian operation is timeously resorted to, the chances are greatly in favour of delivering a living fœtus; with the Cow a living and perfectly viable Calf is almost certain to be obtained, even a long time after labour has commenced and the "water-bag" has ruptured. And even with the Mare it is not at all impossible to rescue a living Foal, if the operation is resorted to before rupture of the membranes.

The chances in favour of the mother are, of course, fewer than with the fœtus; for under the most favourable conditions, after removal of the progeny, there will still remain the great hernial sac, which it will be most difficult to keep the intestines from occupying, and still more difficult to cure in a radical manner—judicious trussing and bandaging

being nearly all that can be done to palliate the effects of the accident.

All these considerations should, of course, be duly estimated by the veterinary surgeon in undertaking the treatment of such a case; and it is scarcely necessary to say that, with the Cow more especially, the butcher will frequently have to be called in when the question of risk and expense has been fairly discussed.

It need hardly be pointed out that it is generally very injudicious to attempt to breed from an animal affected with hysterocele, or an abdominal hernia of any description, notwithstanding the fact that this condition may not militate against gestation and parturition in every case.

With the *smaller* animals, and especially the Bitch, the Cæsarian operation has usually to be resorted to for various reasons, if birth cannot take place; the chief of these are the small size of the creature, the difficulty in reaching the fœtus or fœtuses and extracting them by the natural passage, as well as the irreducible nature of the hernia, which is often extremely constricted at the neck, and attempts at reduction are often followed by death. Besides, the Bitch withstands very serious operations in the abdominal region better almost than any other animal, the entire uterus having been frequently removed by abdominal section without a fatal termination. In this animal the operation is also very simple, and demands only ordinary care and manipulative skill.

Everything is, therefore, in favour of gastro-hysterotomy in uterine hernia of the pregnant Bitch; but in order to ensure whatever success may be possible, it must be performed early, and before serious injury has been done by attempts at reduction or delivery in other ways. It has been argued that it might be preferable to open the sac, divide the constriction which prevents reduction, and return the gravid uterus to the abdomen, when delivery might be effected in a natural and spontaneous manner. And it has been shown that this mode of operating is rational and possible, and may be followed by success should there be no adhesions between the misplaced uterine cornu and the hernial pouch. The experience gained in such cases, however, does not testify very markedly in favour of this procedure, and the evidence is certainly in favour of the Cæsarian operation, and particularly when adhesions exist.

The dangers to be apprehended from gastro-hysterotomy are inflammation and strangulation of the imprisoned cornu and of the uterus, which at this time is so vascular, impressionable, and particularly susceptible to the influence of the air on its internal surface. To avert these dangers, it has been proposed to remove the uterine horn altogether; and we are certainly of opinion that, in certain cases, the proposal is worthy of a trial.

We will describe the Cæsarian operation in another place.

Deviation of the Uterus.

By the term *deviation*, when applied to the uterus, is meant a change in the direction of the organ, by which the cervix and os no longer correspond to the axis of the vagina. This change of direction in the vaginal opening of the uterus may be productive of more or less difficulty in parturition.

Changes in the position of the uterus are somewhat common in woman, whose vertical uterus may easily deviate in any direction, producing those flexions and versions which not infrequently offer

serious obstacles to delivery. With quadrupeds, however, in which the uterus is horizontal, the veterinary obstetrist has but to deal with one kind of deviation of the uterus, the only one possible—that of *inferior obliquity*, which appears to be extremely rare, and corresponds to anteversion in the human female.

According to some authorities, who have more particularly studied it, this change in position may, in certain circumstances, become a very serious cause of dystokia.

The accident has, up to the present time, only been observed in the Cow; and this circumstance is believed to be explained by an interesting feature in the anatomy of this animal, which has been brought under notice by Professor Goubaux, of the Alfort Veterinary School.

It would appear that in Bovines, as noted at p. 18, the abdominal muscles are not attached to the anterior border of the pubis as in Solipeds, but are inserted into a thick ligament found at the external and inferior part of the pubic bones, and which strengthens the symphysis pubis. It consequently happens that, at this border of these bones, the floor of the abdomen is on a lower plane than that of the pelvic cavity; so that there is a kind of step between the two cavities, the height of which varies in different animals, but has been found to be as much as three, four, and even five inches. Dissection has demonstrated that the peritoneum lining the lower surface of the abdominal cavity, on arriving at the pubis ascends this step, in covering it like a carpet, to line the upper surface of the pubic bones and the anterior part of the pelvic cavity.

From this anatomical peculiarity, it may happen that the fundus of the gravid uterus, instead of being directed forward, will incline directly downwards and lie on this pelvic step, not passing beyond the umbilicus, behind which it may even rest sometimes. At the same time, and as a consequence of this arrangement, the other end—the cervix—is tilted upwards in the direction of the sacro-vertebral angle, and it may even compress the rectum against that part. It will be obvious that, through this great deviation in the direction of the cervix, the os no longer corresponds to the axis of the vagina, the canal following, of course, the same oblique ascending line as the cervix. Such an alteration in the position of the uterus entails a similar change in the attitude of the fœtus, which, instead of being placed almost horizontally, is now more or less vertical—the head towards the sacrum, and the buttocks resting on the pubic step.

During parturition we may easily understand how affairs are changed with regard to the performance of this act. The uterine contractions are no longer directed towards the cervix; the os only dilates slowly or not at all, according to the degree of uterine obliquity; the animal is exhausted with ineffectual attempts to expel the fœtus; and if assistance is not rendered, it may succumb without being delivered, or the uterus may rupture. If the position of the fœtus is abnormal, then the case is still worse, so far as artificial delivery is concerned. Garreau has observed that labour may be suspended altogether; the fœtus dies, becomes mummified, and is retained for perhaps a very long time.

Diagnosis.

The diagnosis of this deviation does not appear to be attended with much difficulty. The long duration of labour, and the inutility of the

expulsive efforts, prove that some obstacle to delivery must be present. Consequently, vaginal exploration is resorted to, and when the hand is passed into that canal it reaches a kind of imperforate *cul-de-sac*, at the bottom of which is a large round tumour into which no opening can be found. This tumour is the lower face of the uterus, which, pressed against the corresponding wall of the vagina, projects into the pelvic inlet. Raising the hand towards the sacrum, the os will be discovered much removed from its normal position, and situated above and in front of the uterine tumour just alluded to.

Sometimes the os is completely closed, in other cases it may be more or less dilated. When in the latter condition, there is frequently formed at this point a kind of membraneous transverse fold, raised in the form of a valve, which has been compared to a fleshy band analogous to that which forms the sacculations of the large intestine; this band is stretched across the lower part of the os, and it has to be surmounted before the hand can touch the fœtus. The latter is lodged in a kind of pouch or excavation situated beneath the band, and constitutes the tumour met with at first at the bottom of the vagina.

The more or less vertical position of the fœtus should also serve as a guide.

Complications.

To Saint-Cyr, Garreau, and Schaack, we are indebted for our description of the condition we have been describing, and to the two latter are also due the knowledge we possess of certain complications which are worthy of notice.

Garreau has found the cervix in this uterine deviation thickened, indurated, and the os closed. Delivery was impossible, and the fœtus remained for three months in the uterus without causing any great inconvenience to the Cow. At the end of this period the Calf was extracted by Cæsarian section, and with perfect success; as the Cow quite recovered, and was sold at a good price eight months afterwards.

In one of the cases described by Schaack, the fœtus was in the vertebro-sacral position, and the limbs and head having been secured by cords, delivery was accomplished by strong traction. In a quarter of an hour afterwards, however, the Cow lay down, trembled all over, the muscles of the limbs and the eyes contracted in a convulsive manner, and death rapidly ensued.

At the autopsy, which was made six hours after death, a quantity of blood, in the form of a large clot, was found in the abdomen, and the textures about the pubis were infiltrated with that fluid. The uterus had resumed its ordinary form, and its mucous membrane was intact; but at the inferior part of the organ there was a large triangular tear, about six inches long and four wide; and it was noted that this laceration had caused the rupture of two good-sized arteries, which of course led to the hæmorrhage that caused death so rapidly.

Indications.

The indications for treatment in this deviation are simple; raise the fundus of the uterus, lower the cervix, and bring the os in line with the vagina. When this is accomplished, the uterine contractions will act directly on the cervix, and if this is healthy, dilatation of the os will soon take place; then the fœtus, pushed towards the vagina, instead of against the sacrum, will enter the passage, from which a little judicious

manipulation will in all probability remove it, and thus complete delivery.

Several modes of procedure have been recommended for adoption in carrying out these indications. Indeed, Saint-Cyr states that when the deviation is inconsiderable, and the band mentioned as obstructing the os is not present, reduction is often spontaneously effected by mere decubitus. This, in pushing upwards the fundus of the uterus, brings down the cervix to its normal position by an easily understood tilting movement. Schaack has noticed this to happen in two instances.

In such cases, says Rainard, if the animal persists in standing, it may suffice to raise the belly by means of a folded sheet or blanket, or even a plank held by an assistant on each side of the Cow; or the creature may be gently thrown down on a thick bed of straw.

In difficult cases, however, these measures will not be sufficient, and Garreau recommends the following procedure to be adopted. Introduce the right hand into the rectum and the left into the vagina; with the first press on the head of the fœtus, and push back its body (the vaginal tumour), with the second, tilting, as it were, the young creature into its natural position. This will bring the uterus into its normal situation, and consequently place the os opposite the vagina.

Saint-Cyr, nevertheless, gives the preference to the method recommended and practised by Schaack in these troublesome cases, inasmuch as it is more simple, and experience has demonstrated its efficacy. This method consists merely in throwing down the Cow most carefully, placing the animal on its back, and keeping it in that position by bundles of straw. The weight of the fœtus carries the uterus down towards the spine (inferior); the fundus of the organ is depressed, and the cervix raised towards the pubis (now superior); the obliquity of the uterus is thus got rid of.

Schaack has on two occasions resorted to this mode of reduction, and in each case the abnormal valve disappeared, and parturition was rendered easy.

Professor Peuch, of the Lyons Veterinary School, states that in a case of this description he employed Schaak's method; when the Cow was placed on its back the obliquity disappeared spontaneously, and with the greatest facility.

Torsion of the Uterus: Contorsio Uteri.

Torsion, or "twisting" of the gravid uterus on itself—and which often involves not only the cervix of the organ, but also the vagina—is an accident unknown in the pregnant human female, but for anatomical reasons may occur in animals, and particularly in the Cow, in which it has been most frequently observed. The accident is rare in the Mare; it has been observed in the Sheep and Goat, as well as in the Cat; but though in the Sow and Bitch the uterine cornua may become displaced and twisted on each other, and even become hernied by the broad ligaments, yet torsion of the uterus has not been noted in them, so far as can be ascertained.

The accident will be first studied in the Cow, and afterwards in the Mare and other animals.

History.

Though torsion of the uterus is now recognised as a serious, but not insurmountable obstacle to parturition, yet its existence may be said

to be of recent discovery; for though it was clearly and explicitly indicated in the last century by Boutrolle (*Parfait Bouvier*, second edition, 1766), yet it was not until after much observation and discussion in this century that such a condition was proved to be possible. Boutrolle wrote: "If it is possible to pass two or three fingers into the os (*vêlière*), the hand and arm may be forced through; but if, on the contrary, a finger cannot be passed into it, and the opening is found to be turning, it is a sign that the os is twisted—*that it has made a half-turn on itself*—and it is impossible to enter it."

Though Veterinary Science had gained a sound footing in France soon after the publication of Boutrolle's "Perfect Cowherd," yet its students do not appear to have paid any heed to the amateur's description of the spiral twist of the *cervix uteri*, the difficulty in penetrating the *os*, and the impossibility of birth taking place through it. Indifference or incredulity may have prevailed; and it was not until painful experience had awakened attention to the existence of the accident, that the veterinarians of this century began to notice it.

Nevertheless, in France, Boutrolle's "Cowherd" appears to have been carefully read and usefully studied by those for whom it was written—the country-folks or cowmen, or he may have gained his knowledge from these; for, according to Saint-Cyr, one of their great problems in cases of difficult parturition—a problem not confined to the cowherds of France—was to discover if the calving Cow was not "barrée" (obstructed), if it had not the *torche*, *vêlière*, or *portière torse*, *torte*, or *tordue* (cervix twisted), terms employed according to the localities and dialects, and which signify what Boutrolle has distinctly described.

At the commencement of this century, however, we are informed by Rainard that Maurin of Cantal, and Vieillard of Brioude, two of his pupils, had witnessed this form of dystokia.

In France, other veterinary observers afterwards published similar cases, the first in order being Lecoq, of Bayeux, who in 1837 had occasion to note this accident. In a *Mémoire sur le part laborieux*,[1] he expresses his surprise at the silence prevailing among veterinary authorities with regard to this condition, which was met with from time to time, and was well enough known to breeders. In describing the symptoms he had noted, Lecoq says: "The hand having been introduced into the vagina, and pushed as far as the neck of the uterus, encountered a kind of valve obstructing the entrance to the latter. I was beyond the part I had taken for a valve, and had got into a narrow canal *which had the form of a screw* (*ayant la forme d'une vis*). The Cow died on the following day without having been delivered, and at the autopsy it was found that the uterus was completely turned upside-down — the superior face having become the inferior—and that this version had taken place from right to left."

The first Continental veterinarian who observed—or rather, who described—a complete rotation of the uterus (the previous cases recorded were only those of half-rotation) was Richner, a professor at the Berne (Switzerland) Veterinary School, who, in his "Systematic Treatise on the Diseases of the Bovine Species" (published in 1840), mentions it, and advises rolling the body of the Cow as a means of remedying the accident. In 1842, Blickenstorfer, professor at the Zurich Veterinary School, also wrote a memoir on it. The first in France to direct special

[1] *Comptes Rendus de la Société Vétérinaire du Calvados et de la Manche*, 1838.

attention to it, was Mazure, whose description is one of the best we possess. It is published in the same periodical which contains Lecoq's account. From his narrative, it appears that he was consulted by one of his colleagues with regard to a Cow, the cervix of whose uterus was so twisted that a finger could not enter the os. Mazure gave an unfavourable prognosis; but, notwithstanding, it was attempted to reduce the torsion by making an opening in the right flank in order to reach the uterus. The attempt failed, though it demonstrated that there was a quantity of fœtid serosity and fibrinous flakes in the peritoneal cavity; that the uterus had a rupture in its left posterior border, the rent being rounded in form and having a diameter of from twenty to twenty-four centimetres; and that the fœtus was dead, as had been suspected.

As nothing more could be done with the Cow, it was destroyed, and it was then discovered that the uterus had made a complete revolution on its axis; while towards the part adjoining the cervix, there were found five spiral twists, two of which, more voluminous than the others, were of a greyish colour and hard in texture. Throughout the whole extent of these twists in the uterus, the connective tissue, infiltrated with serosity, formed a swelling which rendered the dilatation of the posterior part, and the passage of the Calf through it, most difficult. The fœtus was perfectly developed and intact, and did not appear to have been dead more than two or three days.

Another Norman veterinarian, Pouchy, described four cases about the same period. These Cows merely suffered from loss of appetite, great distention of the abdomen, unhealthy-looking coat, a fœtid and sanguinolent vaginal discharge, and suppression of milk, for six to eight weeks; when submitted to treatment, and turned out to pasture, they recovered sufficiently to become fit for the butcher.

In Germany, about the same time, according to Dieterich, torsion of the uterus had been the subject of investigation and treatment by Schmidt of Bavaria, Vix of Giessen, Fricke of Hanover, and Irminger. Fricke cured a case by fastening the feet together, two by two, and rolling the animal in a contrary direction to that in which the uterus was twisted.

In Britain, in the same year that Reichner described the accident in Switzerland (1840), Mr. Carlisle, of Wigton, under the head of "Cæsarian Operation"[1] describes an undoubted case of torsion. The circumstance which rendered the operation necessary, was a severe injury the animal had received two days previously, since when it had manifested symptoms of parturition; but though several attempts had been made to extract the fœtus, delivery could not be accomplished *owing to the uterus being twisted.* Cæsarian section having delivered the Calf and its membranes, the Cow only lived a short time. The uterus was found to be "completely rotated, even to the termination of the vagina."

After this period, torsion of the uterus attracted a large share of attention among the most accomplished Continental veterinarians, and particularly after the observations published by Dénoc, in France, in 1845. It formed the subject of animated and interesting discussions at the Belgian Société de Médicine, the Société Central de Méd. Vétérinaire of Paris in 1853 and 1860, the Veterinary Society of Wurtemberg in 1854, and that of Denmark in 1855; and memoirs on it have been

[1] *Veterinarian*, vol. xiii., p. 407.

published by Bordonnat, Rossignol, Gaven, Bouley, Canu, Lemaire, Chambon, Goubaux, Chauveau, Weber, Liautard, Dagoureau, Lessona, Ollivero, Ercolani, Lafosse, Chuchu, Goron, Obig, Heu, Rocco, Marlot, Gourcy, Coquet, and many other foreign veterinarians; while it is alluded to with more or less detail in the treatises of Rainard, Baumeister and Rueff, Zürn, Harms, Lanzillotti-Buonsanti, Cruzel, Saint-Cyr, etc.

In this country it did not receive much attention for some years, if we are to judge from the paucity of allusions to it; though there can be no doubt that the accident frequently occurred. But in recent years many cases have been described by Cartwright (Whitchurch), Woods (Wigan), Bennet, Cox, Russell, Macgillivray, Cunningham, and others. Their observations refer to torsion of the uterus in the Cow.

With the Mare, in which the accident is nearly always fatal, it has been witnessed by Belhomme, Elsen, Delwart, Hamon, Noll, Devaux, Canu, Leconte, Schmidt, Münich, Anderson, and Cox.

It has been observed in the Ewe by Lewis, in the Bitch by Macgillivray, and in the Cat by Vivier.

Nature and Frequency.

Before proceeding to describe the symptoms and other features of this curious accident, it may be well to inquire into its nature and frequency.

As the designation indicates, the accident consists in a rotation of the uterus on its axis, by which its upper surface may successively become lateral and inferior; and lateral on the opposite side and superior, when the revolution is complete. This revolution may take place in two opposite directions; the upper face may at first be *left lateral* or *right lateral*—the first constituting *left torsion*, the second *right torsion*.

Torsion may be *incomplete* or *complete*. There may be *quarter-torsion*, *half-torsion*, *three-quarter torsion*, or *complete torsion*, according to the degree of rotation the uterus has experienced. In those instances in which the organ has made two complete turns, we have a *double torsion*.

The consequences of this rotation are easily seen. The vagina and its prolongation—the cervix uteri—because of their attachments, cannot follow the uterus, and therefore become twisted in a cord-like manner; whence arises stricture of the os—the constriction being all the greater as the rotation is complete—and utter impossibility to effect delivery of the fœtus unless the uterus is replaced in its normal position, or its contents are removed otherwise than through the os.

Incomplete torsion is by far the most frequent form encountered in practice. It is often so slight that it might rather be classed among the deviations of the uterus already alluded to. For instance, very frequently there is only a trifling displacement of the cornu containing the fœtus, and this may carry the uterus with it, giving rise to a condition which bears a certain analogy to the uterine obliquity met with in woman, in which the organ is inclined laterally. Schaack, Rainard, Weiss, and Zundel have often noted these cases in animals; and the latter states that they occur in greatest proportion among the larger lymphatic Cows. In other instances, the torsion consists of a quarter or half-turn, the upper face of the uterus having become lateral or inferior; sometimes the gravid cornu occupies the inferior region of the

abdomen; and at other times, making a wider rotation, it is lodged in the opposite flank.

There are scarcely any means in practice by which we can estimate, with mathematical exactness, the degree of torsion the uterus has undergone; as what we have designated a quarter-turn or revolution only signifies that the organ has made a rotation of 90°, while the half-turn is scarcely 180°. Nevertheless, an approximation is all that can be looked for, and, indeed, is all that is necessary.

As we have already mentioned, Mazure, in 1842, had a case of complete rotation of the uterus on its axis; this was remedied by causing the organ to turn completely round in the opposite direction. Other writers have spoken of a complete rotation in some cases, but it may be surmised that it was only a half-turn. Double, treble, and even quadruple twists have been described; because there have been found two, three, or more spiral ridges or doubles close together, hard, and resisting,

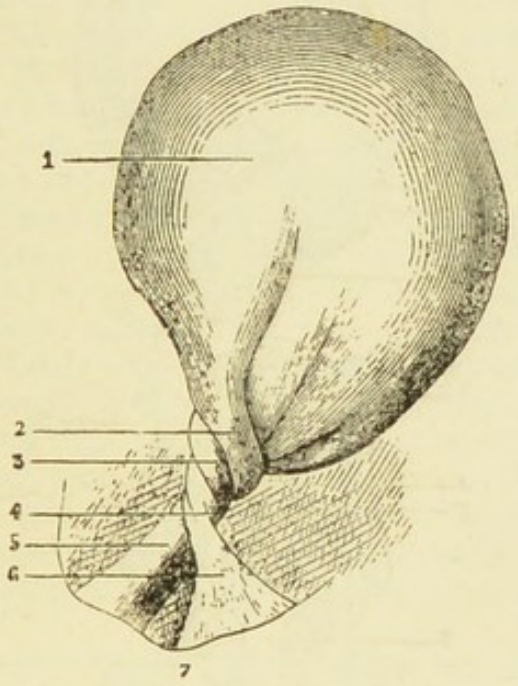


Fig. 86.

INCOMPLETE TORSION OF THE UTERUS.

1, Body of the Uterus; 2, 3, 4, Spiral Twists directed from left to right; 5, Cervix Uteri and Vagina; 6, Suspensory Ligament; 7, Pelvis.

and usually parallel to each other. But these multiple plies are only what a somewhat long and supple cylinder makes when it is twisted.

To account for these multiple *plicæ*, which have erroneously been taken for so many complete turns of the uterus, we have only to accept the illustration offered us by Delafond, who, comparing that organ to a long stocking, puts a weight in the foot of the latter, and gives it a turn in the middle, keeping the open or upper end fixed. Or a small body, to represent the fœtus, may be enclosed in the middle of a handkerchief—the uterus—so as to make a sac. If the end containing the body be turned or twisted on itself, the neck of the sack will have a first ply, representing one-fourth of a complete twist; a second ply will represent the half of a complete twist or turn, and will cross the other; so that when a complete turn has been made, it will be found that there are at least four plies or strands.

Notwithstanding this illusion, however, it is certain that double and even multiple torsion of the uterus may exist; but then the body of the organ and the vagina are close twisted like a cord. This multiple torsion is discovered on making the autopsy of an animal which has died or been killed because of non-delivery. In such a case, it requires two or more turns of the uterus to bring it to its normal position. Such a complicated condition would appear, however, to be very rare.

An important question is that relating to the possibility of such an accident occurring to an organ like this, which is attached to the pelvis by its continuation—the vagina—suspended to the vertebræ in the lumbar region by broad ligaments, and maintained *in situ*, in addition,

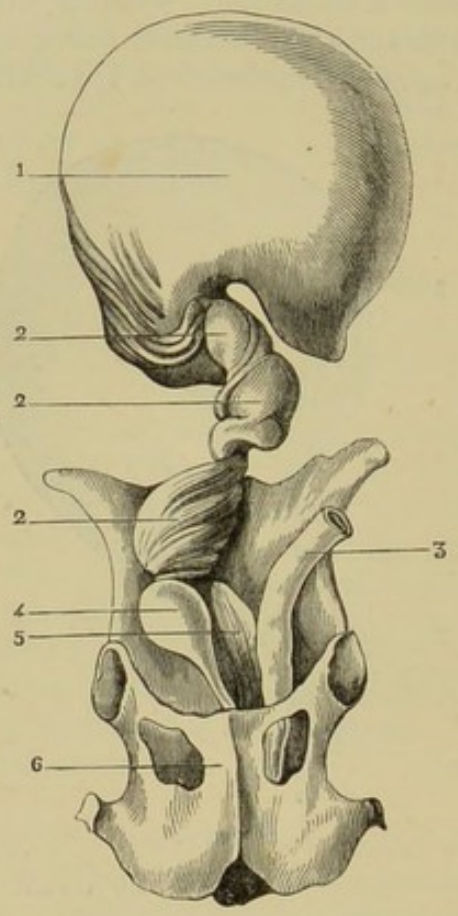


Fig. 87.

MULTIPLE TORSION OF THE UTERUS.

1, Body of the Uterus; 2, 2, 2, Torsion, involving the Body of the Organ; 3, Rectum; 4, Bladder; 5, Vagina; 6, Symphysis Pubis.

by the neighbouring viscera, and more especially by the rumen in the Cow—the animal in which uterine torsion is observed by far the most frequently.

This question can be answered by a reference to what we have stated with regard to the anatomy of this portion of the generative apparatus, at pp. 39, 43, and 46. We have seen that, in the Cow, the concave curvatures of the uterine cornua look downwards, and that it is to these concavities the broad ligaments are attached; so that if the uterus be considered as freely suspended in the abdomen, the extremity of each cornu is turned outwards and upwards, while its base, near the body of the organ, although drawn in the same direction by the ligaments, yet

retains its position, being firmly maintained in it by the body of the uterus, which also receives the insertion of the broad ligaments on its lower face. This insertion causes the uterus to project above the ligaments, which are very broad, particularly at their anterior border, and widely separated from one another in front, near their lumbar attachment. The ligaments suspend the uterus loosely in the abdomen, and allow it to become fully developed during pregnancy. At this period, too, they become greatly increased in substance and length. As gestation advances, nearly the whole of the great size of the uterus is due to the development of the one horn in which the fœtus is situated; and as the other horn retains its normal size, the twisting of this around its ligament, and consequent torsion of the cervix, can be readily understood.

Such is the explanation of the accident given by Chauveau; but Goubaux does not quite assent to it. According to him, it is not because one horn of the uterus is developed more than another, neither is it owing to one of the broad ligaments being longer than its fellow; it is in consequence of the development of the cornua during gestation, and their projecting greatly beyond their means of attachment or suspension, the broad ligaments being thrown altogether back. During pregnancy the cornua are considerably lengthened, while the ligaments do not increase in breadth, their points of attachment to the inner face of the flank or the ilium remaining invariably the same. This projection of the gravid cornu beyond the broad ligament supporting it—and which may be as much as nearly two feet—must render the production of the torsion remarkably easy. We have shown that the uterus is suspended in its ligaments as in a hammock, and if these ligaments increased in width as the gravid organ is developed in size, so as not to be overlapped by the cornua, then it might to a certain extent roll about in the hammock, but could not twist around it. Even if the uterus were suspended at the extremity of the ligaments, as in the Mare, it would be far less liable to torsion, and would swing in the abdomen like a kind of pendulum.

As it is, the projection of the gravid uterus beyond its means of suspension, the peculiar attachment of the broad ligaments to the lower face and concave border of the cornua, and a large proportion of the weight being situated high above and in front of these ligaments—all this makes us comprehend how a shock of any kind may throw the organ off its hammock, and produce incomplete, or even complete, torsion in the pregnant Cow without rupturing the hammock itself.

Rueff and Ercolani have witnessed cases in which the torsion was confined to the gravid cornu; and Stockfleth mentions its occurrence in the body of the uterus, in front of the cervix. Most frequently, however, it involves the vagina, as well as the cervix and body of the organ.

In certain cases alluded to by Zundel, the accident has been accompanied by rupture of the ligaments; and instances are recorded by Dense and Albrecht in which the rupture has extended to the uterus itself. Rueff alludes to a case in which the fœtus had even escaped into the abdominal cavity from a uterus thus ruptured, and, developing in the peritoneal sac, constituted an extra-uterine pregnancy.

With regard to the direction of the torsion, several authorities have maintained that it takes place from left to right. Others, however, have found it to be in the contrary direction, and there appears to be no

reason why it should occur in one way more than another, as the fœtus is developed in either cornu irrespectively. Reynal, however, believes that the obliquity of the inner face of the rumen might dispose the uterus to torsion towards the right. Chauveau is, we think, justified in asserting that torsion always takes place inwards and upwards—the fœtus slipping off its hammock causes this to swing round either to the right or left.

The relative infrequency of this occurrence in the other domesticated animals, is undoubtedly owing to the different arrangement of the uterus and its suspensory ligaments.

With regard to the *frequency* of the accident, this depends upon several circumstances, the chief of which, perhaps, are related to the nature of the country in which the animals are reared, as well as to the manner of rearing them. This will explain, partly or wholly, why veterinarians in one locality are familiar with the accident, while others with as extensive experience never witness it.

Leconte states that he has observed it about a dozen times, in between three and four hundred cases of difficult parturition. Lemaire has met with it seven times in four years; and Rocco speaks of having witnessed about thirty cases of uterine torsion during forty years' practice.

Etiology.

Torsion of the uterus ordinarily occurs towards the termination of pregnancy—about the eighth or ninth month, and its *causes* appear to be very diverse, if we are to accept the numerous opinions which have been offered on this point.

The cause which, of all others, appears to operate most frequently in producing this condition, is a *slip* or *fall*, and particularly on the hind quarters—croup or hocks.

For this reason, uterine torsion is oftenest witnessed among Cows at liberty in pastoral countries where the ground is broken, intersected, or hilly. Therefore it is, also, that the accident is not at all uncommon in Switzerland and the hilly parts of South Germany; while it is almost unknown on the plains, and is very rare indeed among Cows kept in sheds.

Sometimes the Cow has slipped upon its hind-quarters and tumbled over, through coming in contact with another. Marlot and Liautard have seen it arise from a horn thrust in the flank by a companion Cow, the blow throwing the fœtus and the uterus round to the opposite side. It has occurred in a Cow which was often butting with others. Chambon has noted it in a Cow which was in the habit of rolling like a horse; Dagoureau reports it occurring in a pregnant Cow which leapt on others like a Bull, and Liautard in another that used to get its fore feet in the manger. Rocco states that it is produced in shoeing at the forge, when pregnant Cows are either thrown down or put in the travis to be shod; and Rueff mentions a case in which it happened through casting a Cow for the purpose of performing an operation on it. In other instances it has been ascribed to falling when jumping a ditch, or slipping up when descending a steep hill.

Reynal, Mignon, Chambon, Weber, and others, appear to consider meteorism as one of the most certain and most frequent causes of uterine torsion, through the displacement of the viscera which the distension occasions. Either the expansion of the rumen induces unusual

and inordinate movements on the part of the fœtus; or it acts directly on the uterus, and produces displacement of the organ through the changes in situation and relations imposed on the other abdominal organs. Mr. Cartwright, of Whitchurch, was of opinion that great distension of the stomach may, either of itself, or especially in connection with a fall, cause the uterus to be forced on one side, or twisted.

Other authorities, among whom we find Ercolani, attribute the accident to severe toil when Cows are worked—as in draught; others, to deformity or malposition of the fœtus; and others, again, think it may be mainly, if not exclusively, due to the spontaneous and energetic movements of the fœtus *in utero*, towards the termination of pregnancy. It is well known that these movements are sometimes very lively and powerful, and especially when induced by sudden jerks or blows inflicted on the pregnant animal, or when the abdomen is compressed, after the ingestion of cold water, etc. There can be no doubt that the movements which the fœtus executes in order to get rid of uncomfortable sensations or avoid unpleasant positions, gives rise to those various attitudes and mal-presentations which so frequently render birth difficult, if not impossible; and their occurrence may also explain how the young creature may be the means of causing the cornu in which it is contained, to roll and twist around the vacant cornu on the opposite side. In this way Colin endeavours to account for those cases in which the uterus has made several revolutions on itself when the movements persist—a very rare accident, it is true; while he admits that the quarter or half revolutions—which are, after all, most frequent—may occur without the active intervention of the fœtus, or even of the uterus, and may take place through falls or slips.

Torsion from the above cause is all the more feasible, as at the end of pregnancy the amniotic and allantoic fluids are diminished in quantity, and the membranes and uterus are therefore applied closer to the fœtus, and may follow its movements more readily.

Chambon and other veterinarians are of opinion that the irregular and often violent movements which the pregnant animals, and especially primiparæ, manifest when the labour pains commence—lying down and getting up again, throwing themselves first down on one side, then on another, and sometimes even rolling—are the most frequent cause of torsion, which, according to them, only takes place at parturition. The latter opinion is supported by a case described by Landel, in which, when he made a first exploration of the genital passage at the commencement of birth, there was no obstruction; but soon after, on again exploring, he found that torsion of the cervix uteri had occurred in the interval.

Other authorities have supposed the accident to be occasioned by premature straining in parturition, before the os is sufficiently dilated; while others, again, have attributed it to pregnant Cows in sheds not having enough space to lie down.

Lessona and a few others believe that the accident may be due to the habit that certain Cows have of rolling themselves alternately from right to left when they are lying. On the sternum they may do this; but though among Solipeds and other animals rolling on the back is a perfectly natural movement, yet it is rarely if ever witnessed in the Bovine species. Sternal or abdominal rolling could scarcely produce displacement of the uterus.

Rupture of one or both of the broad ligaments has been indicated by

Leconte as always present in torsion; but this is an error, as such a lesion is found to be exceedingly rare after death. But rupture of either or both of these important suspensory bands may take place when pregnancy has well advanced, and there is a severe strain upon them. Then it can be readily understood how the uterus, rolling about among the digestive viscera and mainly retained by the cervix and vagina, may twist and twine on itself, and thus effectually occlude the os.

Torsion of the uterus has been witnessed by Pouchy, subsequent to a birth in which there was eversion of the vagina and uterus.

In all likelihood, the stretching of the broad ligaments, through repeated pregnancies, predisposes to it; though this cannot be the sole cause, as torsion is often met with in primiparæ.

Displacement of the uterus by the pressure of a diseased kidney has been recorded by Rueff. The kidney was of great size, and weighed more than thirty-three pounds.

Symptoms.

We have stated that this accident always takes place towards the termination of pregnancy—from the eighth to the ninth month. But Wegerer, Benzle, and other veterinarians, assert that they have witnessed it so early as the fifth month. Without disputing the correctness of their observations, it must be admitted that, during the early periods of gestation, the means by which the uterus is retained in its situation are sufficiently powerful to prevent any displacement of this kind; and that it can only be at a late period, when the fœtus is fully developed, and, with its membranes, has attained its maximum size and weight—so far as uterine life is concerned, that such an occurrence is likely. And the existence of torsion is generally only discovered when the time for the expulsion of the fœtus has arrived; though it has been said that parturition takes place earlier when torsion is present.

As a rule there is no particular indication of inconvenience or suffering at the moment when torsion of the uterus has taken place, if it has occurred before parturition; and it would appear that gestation may go on to its termination without any appreciable symptoms being noted, or anything like functional disturbance observed.

Even in the initial stage of parturition, when enlargement of the udder, sinking of the croup, swelling and dilatation of the vulva, etc., have become manifest, there is no sign which can be relied upon to prove the existence of torsion. Only in some instances it has been remarked that the tumefaction of the vulva is not so great as in ordinary cases, and that it remains dry, and appears to be buried more deeply between the ischial tuberosities.

Occasionally some difficulty in micturition is observed before parturition, should torsion have occurred—the urine escaping only in small quantity at a time; or there may be total suppression. This interference with the discharge of the urine is due to the compression the bladder experiences from one of the twists in the uterus.

The first labour pains, which soon appear, are usually feeble, and are separated by a comparatively long interval of quiet, during which the animal appears to be nothing amiss. Nevertheless, as time goes on, symptoms of colic are evinced now and again, and though the labour

pains succeed each other more rapidly, and become more energetic, yet birth does not seem to advance; the "water-bag" does not show itself, and nothing appears externally. This condition may persist for six, twelve, twenty-four, and even forty-eight hours; when, if not before, the veterinarian is perhaps requested to attend.

In other instances, however, the symptoms are more marked and severe during this first period. The animal appears to suffer from the pain of intense uterine and abdominal spasms, marked by violent straining, which comes on at longer or shorter intervals; it moves about anxiously; paws energetically now and again; attempts to lie down; rests on its chest or sits like a dog on its hind-quarters; springs up suddenly, and often with a bound. The pulse is quickened, the skin becomes alternately hot and cold, moist and dry; and the expulsive efforts, though so violent, are of course futile.

In many instances, after a period varying from twelve to forty-eight hours, these symptoms may disappear, and the animal seems to have recovered, for the time at least, its ordinary health. To such an extent does this occur, that it might be believed the period of birth had not arrived, and that the symptoms were only those of "false pains."

In the course of from one to six days, however, this normal quietude is interrupted by the recurrence of the labour pains, and in so urgent a form that there can no longer be any doubt as to real attempts at delivery. But still the efforts are not succeeded by any tangible evidence that birth is making progress. As some obstacle to the expulsion of the fœtus now evidently intervenes, a manual examination will probably be made by the veterinarian, if he has chanced to be called in, and after he has heard the history of the case and noted the general symptoms.

The oiled hand, on being introduced into the vagina, meets at first with no obstacle in that canal; but on advancing into it, the fingers soon encounter one or more folds or rugæ, which render the passage more and more constricted towards the cervix uteri. Towards the termination of the vagina, the fingers reach a kind of *cul-de-sac*, formed by the mucous folds, which at this part converge in a spiral manner, their direction being either to the right or left. Although at first there appears to be no passage, yet it will be found that by turning the hand in the same spiral direction as the cavity winds, or rather the rugæ incline, the fingers will be able to penetrate to a certain depth; and if one of the most prominent ridges be followed in this way, it will be discovered that it has a corkscrew-like course.

This is the pathognomonic or distinctive symptom of torsion of the uterus, and it is not found in simple deviation or obliquity of the organ. In the latter condition there is no spiral twisting or rugæ, but merely a fold of mucous membrane passing from behind forward, in an oblique manner; while the hand can be passed with little difficulty to the cervix, the os of which is usually found dilated. It is only this fold of membrane, in uterine deviation, which prevents the passage of the fœtus through the os, by hindering uniform pressure on the cervix.

The kind of spiral infundibulum into which the hand penetrates in torsion of the uterus, varies in dimensions according to the amount of torsion. In the quarter-turn or revolution, it may be possible to get the hand into the constriction, though with difficulty, and to reach so far as to touch the neck of the uterus, which may be more or less

dilated, and allow the position of the fœtus to be ascertained. In accomplishing this manœuvre, the fingers can feel a large salient spiral ring which becomes wider as the hand enters deeper into the organ, and which terminates in the cavity of the latter in a wide membranous, fan-like manner. If the torsion is to the left, this ring inclines to the right, and the membranous expansion in the uterus is directed obliquely from right to left towards the fundus of the organ. The spiral twist is in the direction of the torsion, and the uterus is carried towards the left flank. In torsion to the right, the arrangement is the reverse of this.

In the half-turn or revolution, occlusion is so marked that the fingers can scarcely be made to enter the obstacle, and the cervix cannot be reached unless the torsion is beyond it. There are always two prominent rings—two mucous folds which cross each other, but which, as they recede from the torsion, become wider apart and spread like a fan. We shall investigate the character of this twist hereafter.

In the complete turn, the occlusion is such that only one finger can penetrate to a very slight depth in the spiral stricture, and the direction of the rugæ is very baffling, as they seem to intersect each other, and to run in opposite directions.

In some instances, when the mucous membrane of the vagina is involved, the spiral ridge may be distinguished in the roof of that canal, and even near to its commencement.

When the hand can be introduced into the uterus, it is generally found that the fœtal membranes, as well as the fœtus, are intact, and particularly in the half and complete degrees of torsion. In the quarter revolution, the membranes are sometimes ruptured and the waters discharged for a considerable period.

The fœtus is usually alive soon after the first labour pains; but it quickly perishes, and its death is almost certain to have taken place within forty-eight hours after parturition has commenced. The period of its decease, however, will greatly depend on the intensity of the "pains."

The position of the fœtus varies according to circumstances. It is most frequently in the dorso- or lumbo-ilial position, rarely in the lumbo-sacral, as it follows the movements of the uterus; so that in reducing the torsion the fœtus should be brought into its normal position. Sometimes when the twist is slight and the passage sufficiently large, the fœtus partly enters the pelvis, where it may not only be felt, but seized by the parts first presenting. At other times it is entirely lodged in the abdomen; and at others, again, it may be felt towards the pubis, in a kind of pouch or sub-vaginal tumour, formed by a duplicature of the uterus beneath the inner opening of the os. In the latter case, torsion is complicated with obliquity of the organ, and the tumour not unfrequently considerably elevates the bladder and meatus urinarius.

The form of the abdomen is sometimes characteristic. The fœtus can generally be found higher in it, towards the flank, on the right or left side. This change in the position of the fœtus may also be recognised by exploration *per rectum*, which may also possibly allow the torsion of the uterus to be distinguished, as well as its direction. The uterus can be felt through the wall of the rectum as a tense hard mass, while the broad ligaments may be discovered as hard funicular bands. The Fallopian ligaments, which have encircled the cervix uteri and strangle it, can often be felt; and in recent cases the pulsation of the uterine artery

can be perceived. It may be noted, also, that occasionally the rectum itself is displaced and drawn towards the entangled uterus.

If the animal is not relieved, the symptoms above indicated persist with variable intensity, according to circumstances. The straining and attempts at spontaneous delivery continue either feebly, and with long intervals between, or they are violent and almost incessant. The animal soon ceases to eat and ruminate; it becomes dull and dispirited; fever sets in, and the pulse and respiration are hurried; rigors and grinding of the teeth are remarked from time to time; the lacteal secretion which had commenced is now suspended; the mammæ become soft and small; the eyes sink in their orbit; and extreme prostration ensues. The creature, unable to get up, constantly lies; the pulse becomes imperceptible, while the heart's beats are loud and tumultuous; and death generally occurs from the third to the tenth day after the earliest symptoms were exhibited.

Many authorities are of opinion that death is the only result that can be looked for when assistance is not rendered, and the animal is accordingly left to its fate; and, contrary to what Rainard has stated, they do not admit that the fœtus may become mummified in the uterus and the Cow live and thrive. But we have the evidence of the old French authority, Boutrelle, as well as that of Ercolani, Lessona, Rocco, Gurlt, Liautard, Pouchy (already quoted), and others, that this happy termination is quite possible; and indisputable cases are recorded of Cows with unreduced uterine torsions, which have perfectly recovered and fattened, and in the uterus of which, after slaughter, the desiccated or mummified fœtus has been found.

But yet these must be looked upon as exceptional cases; and while they only prove that spontaneous recovery is possible, it must be admitted that, in the great majority of instances, death is not long in appearing in torsion of the uterus, if the organ is not restored to its normal position.

Diagnosis.

The diagnosis of this accident, and the direction and extent of the torsion, are of great importance from an obstetrical point of view. We will therefore consider (1) *The presence of torsion;* (2) *The direction of the torsion;* and (3) *The degree of torsion.*

1. *The Presence of Torsion.*—To recognise the existence of torsion of the uterus is not attended with much difficulty; and in describing the symptoms we have, to a certain extent, shown the manner in which the accident manifests itself to the obstetrist.

It has been stated that, when the hand is introduced into the vagina of an animal the subject of this displacement, it is soon discovered that there is something in the way, and this appears to be a narrowing of the passage. Passing on, the constriction seems to be increasing, until at the end of the canal there is only a very small opening, into which the fingers may pass with difficulty; when inserted there, it is found that they cannot be pushed straight forward, but have a tendency to deviate to the right or left, and finally to assume a spiral course.

We have also stated that this peculiarity in the constriction is markedly characteristic and distinctive of uterine torsion, and this statement holds good in the large majority of cases; so that it is scarcely possible to make a mistake.

In very exceptional instances, however, the torsion may have occurred in front of the cervix—in the body of the uterus; and then the cervix may be easily reached, while the os may even be penetrated, without discovering any indications of the accident. Such occurrences have been recorded by Stockfleth, Ercolani, and Rueff; and these excellent authorities have also witnessed the torsion limited to the cornu containing the fœtus. Here we have neither the constriction of the vagina, nor the spiral involutions of its lining membrane, to guide us to a conclusion, and we must mainly rely on rectal exploration.

Fortunately, such cases are all but unknown in practice, and probably in ninety-nine per cent. it will be found that the twisting has taken place at the cervix, when we have the infallible distinctive sign—the spiral rugæ in the vagina.

2. *The Direction of the Torsion.*—It has been demonstrated that the uterus may revolve on itself in two different directions, and that in

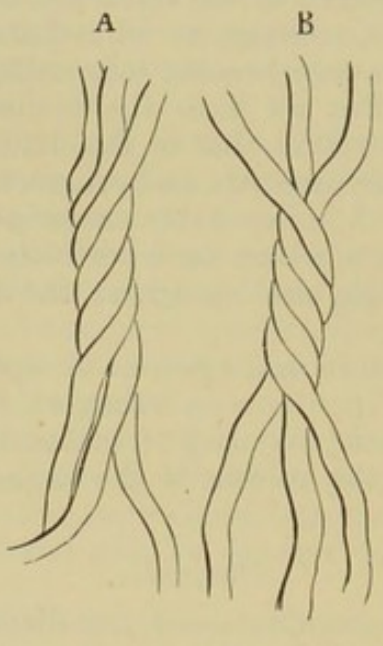


Fig. 88.

A, Cord twisted to the Right; B, Cord twisted to the Left.

order to make a complete revolution, its *upper face* may become *right lateral*, then *inferior*, then *left lateral*, and again *superior;* or if it revolves in the opposite direction, it will become successively *left lateral*, *inferior*, *right lateral*, and once more *superior*.

We have casually indicated how the direction of the twist may be discovered when it has not made a complete revolution. But the manner of discovering to which side the gravid uterus has inclined, has been one of the most debatable in the history of this accident, and has occasioned much controversy and the most contradictory interpretations; up to the present time, in fact, the problem has not met with a satisfactory solution. The confusion prevailing with regard to what appears such a simple matter, is well exemplified in the discussion which took place in 1860, at a meeting of the Central Veterinary Medical Society of Paris, at which the most opposite notions were promulgated. And yet, next to assuring one's self that torsion does exist, the ascertaining of the direction it follows is of supreme impor-

tance, as on this alone depends our being able to rectify the malposition of the organ without delay. The disputation appears to have arisen solely from a confusion of terms—from neglecting to define what was meant by torsion from left to right, or right to left; and Saint-Cyr praiseworthily endeavours, and with success, to settle the question by repairing the omission.

"When," he says, "in its revolution the *left* cornu of the uterus passes *above* the *right* cornu, the upper face of the organ becomes successively *right lateral*, then *inferior*, then *left lateral*, and again *superior*—thus constituting a complete revolution; the torsion is then *from left to right*, or simply *right torsion*."

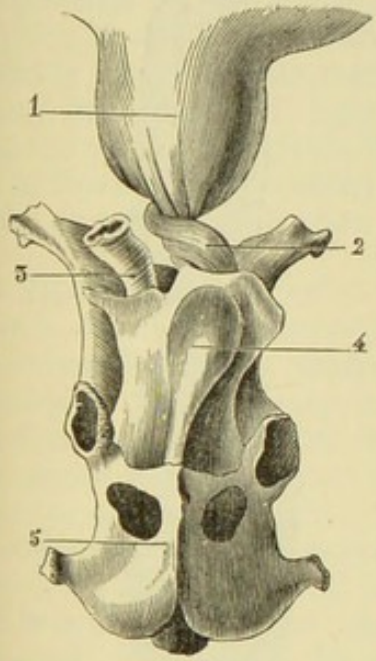


Fig. 89.

LEFT UTERINE TORSION.

1, Body of the Uterus; 2, Cervix Uteri twisted to the left; 3, Rectum; 4, Bladder; 5, Symphysis.

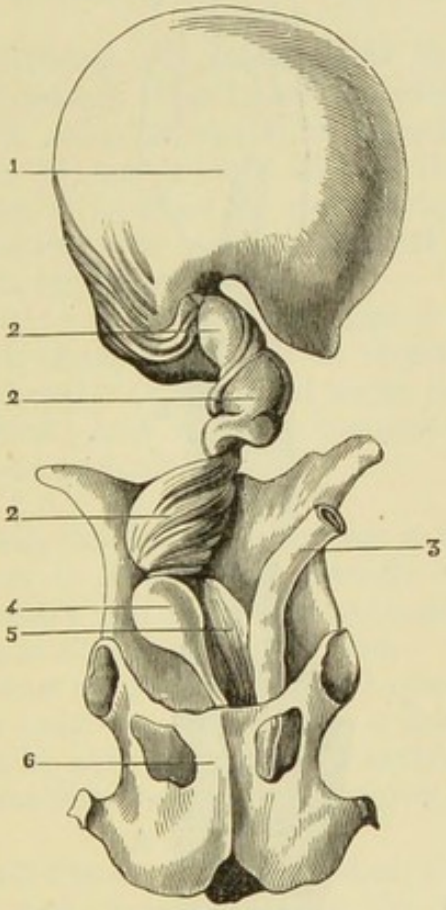


Fig. 90.

RIGHT UTERINE TORSION.

1, Body of the Uterus; 2, 2, 2, Torsion of the Cervix Uteri to the right, involving the Body of the Organ; 3, Rectum; 4, Bladder; 5, Vagina; 6, Symphysis.

The reverse movement constitutes torsion *from right to left*, or, better, *left torsion.*

In other words, the passing of the left cornu *over the right* produces *right torsion;* that of the right *over the left cornu, left torsion.*

Hence we have the simple and easily remembered and understood terms of *right torsion* and *left torsion*, which are synonymous with *torsion from left to right* and *torsion from right to left.*

This being decided upon, the next question is how to distinguish, from a purely objective point of view, a *right* from a *left torsion;* and

this also, it appears, has been a source of difficulty and debate, from neglecting to define terms. Saint-Cyr again has come to the rescue, and his efforts to put the matter in a clear light must be looked on as eminently satisfactory.

Glancing at Fig. 88, we see two pieces of cord, the strands of which exactly, but more clearly, represent the spiral plicæ of the twisted vagina or cervix uteri. It will be observed from the course of the strands, that the pieces are twined in opposite directions : cord A being

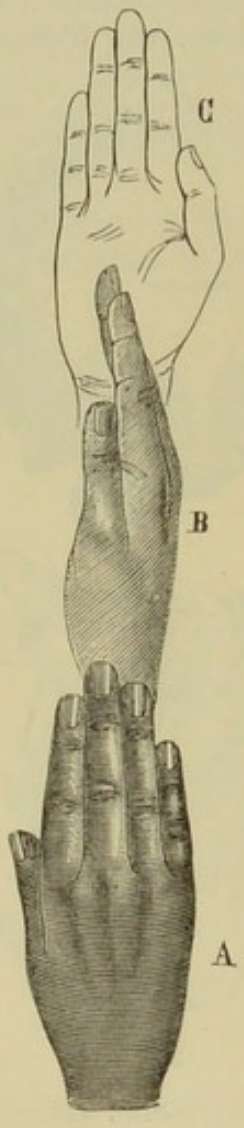


Fig. 91.

RIGHT UTERINE TORSION : MANIPULATION.

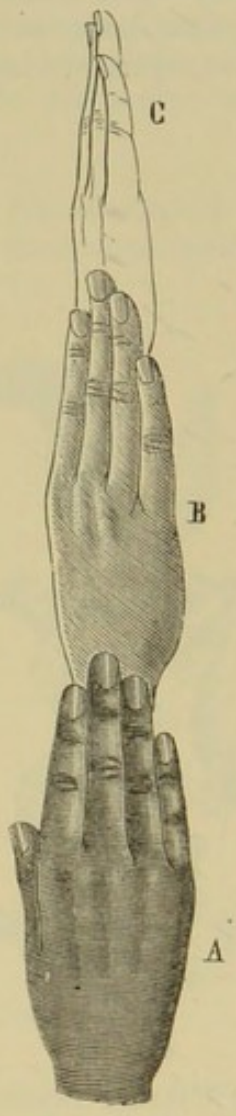


Fig. 92.

LEFT UTERINE TORSION : MANIPULATION.

twined to the *right*, and cord B to the *left*. This disposition of the strands of a rope being generally recognised as exact in the technical language of mechanics, as well as in speaking of the spiral inclination of the thread of a screw, the same application of the terms should hold good in such a mechanical deviation of the uterus as that now under consideration.

These different torsions can be imitated by the handkerchief, as has just been pointed out; and they are well represented in Figs. 86 (left torsion), 89 (left torsion), 90 (right multiple torsion), and 93 (left torsion), which illustrate simple and multiple, as well as right and left torsion.

This being fully understood, it now remains to demonstrate how the different torsions may be distinguished in the living animal, by vaginal exploration. In doing so, we will follow the remarkably lucid directions furnished by Saint-Cyr, to guide practitioners in forming a diagnosis.

Supposing the *right hand introduced in a state of pronation* (palm downwards) into the vagina of a Cow supposed to be suffering from uterine torsion, it is evident that, in order to follow the direction of the spiral folds met with, it must execute a kind of rotary or screw-like movement on the wrist. If this movement is such that the cubital border of the hand, to the *right at first* (Fig. 91, position A), becomes *inferior* (little finger downwards—position B), then *internal*, so as to arrive at a state of *supination* (palm upwards—position C), then *the torsion is to the right.*

On the contrary, if the hand, in following the spiral folds in the vaginal canal, rotates in the opposite direction, of course *the torsion is to the left.* For instance, as in the other case, the hand is introduced in a state of pronation (Fig. 92, position A), but instead of the thumb turning upwards and round to the right, it inclines downward to the left (position B), the little finger ascending until it is uppermost, and the palm of the hand is turned outwards (position C).

This is a very simple matter, apparently; and yet in practice it may be very important. It may be sufficient, then, if the fact is impressed upon the young obstetrist, that when the palm of the hand turns to the left, or inwards, the torsion is to the right; and when it inclines outwards, or to the right, then the twist is to the left.

3. *The Degree of Torsion.*—To ascertain the degree of torsion is more difficult than to discover its existence or direction; though every endeavour should be made to satisfy one's self in this respect, as the "detorsion" will be easy as the torsion is slight, and *vice versâ.*

It has been stated that it may exist as a quarter, half, three-quarter, or a complete revolution; and that it may even extend to a double, treble, or quadruple twist. But it must be always doubtful whether we can diagnose with certainty these different degrees of torsion which may be met with in obstetrical practice.

It is evident, however, that the greater the amount of torsion, so the more will the vagina be constricted, and penetration by the hand rendered difficult. We have already, in treating of the symptoms, drawn attention to the condition of the vagina and cervix uteri in the more simple cases. When, for instance, the hand can be passed without very much trouble as far as the cervix, and the os can be penetrated to such a depth that some parts of the fœtus are felt, then it may be presumed that the organ has only made about one-fourth of a revolution on itself. If the passage is more constricted, the spiral folds closer together, and the cervix can be reached with much difficulty—perhaps only one or two fingers entering the os—we may expect that the uterus has made a half or three-quarter revolution.

But if the vagina is completely occluded not far from the vulva, the fingers being only able to pass into the funnel-shaped infundibulum for a very short distance, and cannot reach the cervix, then there may be one or more complete twists. The spiral folds will also be close and numerous, and for this reason their direction will be all the more difficult to ascertain.

Prognosis.

With the Cow, torsion of the uterus must be looked upon as a serious accident; for except in a few exceptional cases, when assistance is not rendered the fœtus and mother have always perished. Nevertheless, notwithstanding its grave character, modern veterinary science does not consider it beyond remedy; and its records show that, by judicious intervention, mother and offspring may often be saved.

But in order to attain this happy result, a careful diagnosis must not only be made, and the direction and extent (if possible) of the torsion clearly ascertained, but the proper mode of restoring the uterus to its normal position must also be observed and skilfully carried out.

A cautious opinion must always be given, but its favourableness will of course depend upon the brief duration of the parturient symptoms, the degree of torsion, the condition of the animal, and whether it has been subjected to unskilful manipulation before the veterinarian has been called in.

Pathological Anatomy.

When the animal has been subjected to manipulatory manœuvres to effect delivery, or when it has been permitted to live many hours after signs of parturition have appeared, the first important alteration noted on opening the abdomen is that due to peritonitis. There is a quantity of blood-tinted serum effused into the peritoneal sac, in which float shreds of fibrin; and the lining membrane is reddened, deeply injected with blood in parts, and particularly those which have been in contact with the uterus; not unfrequently there is a fibrinous exudate on its surface, and this may cause adhesion between it and different organs.

On removing the intestines and the floor of the pelvis, the uterus and vagina are exposed, and the torsion is visible. This appears as a large, hard cord, composed apparently of a number of spiral strands of unequal size, the closest twined of which are in the middle of the strangulation; this cord—formed by the termination of the vagina and the cervix and body of the uterus—opens out its strands as it recedes from the densely-twined portion towards the fundus of the uterus on one side, and to the vagina on the other (Fig. 93).

The broad ligaments are sometimes compressed between the spiral folds, which they concur to form, and with which they are so intimately connected that very often they cannot be recognised until the uterus has been untwisted. In other instances, they merely envelop the twist in crossing it; so that the extent of the torsion cannot be seen until the ligaments are detached from the ilium on each side.

Rarely, as we have remarked, are these ligaments ruptured; and though some veterinary authorities have maintained that torsion is impossible without one or both being torn, yet this lesion is seldom witnessed. In the large majority of cases, they are tense and greatly stretched, tightly compressing the cervix and rendering occlusion of the os all the more rigid; but when the uterus is reinstated in its natural relations, they are found to be intact.

If the uterus be seized at its fundus and turned in a direction contrary to that of the torsion, the strands of the latter gradually open, widen, and are effaced; while the strangulation disappears, the cervix comes into view, and the vagina assumes its normal length and width, as well as its almost cylindrical form.

So that the hand introduced into the vagina, *per vulvam*, no longer

encounters the spiral plicæ met with in the animal while alive; but passes through the canal, and even into the uterus, without hindrance. The number of turns necessary to accomplish this will indicate the amount of torsion which had taken place. Most frequently only half a turn is necessary, showing that the uterus had made half a revolution on its axis—the upper surface having become the lower. Sometimes the quarter of a turn will suffice to adjust it; while in other instances a complete turn, or even two, three, or four turns in the opposite direction to the torsion, may be needed before the obstruction disappears; though it is very doubtful if more than two complete twists or turns are ever really made.

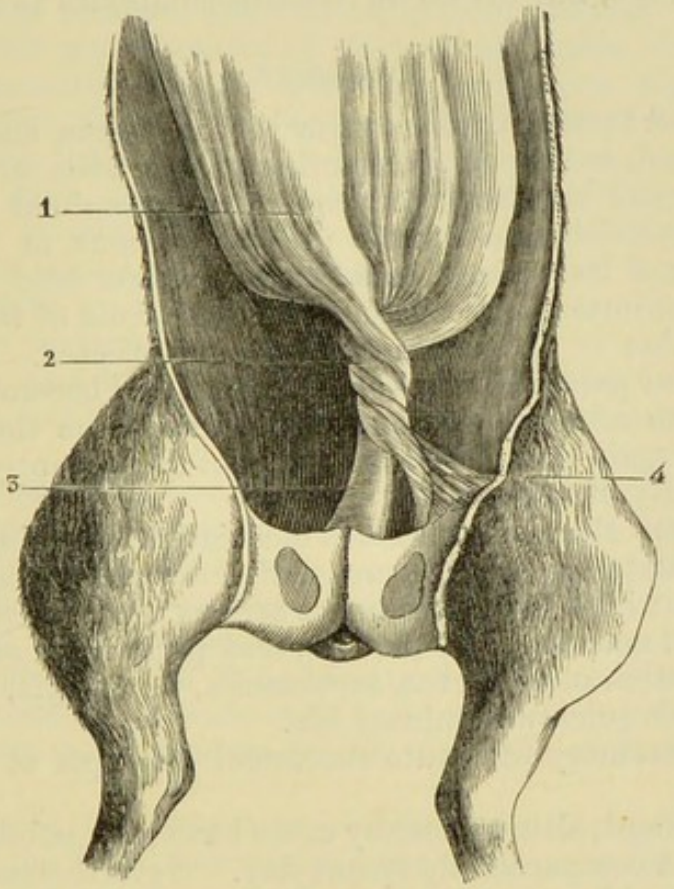


Fig. 93.

LEFT UTERINE TORSION *in situ*.

1, Body of the Uterus; 2, Twisted *cervix uteri;* 3, Vagina; 4, Left Fallopian Ligament.

At times the uterus and vagina exhibit signs of inflammation, particularly towards the strangulation, and the indications of acute metro-peritonitis are frequently most marked. In exceptional instances we may have gangrene of the uterus, probably due to obstruction of the bloodvessels implicated in the torsion.

As a complication, a more or less extensive rupture, complete or incomplete, of the uterus may exist—possibly having been produced by the severe uterine contractions during the life of the animal. This rupture, implicating the walls of the organ, is most frequently met with in its body, in the vicinity of the twisted portion, or at the junction of the gravid cornu with the uterus. The fœtus has been at times found partly fixed in the fissure.

With regard to the fœtus itself, its condition varies with the length of time which has elapsed since it perished, and also whether or not the external air has had access to it. In some instances, even when it has been dead for a long time, it will be found in a state of perfect preservation; in others it is in an advanced stage of putrefaction, the hair and hoofs coming off readily, and the body swollen and emphysematous, while the odour emitted is disgustingly powerful and fœtid.

In rare cases the fœtus is mummified, and this may even occur when it has attained its full development.

Such is an outline of the pathological anatomy of this accident. Numerous illustrations of the various lesions met with after death might be furnished, but the above description applies to all.

Treatment.

The successful treatment of torsion of the uterus had, to the great majority—indeed, to all—of the veterinary obstetrists of not long ago, evidently appeared hopeless; consequently, the animal suffering from this accident was either left to die without succour, or was consigned to the butcher if its carcase could be utilised for food. In some few instances, the animal has recovered from the effects of the torsion, and without reposition of the organ having been effected. After fruitless efforts, the labour pains subside, the fœtus dies and becomes mummified; the Cow is in an ailing condition, perhaps, for some time, but rallies, and may even regain its former condition, not unfrequently even yielding a certain quantity of milk.

In other cases the Cow becomes emaciated and miserable-looking, gives no milk, and generally succumbs, after a variable period, to chronic peritonitis. But in far more instances serious illness ensues at the very commencement, and we have metritis and peritonitis, gangrene of the uterus, putrefaction of the fœtus, septicæmia, paraplegia, or other grave conditions which quickly terminate life.

In British veterinary literature successful attempts at delivery have been recorded.

On the Continent, although many cures have been published, yet they only date from a comparatively recent day. Nevertheless, according to Rainard,[1] Vieillard long ago (1823) succeeded in one instance in saving a Cow and Calf, through having recourse to vaginal hysterotomy. In this case there was inversion of the uterus, the cervix of which was extruded beyond the vagina, and showed three markedly-salient spiral rings. He experienced much difficulty in making convenient openings; the extensive incisions he was compelled to make, in order to remove the fœtus, became lacerations, and there was serious hæmorrhage. Yet the animal made a good recovery. This formidable operation has not found an imitator, and should not require one—except, perhaps, in a similar case, when there is eversion of the vagina, so that the parts to be incised are visible.

The principal—indeed, the sole—indication for the relief of this accident is to *untwist the uterus;* in doing this the cervix and os are restored to their normal condition, and the vagina rendered patent, while the uterus itself assumes its ordinary relations.

Various methods—all of which have been attended with more or less success in practice—have been devised to accomplish this object.

They are (1) *Abdominal taxis;* (2) *Vaginal hysterotomy;* (3) *Vaginal*

[1] *Op. cit.*, vol. i., p. 240.

taxis; (4) *Denoc's procedure;* (5) *Darreau's procedure;* (6) *Rotation of the Cow's body;* and (7) *Gastro-hysterotomy*, or *Cæsarian section.*

1. Abdominal Taxis.—The idea of opening the abdomen and thrusting the hands and arms into its cavity, in order to search for the twisted uterus, then to untwist it directly by turning it on its axis in a contrary direction to the torsion, in order to deliver the animal by the natural passages, is at first sight an eminently rational and practical procedure, and one which, occurring independently to several minds, has been resorted to by a number of veterinary obstetrists. But, however simple and feasible it may appear, yet it is very far from being an easy or always successful method, and this for several reasons. Among these may be cited the great weight of the gravid uterus—from 112 to 180 pounds—its immense size, its convex, smooth, and slippery surface; the limited space there is in the abdominal cavity for manipulation; and the obstacles the other viscera offer to version manœuvres.

"Nothing," says Mazure, after repeatedly trying this method, "appears more simple to the mind than to seize with the hand one of the sides of the uterus, and to swing it round, and especially as it is restoring the organ to its natural position. Yet no one whom I know is competent to perform this simple movement."

"My *confrère* and I tried to swing round the uterus," writes Gosselin, "but it was in vain; all our efforts could not even cause it to change its place."

Bouley attempted this method in 1853, but did not succeed. After failing in other manœuvres to effect the detorsion of the uterus, in despair he made a large incision in the right flank, in order to try if he could not, by direct taxis on the organ itself, restore it to its ordinary condition. But he was disappointed: for the uterus, enormously distended, so completely filled the abdominal cavity that the hand could scarcely be introduced between it and the walls of the abdomen; while the surface of the uterus was so smooth that the operator's fingers could not cling to it.

Notwithstanding, this operation—which, from having been performed in the region of the flank, has received the designation of "laparotomy" (from λαπάρα, *flank* or *loins*, and τέμνειν, *to cut*)—has been practised with variable success in Germany by Fausel (1849),[1] Epple (1852), Kohler (1853), Diccas (1867), Lechleuthner (1868), Obich (1869), Heichlinger (1869), etc.; in France by Darreau, Garreau, and others; in Italy by Santoni and Rocco; and in Denmark by Stockfleth.

We have said that the success attending laparotomy has been variable. This is exemplified in Obich's experience.[2] This veterinarian had three

[1] It is worthy of note that the idea of resorting to laparotomy occurred to an excellent veterinary practitioner in Scotland, perhaps long before it did to Fausel, though for lack of opportunity it was not carried into effect. Mr. Cartwright, of Whitchurch, writing in 1850, "On Torsion of the Uterus in the Cow" (*Veterinarian*, vol. xxiii., p. 248), and its treatment, and proposing to try rolling the animal, adds: "If I did not succeed in this way, I should proceed according to a suggestion given me by Mr. John Steel, of Biggar, Lanarkshire—viz., to make an incision between the ilium and the ribs on the right side, and try to untwist it (the uterus). If I succeeded, I should sew up the wound and allow the labour to take its natural course; but if not, I am not aware that there is any other means but that of performing the Cæsarian operation. Mr. Steel, although he has not yet had an opportunity of testing its practicability, deserves the thanks of the profession for such a suggestion, and it is one which I think very likely to succeed. At any rate, if it does not, we can but perform the Cæsarian operation."

[2] *Wochenschrift für Thierheilkunde*, 1869.

cases of uterine torsion, in which he resorted to this operation to replace the organ. Two of the cases were attended with complete success; but in the third the uterus was of such an extraordinary size and weight, that he failed to restore it to its natural position. He proposed in future to facilitate the operation by using a looped cord with which to raise the organ.

Heichlinger operated successfully on a Cow in the same manner, but the animal afterwards perished through gangrene of the uterus.

It must be admitted that the operation has not been performed sufficiently often, and then sometimes in very unfavourable circumstances, to enable us to draw any satisfactory conclusions as to its value. Darreau, who has been fortunate in some of his attempts, writes: "Direct taxis by an opening made in the flank has had some advantages; I have even thought for a moment after my first success that it would be the only means I should resort to for the future. But unfortunately, new cases upset my predictions, and compelled me to seek for more efficacious means." And Fausel admits that the considerable weight of the uterus may sometimes prove an insurmountable obstacle.

The dangers attending the operation, even if reposition of the uterus be effected, are as great as its difficulties. Several good authorities have therefore recommended its abandonment, or at least its being adopted only in very exceptional circumstances. Franck, however, shows that it is far from being unsuccessful—the uterus having been untwisted in thirteen out of fifteen cases, nine of the thirteen animals recovering, the other four being operated upon too late.

Operation.—Different operators have different modes of operating. Some prefer the animal in a standing position; others throw it down. One selects the left flank; another, and perhaps with more reason, incises the right flank. Saint-Cyr recommends the standing position, with the hind quarters slightly raised. The right hind leg is pulled back by a rope held by an assistant, to prevent the operator being kicked; while the head is tied short. An intelligent assistant introduces his arm into the vagina, in order to follow and announce the results of the untwisting. The operator then makes an incision in the *right flank*, not too high, and from six to eight inches long, which should be sufficient to allow the arm to be easily introduced. This incision should be oblique—downwards and forwards—and skin, muscles (following the fibres) and peritoneum are to be carefully cut through. The hand, damped with warm water, is passed into the abdomen, *above the uterus if the twist is to the left*, but *below it if it is to the right;* then attempts are made to put the organ in place by pressing and pushing it; if any part of the fœtus can be seized, the labour is lessened, and wearing a cloth glove, or wrapping the hand in a piece of thin cloth, will facilitate holding. The task is also lessened in having the abdomen raised by a sheet placed under it, and held by men on each side; or a man on hands and knees under the abdomen is even more advantageous, as he can raise any part required by means of his back or loins.

Having effected detorsion, the wound is closed by suture, and antiseptic dressings are placed over it, these being retained by a wide bandage round the body. The wound quickly heals if peritonitis had not set in before the operation was begun.

According to Obich, within eight days the wound will have healed by first intention.

2. Vaginal Hysterotomy.—Vieillard, so long ago as 1823, removed the fœtus from a twisted uterus by means of vaginal section. In 1856 Ercolani proposed *vaginal hysterotomy*, the opening being made through the upper wall of the vagina, for the reposition of the twisted uterus. The operation is of the same kind, and is conducted in a similar manner, as that for the castration of Cows, introduced by Charlier; except that, instead of the ovaries being seized, the uterus is grasped through the wound, and attempts made to untwist it. Rueff speaks in favour of the proceeding; but we cannot find that it has ever been carried into practice, and serious doubts may be entertained as to the likelihood of its being successful, owing to the weight and size of the gravid uterus, and only one hand being employed to turn the displaced mass, unless the torsion be very trifling; in which case a simpler operation might succeed.

If attempted, not much risk may be apprehended from incising the vagina, as it has generally been found to be attended with little danger, and cicatrisation soon takes place.

3. Vaginal Taxis.—All sanguinary and serious operations for the cure of uterine torsion—like the two preceding—should be avoided, if possible, until the simpler means which modern veterinary science has indicated are tried. We allude more particularly to *version*, which rarely fails to bring the case to a satisfactory termination. That is, of course, on the assumption that this is resorted to sufficiently early; for it must be remembered that nothing is gained by delay in this accident, and if relief is to be afforded it must be rendered promptly, and as soon as the existence of displacement is fairly established. When delay has been allowed to take place, more or less serious consequences must ensue to either the fœtus or the maternal organs, or to both.

In certain cases of very incomplete torsion—quarter rotation of the uterus, for instance—and when there is sufficient space in the vagina for the hand to pass through the obstacle and into the os or uterus, detorsion has been accomplished by seizing the most suitable parts of the fœtus and exercising direct traction on it. Instances of success by adopting this course have been furnished by Chambon, Cann, Gaven, Darreau, and others.

The mode of procedure may be as follows:—After ascertaining the direction of the torsion, the arm is to be introduced into the uterus as deeply as possible; if the fœtal membranes are yet intact, they must be largely ruptured, and the most convenient parts of the fœtus sought for. In this respect it will be found that every part of the young animal does not offer the same advantages to the operator, for reposition of the uterus. The head is too large, and does not afford sufficient hold for the hand; the pasterns and knees are too much removed from the body and too round; but the hocks and elbows are, of all parts perhaps, those best adapted for this kind of manipulation. If one of them can be reached, it should be firmly grasped, and endeavours made by it to raise the body of the fœtus, at the same time giving it a turning movement contrary to that which would be given to the uterus in order to untwist it.

Supposing, for example, that the torsion is to the *right*, and that the fœtus, offering an interior presentation, is, from the fact of the quarter revolution of the organ, in the *right dorso-ilial position;* then the object must be to place it in the *dorso-sacral position.*

To effect this, the right hand, in a state of *supination* (knuckles downwards, palm upwards), must be introduced *beneath* the fœtus, and, if possible, the left fore limb seized by the elbow; then the operator, turning his arm round, raises the body of the creature, at the same time turning it so that the withers describe the arc of a circle from right to left—from the right flank of the Cow towards the sacrum.

Sometimes when the fœtus is alive, at the moment this manœuvre is being executed it makes a movement which greatly assists the efforts of the operator.

If the dimensions of the vagina admit of it, the limbs of the fœtus may be drawn into the pelvis, and even as far as the vulva; and while the operator is acting as described on the upper part of one of the legs, an assistant presses on the free portion, and by thus aiding in the version considerably facilitates the task.

By this procedure several obstetrists have been successful in readjusting the uterus, through the medium of the fœtus—the adjustment being ascertained by the disappearance of the spiral mucous folds from the vagina, and the patency of the canal.

Nevertheless, it has been remarked that this operation is not so easy as one would be inclined to imagine without testing it in practice. It requires much force to raise and turn the fœtus in this way; and the constricted vagina and powerful uterine contractions are formidable obstacles to the exercise of that force.

Some veterinarians, as Meyer and Losner, have succeeded in adjusting a slightly twisted uterus by introducing the hands into the vagina, and aided by assistants, who manipulated either with their hands or by means of boards or sheets applied underneath the abdomen, so as to set the organ straight. Of course, such attempts must be greatly promoted if the fœtus can be reached and used as an instrument in the manner just alluded to.

4. Denoc's Procedure.—Denoc appears to have been the first veterinarian who attempted reduction of this torsion by the simple means stated above, but applied in such a manner as to merit the designation of "original." His procedure marked a great step in advance, so far as veterinary obstetrics are concerned.

In 1845 he describes the case of a Cow[1] unable to calve, but whose *os uteri* was sufficiently dilated to allow him to pass his hand into the uterus, where the fœtus lay in a good position, but from which it could not be expelled, owing to a wide membranous fold extending from the cervix to the fundus of the organ.

His manner of getting rid of the torsion consisted in suspending the animal by a very narrow sack passed under its chest; and two pulleys having been fixed in the wall on the right side—one corresponding to the fore limbs, the other to the hind ones—the fore legs were tied by a cord which passed through the corresponding pulley, while the hind ones were also secured by another cord running through the posterior pulley. Five men were posted to the distal end of each of these cords, and directed to pull. When this was done, the suspended Cow was swung into a dorsal position. Then two strong men, placed on the left side, were directed to push the animal's body to the right—a movement which caused it suddenly to rotate.

An exploration with the hand led to the discovery that the uterus

[1] *Recueil de Médecine Vétérinaire*, 1845, p. 69.

had changed its place, but that there was either a double torsion, or the inversion of the animal had only incompletely turned the uterus, as the duplicature was still present at the cervix.

Another pull was given at the cords, and the previous manœuvre repeated, and this time with good effect, as it was found that the obstructing fold had now vanished, and the uterus was in its ordinary position.

The Cow was then left alone, to await the result of its own expulsive efforts; but nothing having transpired after about an hour, a dose of ergot of rye was administered. Another hour had not elapsed when parturition was accomplished without the slightest difficulty, two Calves being born.

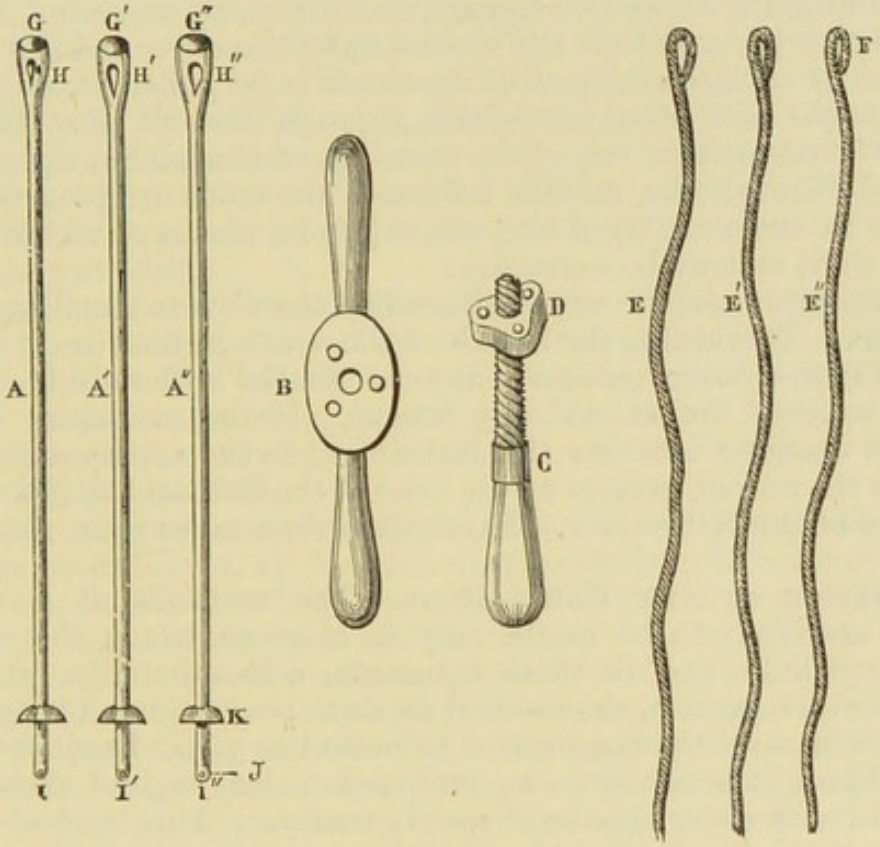


Fig. 94.

DARREAU'S RETROVERSOR.

5. DARREAU'S PROCEDURE.—Denoc's method does not appear to have been much practised, either because it was lost sight of, or was only adapted for cases of very slight torsion; and in view of the great difficulty generally experienced in vaginal taxis—which is, after all, the most reasonable, least dangerous, and perhaps the most convenient of all methods—several devices have been brought forward to render it more easy and effective. Of these none deserves more notice than that of Darreau, which was brought before the Central Veterinary Medical Society of Paris in 1852. The improvement in vaginal taxis for this accident mainly consists in the employment of what has been designated a "uterine retroversor" (*uterin rétroverseur*)—an appliance which would appear to be very ingenious, if complicated. And, besides, it is only of service in those cases in which the hand can be introduced in the uterus and the feet of the fœtus seized—a state of affairs, unfor-

tunately, not always—nor indeed very often—present in torsion of this viscus. Liautard and some others, however, while admitting that the apparatus is not very easily applied, yet testify to its utility.

The apparatus is composed of three rods (A, A′, A″; Fig. 94); of a winch (B); of a screw, with a movable screw-nut (D), pierced by three holes; and, finally, three cords (E, E′, E″) with a loop (F). The end of each rod (G), a little thickened, has a longitudinal hole (H); the other extremity (I) has a hole punched through it, and a shoulder (K). This end of the three rods is inserted into the three holes of the winch.

The apparatus is put together for use in the following manner:—The cords are fastened by their loop (F) to the two pasterns and the lower jaw of the fœtus, and serve as points of attachment as well as conductors to the rods. With this object the obstetrist passes them, one by one, through the hole (H) in each rod; then, by one hand, he seizes the extremity (I), and with the second hand the other end (G); directing the latter towards the part of the fœtus to be pulled at, an assistant who keeps the cord tense passes this through the hole (I). This done, each rod is inserted in one of the openings of the winch, the screw (C) is pushed through the middle hole, and the cords are passed through the holes in the nut (D) of the screw (C), by means of which they are made as tight as may be necessary.

The apparatus may be used either while the Cow is standing or lying on its back. By turning the handle of the winch in a contrary direction to the torsion, counter-torsion is at once effected without difficulty, and without causing the animal any fatigue. If the resistance is at all great, the operator entrusts the instrument to the assistant, passes his hand into the uterus, presses on the head of the Calf, and in this way aids the action of the retroversor. Parturition then takes place naturally.

6. Rotation of the Cow's Body.—The methods of Denoc and Darreau are likely to be useful only in cases in which the uterus is slightly twisted; and in these instances, and others in which the torsion is much greater, the method about to be considered is so simple, attended with so little danger, and hitherto has yielded such favourable results, that it is certainly to be preferred, unless vaginal taxis can be resorted to with every chance of speedy success. This method consists in rolling the animal affected with uterine torsion, in such a manner that the twist which forms an obstacle to parturition is effaced, and the genital passages are open for the passage of the fœtus.

This method has been in vogue for a long time, and its introduction is due, according to Dieterichs, of the Berlin Veterinary School, to Fricke, a Hanoverian veterinary surgeon. At least this would appear to be the fact from what Dieterichs has stated with regard to Denoc's procedure in 1845,[1] when he says that not only had Schmidt, Vix, Irminger, and Schenker—all German veterinarians—mentioned the occurrence of torsion of the uterus; but that Fricke, in addition, cured a Cow of the accident by tying its feet, two and two, then rolling it, taking care to move it in a contrary direction to that in which the torsion had been produced.

Strebel, however, asserts that Richner of Berne recommended rolling before either German or French veterinary surgeons did—the move to be made in a direction the opposite of the uterine twist, the Cow's body to be higher behind than before. However this may be,

[1] *Recueil de Médecine Vétérinaire*, 1845.

German, French, Belgian, Swiss, and Italian veterinary obstetrists have practised this method of reduction in a very large number of instances, and altogether with most gratifying results. And veterinary surgeons in this country have also found the method very satisfactory. As with Denoc's rotation method, this is a version of the uterus, and not of the fœtus.

The manner of rolling the animal varies somewhat with different authorities, but in principle all are agreed. The first step, after ascertaining the existence and the direction of the displacement, is to empty the udder of its milk as completely as possible, so as to prevent the gland being injured during the operation.

While this is being done, a sufficiently roomy place should be got ready, and the floor covered with a thick layer of straw or moss litter; on this the Cow is thrown on the proper side, and with all possible care, the feet being fastened together. The hand and arm are then to be introduced as far into the vagina as its condition will permit. Should the os be accessible, and dilated, some part of the fœtus must be secured, and more especially a limb; this must be firmly maintained in one position. If the fœtus cannot be reached, then nothing remains but to make the wall of the vagina the point of resistance until a better can be made available.

The assistants are then to pull at the ropes which secure the feet of the Cow, so as to bring the animal on its back; then gently, and without jerking, allow it to fall on the opposite side. This being done, the animal is raised on its chest, by the shoulder and quarter, and turned over on the side on which it was thrown. In this way it will have made a complete rotation.

While the assistants are rolling the Cow, the operator, with his hand in the vagina or uterus, as the case may be, endeavours, by pressing in the opposite direction, to keep the organ fixed and to prevent its following the movement the body is undergoing.

If the operation is well conducted, and the body of the Cow moved in the proper direction, the obstetrist will find, as rotation is carried on, that the genital passage is becoming wider and the obstacle disappearing, until, the spiral rings having become effaced, the hand can reach the cervix and penetrate the uterus if the os is relaxed. Generally a gush of the liquor amnii from the organ announces the termination of the operation.

If, however, the hand is more strongly compressed by the spiral folds as the animal is turned on its axis, and the vaginal canal is diminishing in length, it is a proof that rotation is effected in the wrong direction. This is remedied, of course, by reversing the movement.

Sometimes it is sufficient to make the animal execute a complete turn to bring the uterus into its usual position. More frequently, however, this rotation only relaxes the constriction and does not entirely efface the rings; so that it is necessary to continue the turning—always in the same direction—until the desired result has been obtained. Then parturition can be completed in the ordinary way.

It will be seen from this description that the method consists simply in rolling the Cow as one would roll a barrel; and the only point now to be discussed is the direction in which it should be rolled.

This point, strange to say, has given rise to as warm and unsatisfactory discussions as some of the other points to which reference has already been made. Some authorities have declared that, to achieve

the reduction of the torsion, the Cow must be rolled in the same direction as it; others assert that the rolling should be contrary to the torsion; while others, again, pretend that both procedures are correct, according as in one the uterus is maintained fixed, while in the other it remains free in the abdominal cavity.

The confusion imported into the discussion was probably largely due to the manner in which each disputant looked at the question—or, rather, to the position in which he mentally placed himself during the supposed operation. For instance, one may have fancied an animal in a standing attitude placed before him; another, with a Cow lying on its back; another stood in front of the beast; another imagined he was behind it; and another stood at its right side, while a seventh viewed it from the left. Consequently, each discussed the torsion, and the mode of remedying it by rolling, from his own particular point of view; so that the terms they employed in the discussion could not fail to be contradictory.

Fortunately, in practice no great harm could result; as in whatever direction the torsion may have existed, and however baffling the spiral curving of the vaginal rugæ may have appeared in bad cases, the grand test and guide was the effect produced by rolling. If, when the Cow was turned to the right, the vagina became shorter and more firmly constricted, then it was evident that the animal was being rolled in the wrong direction, and rolling to the left was indicated, when the constriction would be diminished and the vagina lengthened. The procedure might be empirical; nevertheless it was invaluable.

But there can be no reason why the remedy should be empirical, or why the confusion in terms which has, unfortunately, existed should be allowed to hinder the progress of science, and even throw obscurity on the practice of such an important operation in obstetrical surgery.

Saint-Cyr had already explained as succinctly and clearly as possible the exact meaning to be attached to the terms "right torsion" and "left torsion"; and he has set himself as diligently to demonstrate what should be understood by "rolling an animal to the right," and "rolling it to the left." He supposes an animal laid on its *right side;* if it is desired to turn it on its left side, it is evident that this may be accomplished in two different ways: first, by rolling it on its *back* and allowing it to fall on the left side; and, second, placing it on its *sternum* and pushing it over on its left side. In both cases the result is the same: the animal lying *at first* on the right side, finds itself *at last* on the left side. And yet it is perfectly obvious that the second movement is exactly the reverse of the first; while it is not less evident that the creature in both movements has been turned from *right to left:* for this expression in its real sense simply means that the animal has been moved from its right to its left side.

But in order to give to this expression a precise signification, a conventional interpretation is necessary. This, Saint-Cyr proposes, should be as follows:—"It ought to be thoroughly understood that, in the movement of rotation impressed on the body of an animal, we should always commence by placing it on its back before bringing it on the side opposite to that on which it first lay."

In this sense, "to turn or roll a Cow from right to left," means that the animal, "laid at first on its right side, was placed on its back, then on its left side, then on the sternum, and finally on the side from which it commenced—the right."

The contrary expression of course means a precisely contrary movement: left side, back, right side, sternum, left side.

From all this it must be admitted that, in order to effect detorsion of the uterus, the Cow should be rolled in the same direction the uterus followed during torsion; and it is also clear that the uterus does not participate to the same extent as the body of the animal in the rotatory movement to which the latter has been subjected.

Supposing, as Saint-Cyr has done, that the torsion has been recognised as *left*, and as is depicted in Fig. 93 (p. 327).

In such a case the animal would be cast on its *left side*, and turned successively on its back, right side, sternum, and left side—*it would be rolled, in fact, from left to right.*

If one complete rotation does not suffice, then the movement must be continued in the same direction until the hand can freely pass to the cervix and into the uterus.

The soundness of these views of our estimable colleague is amply verified in the very numerous cases of torsion of the uterus which have been published during the last thirty years on the Continent, and particularly in France, of which he gives a few examples. All the facts collected by him are unanimous in justifying the acceptance of the precept which he has formulated in the following brief and distinct manner, for application in these often-times difficult cases: *Torsion to the left—lay the animal on the left side and roll it to the left. Torsion to the right—lay the animal on the right side and roll it to the right.* Or the same precept might be formulated in this way: *In torsion from right to left roll the Cow from left to right; and vice versâ.*

Though this precept appears contradictory to what has been recommended above—in order to reduce the torsion, make the body of the animal execute an equal degree of movement, and in the same direction, as that executed by the uterus; yet the contradiction is only apparent, not real. In fact, in this manœuvre the movement of rotation does not really commence at the moment when the Cow, lying on its side, is turned on its back; but rather at the time when it is thrown on its side from the standing posture. If it is thrown on the left side for a left torsion, it really falls from right to left—or in the same direction as the uterine twist.

Since the publication of these valuable remarks, further confirmation of their exactness has been afforded by various papers published in different veterinary periodicals.

There is not much to add with regard to this "rotation" treatment of torsion. We have recommended that if the animal can be moved from its stall, and time permit, it should be thrown down on litter in a roomy place; all the limbs may be tied together at once; or first the two fore and then the two hind legs, these being fastened together afterwards, but not allowed to cross. For an ordinary-sized Cow five assistants are necessary; one of these is to be placed at the animal's head to hold it, and make it follow the movements of the body; the second should keep the limbs as close to the belly as possible, when the Cow is rolled over on them. It is very important during the operation that the hocks be kept flexed as much as possible, in order to prevent the udder being damaged, and also to avoid muscular injuries to the upper part of the hind limbs. The other three assistants should lift and roll the Cow, and aid the second in pulling at the hind legs when the animal is being placed on its back. We have already described

how, and explained why, rotation should be made either in one direction or the other.

The operator need not endeavour to render the uterus perfectly immovable during the rolling, as it turns a good deal with the body of the animal, and particularly when the mass of the rumen presses with all its weight on the organ. This is also the reason why, according to Zundel, a half or even quarter torsion requires for its reduction at least a complete revolution of the body. It often needs a number of turns to reduce the torsion, but generally two, three, or four are sufficient.

There is, therefore, no pressing necessity for maintaining the uterus absolutely fixed while the Cow is being rolled; indeed, as a rule it is no easy matter to keep it at all near the desired position, there being a great difficulty to find a part to cling to. The hand should rather be employed in discovering the effects of the version, and finding when the genital passage is patent.

Violet attributed his insuccess in some instances to the want of resistance he could oppose to the turning round of the uterus as the Cow was rolled, when he held the feet of the fœtus. He therefore tied the two pasterns of the latter together, after he had brought them out of the vagina, giving the cords to assistants wherewith to exercise gentle traction. A thin piece of wood was passed between the legs of the fœtus, which served as a lever by which the creature was made to aid in reducing the torsion, the Cow being rolled half round, rarely altogether round, whenever moderate resistance was experienced. In this way the spiral constriction was made to disappear and the genital canal opened, without injury to Cow or Calf.

It is always a very great advantage in an incomplete twist to pull the fœtus into it as much as possible, as its body can then be made a lever in the way suggested by Violet.

An important precaution in this operation has been notified by some practitioners; and that is to roll the Cow on a slightly inclined floor, if possible. It may be observed, however, that while Wegerer and others recommend that the hind quarters of the animal should be the highest, Chambon and Liautard maintain that they ought to be lower than the rest of the body. And we can scarcely be in doubt as to the correctness of the latter opinion; for in the position indicated, the uterus falls towards the pelvic cavity, and this favours relaxation of the torsion, and the more easy introduction of the hand through the obstacle in the vagina, if it is desired to attempt to fix the organ by the hand while rolling is taking place.

Wegerer's position—the hind quarters raised—is nevertheless to be preferred if it is sought to fix the uterus by its own weight, when the hand cannot be passed into the vagina, or cannot act advantageously there.

As in the majority of cases there is only incomplete torsion, and all that has to be done is simply to replace the fœtus, or rather the uterus, on its bed or hammock, reposition can sometimes be effected by merely rolling the animal on its back.

In some instances, when slow steady rolling will not suffice, a quick or jerking roll may be successful; in other instances it has been found advantageous to place the animal on its back, and roll it from side to side.

Wegerer, Sacchero, Rueff, and some others have combined rolling

with abdominal manipulation and compression, so as to fix the fœtus and uterus, or to push them in the desired direction for effecting detorsion; at the same time rotation is practised according to the directions laid down.

Numerous practitioners are content to roll the Cow without attempting to fix or manipulate the vagina or uterus, and many successful cases are recorded by them.

But this success appears to have been obtained at the expense of the Cow or its fœtus, as the rotation had to be carried on for a longer time than if the organ had been fixed; several turns may be necessary where one would suffice with the hand in the vagina.

If detorsion does not take place so soon as anticipated, there is no reason to despair. If the direction of the twist has been exactly made out, the rotation may be continued. Weber, Wannovius, and Fischer mention instances in which the Cow has been rolled from fifteen to twenty turns before success crowned their efforts. It is even mentioned that the rolling in some cases has occupied an hour or more. Weber writes:—"The Cow is often rolled for more than an hour. The operation is laborious, sometimes painful, to the operator; it demands an expenditure of strength which the most vigorous can scarcely boast of, and requires much *amour-propre* to undertake it. The efforts required to complete it are so great, that often when a successful result has been obtained the operator is out of breath and exhausted."

Happily, these extreme and baffling cases are rare, and they have generally been observed with Cows in which the fœtus was dead. It is a common remark that reposition is easier when the fœtus is alive than when it is dead.

Unfortunately, cases will be met with in which replacement of the uterus, and, consequently, delivery of the fœtus, is impossible by this method of rotation, and these are more particularly cases of multiple torsion. Rueff says that they are sometimes accompanied by decomposition of the fœtus, when the gases which are developed in the uterus inflate the organ, and prevent its being untwisted. In other instances there is plastic adhesion between the spiral folds, or between the uterus and other abdominal viscera, or even the parietes of the abdomen.

When the uterus, by its exaggerated volume, appears to offer an insurmountable obstacle to reposition, it has been recommended to puncture it through the vagina, and allow a quantity of its contained fluid to escape, so as to reduce it to manageable dimensions, when the other measures can be resumed.

It is also advisable, in all cases of torsion, to empty the digestive organs as much as possible, by an active purgative.

It has often been predicted that the rotation procedure may give rise to serious accidents—such as volvulus of the intestines, herniæ, etc. But we cannot find any notice of such accidents having occurred.

If the diagnosis is correct, the nature and direction of the torsion well ascertained, the animal not too much exhausted, and the parts involved not seriously injured, a successful result may be anticipated in the large majority of cases, when the treatment above indicated is carried out.

When the uterus is placed in its normal position, the genital passages patent and in a proper state for delivery, the Cow not much exhausted, and the fœtus in a good attitude for birth, time may be allowed for

Nature to effect the expulsion of the young creature. Birth is generally not long delayed under such circumstances, and the operator has the satisfaction of knowing that he has been the means of saving the Cow, and very often its progeny, with but trifling inconvenience to both. The after-consequences, so far as the Cow is concerned, are of no more importance than those of ordinary parturition.

But not infrequently, deceived by the slight symptoms of indisposition the Cow at first exhibits, the owner does not send for the veterinarian until too late to save the fœtus, and even the Cow.

In some cases it will be found that birth cannot take place after reposition of the organ, from inertia or paralysis of its muscles; this is due either to the great extension the fibres have experienced, the interrupted circulation of blood in the organ, or injury to its nerves.

In such cases stimulants should be given, and friction applied to the abdomen and loins. Ergot of rye is recommended by Continental veterinarians. Should uterine action not speedily ensue, and particularly if the os is dilated and the membranes are ruptured, the fœtus must be removed by traction. If the os is impervious, and atony of the uterus continues, then steps must be adopted to deliver artificially.

When the torsion has been in existence for some time, the liquor amnii expelled, and the uterus closely applied round the fœtus, then extraction is difficult and laborious, and prolapsus uteri is not unlikely to follow. The genital canal should be lubricated with glycerine, and injections of tepid water may be thrown into the uterus; when the secundines are removed, it may be necessary to inject some antiputrescent substance, if there are foul-smelling discharges or any apprehension of septicæmia.

In serious cases, after reposition of the uterus and delivery of the fœtus, grave complications may ensue—such as metritis, metro-peritonitis, etc. It may also then be discovered that a rupture of the viscus exists.

These complications must be treated according to their indications.

7. Gastro-hysterotomy, or Cæsarian Section.—This operation has been recommended when the other measures described above have failed, with the object of saving the fœtus, if it be alive, or to preserve the life of the Cow. Laparotomy may be resorted to sometimes, instead of abdominal section towards the linea alba.

Rocco[1] has twice successfully performed the Cæsarian section in torsion of the uterus, and delivered living Calves. Lemaire[2] relates a case of torsion and rupture of the uterus, in which recovery was hopeless. The Cow was killed, the abdomen immediately and widely opened, and the fœtus extracted from the uterus with all haste. The Calf was alive, and did well. Violet has also had recourse to this operation for the same reason; the Calf lived, but the Cow died two days afterwards.

We shall describe the operation hereafter.

Torsion of the Uterus in the Mare.

Torsion of the uterus in the Mare is a rare accident. This is doubtless owing to the direction of the uterine cornua, and the manner in

[1] *Il Medico Veterinaria*, 1863.
[2] *Recueil de Médecine Vétérinaire*, 1858.

which the broad ligaments are attached to them, which renders rotation of the organ very difficult, unless there is some anatomical anomaly in the parts.

The possibility of such an accident in this animal has been experimentally demonstrated by Goubaux, in 1864, while instances of its occurrence have been published by Tisserant[1] in 1846, Belhomme[2] in 1850, Elson and Delwart[3] in 1852, Hamon[4] in 1860, Anderson[5] in 1860, Canu[6] in 1861, Schmidt[7] in 1863, Gierer[8] in 1863, Jansen[9] in 1866, Cox[10] in 1875 and 1877, Rolls[11] in 1878, Deneubourg[12] in 1880, Oreste[13] in 1881, and Münich[14] in 1892. There can scarcely be a doubt that it is much more frequent than is suspected, through its not being recognised, and Saint-Cyr has given some instances which go to prove the truth of this statement.

Causes.

The causes of uterine torsion in the Mare are not well ascertained. It is not improbable that some of the causes which produce it in the Cow will also be effective, in certain circumstances, in the Mare.

Wolff mentions that he has witnessed it in a Mare which had suffered from attacks of colic four days previously, and when so affected had thrown itself down and rolled violently. In Cox's case, a few weeks before parturition the Mare had an attack of colic, and rolled over several times.

The accident has only been seen in Mares whose period of pregnancy had nearly terminated. In Elsen's case the Mare had been ten months pregnant; in Hamon's case the ordinary period had expired; and the Mare which was attended by Schmidt was within a few days of foaling.

Symptoms.

The general symptoms appear to be similar to those observed in the Cow. In the majority of instances the animals appeared to be affected with severe colic, and attempts at micturition were frequent. The local symptoms, however, differ somewhat, the torsion being generally more forward in the body of the uterus; so that the spiral vaginal folds are often not so distinct, and, from Goubaux's experiments, may even not be felt at all.

Rectal exploration is recommended by Saint-Cyr in these cases, the torsion being felt as a thick, short and hard cord. Schmidt easily introduced his hand into the rectum as far as the abdominal margin of the pubis, and there he felt under his hand an obstacle which prevented further progress, as only three fingers could be introduced beyond this. The body under his hand was hard, resisting, and immovable; whereas the contents of the colon were soft and easily indented by the fingers.

[1] *Journal des Vétérinaires du Midi*, 1846, pp. 337, 343.
[2] *Procès-Verbaux de la Soc. Vétérinaires de l'Yonne*, 1850.
[3] *Annales de Méd. Vétérinaire de Bruxelles*, 1852, p. 452.
[4] *Recueil de Méd. Vétérinaire*, 1860, p. 612.
[5] *Veterinarian*, 1860, p. 317.
[6] *Recueil de Méd. Vétérinaire*, 1861, p. 186.
[7] *Ibid.*, 1864, pp. 290, 714.
[8] *Magazin Von Gurlt und Hertwig*, p. 322.
[9] *Ibid.*
[10] *Veterinary Journal*, vol. i., p. 264; vol. iv., p. 28.
[11] *Ibid.*, vol. vii., p. 11.
[12] *Traité Pratique d'Obstetrique Vétérinaire.*
[13] *Revue Vétérinaire*, 1881, p. 43.
[14] *Wochenschrift für Thierheilkunde*, 1892.

The posterior portion of the floating colon, as in this instance, may be obstructed in the Mare by the twist formed by the uterus and the broad ligaments, and this obstruction will, of course, prevent expulsion of the fæces.

Prognosis and Treatment.

This accident must be considered much more serious in the Mare than in the Cow, for some of the reasons already alluded to as influencing parturition and its results in these animals. A large majority of the cases terminate fatally; of seven alluded to by Franck five perished, and a similar mortality attended those I have investigated. The fœtus is nearly always dead.

The treatment must, of course, be similar. Belhomme succeeded, by powerful traction, and without previous reduction of the twisted uterus, in extracting a dead Foal in what he describes as a case of "demi-torsion." It is probable that the torsion could not have been so great, for when it exists to this degree delivery by traction is impossible.

Elsen and Delwart succeeded in reducing the torsion in their case, by rolling the Mare in the manner we have recommended to be adopted with the Cow. In this instance, however, everything was against the success of the operation, for the fœtus had already been two months beyond its time in the uterus; it was dead and in a state of putrefaction, and had to be removed piecemeal. The Mare died from septic infection eleven days after the operation.

In Canu's interesting case the result was favourable. The mare had been endeavouring to foal, it would appear, for ten days, and was evidently about to succumb. Canu, recognising torsion of the uterus, was proceeding to open it by force, when the animal fell with great violence, and the shock her body received had the unlooked-for result of completely untwisting the organ; so that parturition, though difficult, became possible. The Foal was dead, as might have been predicted; but the Mare was saved, and continued to recover sufficiently to be put to light work, when, on the thirtieth day after the operation, it was attacked with metrorrhagia which nearly proved fatal. It eventually got well.

Deneubourg's case was similar to Canu's, and a living Foal was eventually extracted, but it died in a few hours; the Mare recovered.

In Oreste's case the fœtus was putrefied, and the Mare succumbed to septic metritis before reposition of the uterus could be attempted.

Hamon, in France, and Schmidt, in Germany, endeavoured to effect reduction of the torsion in their cases by rolling the Mares first in one direction, then in the other; but without success, as both animals died without being delivered.

Gierer observed two cases of complete torsion in Mares, in both of which the accident was complicated by a large rupture at the base of the uterus, through which the fœtus had escaped into the abdominal cavity.

Cox found the head and fore legs of the fœtus protruding through the inferior wall of the uterus. Exploration discovered the vaginal passage beyond these parts, but it suddenly terminated; though a small rugose opening, barely admitting two fingers, was found. The Mare died in two hours; and on examination there was noted a *double twist* of the cervix uteri, with rupture of the uterus and vagina.

The most recent cases recorded are two by Münich.[1] In the first the Mare had been showing symptoms of colic for some days, and a vaginal exploration discovered left-sided torsion of the uterus; there was a very foul odour. As the Mare was dying nothing was attempted. Death was due to septic metro-peritonitis. In the second case the Mare was lying down and straining violently. An examination proved it to be another instance of complete left-sided torsion, which required eight turns-over of the Mare to adjust; a very small Foal was extracted, but the straining continuing, the presence of another fœtus was suspected, and Münich was making another exploration of the uterus, when suddenly a mass of the small intestine escaped *per vulvam*, through a tear in the upper portion of the uterus, near the pelvic inlet, and at the point where he had felt the strongest tension before commencing to untwist the organ. The Mare was destroyed, and the Foal died in twelve hours.

Torsion of the Uterus in other Animals.

We need scarcely allude to this accident in the other animals mentioned as liable to the accident, as it is almost impossible to diagnose its existence, owing to their small size. Besides, it appears to be extremely rare in them.

In multiparous animals the fœtuses develop simultaneously in both cornua, which, increasing in volume, yet remain independent; so that torsion may occur at or near the cervix and occlude both cornua, or it may take place at any part of one cornu. In such a case, when parturition occurs, none of the fœtuses can be expelled, or those in the non-twisted cornu may be born with difficulty, and even one or more of those in the twisted horn if the twist happened some distance from its base; the fœtuses beyond the stricture are, of course, retained and soon perish, as does the parent in the majority of cases—and generally rapidly, from strangulation of the viscus. Sometimes the severe straining causes extrusion of the unconstricted cornu.

When the practitioner is called in time, detorsion may be attempted by external manipulation through the abdominal walls, or even through the vagina, if the animal be sufficiently large. By rolling it quickly several turns and suddenly stopping, Saint-Cyr thinks detorsion might be effected; he also recommends trying brief suspension by the hind legs and then rolling. But the difficulty is to know in which direction to roll the body. As a last resource gastrotomy or laparotomy may be resorted to.

One instance in the *Ewe* is recorded by Lewis,[2] which he put right by rolling the animal over five times without withdrawing his hand from the vagina, and exercising slight pressure with the point of one finger against the os uteri; with each turn of the animal the canal perceptibly dilated.

Saint-Cyr[3] records an instance in a four-year-old *Sow*, which, arrived at the full period of gestation, began to strain very violently; this continued for four hours, when suddenly a large mass protruded from the vulva, and the animal soon died. The mass was found to be one of the uterine cornua, having an extensive tear with lacerated and ecchymosed

[1] *Wochenschrift für Thierheilkunde*, 1892.
[2] *Veterinary Journal*, 1886, p. 319.
[3] *Op. cit.*, p. 496.

borders. The other cornu was in the abdomen, and contained two voluminous fœtuses, the expulsion of which was hindered by a half-twist at its base near the pelvic inlet—the torsion being from left to right.

Macgillivray[1] alludes to a case in a small terrier *Bitch*, which he put under chloroform and secured the Puppies one by one by means of Breulet's apparatus; one of these and the parent survived.

Guillebeau[2] had also a case of a Bitch which expelled two decomposed Puppies after a dose of ergotine, but after suffering for ten days she died. The left cornu was found to be strangulated by having become twisted completely round, involving the broad ligament as well. Beyond this twist were two emphysematous fœtuses; and behind it the uterus was much atrophied and its canal entirely obliterated; so that it would have been impossible to extract the fœtuses by this way.

Vivier[3] and Violet[4] each give an instance of this accident in the pregnant *Cat*, death resulting in both cases.

CHAPTER III.

Dystokia from Morbid Alterations in the Generative Organs.

Following the arrangement adopted by Saint-Cyr, we will in this chapter study the obstacles to parturition which are due to (1) *Tumours developed in, or in the vicinity of, the genital organs of the female;* (2) *Hernia of the bladder;* (3) *Rigidity of the cervix uteri;* (4) *Morbid degenerations of the cervix uteri;* and (5) *Obliteration of the os uteri.*

1. Utero-Vaginal Tumours.

The tumours met with in the vagina and uterus differ much with regard to their nature, origin, structure, and influence on the act of parturition. Sometimes they are contained in the interior of the genital organs—in the uterus or its cornua or cervix, and on the walls of the vagina, as well as on the labia of the vulva; at other times they have their seat in the neighbouring parts or organs—in the bladder, rectum, or pelvic connective tissue. They may be constituted by degeneration or displacement of these parts, or by heteroplastic products developed there.

Their volume, form, and consistence are very diverse; and they may either adhere closely or loosely to the adjacent parts, being fixed in the one case and movable in the other. Some are attached or implanted by wide bases, others are pediculated or retained by a more or less narrow pedicle.

Tumours of the soft parturient passages are rather rare in the domesticated animals, and their occurrence has been frequently brought under observation. The first instance is probably that recorded by Jeanroy, in 1828.[5] Since that period a number of cases have been

[1] *Veterinary Journal*, 1888, p. 153.
[2] *Archives Vétérinaire*, 1882, p. 361.
[3] *Ibid.*, 1876, p. 424.
[4] Saint-Cyr's *Traité Obstetrique Vétérinaire*, p. 497.
[5] *Recueil de Méd. Vétérinaire*, 1828, p. 639.

recorded by veterinarians in this and other countries, and some of these are very interesting.

With regard to parturition, these tumours may be considered in a general manner according to their (1) *Seat;* (2) *Mode of attachment;* and (3) *Consistence.*

1. *Seat.*—The situation of genital tumours—whether in the vagina, on the cervix uteri, in the os uteri, body of the uterus, or cornua—will make a very great difference in the act of parturition.

Those tumours which are developed in the uterine cornua may, by altering the structure of the walls of the uterus, hinder the amplification of the organ, impair the nutrition of the fœtus, and even cause it to be expelled prematurely. If, however, they do not interfere with the regular course of gestation, birth may take place in a natural manner and without interruption. If the fœtus is situated behind the tumour, towards the body of the uterus, of course it meets with no obstruction in its passage outwards; and if it should happen that labour is longer and more difficult than usual, this can only be attributed to the alteration the pathological production has effected in the muscular structure of the uterus, and which may produce a diminution in its contractile or expelling power.

When, however, the tumour is between the fœtus and the genital passages, the case is much more serious. If it is fixed directly on the cervix, it may prevent dilatation of the os to the necessary extent, or perhaps altogether. When it is situated in front of the cervix, towards the body of the uterus, but in the immediate vicinity of the former, and is movable to a certain degree, it may be carried into the dilated os, occupy it to a greater or less extent, and render the exit of the fœtus impossible, unless the tumour is moved out of the way. If the tumour occupies the vagina, it will prove a more or less formidable obstacle, according as it is large or small, hard or soft, and consequently diminishes the lumen of this outlet for the fœtus.

2. *Mode of Attachment.*—The manner in which the tumours are attached to the membranes from which they arise, has some influence on their action as obstacles to birth. They have either a wide base of attachment, or they are sessile or pediculated.

Those tumours which have a very wide base are generally of a malignant character; and though they may prove very serious, so far as the female is concerned, yet they do not often prove a cause of difficult parturition, provided they are not situated in the vagina or on the cervix. Animals so affected do not generally breed, though they may regularly exhibit œstrum; if, however, they should chance to conceive, and pregnancy has terminated, with these exceptions parturition may not be delayed in its course.

The circumscribed sessile tumours are generally more serious than those which are pediculated; as the latter may be more or less easily displaced when they are in the way, and delivery rendered as easy as usual. Or if the pediculated tumours cannot be temporarily removed from the path of the fœtus, they may easily be altogether got rid of by a simple operation, particularly if their base is very attenuated.

3. *Consistence.*—The hardness or softness of the tumours has an important bearing on their obstructiveness. Such tumours as the fibroids are so dense and inelastic, that the strongest compression will scarcely diminish their volume or alter their shape; while others—

such as the condylomata or papillomata—readily change their form and dimensions when submitted to pressure.

We will allude to each of these morbid productions more fully hereafter.

Diagnosis.

The diagnosis of these tumours is not always so easy in the domesticated animals as in woman. In the latter, the surgeon may sometimes have to discover the existence and determine the nature of such growths during pregnancy; and he may, consequently, be prepared beforehand to overcome the difficulties which will present themselves at a later period. But with the veterinary obstetrist's patients this is not so; and it is only and always during parturition, in the midst of the trouble which inevitably accompanies a difficult birth, that he is called upon to give an opinion.

But as some compensation for this disadvantage, in animals direct exploration is easier than in woman; while the entire hand can be introduced into the genital passages of the larger creatures with facility, and every part be explored; so that if the period is late for acquiring information with regard to the existence of tumours, yet these facilities enable the obstetrist to obtain most valuable notions with regard to diagnosis, prognosis, and treatment.

But this exploration should be complete and intelligent; as errors in diagnosis are easily committed, and may lead to serious consequences. Here the hand, not the eye, must be the guide, and just as the sense of touch is well developed in it, so it will all the more readily distinguish between a tumour, the "water-bag," or some part of the fœtus which is covered by or denuded of its membranes; as well as discover the exact seat, volume, consistence, and mode of attachment, besides something of the nature, of such pathological productions as are now being considered.

Treatment.

The indications for the treatment of these obstacles to birth will, of course, depend upon a variety of circumstances, the majority of which have been referred to. Sometimes we may be able to act directly on the tumour, and remove it; in other cases, from its situation and nature, it may be beyond the reach of direct action.

When in the vagina and not far from the vulva, and particularly when pediculated, it is occasionally extruded as the fœtus is expelled from the uterus, and may then be readily seized by the hand or forceps, and taken out of the way. In such a case the tumour may be either drawn outside the vulva, pushed to one side so as to clear the passage, or extirpated.

If it is situated beyond the os, and is sufficiently movable, it may be pushed in front of the pelvic inlet, and the parts of the fœtus which present be immediately brought therein so that the tumour may be kept out of the track of the latter.

Should the growth be of the nature of a cyst or abscess, merely puncturing it by means of a bistoury, scalpel, or trocar, will evacuate its fluid contents, when it will collapse and birth be rendered possible.

When it is a pediculated tumour like a polypus, it may be got rid of at once by extirpation, if the pedicle is easily accessible. To this end the pedicle may be simply *cut* through; but this measure, though the

most expeditious, is not always the best; as there may ensue internal hæmorrhage, which will be all the more troublesome as hæmostatic agents are difficult of application to the wound.

The pedicle may certainly be *ligatured*, either in mass or partially, previous to extirpation, in order to obviate the disadvantages attending simple excision. This means has been successfully employed, and though perhaps a longer and more difficult operation, it is to be preferred when possible.

Removal by means of the écraseur is preferable to all others when possible. It is no more difficult than simple excision, and so far as hæmorrhage is concerned, it is as safe as the ligature, while the consequences are much more trifling.

When the base of the tumour is very small, and has but a slender attachment to the textures from which it springs, and when, in addition, it is beyond the application of a ligature or the écraseur, it may be torn off or removed by the finger-nail.

The most difficult tumours for treatment are those which are hard and sessile, and to which the foregoing measures are not applicable. It sometimes happens, however, that these formations have only a very loose connection with the subjacent tissues, and it is often possible to remove them either wholly or in part, by making incisions through them, and enucleating the divided portions by means of the fingers.

It is rare that neoplasms developed in the labia of the vulva offer any obstacle to birth; should they chance to do so, however, it is easy to remove them by means of the scalpel or bistoury. If the subsequent œdema of the labia has not disappeared when parturition commences, and if it hinders exploration by the hand, or the expulsion of the fœtus, it may be combated by scarifications. These, however, should only be made during parturition.

There may occur cases, nevertheless, in which, either from the nature, mode of attachment, or situation of these tumours, their removal is not possible, and birth cannot be effected. In such cases it will be for the obstetrist to decide whether he will have recourse to embryotomy or Cæsarian section—this decision being arrived at after duly weighing all the circumstances and facts relating to them.

Having completed these general considerations on utero-vaginal tumours as a cause of dystokia, and offered the above indications in the way of treatment, we will now proceed to notice each class of these formations, in so far as they have been recognised as obstacles to parturition in animals.

CANCEROUS, CARCINOMATOUS, OR SARCOMATOUS TUMOURS.

Cancer of the uterus and other organs of generation would appear to be rare in animals, and very few veterinary writers allude to it. Even those observations which have been published have but little interest for the obstetrist, as nearly all of them have no relation to difficult parturition. Some cases, however, have been recorded in which cancer of the cervix uteri has produced contraction of the os, and necessitated operative interference in order to effect delivery; and one or two instances are noted in which cancerous tumours have elsewhere proved an obstacle to parturition, and even when that act has been accomplished have proved dangerous from the hæmorrhage they occasioned.

When the cancer is situated at the cervix, and the os cannot be

dilated by the fœtus, then treatment must be directed to effect sufficient dilatation for its passage through the canal. In nearly every instance this must be accomplished by free incision of the cervix.

CONDYLOMATOUS, PAPILLOMATOUS, AND LIPOMATOUS TUMOURS.

These tumours are met with most frequently in the generative organs of the Cow and Bitch, and particularly in the vagina. They seldom prove a serious obstacle to the passage of the fœtus.

They first appear as soft, fungoid, cauliflower-like vegetations, which bleed from the slightest contact, and are readily crushed or deformed. In the Bitch they sometimes completely fill the vagina, and give rise to a constant sanious, and most offensive, discharge from the vulva.

Lipomatous tumours are also most frequently noticed in the vagina of the Bitch; and in two instances observed by Oreste and Falconio, one tumour was the size of a filbert, the other of a large walnut.

The general indications for treatment are applicable to these growths, though they seldom, if ever, prove an obstacle to birth.

FIBROID AND MYOMATOUS TUMOURS.

Fibroids are not at all uncommon in the generative organs, and are frequently the cause of difficult parturition. They have been observed in the uterus and vagina of the Mare, Cow, Sow, Goat and Bitch.

In *structure*, it would appear that the fundamental portion of these tumours is composed of connective tissue, which may present the histological characters of areolar, mucous, or tendinous tissue, the fibres of which, more or less closely interlaced, have connective tissue corpuscles or cells lying between them, and are cemented into a solid mass by an inter-elementary, more or less abundant, amorphous substance that greatly contributes to increase the consistency of the neoplasm, giving it a dull white or nacrous appearance, as if composed of cartilaginous tissue. The connective tissue corpuscles composing these tumours are sometimes considerably enlarged and hypertrophied, and this is more particularly observed in the fibroids of the uterus. This arrangement has been found to exist in the uterine fibroma of a Cow examined by Ercolani in 1855; cartilaginous transformation of the structure has even been detected.

The fibroids are developed from the submucous or subserous connective tissue, or from the muscular texture of the uterine parietes. When the latter, the tumour is rarely pediculated, but nearly always remains sessile. The uterine fibroma of submucous origin is certainly at first sessile, and is covered by the mucous membrane; but as it grows it becomes pediculated.

The fibroids of the uterus, as well as those of the vagina, are sometimes covered by the mucous membrane, and at other times grow beyond it. They are sessile or pediculated, and are of variable volume and consistency; their surface is either smooth or irregular, as if composed of a number of smaller tumours.

Franck mentions that the pathological museum of the Munich Veterinary School contains the uterus of a Cow, one of the cornua of which is occupied by a myomatous tumour springing from the muscular layer of the part, and as large as a man's head.

Sometimes the pediculated fibroids of the uterus, in consequence of

the elongation of their pedicle, extend beyond the os into the vagina, and even in some instances pass through the latter and the vulva, and remain suspended between the thighs. A case of this kind has been observed by Granaveri and studied by Ercolani.[1]

As we have observed, the presence of fibroids has a variable influence on the process of parturition, according to their situation. Of course, the larger, and particularly the submucous interstitial fibroids, only very exceptionally allow successful fecundation to take place; though in some instances, when this occurs, absorption follows. During labour they may predispose to rupture of the uterus, from the alteration they have produced in the texture of the organ.

Submucous or subperitoneal fibroids, when situated towards the fundus of the uterus, or when only of a moderate size, very frequently offer no particular obstacle to birth, and interfere but little with labour. It is only when they are very large, and situated towards the cervix or vaginal canal, that they may become a serious impediment to delivery. Those with short pedicles, and which are designated "polypi," may be rejected backwards before the advancing fœtus, and be mistaken for some part of the latter by the unobservant obstetrist.

Sometimes the tumours soften towards the termination of gestation, so that during parturition they may be sufficiently compressed and flattened for the fœtus to pass over them. If they have an elongated pedicle attached to some part which is easily displaced, they may be pushed beyond the vulva by the fœtus, or the pedicle may be ruptured by the latter, and the parturient passage thus left unobstructed.

The recognition of these tumours is not very difficult when they are within reach of the hand. To prevent their being mistaken, during manual exploration, for some part of an ordinary or deformed fœtus, their nature and mode of attachment must be attended to. With this object, the hand should be carefully passed between them and the uterus and vagina in every direction, so as to find their pedicle, and thus be assured that they do not belong to a fœtus.

With regard to the treatment, we must refer to the general indications already given. We may only add that when the tumours are not very large, it is better not to interfere until Nature has done what it can in overcoming the obstacle; for in these instances, as in so many others, it sometimes effects surprising results. If they are pediculated and can be reached, they may be incised, ligatured, or removed by the écraseur; should the base not be attainable, or very extensive, they may be partially extirpated.

If, after parturition, there appears anything like serious hæmorrhage due to this extirpation, this may be suppressed by plugging with lint or fine tow, which may be steeped in perchloride of iron.

THROMBI OR HÆMATOMATA.

Thrombus or hæmatoma of the vagina or vulva, usually appears most frequently after delivery. Pfirter, however, has recorded the case of a Mare in which a large blood tumour, or hæmatoma, was caused by the rupture of bloodvessels and the escape of blood into the connective tissue around the vagina. It formed a great swelling on the sides of the

[1] *Oreste and Falconio.* Studii sulle Neoplasie a Massa distinta degli Animali Domestici, p. 58.

vagina and vulva, the infiltration of blood extending to the perinæum. This tumefaction proved an obstacle to parturition; so that it was necessary to open it freely, and take away the clots of blood which had formed. The hæmorrhage which ensued was checked by the injection of a solution of perchloride of iron.

Saake has observed these blood-cysts most frequently in Swine; death from hæmorrhage has sometimes resulted from their rupture.

The application of ice or cold water, or perchloride of iron, or even the actual cautery, and plugging the vaginal canal, will generally arrest the bleeding.

SEROUS CYSTS.

Kopp, Hering, Ayrault, Lafosse, Liautard, Müller, and others, have observed serous cysts on the vaginal mucous membrane, and even in the uterus, of the Mare and Cow.

The vaginal cysts are of variable size, but most frequently as large as a pear, which they are generally not unlike in shape. They are attached to the mucous membrane by a very narrow pedicle, and in some instances appear between the labia of the vulva when the animal is reclining, but disappear again into the vagina when the standing posture is assumed; though occasionally they are so large that they cannot return without assistance.

The cyst is smooth and transparent, and contains a clear limpid serosity, in which albuminous flakes are often observed.

Not infrequently the glands of Bartholin in the vagina of the Cow are greatly distended with mucus, serum, or even pus, as a result of inflammation.

Such cysts are not likely to retard parturition, and if they should, their treatment is very simple; as a lancet puncture suffices to evacuate the fluid they contain, and the walls readily adhere and cicatrise.

Hering has seen them occupy the vagina and extend into the uterus; and in the latter organ their presence may be more serious than when they are limited to the vagina. They may prove troublesome obstacles to delivery, as well as dangerous to the animal in whose uterus they have formed.

When the cyst is attached to the cervix or its neighbourhood, it may pass into the os and obstruct it, and thus prevent the fœtus passing through. When very large it may so closely simulate the "water-bag," as to be mistaken for it—though the mistake need not lead to grave results; indeed, if ruptured the cyst immediately collapses, and can no longer prove a barrier to the expulsion of the fœtus. If the cyst is situated towards the os, and if puncturing it be deemed inadvisable, pushing it beyond the pelvic inlet out of the track of the fœtus will be sufficient to overcome the obstacle.

Vaginal cysts may be mistaken for an everted bladder: a mistake which we are assured is often committed, from the external aspect of the tumour, its oval shape, and its colour. Of course, this mistake would prove most unfortunate, if the treatment we have recommended be adopted; but a careful examination should always be made before any active interference is attempted, and this examination will obviate such an error.

Hernia of the bladder through the ruptured walls of the vagina, may also simulate a vaginal cyst; and if it be punctured in this position it

will lead to the same lamentable results, in all probability, as in inversion.

HERNIA OF THE BLADDER INTO THE VAGINA: VAGINAL CYSTOCELE.

Dystokia from the existence of a vaginal cystocele is a somewhat rare accident, and only a few instances are recorded as having been observed in the Mare and Cow during parturition.

Inversion of this viscus may occur in two ways:—1. When empty, it may, by spasmodic contraction of its walls, evert itself—the mucous membrane becoming external and the peritoneal coat internal—and thus turned outside-in, it may pass through the meatus urinarius into the vagina; 2. It may, without being everted, escape into the vagina by an old or recent fissure in the floor of the passage. Most of the cases occur during parturition, and when the animal is straining violently, whereby a portion of the contents of the abdomen and uterus are pressed against the bladder, and may thus produce its inversion. It is not at all improbable that the viscus may, in consequence of the pressure it occasionally receives, be in a spasmodic state, or the cervix may be dilated and relaxed at times (Cartwright).

In the Mare and Cow the urethra is short, straight, and wide; and this no doubt renders the bladder liable to inversion. Zundel states that it may, during parturition, acquire such dimensions from retention of urine that it will entirely fill the vagina, and protrude externally during the expulsive efforts of the animal.

However this may be, it is certain that the cystocele will present a different appearance in the vagina according as its peritoneal or mucous membrane is visible: *i.e.*, everted or non-everted.

In the first case we find a somewhat hard, red tumour with a corrugated surface, and attached to the floor of the vagina by a short narrow pedicle. Examining the lower wall of the vagina attentively, the meatus urinarius cannot be found, but on the soft pulpy surface of the tumour will be observed two small openings—the apertures of the ureters—from which a fluid continually escapes, and which may be recognised by its odour as urine; this fluid may even be thrown out with a certain degree of force during the labour pains. These characters should be sufficient to indicate the nature of the obstacle.

In the second variety, the bladder escapes through a rent in the wall of the vagina, and this rent may only involve the muscular layer—the vaginal mucous membrane remaining intact; or, which is more frequent, the muscular and mucous tissues may be ruptured. In either case there is found in the vagina a round, smooth, and fluctuating tumour, attached to the floor of the canal by a pedicle more or less wide, and beneath which the meatus urinarius can be seen or felt. The most striking pathognomonic feature of this kind of tumour is its rapid growth, in consequence of the accumulation of urine in the interior of the displaced bladder, the fundus of which is towards the vulva and the neck directed forwards—its position being the reverse of normal; the fundus, by pressing on the urethra—which is doubled on itself—prevents the urine from escaping, and we have in this way a rapidly increasing vaginal tumour. In a case recorded by Violet,[1] the tumour had acquired, within eight hours, a diameter of from eight to ten inches. Such a tumour must, therefore, constitute a more or less serious obstacle to parturition.

[1] *Recueil de Méd. Vétérinaire de Lyon*, 1862, p. 371.

We have pointed out the necessity for a careful examination of the tumour, in order to avoid making a mistake, as the cystocele resembles other tumours, and especially the cysts we have already described, or even the "water-bag," and an error in diagnosis may lead to grave consequences. Such an error is recorded by Charlot,[1] who, being called upon to attend a Cow which had been attempting to calve for three days, found on separating the labia of the vulva a whitish, tense, and fluctuating tumour. Thinking that this was only the "water-bag," he punctured it, when the colour and odour of the fluid which escaped quickly undeceived him. When the bladder had collapsed, he then recognised the tear in the vagina through which the viscus had passed. The Cow being in a dying condition and the fœtus still alive, Charlot had recourse to the Cæsarian section; the Calf was saved, but the mother died.

As the diagnosis of this accident is of so much importance, we will notice the symptoms in greater detail.

Protruding through the opening of the vulva, or immediately within the labia, will be discovered a tumour of a pyriform shape, and varying in size and colour according to the duration of the accident. Sometimes this tumour will be seen hanging from within the vagina by a kind of pedicle, for at least eight or nine inches, and will contain two or three pints of fluid. At times the protruded part will be nothing more than a thickening of the bladder, produced by strangulation and inflammation; and it will be changed from its normal colour to that of an inflamed surface, or, if it has been hernied for some time, to a darker hue. Sometimes it will become gangrenous and slough; at other times its surface appears rugged and plicated, and on occasions a large quantity of blood has exuded from its surface. Should there exist any doubts as to the nature of the tumour, the meatus urinarius must be looked for; if that cannot be discovered, then the greatest circumspection should be exercised. The attachment and situation of the protrusion should be noted, and also whether it is continuous with the vagina. The nipple-shaped prominences which mark the openings of the ureters into the bladder should likewise be looked for, as their presence will at once denote the case as inversion of this viscus, as will also the escape of urine from them.

Treatment.

The chief indication in vaginal cystocele is *reduction* or reposition of the displaced viscus. This, however, is not always, if ever, an easy task. In a case of simple hernia, the bladder is soon distended by the urine, and owing to the increase in size, it cannot be returned by the opening through which it passed when it was empty. Compression of its walls will not suffice in the majority of cases to evacuate its contents, because, as has been shown, the weight of the organ lies upon the doubled urethra. To empty the bladder a catheter must be employed; the shoot of an elder-tree deprived of its pith has been successfully used for this purpose on an emergency. Once emptied, the bladder readily resumes its normal situation.

Puncture of the organ has been practised when catheterism was not tried; a fine trocar being inserted obliquely into the upper part of the viscus—which was now of course the inferior part—so as to make it

[1] *Journal Pratique de Méd. Vétérinaire*, 1826, p. 165.

pass for a certain distance between the membranes before entering the cavity of the sac, in this way imitating the entrance of the ureters. The operation was completely successful, as the bladder had been little more than half emptied before the hernia was spontaneously reduced.

Cartwright says, with regard to treatment of cystic inversion: "Provided we are called to the case at an early period, and before a thickening of the parietes of the bladder and sphincter has taken place, we most probably will succeed. We should, with the left hand, press gently upon the sides, and with the right hand the fundus of the bladder, until we feel it gradually receding from us; after which we may carefully introduce a pessary or catheter, so as fairly to force it into its natural situation. If there should be violent straining at the moment we are employing the staxis, we had better desist for a time until we have abstracted four or five quarts of blood, or give a dose of opium in solution, to allay any irritation or spasm. But if we cannot succeed in this way, I think a far more preferable plan will be to get a stick with a round blunt point that will pass through the sphincter, and force it against the base of the protruded fundus. A very excellent instrument would be a female catheter, such as is used for the Cow or Mare, as it would have the necessary curve. In thus trying to re-invert it, we may use considerable force without rupturing it; though, of course, we must be cautious in our pressure."

Sometimes it is no sooner returned than it is again everted, and this repeatedly. In such cases pencilling around the meatus with nitrate of silver, dashing cold water on the vulva, and walking the animal quickly about, have caused its retention.

Should the distended cystocele be immediately in the track of the fœtus, and the expulsion of the latter urgent, if the bladder cannot be returned before birth it must at least be emptied, to allow the young creature to get through the vagina. As the latter passes over it, the viscus should be protected from injury by the fingers.

We will return to a consideration of this condition when treating of the accidents occurring as a sequel of parturition.

TUMOURS IN THE VICINITY OF THE GENITAL ORGANS.

Tumours in the bladder, when of large size—as polypi, steatomatous growths, etc., as well as calcareous concretions, may hinder parturition, or even render it impossible. Even an excessively distended bladder may offer an obstacle to the accomplishment of this act, either in checking the advance of the fœtus, or by sympathetically disturbing the uterine contractions.

The indications here are obvious.

Tumours of various kinds may be developed in the connective tissue of the pelvic organs, and especially between the vagina and rectum, and more or less obstruct labour. Ovarian tumours may also prove troublesome, as may likewise multiple abscesses and cysts in the neighbourhood of the genital passages. In some cases these may be successfully punctured; in others extirpation may be possible; while in others, again, the obstetrist can only choose between embryotomy and the Cæsarian section.

Distention of the rectum from an accumulation of fæces may prove a cause of dystokia—particularly in the Mare; but this should be easily

discovered, and readily removed. Tumours in the immediate vicinity of the anus are rarely a cause of difficult parturition.

We have already alluded to melanotic tumours.

2. Rigidity or Spasm of the Cervix Uteri.

Rigidity or *spasm of the cervix uteri*, or *stenosis of the os*, is a condition not infrequently met with among animals—most frequently in the Cow, next in the Goat, and less often in the Mare. It appears to be more common with nervous, irritable animals, and especially primiparæ, than others; though it is sometimes noted in emaciated and debilitated animals, and even in those which are old, and which have previously brought forth without any trouble.

Without any modification in the structure of the cervix, but merely by a kind of rigid contraction of its fibres, the os remains closed, and cannot be dilated by the efforts of the parturient animal. The cervix is not soft and elastic, as in the normal condition, but feels prominent and rigid, and shows less sensibility than usual; while the os will not admit a finger, or if it does, it grasps it most powerfully.

The majority of veterinarians admit the existence of spasm of the cervix, while others maintain that rigidity and spasm are synonymous terms, in so far as this condition is concerned. The first are ready to confess, however, that spasm is not always present, because very often the "pains" are feeble and few, and the absence of dilatation appears to be due rather to something abnormal in the contractility of the uterus, as a whole, than of this part in particular; whereas, when there is spasm, it has usually been observed that there are inordinate and disordered contractions of the organ. In short, it has been attempted to prove that in rigidity of the cervix there is a purely passive condition of this part, while in spasm there is an active contraction of the organ. In reality, there is no marked distinction between the two conditions, at least so far as obstetrical practice is concerned; and this form of dystokia, in its more salient features, might be looked upon as merely an exaggerated manifestation of that derangement which has been designated tumultuous or irregular parturition, or "false labour" (*metripercinesis*, as distinguished from *metracinesia*, or feebleness of the uterine contractions), in which the contractions are irregular or partial.

We have remarked that there are two sets of muscles in the uterus—the circular and longitudinal, and that there exists a marked antagonism between the circular fibres of the cervix and fundus of the organ, and the longitudinal fibres. So that if the first are more active than the second, and the latter cannot, as a consequence, overcome the resistance they offer, the os remains closed and labour cannot advance. This is, we think, the true explanation of this condition.

Symptoms.

The symptoms vary somewhat. In one case there may be at first nothing unusual to be noted, the pains being manifested with their usual regularity and intensity, and the animal in noways distressed. The only thing that is likely to awaken suspicion, is the unusual duration of parturition, which may extend over two, three, or more days, if assistance be not afforded. As the period is prolonged, the animal may in some instances lose condition, exhibit indications of exhaustion and suffering, and gradually sink; or it may appear ill for some days, then

ally and assume its ordinary appearance—constituting a case of "missed birth."[1]

In other instances, the creature manifests an unusual amount of excitement at first; there is agitation, straining, and symptoms of colicky pains; the abdomen is frequently looked at by the animal, which lies down but soon gets up again; the pulse is full, strong, and frequent; the conjunctivæ are injected; the skin is hot; fæces and urine are passed at frequent intervals; there is thirst and anorexia; and sometimes during the throes the vagina is protruded beyond the vulva, and appears as a large red mass.

A vaginal exploration is necessary, in order to learn the cause of obstruction. This should be carefully and gently made—the latter precaution being most important to observe during the throes. It may be necessary, if the mucous membrane is dry, to inject some emollient fluid into the vagina, or introduce it by a sponge.

When the hand is passed through the vagina, the os will be found more or less contracted, so that scarcely one or two fingers can be introduced into it, owing to the spasmodic resistance it offers, while the cervix preserves its elongated shape.

In the Cow, the cervix and vagina are frequently filled with a tenacious gluey matter, which sticks to the fingers like bird-lime, and by fixing together the margin and walls of the os doubtless increases the resistance the canal offers to dilatation.

If the finger can be introduced into the os, it will be found that there is neither deformity nor morbid induration, and that the constriction is due to the fibres of the cervix alone.

It has been pointed out that, contrary to what is stated above, the cervix uteri is sometimes completely effaced; the bottom of the vagina being occupied by a kind of smooth-surfaced ball, in the centre of which is a narrow opening, and through which the fœtus can be felt. The convex body is the posterior segment of the uterus which, pressed by the head or some other part of the fœtus, is pushed into the vagina; while the small aperture is the os—partially effaced and undilated. This trace of the os, instead of being in the centre, is at times more or less to one side, and occasionally it can only be found with much difficulty.

What seems to establish the spasmodic nature of the affection, is the fact that in many cases, in the intervals of the "pains," the cervix feels soft, and the os becomes dilated sufficiently to permit of the introduction of one or more fingers, or even of one or two limbs of the fœtus. But the moment attempts are made to dilate it, the cervix again becomes rigid, and this condition is greatly exaggerated when the next pain comes on.

[1] We may here call attention to certain signs presented by Cows, and which have been described by Biot (*Recueil de Méd. Vétérinaire*, 1876, p. 1007) as essentially pathognomonic of uterine disturbance in these animals, and for this reason have been specially designated as *uterine*. These signs, upon which he places the greatest diagnostic value, are observed when the sick Cow is approached or touched in any way. The animal then suddenly elongates the neck, extends the head, yawns, protrudes the tongue, and emits at the same time a kind of dull moan, but which is rather a powerful expiration than a real moan." When these signs are present, Biot asserts that the *corps délit*—the disturbance—is in the uterus, and never elsewhere. Laborious or protracted parturition, malpositions of the fœtus or monstrous conformation, occlusion or induration of the cervix uteri, hydramnios, torsion of the uterus; and after parturition, inversion of the uterus, retention of the placenta, and vitulary apoplexy with or without paralysis;—all these may give rise to the manifestation of this singular phenomenon, which he has never witnessed in any other affection—not even in chronic diseases of the uterus.

Diagnosis.

From the symptoms enumerated, there should not be much doubt or delay in diagnosing this cause of dystokia. As in so many other instances, however, the necessity for a correct diagnosis is imperative, as on its accuracy will depend the success of treatment.

If the exploration has been carefully made, the state of the cervix will at once explain the delay in birth. Perhaps the only other condition of the cervix with which it might be confounded is "induration"; but in spasm this part is hot, tense, and painful, and neither hard, lumpy, nor deformed, as in the latter.

Prognosis.

Simple rigidity or spasm of the cervix uteri, provided there is no alteration in its texture, is not in itself of very much consequence. In many cases Nature overcomes the obstacle, and in the course of twenty-four, forty-eight, or seventy-two hours of more or less severe and exhausting labour, delivery is effected spontaneously, and the animal and its progeny are none the worse after a short time. This delay has been most frequently observed in the Cow and Goat; in the Mare it is rarely so prolonged.

But, as a rule, it is not advisable to allow so much time to elapse after labour has commenced, without at least ascertaining the nature of the obstacle which delays birth; as during the longer intervals especially, complications may arise which might lead to serious results. The fœtus may die, or it may assume a wrong position in the uterus, which may afterwards prove troublesome to the obstetrist; the mother may become exhausted and the uterus paralysed, so that the fœtus cannot be expelled when the os is dilated; or, still more serious, the energetic contractions of the uterus may produce rupture of the organ.

So that a prognosis must be based on these considerations; and both the owner of the animal and the veterinarian must bear in mind the fact, that while premature and too active intervention in such a case is to be deprecated, too long delay in affording assistance is to be equally guarded against.

Treatment.

As this condition of the cervix uteri is, at the commencement, of no great importance, and merely retards natural delivery, active interference is forbidden for some time.

When the first signs of parturition do not extend beyond some hours —one or two for the Mare, five or six for the Cow, according to Saint-Cyr; when the obstetrist, by vaginal exploration, has assured himself that the genital organs, as well as the pelvis, are not in any way deformed or altered; that the animal is all right otherwise; and that rigidity of the cervix is alone the cause of delay in birth; then he ought to wait, while being prepared at the same time for any emergency. The glutinous matter which has been mentioned as occupying the vagina and os, and covering the cervix, should be removed as much and as gently as possible from these parts, so as to permit dilatation to take place when the spasmodic constriction begins to yield.

If, however, labour appears to be unduly prolonged without any progress being made in parturition, and if the "pains" are energetic, while the animal's condition is not so satisfactory, then intervention may be counselled. But this intervention should be of the simplest

and mildest character, and in the majority of cases it will be attended with entire success. Injections *per rectum* or *vaginam*, of emollient or oily fluids, to which tincture of opium or extract of belladonna has been added; the ointment or extract of belladonna smeared around the cervix or introduced into the os; blankets or sacks steeped in hot water and applied over the loins of the larger animals, or warm-water baths for the smaller ones; and, in certain cases, the administration of draughts containing some soothing medicament — such as chloral, chloroform, or opium;—these are the means to be adopted.

Bleeding has been advocated by some authorities—particularly on the Continent; but unless something very unusual in the general condition of the animal demands it, the abstraction of blood is of very questionable value.

Opium is of much service, from the influence it possesses in controlling the uterine spasms; it is therefore to be recommended when the "pains" are severe and frequent. It may be given in large doses, both in draught and enema, and frequently.

Chloral hydrate and chloroform, particularly the former, are of great utility, and possess advantages over opium as soothing agents.

For a very long time, belladonna has enjoyed the reputation—and apparently with justice—of being one of the best agents for combating spasm of the cervix uteri, and permitting dilatation of the os. Occasionally its efficacy has been contested, but the great balance of evidence is in its favour, and its employment is almost a matter of course with every veterinary obstetrist. It is generally applied in the form of *extract* around the cervix, about a drachm or so being required for one application—it is rare that a second application is needed. Time should be allowed for its action. For the Bitch one-fourth or one-fifth of the dose is sufficient.

If cocaine were not so expensive it would also prove most useful in such cases, especially in the smaller animals, as a solution of it acts so promptly and effectively.

Sometimes it is attempted to dilate the os uteri by manipulation—the fingers and hand being the dilators; but this means should not be adopted until milder measures have failed, and until time and patience have been exhausted over them. The hand and fingers well oiled, or smeared with extract of belladonna, should be introduced in the form of a cone, towards the os; if they cannot be passed into the canal in this shape, then the insertion of one finger may be attempted, followed by a second, and so on until the hand has been pushed through.

Very frequently this cannot be accomplished at the first trial, nor yet at the second; but with patience and judgment it rarely fails, and if conducted with the care and gentleness which all operations of this kind should receive, such manipulation may be attempted without the least danger at intervals of a few hours, until crowned with success. The condition of the os should be ascertained, after a certain period has elapsed since the last attempt, every precaution being adopted to prevent injury; and an entrance to it ought only to be effected when the resistance has greatly diminished, and can easily be overcome.

Mechanical dilatation of the os by means of the sponge tent has been much, and most successfully, employed in human obstetrics for a long time, and the method has recently been greatly simplified and perfected by Sims, Joulin and others. It is perfectly applicable to animals. The tent can perhaps be purchased at any druggist's, but if not it is easily

made. Joulin makes those he uses in the following manner:—From a somewhat fine and dry sponge of inferior quality, he cuts two long conical pieces, one about three and a quarter inches in length, about an inch wide at the base, and one-third of an inch at the apex; the other five or six inches in length, two and a half inches at the base, and one-third of an inch at the apex. Of course they would require to be larger for animals.

These cones are then prepared for use by wrapping them closely round in twine, the circles of which should be so near each other as not to leave ridges on the sponge. By this pressure the tents become extremely compact, and look like a thick bougie.

When required for use, the twine is removed—this should not be done until the tent has been prepared for at least two or three hours, when it will have acquired sufficient rigidity. A piece of cord should be attached to its base, so as to allow it to be withdrawn when inserted in the os; but before this insertion takes place, the apex must be covered with a little lard, cerate, or extract of belladonna. The sponge is passed into the os as far as possible, either by the fingers or forceps, and until the base of the tent is close to the margin of that opening. The narrow and slightly flexible apex of the tent allows of its passage through the os into the uterine cavity; but in order to be successful the operation must be quickly performed, otherwise the sponge rapidly absorbs mucus and loses its rigidity.

No plugging or other means are necessary to retain the tent, as the portion which projects into the uterus quickly increases in size from the absorption of moisture; so that, after a few minutes, a certain amount of force is necessary to withdraw it therefrom by means of the cord.

The sponge-tent acts in several ways, and simultaneously: 1. It detaches the membranes, and this is often sufficient to induce labour; 2. It acts as a foreign body in irritating the posterior segment of the uterus, which reacts by contracting; 3. It dilates the inner opening of the os; 4. It also dilates the entire length of the os, by swelling through imbibition of the uterine mucus.

To obviate the risk of softening before it is inserted into the os, Joulin prepares the tent in the following manner. Instead of wrapping it round with twine while it is in a dry state, he saturates the sponge in a solution of gum arabic, and then having rolled the twine round it, leaves it to dry for some days. After this treatment it preserves a certain degree of suppleness, but may remain for a minute or two in contact with mucus before imbibing it.

Barnes' procedure for the dilatation of the os uteri in woman, has also proved of great service in human obstetrics; but to our knowledge it has only once been tried with animals, though there is no reason why it should not be successfully employed, not only in producing abortion in those cases to which we have previously alluded, but also in the morbid condition now under consideration.

This procedure consists in dilating the os by means of fiddle-shaped india-rubber bags, which, for women, are of three different sizes; but the very largest of them would probably be required as the smallest size that could advantageously be used for the Cow or Mare.[1]

The bag (Fig. 95), in an empty condition, is introduced into the os by means of a whalebone sound or director, which fits into a small pocket

[1] These bags are made by Weiss and Son, surgical instrument makers, Strand, London. When ordered, the animal for which they are to be used should be mentioned.

at the side; it is pushed through the canal until the pocket end projects into the uterus; then water is steadily injected into it by means of the tube attached to the other end. When filled with water the bag remains in the os, in consequence of the middle portion being narrower than the two ends.

This dilator produces the same results as the sponge tent, over which it has some advantages. The only drawback to it is, perhaps, the thickness of its substance; as it cannot be passed into the os unless this is permeable to two or three fingers.

A simpler contrivance than that of Barnes, and which will perhaps be found useful on similar occasions, is that designed by Schnakenburg, and named the "Sphenosiphon." It is merely the bladder of an animal tied to a syringe, and which, when water is injected into it, mechanically dilates the cervix. For veterinary purposes, the bladder might be attached to a piece of indiarubber tubing, which again could be fixed to the nozzle of the syringe. It and Barnes' dilator act in the same manner as the natural "water-bag," formed by the fœtal membranes and liquor amnii.

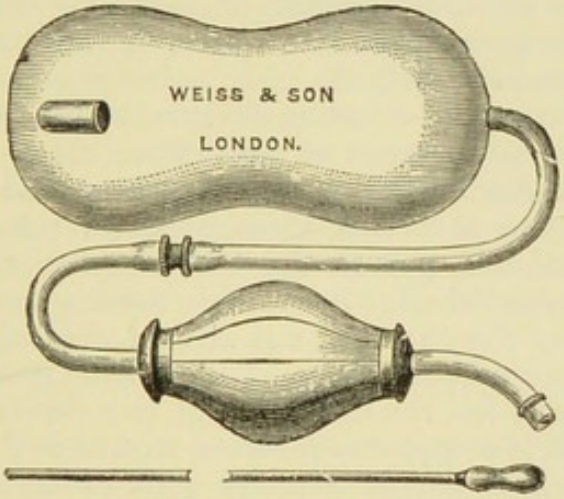


Fig. 95.
BARNES' UTERINE DILATOR.

Another means which has been successfully employed in such cases, as it is simple and without danger, and at the same time effective in producing premature artificial delivery in woman, is the *uterine douche* introduced into obstetrical practice in 1848, by Kiwisch of Dresden. This is generally known as the "ascending uterine douche," and consists of a jet of water at a certain temperature directed against the posterior uterine segment for some minutes, and repeated, if necessary, at intervals of two or three hours. It is often resorted to in woman to favour the dilatation of an *entirely closed* os, and to prepare it for the application of another method, which may be either Barnes' or Schnakenburg's.

This method might be adapted to animals in the following manner. The apparatus may consist merely of a bucket, or barrel with one end out, such as may be found in almost every stable or cow-shed, and a long piece of indiarubber tubing about half-an-inch in diameter, which can be procured easily and cheaply. To one end of this tubing is fitted the pipe of an ordinary syringe—either enema or garden; the other end is immersed in the barrel or pail, which should be filled with tepid water at a temperature of about 104° Fahr., and placed sufficiently high to yield a pretty strong jet.

In order to set the water flowing, the tube must be exhausted of air by suction with the mouth, and the end provided with the syringe pipe carried into the vagina and directed towards the cervix uteri. Each douche should continue for about ten or fifteen minutes, or longer; and it may be repeated every two or three hours, or even at shorter intervals, according to circumstances, until the desired effect has been produced.

Cazeaux speaks highly of this method of dilating the cervix in woman, and for the following reasons:

1. The uterine douche prepares the act of premature birth with the greatest possible gentleness, by means of the softening and the necessary dilatation of the inferior segment of the uterus.
2. By this means all preparatory treatment is needless.
3. This procedure is easily employed, and not at all disagreeable to the woman, as the injection of warm water does not produce any discomfort.
4. It does not require much time.
5. Its action can be graduated at the will of the obstetrist, who may, according to requirements, increase or diminish the duration of the douche and the temperature of the water, as well as vary the parts of the cervix on which he directs it.
6. Finally, it can never occasion lesions of the genital organs, nor yet injure the fœtal membranes or the fœtus.

This uterine douche is well worthy of notice, and though there are only, so far as we can ascertain, three cases on record in which it has been tried with animals, yet as these were most successfully treated by it, it may be assumed that it will be found a most valuable means of not only dilating the os uteri, but also of controlling the action, or relieving certain morbid conditions, of the uterus itself.

Rougher treatment for the dilatation of the cervix than that which has been described, is sometimes resorted to, either through impatience, ignorance, or in cases which demand prompt action; as the other measures require a certain amount of time, from the slowness of their operation—though perhaps this is rather an advantage than otherwise.

Forcible dilatation of the os uteri has been practised in human obstetrics, and special instruments have been devised with this object. Such dilators have been constructed by Osiander, Busch, Mende, and Krause, but they have not been much used, as milder measures are preferable. The same remark is applicable to veterinary obstetricy, in which there is only too often a tendency to imagine that because the patient is an animal, so all the more force and brusqueness can be resorted to.

Forcible dilatation of the cervix, which is not to be recommended, except perhaps in very exceptional instances, has its advocates, and two cases reported by Oschner, a Swiss veterinary surgeon, prove that it may be successful, notwithstanding its disadvantages. In these cases, every other known means had failed; so Oschner procured a pair of large fire-tongs used by blacksmiths, and wrapping their jaws round with tow which was smeared with grease, he introduced them, closed, through the os; then an assistant gradually opened the shanks or handles of the tongs, and so produced the desired widening of the passage. The inflammation set up by this manœuvre was dissipated by the employment of soothing remedies, after fifteen days' treatment.

It is obvious that such a mode of dilatation should not be practised,

unless there is something most unusual in the case; as it is a most painful operation, and likely to produce contusions and lacerations of the cervix, which may require much time and attention to repair.

Incision of the cervix (*vaginal hysterotomy*) is another operation which can scarcely ever be required for rigidity or spasm of this part, and ought to be reserved for more serious conditions. At any rate, it should not be practised until the other measures we have enumerated have been fairly tried, as it is an operation not without risk of ill consequences.

In some cases, in which the spasmodic action of the uterus is irregular, and leads to occlusion of the os, it might be advisable to resort to anæsthesia, produced by the inhalation of ether or chloroform. Of course the anæsthesia should not be pushed to complete insensibility, but be limited to semi-consciousness or "obstetrical anæsthesia." This is more particularly to be recommended for the smaller animals.

In the majority of cases, when the rigidity has been dispelled or the spasm relaxed, birth will take place without further assistance being required; though it may be well that the obstetrist assure himself that the fœtus is in a favourable position for delivery. If there appears to be atony of the uterus or the mother is exhausted, or if the fœtus is dead or in a faulty position, then it will be necessary to afford aid in parturition by adjustment and traction.

In very many instances, it must be remembered, this rigid condition of the cervix is due to malpresentation or malposition of the fœtus in the uterus; and even when the os has been sufficiently relaxed, the young creature cannot pass through until it has been properly placed, and not unfrequently aided through the genital canal.

3. Induration of the Cervix Uteri.

Induration of the cervix is the term applied to this part when its texture is altered in any way—whether the alteration be fibrous, sarcomatous, or cancerous—so that its elasticity being destroyed, and its structure inextensible, it offers an obstacle to parturition.

This alteration, or "scirrhus," as it has sometimes been designated, is not at all infrequent; but it has been observed, it appears, nearly always in the Cow, and would seem to be almost, if not quite, peculiar to that animal.[1] The reason for this partiality has been variously accounted for, but probably Bouley, in an unpublished note to Saint-Cyr, has afforded the most satisfactory explanation. He remarks that "irritation produces in the Bovine species phenomena of *induration* much more durable than in any other species; in proof of this, witness the *plastic* engorgements—so adverse to suppuration, and so slow to disappear—which are caused by a seton introduced beneath the skin of an Ox; witness, also, the enormous swellings observed as a consequence of inoculation for pleuro-pneumonia (Bovine), and those indurated tumours vulgarly designated *osteo-sarcomatous*, so frequent on

[1] I can only find one case mentioned as occurring in any other animal, and that happened in a Ewe. It is reported by Shentone (*Veterinarian*, vol. xxix., p. 36), who says that the creature had been in labour since the previous night, but had made no progress, and was very much exhausted. "It was a case of scirrhous os uteri. I told him (the owner) I would divide the stricture as the only means of saving her, but in her case it was almost a 'forlorn hope.' However, I did divide it, cutting in two places, parallel to each other, and with a good deal of difficulty extracted a large Lamb that had, from its appearance, been dead for some time." The Ewe recovered.

the maxilla, and which repeated irritation caused by the prick of a needle are sufficient to produce. This seems to be a general organic fact, of which induration of the cervix uteri is only a particular instance."

This induration must not be confounded with the dense, fibrous, though normal, consistence of the cervix of the Cow's uterus, which, there can be no doubt, has often been mistaken for a diseased condition, and particularly when in a rigid or spasmodic state. The distinction between what we may term the *functional derangement* and the *pathological alteration* of this part, is of great importance from an obstetrical point of view; as the first may be remedied by the mild and innocuous measures enumerated, while the second can only be overcome by a more or less serious surgical operation.

In some cases, perhaps, the induration is congenital; but it must be admitted that, as a rule, it is due to the influence of disease or injury—past or present—in the textures. It may, therefore, be expected to be more frequent in old animals, or those which have already been bred from, than in those which are young or are pregnant for the first time, though these do not appear to be exempt.

Rancon assured Rainard that morbid induration of this part was witnessed more frequently in the ancient Briançonnais, where he practised for thirty-six years, than in other regions of France. We are not aware whether the influence of breed or locality has been observed to influence its prevalence in other countries.

Symptoms.

Owing to the situation of the cervix, and the nature of the tissues entering into its composition, as well as to the slowness with which the pathological alterations take place, this condition may be in existence for a long time without any appreciable change being observable in the animal's health. Therefore it is that Cows which are so affected do not exhibit anything during the whole period of pregnancy, which might lead a person to suspect the existence of uterine disease.

In some cases, however, towards the termination of pregnancy there has been remarked a listlessness or gradually increasing debility, which has been so great at last that the animal assumed the recumbent position, and could not get up without assistance. This general weakness has been mistaken for paraplegia, though it has sometimes been supposed to be due to lumbago; though it may have been merely a symptom of generalised cancerous infection, the part itself being the seat of cancer.

But in the great majority of cases, the existence of induration is not suspected until parturition sets in, when the labour pains, which may continue for a long time, attract more than ordinary attention, as birth does not take place. And not infrequently during the pains, and more especially when the animal is lying, a livid, irregular-shaped, and nodulated kind of tumour appears between the labia of the vulva; this is the undilated cervix uteri.

In other instances, however, nothing is observable externally, and a vaginal exploration is necessary. The cervix is then discovered to be more or less dense without being much increased in size, or it may protrude into the vagina, and form a voluminous, irregular, nodulated tumour which in some cases feels as hard as wood, and in others has a rugged, soft, and ulcerated surface. Some veterinary obstetrists have described transverse rugæ, composed of a solid, unyielding, fibro-cartilaginous material, in the os.

The os is not always easily found, and it is sometimes so contracted that one finger cannot be introduced into it; at other times it is not so constricted, and the fœtus may be felt through it. But in every case it is irregular and deformed, deviated from its usual direction, and its walls greatly thickened, perhaps corrugated. Its degree of hardness and thickness will indicate whether, and to what extent, it can be dilated; and this condition may not only involve the whole of the cervix, but also the walls of the uterus itself, as well as those of the vagina.

When the cervix is ulcerated, the hand will be found covered with blood after the examination.

Diagnosis.

The diagnosis of this condition must be left, to a large extent, to the tactile impressions derived from a vaginal exploration. In some cases an ocular inspection of the cervix may be possible, and the previous history of the case may also be useful in this direction.

Prognosis.

The influence of the induration on the act of parturition will depend upon the degree and extent of the alteration in the cervix. If this is not very serious, and does not implicate the organ very much, and particularly if the induration is localized in some unimportant part, parturition, though protracted, may nevertheless be accomplished without assistance. Often, however, the results are troublesome; one of these is laceration of the cervix, from its unequal dilatation.

Though there is a great difference, pathologically speaking, between the various alterations—for example, between simple fibrous transformation and cancerous degeneration—yet it is admitted that the most benignant alteration is infinitely more serious, from an obstetrical point of view, than simple rigidity of the cervix, either in its immediate or remote results. This Saint-Cyr has proved to be the case in nineteen recorded observations. Of these, seven were more or less unfortunate in their results; in three instances the mother and fœtus succumbed; in other three the mother died, but the progeny was saved; and in the seventh, the Calf died, but the Cow lived. This is a very high rate of mortality, and yet Saint-Cyr is not quite certain that in these nineteen observations there were not some which were rather cases of simple rigidity than induration of the cervix. For as Rainard remarks—and the remark would also apply to the observations recorded in English veterinary literature—it is not always easy, for lack of sufficient details, to discern clearly to which category belongs such or such an observation given by writers under the title of "indurated cervix," "schirrous cervix," "stricture of the os uteri," etc.

In arriving at a prognosis in a case of this description, the immediate results are not alone to be taken into consideration; as pregnancy and the manipulatory operations necessary to effect delivery—which is always tedious and difficult—give to morbid alterations of these parts—even when quite benignant in their nature—an exceptional gravity; so that many animals, even after a comparatively easy delivery, succumb soon afterwards to the diseased condition. The uterus may be ruptured through the efforts at delivery.

Pathological Anatomy.

The lesions found after death are generally alluded to as "fibrous degeneration," "scirrhus," or "cancer" of the cervix; and it is usually mentioned that this part was "hard and like cartilage," "creaking under the knife like cutting an unripe apple or turnip"; or that there was "schirrus" or "cancer," "nodular and hard like cartilage."

Macgillivray states that when the contraction of the os uteri is the result of prior disease, it will generally be found of a hard fibroid nature; while, on the other hand, where the contracted parts are soft and very much thickened, acute disease will commonly be found accompanying the stricture. "In hard stricture, the transverse rugæ or folds appear generally to be transformed into a compact, unyielding fibro-cartilaginous material; in one very serious case I found six of these hardened unyielding transverse rugæ or folds between *the os tincæ* and *os internum*. In soft stricture, without any actual disease being present, the contraction is generally confined to the os and the vaginal portion of the cervix uteri. In cases of complicated stricture, or, in other words, stricture accompanied by some active disease, it will often be found that the stricture is merely the concomitant effect of the disease, and such causative disease will almost invariably prove to be either ulcerative, schirrous, really cancerous, or fungous in its nature. . . . Deposits of a fibrinous nature are only too common in patients of rheumatic constitution."

Treatment.

The condition of the cervix uteri being ascertained, there should be no delay in resorting to active measures, as it is impossible for delivery to be effected, in the great majority of cases, without such interference. Here the necessity for a correct diagnosis is, as we have already urged, of the greatest moment; for if the obstacle to birth is only rigidity or spasm of the uterus, this can generally be overcome by mild measures and without risk or injury to the animal; whereas, in induration these measures would be ineffective, and valuable time must be lost in trying them.

Delivery, in induration of the cervix, must be effected by one of two serious operations. This must be either *vaginal-hysterotomy* or *gastro-hysterotomy*. We shall again allude to and describe these, in speaking of obstetrical operations.

It may only be necessary in this place to say that *vaginal hysterotomy* —by which is meant incising the cervix, either completely or partially, in one or more places—does not offer any very dangerous consequences when the textures are healthy; though when they are much degenerated, the operation may be followed by troublesome, if not fatal results. Nevertheless, dilating the cervix by incision is rarely so serious for the mother as the Cæsarian section; though the fœtus may incur more risk, as, after the cervix has been relaxed, it is often a tedious and difficult operation to effect delivery, and strong traction may even be necessary. As this measure offers a chance of saving both mother and fœtus, it should, as a rule, be preferred to gastro-hysterotomy; and this preference is still further warranted by the fact that the life of the mother is of more value than that of the fœtus, and if one must be sacrificed it should be the latter. Should the fœtus happen to be dead, then there is an additional motive in preferring incision of the cervix.

When the os has been considered sufficiently dilated for the introduction of the hand and arm into the uterus, then the fœtus should be placed in position for extraction—the most favourable being, of course, the vertebro-sacral, with the head and fore-limbs towards the os. Should it be found impossible to engage these in the passage, then more incisions may be made in the cervix, and this can be done without displacing the fœtus.

It is well to remember that it is very much better to dilate the os by incision than by laceration, through unduly forcing the fœtus into it. At the same time, judicious traction should be made during the maternal efforts.

Aubry, Van Dam, and some others, have witnessed fatal hæmorrhage resulting from the incisions; while metro-peritonitis has also been reported as an equally unfortunate sequel.

But these cases are exceptional. Those veterinary obstetrists in this country and on the Continent who have had most experience in the operation, are unanimous in asserting that, provided certain precautions are adopted in making the incisions, no such results are likely to follow.

Donnarieix states that, in thirty years, he has performed vaginal hysterotomy in sixty cases of schirrus and other kinds of induration of the cervix leading to occlusion of the os uteri, and of these only one died, though the cause of death was not ascertained. Recovery is the rule and death the exception.

Of course, recovery must always be doubtful if the disease of the cervix is of a malignant nature, as the operation and the irritation caused by the extraction of the fœtus will, in all probability, hasten its progress.

In some rare instances it may be advisable to have recourse to the Cæsarian section at once. When, for example, labour has been severe and prolonged—when some days have elapsed since parturition commenced, and the veterinary surgeon is not sent for until amateurs have exhausted their efforts and the animal is sinking; or when, from a vaginal exploration, it is ascertained that uterine or vaginal disease is so extensive and advanced that the mother cannot live much longer, and the fœtus is alive; then this formidable operation should be adopted without delay.

4. Complete Obliteration (Atresia) of the Os Uteri.

Congenital atresia of the os uteri may at once be admitted as an impossibility in obstetrics, as if this canal is *completely* closed impregnation cannot take place. But between fecundation and parturition certain alterations may occur which, by leading to more or less persistent closure of this passage, will prove an obstacle to birth. These alterations may indeed exist at the period of fecundation, but then the uterine opening must be only partially closed; and, in fact, at parturition the os may be superficially and partially, as well as completely, occluded. This condition has been observed in the Mare, Cow, and Sheep.

Causes.

The occlusion may be due to agglutination of the walls of the os, the formation of fibrinous membranes or bands, the development of cicatricial tissue from wounds or injuries sustained in previous pregnancies, etc.

Symptoms.

These are, of course, the usual external symptoms of retarded parturition. Internally, the hand, on being introduced into the vagina and pushed towards the cervix, comes in contact with a round, smooth, and tense, but fluctuating tumour at a variable distance from the vulva, or even between its labia; the fœtus can be felt through this tumour, and this might lead to the supposition that this is the "water-bag." But on passing the hand to the base of the tumour, instead of finding the borders of the os—as we should do if it were the fœtal membranes—there is discovered a circular furrow, one side of which is the extremity of the vagina, and the other is continuous with the tumour—which is the posterior segment of the uterus pushed into the vaginal canal. On the surface of this tumour may be found a small imperforate depression; in other instances there is a kind of prominent ring, like the top of the neck of a bottle, but without an opening; this is the cervix. In other cases no trace of the cervix or os can be distinguished.

Results.

If relief is not afforded, the mother may die from exhaustion or rupture of the uterus; or a rupture may occur through which the fœtus and its membranes will pass, and the mother survive for a longer or shorter period, constituting a case of extra-uterine pregnancy. Or neither of these results may happen, but after a certain time the labour pains and the other indications of parturition subside, the dead fœtus is gradually desiccated as the fluids surrounding it become absorbed, and the parent does not appear at all amiss, its condition being perhaps only accidentally discovered, either when it dies or is killed long afterwards, or when the remains of the fœtus begin to be expelled in a vicarious manner.

Diagnosis.

The diagnosis of this condition must be based on the signs just alluded to. The only other anomaly, perhaps, with which it might be confounded is deviation of the uterus, in which the cervix may be tilted up towards the vertebro-sacral angle, even almost beyond the reach of the hand. The position of the cervix and os tincæ should be the guide in diagnosis.

Treatment.

As in induration of the cervix, so in atresia; delivery must be effected by incision, or puncture if the os is found to be obstructed by superficial fibrinous bands or membranes. For the latter, the extremity of the finger or a metal catheter may suffice, the pressure being gradual and the movement semi-rotatory. The bands may, in rare instances, be ruptured by means of the finger-nails or divided by scissors. If, however, the resistance is too great, and the os is closed either through the production of cicatricial tissue or other morbid alteration, then it will be necessary to incise it as for induration, and in the way to be hereafter described.

But if the os is obliterated and the cervix cannot be found, then the portion of the uterus which protrudes into the vagina must be incised, and the fœtus removed by this artificial opening. With this object, Hubert recommends a convex bistoury, the blade of which is covered

to within a few lines of its point. The instrument is to be directed to the part where the os is supposed to be; then the coats of the uterus are to be carefully incised to a small extent—layer after layer, until the escape of the liquor amnii announces that the fœtal membranes are opened. The small slit thus made is to be enlarged by a probe-pointed bistoury—the enlargement being either crucial or T-shaped. Then the fœtus is to be extracted.

Hubert has performed this operation once on a Sheep, and a shepherd by his direction also performed it on another Sheep, and in both cases the result was favourable for mother and offspring.

CHAPTER IV.

Other Causes of Maternal Dystokia.

There are some other causes of Dystokia which, though comparatively rare, yet deserve the attention of the veterinary obstetrist, and will complete our notice of the maternal obstacles to parturition. These are: (1) *Anomalies of the placenta;* (2) *Morbid adhesion between the fœtus and uterus;* (3) *Stricture of the uterus by external bands;* (4) *Persistent hymen;* (5) *Vaginal and vulvar atresia.*

1. Anomalies in the Placenta.

We are but little acquainted with the morbid alterations of the fœtal membranes of animals, and of those changes which lead to their more or less permanent adhesion to the fœtus and the uterus. The subject appears to have received very little attention, and the observations are so few that Saint-Cyr makes no mention of these adhesions as a cause of difficult or impossible birth.

It is very probable that animals are less subject to disease of the uterus and the placental membranes than the human species, and this would account to a certain extent for the absence of notice of such occurrences. Nevertheless, that animals are disposed to metritis, endometritis, and perimetritis, no one can deny; and that we may also have such anomalies as hyperplasia of the chorion, as well as myxomata of that membrane, in addition to new formations of the placenta, as well as placentitis, might be expected. But, as we have observed, there is indeed but little direct evidence to prove that any of these morbid conditions ever exist, though some of them at least may lead to abortion, while others might give rise to obstacles which would retard or altogether prevent birth.

Scirrhous Chorion.

According to Cox,[1] scirrhous chorion is occasionally met with in animals, and proves an obstacle to parturition.

The membrane is found to be separated from the uterus, and envelops the fœtus, as it were, in a leather bag, no part of the creature being distinguishable. This is probably the condition known in woman as *myxoma fibrosum placentæ.*

The labour pains are seldom violent, though the fœtal membranes

[1] *Veterinary Journal,* 1877, p. 105.

(water-bag) cannot be expelled into the vagina, even when the os uteri offers no obstacle.

An early examination is necessary, as the fœtus soon perishes. An incision must be made through the chorion, and the fœtus extracted.

2. Morbid Adhesion between the Fœtus and Uterus.

Adhesion between the uterus and its contents may be due to inflammation of a portion of the mucous membrane, to hyperplasia of the chorion, or to disease of the ovum or placenta, by which the two latter are brought into direct contact with the interior of the organ. Or it may be owing to a deficient quantity of liquor amnii when the fœtus begins to be formed; for if the amnion, in the course of its development, is not separated from the growing fœtus by a sufficient quantity of fluid, connection between them is almost certain to be established either in isolated spots (Simonart's "bands"), or over a wide surface. Adhesion between the amnion, chorion, and lining membrane of the uterus, is then not only possible but probable, and in this way the fœtus is brought into a solid union with the maternal organ. It can readily be understood that such an occurrence will prove a very serious obstacle to birth, and greatly endanger the life of the mother.

Rainard[1] furnishes us with two observations, a writer in the *Veterinary Journal* ("Nemo")[2] with another, and Naylor[3] with two.

Rainard justly remarks that veterinary surgeons should be aware of the possibility of such adhesions, either with the placenta or the envelopes, and, through them, with the uterus; and that they are otherwise easier recognised than those external to the uterus.

The hand, introduced into the uterine cavity, is passed over its inner surface, around the fœtus, as it were: and by this means the existence, seat, extent, and resistance of the adhesions will, in the majority of cases, be ascertained. When the adhesions are situated towards the fundus of the organ—its most distant part, and where the hand cannot reach, then there will be difficulty; but this must be overcome by raising the uterus and throwing it backwards, by elevating the front part of the animal's body, and lifting the abdomen by means of a plank, blanket, or sack.

Most frequently the adhesions can be broken up by the fingers; but if they are too strong, then a bistoury or other convenient instrument will have to be employed. Their incision must be carefully made, and the "crutch" or "repeller" (to be hereafter described) will be useful in keeping the fœtus away from the part where the separation is being effected. The cutting should be done gradually and steadily, the point of the instrument being kept at an equal distance between the fœtus and the mucous surface of the uterus.

In alluding to these *internal* adhesions, it may be observed that some very rare cases are recorded, in which parturition was opposed by *external* adhesions between the peritoneal covering of the uterus and the sac of a hernia, or neighbouring viscera.

[1] *Traité Complet de la Parturition*, vol. i., p. 461.
[2] *Veterinary Journal*, vol. iii., p. 262.
[3] *Veterinarian*, vol. xxiii., p. 324.

3. Stricture or Occlusion of the Uterus by External Bands or Membranes.

A number of writers, especially in foreign periodicals, have described the presence of bands or membranes external to the uterus—either in the peritoneal cavity or vagina—obstructing the passage of the fœtus and rendering birth almost, if not quite, impossible without an operation.

With regard to the treatment of these cases, but little can be said. When the bands are in the vagina, their division is the principal object, after which, if no other obstacle is present, delivery can take place. When, however, the uterus is constricted by an external abdominal band—though this condition will be difficult to diagnose—then probably no course can promise anything like a successful result except the Cæsarian section.

4. Persistent Hymen.

At p. 30 there was described a wide duplicature of the lining membrane of the vagina which covers the meatus urinarius, and which looks like, while it acts as, a valve (*valvula vaginæ*) to that opening. This membrane, which stretches across the passage and separates the vulvar from the vaginal canal, is the analogue of the hymen of woman; and, as in her, it may persist after the impregnation of primiparæ—having escaped rupture during coitus—and becoming abnormally rigid, may prove an impediment to birth in some instances, though it must be confessed they appear to be exceedingly rare.

This cause of dystokia should be very much less frequently met with in the Equine and Asinine species than other of the domesticated animals, in consequence of the size and conformation of the male organ of copulation, from which the membranous vaginal partition can scarcely escape rupture, when it is present, which is only occasionally.[1] With the Bovine, Caprine, Ovine, and Porcine species, however, the case is different, as the penis, from its volume and shape, is far less likely to lacerate the hymen; and it is in the Bovine species alone that the persistence of the latter at parturition has been found—at least so far as published observations show; and in all the instances the animals have been young and primiparæ.

It is just possible that in many animals of these species, the hymen may be more or less intact until parturition sets in, when the fœtus, in its passage through the vagina, ruptures and effaces it without much delay resulting, or any other cause which might attract attention.

But in others—few though they be—the membrane would appear to

[1] The hymen appears to be only exceptionally present in the Mare, though it is an error to assume that it is always absent. Not only is it sometimes to be found, and occasionally of large size and extraordinary tenacity, but it may even become a source of trouble in unimpregnated Mares. Of this we have an example by Mr. Thomson, of Beith (*Veterinarian*, vol. vii., p. 147). That veterinarian was called to see a young Mare, said to have inversion of the bladder. On his arrival, he saw protruding from the vulva a membranous sac containing about a quart of fluid in its cavity. An examination proved the sac to be a simple membrane, extremely vascular and much inflamed. It was easily pushed back into the vaginal cavity, where it was found to be attached to the posterior part of the urethra and all around the vaginal canal, so that the passage to the os uteri was completely obstructed; the membrane could not be pushed so far forward as the cervix. On removing the hand, it again protruded whenever the Mare made an effort.

In another instance—a year and a half old Filly—Mr. Thomson observed an intact hymen—but there was a small opening in it—immediately behind the urethra.

offer a rather serious amount of resistance to the expulsion of the young creature, and demands the services of the obstetrist.

The cases recorded are exceedingly few.

Treatment.

The indications for treatment, when the hymen is present and an obstacle to birth, are obvious: divide it at once. This division may be made in the middle of the membrane, and does not demand any particular care or surgical knowledge; though it is well to make a close examination before the incision is made, in order to avoid making a mistake should the membrane appear as a tumour.

5. Vaginal and Vulvar Constriction or Atresia.

Stenosis and atresia of the vulva and vagina have not infrequently been recorded as either delaying, or altogether preventing, parturition in animals, according as the obstruction was incomplete or complete.

This condition may exist previous to impregnation, but to such an extent as to offer no obstacle whatever to that act; or it may become developed in the interval between impregnation and parturition. Of course, if atresia is complete, and of such a character that the spermatic particles cannot pass into the os uteri, impregnation will not take place, and the animal remains sterile.

The condition may, therefore, be congenital or acquired. Incomplete congenital stenosis of these passages is not at all uncommon in young animals, in which the vulva and vagina are often so constricted and inelastic, that during copulation they are injured, and this injury tends still more to diminish their calibre and dilatability during pregnancy. Congenital stenosis to a very abnormal degree may sometimes exist, however, without any apparent traumatic influence.

Acquired stenosis or atresia is generally the result of certain diseases or injuries, such as inflammation, suppuration, ulceration, and laceration, often due to difficult parturition. These may lead to hypertrophy and density of the tissues, hard resisting cicatrices, solid adhesions, or partial or complete obliteration.

Malposition of the vulva may also lead to atresia. I witnessed a case of this kind in an Arab Mare of high pedigree in Syria. The vulva was partly below the ischial arch.

In primiparæ, cases of abortion, in which birth occurs in a hurried manner, as well as when the water-bag is ruptured too soon, or in those breech presentations in which the hind legs are bent forward and only the hocks offer—in all these the narrowness of the vulva and vagina, from lack of preparation, is often an obstacle to parturition, their tissues being "hard."

But with patience and warm emollient injections, as well as careful and gradual manual dilatation, this obstacle may be overcome. When birth is taking place too hurriedly, Rainard recommends closing the animal's nostrils and opening its mouth, pulling out its tongue and pressing on the loins to prevent its arching the back and straining. It is very rare that the resistance is serious, and in the great majority of cases birth occurs spontaneously, or with trifling assistance.

Some authorities, however, have met with instances in which it was necessary to dilate the vulvar orifice by incision, in order to prevent this part being lacerated, and to spare the animal pain and subsequent deterioration.

When the dystokia is due to disease or a traumatic cause, birth is more difficult; and this difficulty is increased as the pathological alteration is extensive.

Treatment.

The treatment of stenosis of the vulva and vagina must be, of course, surgical, and will vary according to the cause producing the constriction. But it will chiefly consist in incisions carried to a depth and extent commensurate with the exigencies of each case, and modified according to the anatomy of the part which forms the seat of stricture. It will be found that lateral incisions are, when they can possibly be practised, preferable to those made either superiorly or inferiorly, as they are less likely to be followed by inconvenient alterations and unfavourable consequences; while, with regard to the vulva, the textures at the sides of that orifice have more vitality, and therefore cicatrise more rapidly than at the superior commissure.

BOOK II.

FŒTAL DYSTOKIA.

Though the obstacles to parturition offered by the maternal organs are somewhat considerable in number, yet it is found in practice that those due to the fœtus are far more frequently met with, and are much more numerous; though all of them may not constitute real or serious obstacles, some being easily removed or overcome, when birth takes place without any difficulty.

The obstacles which the fœtus may offer to birth are, for convenience of study, divided into two natural groups, according as they result from some physical condition of the young creature itself, or from the more or less irregular manner in which it is presented at the pelvic inlet. Each of these groups, again, it is needless to add, embraces a certain number of varieties of obstacles; but though grouped and classified in this way, it must be remembered that difficult parturition due to the fœtus may not be owing exclusively to any one of these obstacles in every case, but in some instances may result from a combination of two or more of them.

This combination, however, does not preclude us from studying them separately; indeed, their separate consideration is absolutely necessary, as it is only by analysing them that we can realize their influence in hindering birth, either when alone or combined.

As will be seen from the following synoptic table, the obstacles in the first group are very numerous and varied, and require careful consideration from the obstetrist—opening, as they do, a wide field for investigation and reflection, as well as practical deduction; and none the less so with those of the second group, to be dealt with hereafter.

Synoptic Table of Fœtal Dystokias independent of Presentations and Positions.

Dystokia from
- *Umbilical Cord.*
- *Excess in Volume.*
- *Excess in Growth of Hair.*
- *Anomalies and Diseases of Membranes.*
- *Abnormal Quantity of Placental Fluid.*
- *Diseases*
  - Hydrocephalus.
  - Ascites, Anasarca, and Hydrothorax.
  - Emphysema.
  - Polysarcia.
  - Contractions.
  - Tumours.
- *Monstrosities.*
- *Multiparity.*

GROUP I.

OBSTACLES INDEPENDENT OF PRESENTATIONS AND POSITIONS.

In this group, the maternal organs of generation and those parts immediately concerned in parturition may be perfectly healthy, and the fœtus itself may be in a favourable position for expulsion; yet birth is either protracted or rendered impossible without assistance, because of the umbilical cord, the excessive volume of the fœtus, excess in growth of

hair, anomalies in or diseases of its enveloping membranes, an abnormal quantity of placental fluid, anomalies in the umbilical cord, disease or malformation of the young creature, or a plurality of fœtuses in animals ordinarily uniparous.

CHAPTER I.

Various Extraordinary Causes.

The Umbilical Cord as an Obstacle to Birth.

Anomalies in the umbilical cord are not a very common cause of dystokia.

The cord may be unusually *short;* but this deficiency does not appear to operate prejudicially in parturition, as the natural twist in it admits of its elongation to a certain extent, while during the act of expulsion the walls of the body of the uterus approach the cervix as the fœtus advances into the vagina. Even if the cord happened to be *too short*, it is questionable whether it would constitute a serious obstacle to birth, as it would most probably either rupture or the placenta would separate from the uterus.

If by chance the fœtus should not be expelled until it was discovered that the cord was insufficiently long, this might easily be cut in the vagina, as far as possible from the fœtus, the ends being compressed by the fingers and ligatured after delivery.

In the domestic animals the cord is never so long as to occasion what has been designated in human obstetrics *prolapsus of the cord, i.e.*, its descent into the os, vagina, or outside the vulva, after rupture of the membranes, and alongside the presenting part of the child—an accident attended sometimes with great danger to the latter, from compression of the funis.

The comparatively short cord of the domestic animals also exempts them to some extent from another frequent cause of difficult labour met with in woman—the *coiling* of the funis around some part or parts of the fœtus. Nevertheless, this coiling has been observed in animals—more often, perhaps, with the Mare than the Cow. Havon, Delwart, Hurtrel D'Arboval, Rueff, and Sacchers have seen the cord coiled around the neck, and more especially when the fœtus was in a wrong position—head bent towards the flanks, near the cord. Gaven has found it round the loins; and numerous observers have noted it encircling one or more of the limbs. Remondeau found the cord round both hocks of the fœtus in an Ass; this formed a serious obstacle to birth, and embryotomy had to be resorted to before delivery was effected. Daubenton had remarked the frequency of leg coils in Sheep.

Coiling of the funis around any part of the fœtus is not in itself a common cause of dystokia, although it may render delivery protracted and fatiguing. It is more likely to induce asphyxia in the young creature, from the stretching and diminished calibre of the bloodvessels composing it, and consequent check to the flow of blood.

Rainard is of opinion that the obstacle to parturition from coiling is less serious in the Mare and Carnivorous animals than other creatures, because of the readiness with which the placenta is detached in them.

The dangers of strangulation are also much less when the fœtus presents anteriorly; when the presentation is posterior, there is risk of suffocation, because it is difficult to ascertain the situation of the cord in order to divide it; and the uterine contractions, as well as the artificial traction, tend to tighten the funis around the neck.

In the human species, it has often been remarked that children are sometimes born with their limbs deficient, and the spontaneous amputation has been attributed to the constriction produced by this coiling or twisting of the umbilical cord around the part, during the development of the fœtus. Vrolig, Hillairet, and Goubaux have recorded similar mutilations in animals.

Diagnosis.

There are so many causes of dystokia, that it is often a puzzling matter to ascertain that which is really in operation in some instances, and this is one of them. When nothing can be discovered as likely to hinder birth—neither narrowness of the passages, excessive size of the fœtus, malpresentation, or other obstacle—a careful examination should be made of the umbilical cord, in order to ascertain whether it is relaxed or tight, or encircling any part of the body. If it is relaxed, then the obstacle must be sought in something else; but if it is in a state of tension, and especially if round the neck or limbs, then to it may be ascribed the dystokia.

Indications.

When coiling of the funis is ascertained to be the cause of difficult parturition, the indications are to uncoil it; or if this cannot be effected, then it must be divided either by the fingers, scissors, or a probe-pointed bistoury—hastening delivery as much as possible afterwards. There is not much to be feared from hæmorrhage after section of the vessels, as they seldom bleed.

But to avert danger from hæmorrhage or asphyxia, delivery must be delayed as little as possible. A ligature around the cord before birth will certainly produce asphyxia very promptly. In order to prevent both of these occurrences—asphyxia and hæmorrhage—Saint-Cyr proposes to pass a string around the umbilical cord, leaving its two ends outside the vulva; these are passed through the two holes at the end of a porte-cord, one of them being fastened with a knot there, while the other is carried through the ring at the handle. When the umbilical cord is about to be cut, this instrument is pushed into the uterus close to the body of the fœtus, and the line being pulled tight, the vessel is divided on the placental side. This checks hæmorrhage, and delivery can be effected without much, if any, hindrance from the porte-cord, which can be held by an assistant, the string being tied firmly round the handle, if need be.

Excess in Volume of the Fœtus.

Excess in volume of the fœtus, due to normal or abnormal development of either the whole or only part of its body, is far from constituting an unfrequent cause of dystokia in the domestic animals — rendering spontaneous birth more or less difficult or altogether impossible, notwithstanding the healthy condition of the maternal organs, the regu-

larity and energy of the uterine contractions, and the favourable position of the fœtus.

Causes.

Several causes may be in operation to lead to excessive development of the fœtus—either wholly or partially. Among these we may cite the following as the principal:

Prolonged Gestation.—It has been shown that the fœtus may be retained without injury for several weeks beyond the period usually allotted for its expulsion, and there can be little doubt that during this interval its development is continued. This extra-development being unprovided for in the dimensions of the genital passages of the mother, leads of course to protracted or difficult parturition.

There are instances recorded of the fœtus of the Cow and Mare weighing 117, 165, and 189 pounds. It may therefore be readily understood that the greatly exaggerated volume which this weight represents, must meet with much resistance in passing through a canal that, in ordinary circumstances, gives exit to a fœtus weighing from 56 to 80 pounds.

Reduced Number of Fœtuses.—With multiparous animals, when the number of fœtuses is smaller than usual—as with the Bitch which has only one or two, instead of five or six—the excess of nutriment they receive often increases their bulk to an abnormal degree; and as almost every breeder of dogs knows, this frequently leads to serious results in parturition.

Disproportion in Size between the Male and Female.—There can be no doubt that a disproportion in size between the male and female, in many instances, exerts a marked influence in this direction. More especially is this the case in *crossing with different breeds*, or in attempting to breed from *too young* females.

Delorme, quoted by Rainard (vol. i., p. 474), says that he has known a certain number of Camargue Ewes die every year through non-delivery, they having been put to Dishley Rams, which were much larger than the native Sheep.

The case of small Bitches crossed by large Dogs is familiar to all dog-breeders. There appears, indeed, to be a natural tendency in some small-sized Bitches to seek intercourse with Dogs much larger than themselves, and this preference not infrequently leads to fatal consequences in parturition.

But in many instances dystokia is due to exaggerated development of some particular region of the fœtus, and more especially of the head—a peculiarity derived from crossing, or breeding from a male possessing this character. Indeed, some authorities deny that crossing small female animals with males which are generally larger, is likely to prove a source of difficult parturition, provided there is nothing unusual in the proportion of any region of the latter. It is pointed out that, in the human species, small women are very often married to very large men, and yet their accouchements are more or less easy. It has also been remarked that Melingié, in order to form the breed of Sheep known in France as the *Charmoise*, coupled the small *Berrichonne* Sheep with the great New Kent Rams; and yet in two thousand births only one was difficult.

A German veterinary surgeon, Nathusius, mentioned by Rueff and Baumeister, asserts that in the cross between the small Merino Sheep

with the huge English Rams, he has observed fewer difficult births than in flocks composed solely of Merinos. And Saint-Cyr states that he has often seen little "Bressanne" Mares, which were put to big Percheron or Anglo-Norman Stallions, foal without difficulty at the ordinary period. We might also adduce the small female Ass coupled with the Horse-Stallion, and which rarely suffers during birth. Abortion or premature birth may be more frequently the consequence of such "mésalliances."

Though certain facts could be opposed to the above conclusions, yet it must be admitted that the *uniformly* exaggerated development of the fœtus is not a very common cause of dystokia, and is, as a rule, only so when the pelvis of the female is smaller than usual. So that we must look rather to special conformation than exaggerated development. And so far as conformation is concerned, we find that excessive development of the croup, chest, or head have the principal influence.

With regard to the *head*, it is indisputable that of the three regions this most frequently proves an obstacle to parturition. In the Bitch this is most particularly remarked. But it is also noted in other animals.

Price, in his book on Sheep, mentions that a grazier in Appledore employed Leicester Rams for several years, and obtained a breed with very small heads and "kindly disposition"; but he did not approve of them, because they were not sufficiently large, and did not fetch a good price in the market. He therefore, in the summer of 1804, hired some large Kentish Rams, in order to give size to his flock. In the following lambing season, he lost twelve Ewes, from the immense size of the lambs' heads, and he was obliged to "draw" (extract artificially) nearly all his Ewe lambs. In 1806 he had the same difficulty, and lost nine Ewes in a flock of two hundred and fifty, from this cause.

Mr. Cartwright (Whitchurch) casually states that he has frequently known of some Bulls "getting Calves with very large heads, and causing great difficulty in calving; and the owners, finding what trouble there was at calving-time, and the danger of losing their Cows, have sold them, and obtained others whose breed have not this objection."

Rueff and Baumeister,[1] in alluding to this subject, remark that in the Bovine species it is nearly always the head which forms the chief obstacle to birth; and they refer for proof of this statement to the small native Cows of Wurtemberg, which, when crossed by the original Simmenthalern Bull, have often difficult labour, as the latter breed has often a large head.

And Schaack writes to Saint-Cyr, stating that for thirty years the Cows in the district of Lyons were all put to a Bull remarkable for its massive framework. The head especially was very developed, and as the animal transmitted this conformation to nearly the whole of its progeny, the size of the head of the fœtus very often rendered parturition difficult.

Breeding from immature undeveloped animals is almost certain to produce laborious births; and the reason for this is not difficult to find: the genital canal, and particularly the pelvis, is not sufficiently developed for the passage of the fœtus. A very striking instance of this, as well as of very remarkable precocity in the Bovine species, is given by Mr. Barker.[2]

Influence of Food.—There is no convincing proof before us that the

[1] *Op. cit.*, p. 247.
[2] *Veterinary Journal*, vol. iii., p. 336.

manner of feeding or kind of food has much influence on pregnant animals, so far as excessive volume of the fœtus, and consequent difficult parturition, is concerned.

Cox[1] says: "The size of the fœtus depends considerably upon the condition of the parent and the kind of food given to it. Fat animals, and those emaciated from the continuous use of food of a poor nature or insufficient in quantity, bring forth a small fœtus. Where the debility is the result of pregnancy, and food has been given of a nutritious character and in sufficiency during that period, the fœtus will be disproportionately large, the extra nutriment having been diverted to its growth. Green food, or 'depasturing,' causes the fœtus to grow rapidly and attain a great size; but Nature compensates for this by giving with such diet greater relaxation of the tissues of the dam, and an increase of the placental fluids to lubricate and assist at delivery."

Diagnosis.

The diagnosis of excessive volume of the fœtus is difficult, and can only be established, as a rule, at parturition; for we do not possess any certain means of appreciating the dimensions of the fœtus *in utero* before its enveloping membranes have ruptured and the os is dilated. An unusual size of the maternal abdomen towards the termination of pregnancy, is an uncertain and very often a deceptive sign.

Nasse, a German veterinarian, imagined that this excess in development might be ascertained by weighing the animal during pregnancy. With regard to the Bitch, he thought there was danger when the weight was increased by two-fifths during this period, the normal increase being only one-third. But it is evident that an inordinate increase in weight may be due to other causes than the fœtus or fœtuses —such as an unusual number of these, an excess of amniotic or allantoic fluid, greater obesity of the Bitch, etc. Otherwise, if this test could be applied to the Bitch with practical results, the conclusions derived from it could not be made applicable to the other animals.

The only circumstance which might give rise to suspicion, is the prolongation of pregnancy beyond its ordinary period; though this suspicion, as we have seen, will not always, nor yet very often, be confirmed.

It is only, then, at parturition that this obstacle on the part of the fœtus can be ascertained. If at this time, in spite of energetic and sustained uterine contractions, labour is protracted and does not advance, and if on exploration the pelvis and genital organs are found to be well formed and normal, the os dilated, the fœtus in a favourable position and not malformed, it may be suspected that the obstacle to birth is dependent on the large size of the latter. A closer examination will probably confirm this suspicion.

With the *Bitch*, the principal obstacle, as has been already said, is generally the head of the Puppy, which, when it is large, is lodged at the entrance to the pelvic inlet, where it can be touched *per vaginam*.

The common-bred Bitch, with muzzle more or less elongated, when fecundated by a male of the same size and conformation, and bringing forth from five to eight young, has usually no difficulty in pupping. The tapering or conical form of the muzzle of the Puppies allows it to enter the passage and pass easily through, under the influence of the uterine and abdominal contractions. But when the Bitch is of small size, and has been impregnated by a larger and young vigorous Dog,

[1] *Veterinary Journal*, vol. i., p. 265.

and especially if the muzzle of either or both of the parents is short and the cranium brachycephalic—as in the King Charles Spaniels, Pugs, and Bull-dogs—parturition is oftentimes extremely difficult, as the forehead in these breeds is very large and cylindrical. This difficulty, as has been mentioned, is increased as the number of Puppies is small, as then the latter are more developed.

With the *Cow*, the head of the Calf may also be the chief impediment, and provided the young creature is otherwise in a favourable position, the muffle may pass through the inlet, but the remainder of the head remains fixed like a wedge in the long and almost undilatable bony canal. The head is often so firmly wedged at this part that it can scarcely, even with much force, be advanced or pushed forward, and this "wedging" is always one of the most serious difficulties which the obstetrist has to overcome.

With the *Mare*, the head of the Foal is smaller, longer, and more tapering than that of the Calf, and meets with much less resistance in passing through the comparatively short and wide canal. But as Saint-Cyr points out, and as we have previously shown, in the Equine and Bovine species the young creature finds more difficulty when the anterior part of its body—chest and shoulders—begins to enter this part; and from their respective dimensions it is evident that, even under ordinary conditions, the anterior region of the fœtal trunk must submit to a certain degree of diminution in order to pass the pelvic inlet of the mother.

The limits within which this diminution is compatible with physiological parturition are not yet perfectly ascertained; though there can be no doubt whatever—for we have facts to prove it—that the development of the young creature may be so exaggerated that sufficient reduction cannot be effected to allow of its being born.

In some cases the head is so large that it can scarcely pass through the pelvis of the mother; but it is generally the thorax that forms the greatest obstacle—especially in the Cow, and if it is to get through the genital canal this is the part that has to undergo most reduction by compression. In other instances, and especially with the Foal, the passage of the croup presents the greatest obstacle, and the difficulty may even be serious.

Prognosis.

In such cases as those we are now studying, in which birth is delayed through undue development of the fœtus, it generally happens that the membranes have ruptured and the liquor amnii has escaped at an early stage; consequently, the maternal passage is dry and tenacious, and perhaps swollen and irritated; while the fœtus, no longer protected in its hydrostatic bed, is directly exposed to the uterine contractions, and in proportion as these are energetic, so does it the more rapidly succumb. The mother, in turn, becomes exhausted through unavailing efforts at expulsion, and if judicious assistance is not opportunely rendered, is not long before it also perishes.

It will, therefore, be seen that a prognosis in such cases of dystokia cannot always be of a favourable kind, as very often the death of the fœtus, if not of the mother, has to be taken into consideration. More particularly is this the case with the smaller animals—and especially the Bitch, though, as has been shown, the larger females, if they do not die so frequently, yet are not exempt from danger.

Indications.

The indications for the treatment of these cases are similar to those given for constricted or contracted pelvis: (1) Extraction of the fœtus entire by manipulation; (2) Removal by embryotomy.

1. *Extraction of the Fœtus entire.*—If the "waters" have escaped for any length of time and the parts are dry and viscid, warm emollient fluids—as linseed-tea—should be injected into the vagina, and if necessary the portions of the fœtus presenting may be lubricated with glycerine, oil, unsalted lard, or any other lubricant. The hand should then adjust the fœtus, if this is requisite, and attempts be made to extract it by judicious traction—cords on the head and limbs, and other accessory means to be hereafter described, being employed as occasion demands.

The degree of traction will depend upon the amount of resistance to be overcome, it being carefully borne in mind that a medium degree of force well directed is often more effective than severe traction misdirected and inopportune.

For this reason it is that a careful adjustment of the fœtus should be made before any force is resorted to, the "wedged" portions being "eased" and well smeared. It not unfrequently happens that a very trifling displacement of the fœtus will allow it to pass gradually through the pelvic canal, and lead to the successful termination of a case which otherwise many would consider impossible to deliver.

2. *Embryotomy.*—When forcible extraction is deemed impossible, or dangerous for the mother, and when the latter has ceased to aid in expelling the fœtus, then the only alternative is embryotomy, which, entailing as it does the destruction of the progeny, yet affords the only chance of saving the parent. The operation will be described hereafter. In the meantime it may be noted that if the obstruction is due to a large head, this must be removed by decapitation; then if the thorax be also found too voluminous, perhaps a slight half-screwing movement of this part, coupled with traction, will move it outwards. Otherwise the body must be taken away piecemeal.

In the Bitch a similar process is resorted to; if the head is too large to pass through the pelvis by means of any of the apparatus to be hereafter described, it must be crushed in every direction by forceps; then, if extraction cannot be effected, the Cæsarian section is the last resource.

Excess in Growth of Hair.

The only instance of this cause of dystokia I can find is that recorded by Eberhardt,[1] of Fulda, who found a Cow unable to calve, and on examination discovered the fœtus fixed in the genital canal, the presentation and position being normal. A careful examination discovered no other obstacle to birth than a most unusual quantity of long, thick, shaggy hair—which was quite dry, from the waters having escaped some time previously. This offered most resistance at the upper part of the vagina, and so great was it that the fœtus could not be moved. Having secured the fore-limbs and head by cords, Eberhardt smeared his hand and arm well with grease, lubricated the passage thoroughly, and rubbed the hair plentifully with the same material; then by suitable traction and manipulation birth was readily effected.

[1] *Deutsche Zeitschrift für Thiermedicin und Vergleichende Pathologie*, 1877, p. 299.

Anomalies in, and Disease of, the Fœtal Membranes.

It is very rare indeed, so far as published observations are evidence, that anomalies in, or disease of, the fœtal membranes prove an obstacle to birth. That they may sometimes do so, however, is evident from what we have previously described. As Franck justly remarks, it is not unlikely that the retention of the fœtal membranes after birth is due, in many cases, to inflammation of the placenta (*placentitis*). A not unfrequent condition of the membranes is congestion of, or extravasation into, the placenta, rupture of the capillaries (*capillary apoplexy*), and hæmorrhage between the placenta materna and placenta uterina. Partial separation of the two placentæ is also not very uncommon in the Mare; and metrorrhagia may be due, at times, to *placenta prævia*. Such hæmorrhage, when it occurs in the uterus (see Fig. 53, p. 88), and the blood mixes with the uterine milk, gives rise to a chocolate-coloured fluid between that organ and the fœtal membranes; and in the asphyxia and intra-uterine respiration (pulmonary) of the fœtus, this reddish-coloured fluid is often present in the lungs.

Hartmann alludes to a case in which the chorion papillæ of an aborted Foal were small, pale, hard, and cartilaginous; and Broers[1] describes two fœtuses in the uterus of a Cat, on the inner surface of the membranes of one of which were numerous vesicular extravasations, while the other could scarcely be recognised. It may be surmised that many abortions or fœtal deaths are due to disease of the placentæ.

The fœtal membranes may be too *thick* and resisting, or too *thin* and friable. In the first condition, they resist the labour pains too long, and after the os uteri is completely dilated they may be found intact outside the vulva; the fœtus may even be expelled in them. Such tenacious membranes may, to a certain extent, hinder delivery—though they seldom, if ever, produce dangerous consequences, except to the fœtus.

Very thin membranes may, on the contrary, not resist the uterine contractions for a sufficient length of time, and therefore rupture before the os is sufficiently dilated. The consequent escape of the "waters" will render labour longer and more difficult. The utero-vaginal canal is dry and retentive, and the contractions of the uterus are weaker and much less effective.

The treatment for both of these conditions has been already indicated.

At p. 368 we alluded to *adhesions* between the fœtus and its membranes, and the uterus, as a cause of protracted or impotent labour. We have now to refer to adhesion of the membranes to each other, or to the fœtus only, as a cause of difficult labour.

These adhesions are generally of the nature of fibrinous bands passing between the membranes, or from the surface of the young creature's body to the interior of its envelopes, due to the development of some local inflammation. Such cases are certainly rare, but their occurrence must nevertheless be taken into account.

Rainard[2] mentions an instance in which a hairy band or cord attached the envelopes to the head of the fœtus—a shred of skin having probably been partially detached from the forehead, from a kick received by

[1] Caustatt's Jahresbericht, 1861, p. 53.
[2] *Op. cit.*, vol. i., p. 492.

the Cow some time previously, and, becoming fixed to the membranes, formed an obstacle to birth.

Vincent describes a very interesting case, in which the skin covering the joints of the first and second phalanges of the right fore-leg of the fœtus had contracted close and strong adhesions with the envelopes, and these with the uterine mucous membrane. These adhesions opposed a serious obstacle to birth, which could not be accomplished until they were broken up by the fingers.

Adhesion of the membranes to the uterus does not always prove an obstacle to spontaneous delivery, however.

Indications.

Adhesions, when they exist and are a cause of dystokia, and when they can be reached, must be broken up or cut through. In the majority of cases, the fingers will suffice; if not, then a bistoury must be used.

Difficulty in parturition in the Cow is sometimes experienced from the envelopes being torn in several places, and the head or limbs, or both, passing through these fissures.

In such cases the entangled parts of the fœtus must be sought for, released, and brought into a favourable position by tearing or cutting through the obstacles.

Abnormal Quantity of Placental Fluid.

We have already described the condition known as "hydramnios," and have pointed out that when it exists abortion nearly always takes place. When the accumulation of fluid interferes with parturition, labour is slow and delivery difficult, owing to the great distention of the uterus and the pendulous state of the abdomen.

The indications for treatment have been given at p. 186.

An unusually small quantity of the liquor amnii, when it is not due to premature rupture of the envelopes, has not, to my knowledge, been mentioned as a cause of dystokia; though there is no reason why this deficiency should not lead to protracted labour, if we call to mind what has been said as to the uses of this fluid.

The indications will be the same as for those cases in which the fluid has escaped prematurely.

CHAPTER II.

Diseases of the Fœtus.

While in the uterus the fœtus may be affected with disease, which, causing its death, will lead to abortion or premature expulsion, or perhaps undue retention. Other abnormal conditions, more or less allied to disease, may give rise to vicious conformation or excess of volume, generally or locally, and thus prove a cause of difficult parturition. These conditions may produce *hydrocephalus*, *ascites* and *anasarca*, *emphysema*, *polysarcia*, *muscular contractions*, and *tumours* of various kinds.

Hydrocephalus.

As the term implies, "hydrocephalus" signifies dropsy of the brain, the dropsy being constituted by the accumulation of a more or less con-

siderable quantity of fluid in the cranium of the fœtus, leading to a proportionate enlargement of that region.

This diseased condition is not at all uncommon in the Bovine and Equine species, and some of the specimens of craniums found in museums are wonderfully deformed, through the accumulation of fluid in their interior.

Pathological Anatomy.

This diseased condition is recognised by a more or less exaggerated development or volume of the cranium, the vault of which has been elevated and distended by the fluid collected in the brain ventricles.

In some cases the distention has been so slight that the frontal bones are not much raised; while in others the collection of serum has been so great that these and other bones of the cranium are displaced, and the forehead—rising almost at right angles to the face—suddenly reaches an extraordinary height, giving the creature a startling appearance. The hydrocephalic tumour varies in shape as well as in volume. It is sometimes quite globular, and protrudes so high and so much over the

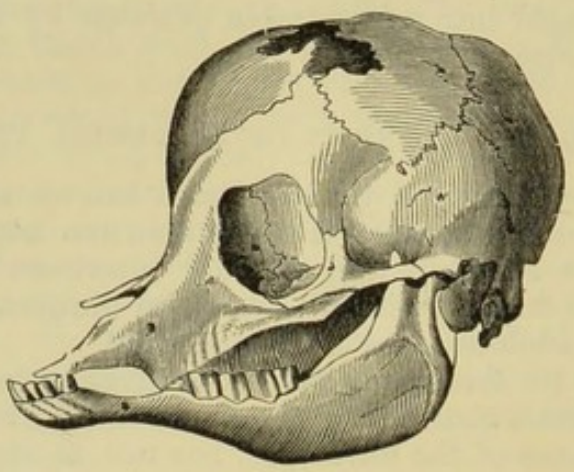


Fig. 96.

Skull of a Hydrocephalic Calf: the Cranial Bones are partially destroyed and defective.

face, as to give the physiognomy a strangely human appearance (Fig. 99); in rare cases it is narrow, but excessively protuberant, involving only a part of the cranium (Fig. 100); at other times it is bilobular, and the divisions may be either alike or unequal in volume. Not unfrequently the diameter of such a tumour in the Calf measures more than a foot. The tumour is soft and depressible in parts, hard and resisting in others, owing to the bones of the cranium being altered and separated in places. These bones—and particularly the frontal, temporal and parietal—are, as a rule, considerably deformed and thrown out of their natural position, and in places so expanded and rarified as to be no thicker than tissue-paper; when the internal distention has been very considerable, so that their borders do not meet as in their normal condition, but are often widely separated, leaving between them vast fontanellæ occupied only by a thin translucid membrane—the *dura mater*, which is in immediate contact with, and adheres closely to, the skin.

In some instances—especially in the Calf—the bones in their upper part do not join at all, and the roof of the cranium—or, rather, of the

cranial tumour—is entirely absent (Fig. 97). In other instances, and particularly in the Foal, a kind of bony arch extends from the nasal to the occipital bones, in the direction of the saggital suture, with only here and there, on each side, small osseous patches from the parietal or temporal bones, which adhere to the dura mater.

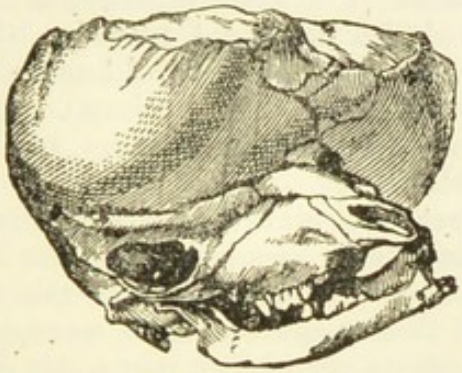


Fig. 97.

SKULL OF A HYDROCEPHALIC CALF: THE ROOF OF THE CRANIUM IS ABSENT.

The tumour is always entirely covered by intact, though sometimes very thin skin, to which the hair is ordinarily attached, and is indeed at times longer than usual, especially at the sides. This often makes the animal appear as if it wore a high fur cap (Fig. 99).

Owing to the great development of the forehead, the upper jaw appears to be shorter than usual; and, indeed, it will be found that it is really so (Fig. 96).

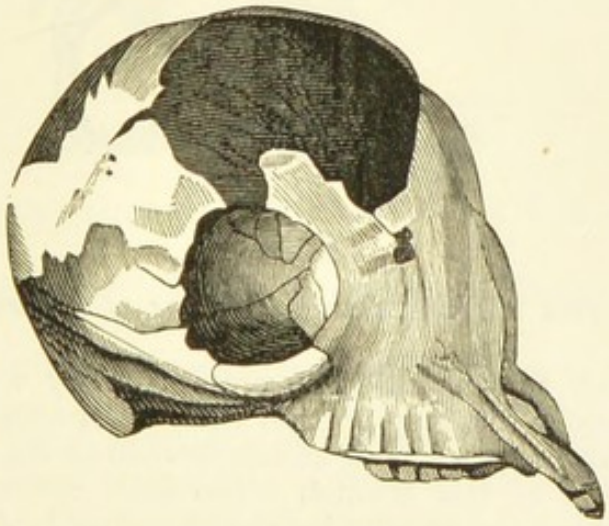


Fig. 98.

SKULL OF A HYDROCEPHALIC FOAL: THE CRANIAL ROOF IS DEFICIENT AT THE SIDES.

When the cranial cavity is opened and the dura mater incised, there is found a quantity—varying with the dimensions of the tumour—of limpid, colourless, or slightly yellow or greenish serum.

The quantity of fluid varies considerably, but it is generally from two to four pints in the Foal and Calf. Rainard estimated the quantity of fluid that had been contained in the skull of a Calf sent to him, at two

and a quarter litres—the largest quantity he had met with. Drouard, however, in 1842, published the details of a case of a Foal whose cranium held four and a half litres (about eight imperial pints).

Fig. 98 represents a Foal's skull, now in the museum of the Lyons Veterinary School, and which, from its dimensions, Saint-Cyr calculates to have contained eight litres (about thirteen pints). Kopp not long since exhibited the head of a Foal before the Veterinary Society of Alsace, the diameter of the dropsical cranium of which was fourteen inches, and which, it was computed, would contain about twelve litres of fluid (more than two and a half gallons). And Quesnel has also shown a skull of about the same dimensions, to the Veterinary Society of Calvados et de la Manche.

Mr. Olver[1] describes the cranium of a hydrocephalic Foal which measured thirty-six inches in circumference, ten inches from one orbit to the other, and twenty-seven inches from the occipital crest to the nasal bones. At least twelve pints of fluid were contained in the cavity, and the cerebral substance remaining was quite disorganised, the dura

Fig. 99.

CALF AFFECTED WITH HYDROCEPHALUS : ITS SKULL IS REPRESENTED IN FIG. 97.

mater being much thickened. The cranial cavity was almost wholly surrounded by bone; the only portion which was only enclosed by skin was a space about four inches in circumference at the top.

In the Museum of the Munich Veterinary School is a skull, the cranium of which measures nine by eleven inches in diameter.

Professor Lombardini[2] speaks of the head of a Calf, the cranium of which was more than fourteen inches high; it was eight and a half inches long, and four and a half broad. This Calf, with two others—well formed—was aborted at six months, without any injury to the Cow which was six years old. There can be no doubt that if the full period of pregnancy had been reached, this Calf would have proved troublesome to extract.

But these latter are quite exceptional instances, and are three four times larger than those usually met with.

[1] *Veterinarian*, 1874, p. 481.
[2] *Giornale di Veterinaria*, 1873.

This accumulation of fluid takes place in the ventricles of the brain, as has been ascertained from dissection by Rainard, Taiche, Chouard, Axe, and others, who have found the tumour formed externally by the skin, and internally by the membranes of the brain, to which adhered a thin layer of cerebral substance. The spinal cord, plexus choroides, and cerebellum, have been generally observed to be intact, and only the cerebral hemispheres are destroyed more or less completely.

Though this alteration, or rather destruction, of the brain is of so serious a character, and though it must have begun at an early period of uterine life, yet it does not appear to have much influence on the development of the fœtus; as this is usually found to be full grown, its skin covered with hair, and well formed everywhere except in the head. Exceptional cases occur, however, in which development is arrested; as in some mentioned by Lecoq, of hydrocephalic Calves whose limbs were atrophied and the bones cartilaginous.

If intra-uterine existence can be maintained by the hydrocephalic fœtus until the period of parturition, it generally perishes during birth or soon after—usually after one or two respirations. In some exceptional cases, however, such creatures have lived to the eighth day after

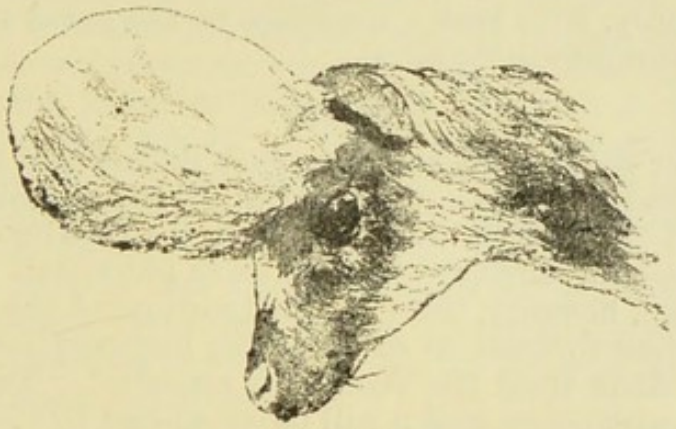


Fig. 100.

Extraordinary Development of the Cranium of a Hydrocephalic Calf.

birth, and they may survive even longer if the dropsy is not very extensive.

In the most favourable cases, nevertheless, there is little profit to be expected from keeping such animals alive, as they are ordinarily weak and thrive badly; they can rarely stand, and they refuse the teat, being usually in a semi-comatose state; if the tumour chances to be pressed upon, the young creature becomes completely unconscious and lies in convulsions.

Very few cases of recovery, even in the mildest form of the malady, are recorded.

The obstacle this congenital condition of the fœtus presents during birth, must, of course, depend upon the volume of the cranial tumour. The birth of a hydrocephalic fœtus often takes place spontaneously, though perhaps only after much straining. If the cranium is not very large, and provided the labour pains are sufficiently energetic and the position favourable, the tumour yields, and the head becomes elongated in its passage through the os and the pelvis, or it may rupture internally and the fluid escape by the ears, nostrils and eyes. When extremely

large, the cranium may offer an invincible obstacle to spontaneous delivery, notwithstanding the most powerful labour pains.

And, besides, the mechanism of parturition in such cases varies with the presentation—anterior or posterior. The head of the hydrocephalic fœtus being more or less spherical—instead of conical, as in the normal condition—it results that this part, when the young creature is pressed upon by the uterus, no longer acts as a wedge to gradually dilate the os uteri. The head certainly commences the work of dilatation, but in a very incomplete manner, and when the jaws—particularly the upper one—have cleared the os, further progress is checked by the voluminous forehead. If the hand is introduced into the vagina, the cervix uteri is found to be contracted on the nose or jaws of the fœtus; and the delay in further expulsion depends upon the size of the cranium, the protrusion of the uterus into the pelvic cavity, and the exhaustion of the organ by futile contractions.

In the posterior presentation, birth takes place in the manner already described; the hinder extremities advance through the os, then the body and neck, and birth is apparently taking place satisfactorily until the head reaches this aperture, when further advancement is stopped—the resistance to expulsion being in proportion to the volume of the head.

Not infrequently, with such a condition of the fœtus we have also a malposition to complicate matters.

Diagnosis.

In the anterior position, there is not much difficulty in diagnosing the presence of hydrocephalus; as the hand can feel the voluminous spherical cranium beyond the muzzle and eyes, with the ears on each side, and its unequally resisting surface—hard in some parts, soft or fluctuating in others. When, however, there is a malposition of the fœtus, then it is sometimes more difficult to discover the hydrocephalus; and often this cannot be done until the position is remedied. The head should be sought for in every case, and it will be recognised by the mouth, eyes, and ears; after which the size, consistence, and form of the cranium can be estimated by passing the hand over it.

In the posterior presentation, hydrocephalus has been recognised while the fœtus was still in the uterus. The greatly enlarged head may be felt *per rectum*, or even through the abdominal walls. But, as a rule, it is only at an advanced period of labour, and when the body of the young creature is already beyond the os, and perhaps without the vulva, that a difficulty is discovered and the cause sought for.

In such a case manual exploration is necessary, and this should be effected, if possible, by passing the hand between the fœtus and the wall of the vagina. This is difficult if the body is still in the passage, and it may be requisite to have recourse to traction to withdraw it therefrom. If, however, it is beyond the vulva, then the hand can be easily passed along the neck as far as the head, when the real state of affairs can be discovered.

Indications.

The indications for treatment in cases of dystokia from hydrocephalus alone, without reference to such a complication as malposition of the fœtus, are few and simple.

When the hydrocephalus is not considerable, judicious traction will often accomplish delivery; and several cases are on record in which

Foals and Calves whose craniums were of large size and full of fluid, have been delivered by this means, some of them alive, and in the posterior as well as the anterior presentation. In such a case, supposing the fore-feet present, these should be secured by cords, the ends of which may be given to an assistant; then the hand should be introduced into the vagina, and if necessary the os should be dilated sufficiently to allow of another cord being fastened on the upper, or, perhaps better, the lower jaw, which is often wider. Traction can then be made during the throes of the mother.

When, however, traction will not effect delivery because of the size of the head, and the mother is becoming exhausted, the cranium must be punctured—an easy operation when the presentation is anterior, but more difficult when it is posterior.

The puncture may be made by means of a bistoury, a scalpel or ordinary knife, or, which is preferable, a somewhat large trocar and cannula, curved if possible. The most fluctuating part of the tumour should be penetrated, and the fluid having escaped, the cranial parietes collapse, or give way to pressure; the head is thus greatly reduced in size, and delivery can be completed.

Rainard recommends the puncture to be made on the side of the cranium; and should it be necessary to still further reduce the size of this part by bone-forceps or other means, the side will be found most suitable. In the posterior presentation, the back of the head may be punctured, and the weight of the young creature's body, hanging beyond the vulva, will sufficiently steady the head for this purpose; but in the anterior presentation, traction should be made by means of the cords while the cranium is being opened.

Rainard informs us that Conte, being called to assist a Mare in foaling, found a posterior presentation, and having diagnosed hydrocephalus, he was able by version to convert it into an anterior presentation, when the head was easily punctured.

Embryotomy has been recommended in such cases; but beyond reducing the size of the head, if that is the only obstacle, there is no necessity for resorting to further breaking up of the body of the fœtus. Indeed, it will be found that, in ordinary cases, patience and judicious manipulation will often enable the obstetrist to dispense with craniotomy.

Ascites, Anasarca, and Hydrothorax.

"Ascites" (fluid in the abdominal cavity) and "Anasarca" (fluid beneath the skin), either partial or complete, do not appear to be such frequent diseases of the fœtus as hydrocephalus, the cases recorded being comparatively few.

Anasarca has been observed in the Foal, Calf, and Kid, and ascites chiefly in the Calf. These pathological conditions have generally been confounded.

With regard to ascites, it appears that in all the recorded observations, the fœtus was in what we have designated the "natural presentation and position"; though in some cases these were complicated—the head being turned back on the left side or all the limbs presented with the head.

Sometimes the fœtus has ceased to live before the full period of preg-

nancy has expired, and is expelled from the uterus; at other times it reaches maturity, and living through a few of the early pains, it succumbs before parturition is completed, either from the effects of protracted labour or from the manœuvres adopted to extract it. None appear to have been born alive; nor would they be likely to live if by chance they were extracted before death seized them. In addition to the abdominal cavity, the scrotum is often enormously enlarged through

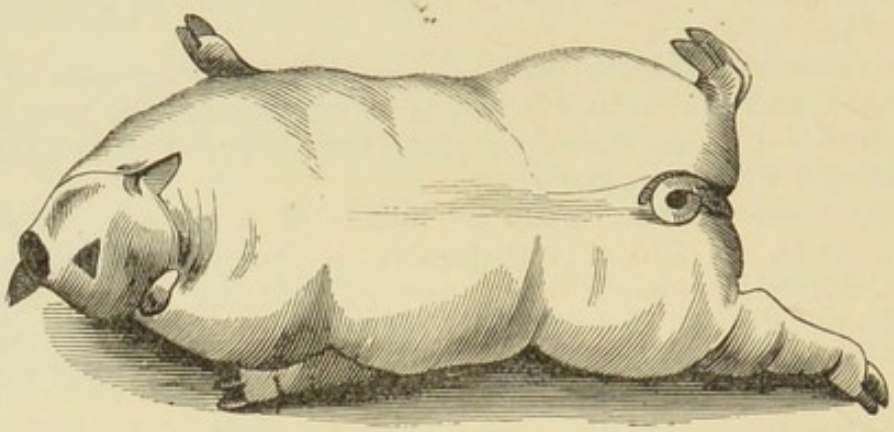


Fig. 101.

Anasarcous Fœtal Calf.

its communication with the latter, of which it is only a kind of diverticulum. Hydrothorax is often combined with ascites, and in one case recorded the scrotum was enormously distended with the peritoneal fluid.

With regard to anasarca, Noyes[1] has witnessed a number of cases

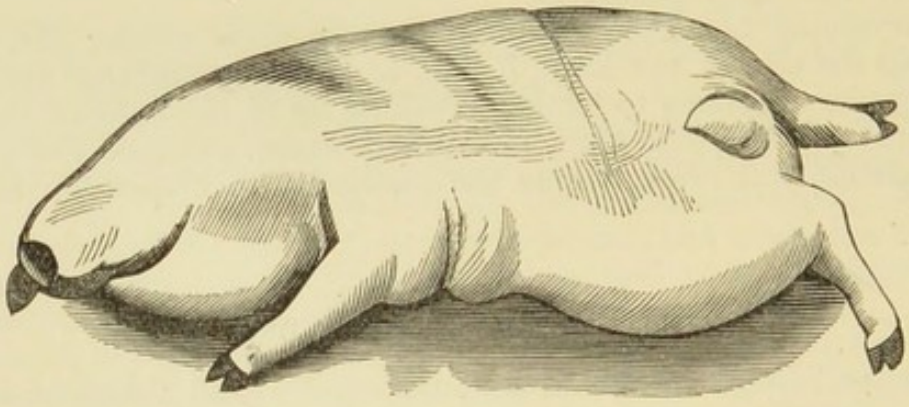


Fig. 102.

Anasarcous Fœtal Calf.

of *general anasarca* in the course of a year, in the neighbourhood of Mirepoix, France. He states that the Calves were born at least three weeks before their time, and always dead. The connective tissue of the entire body—from the head to the croup—was infiltrated with serum, the young creatures being double or treble the size of ordinary Calves; the head especially was enormously large. During pregnancy

[1] Rainard, *op. cit.*, p. 476.

the abdomen of the Cows was so developed, that their owners thought they were bearing twin Calves.

Quétier has published details of analogous cases of general infiltration, in which the fœtus was at least twice its natural size.

This condition has been witnessed in the fœtus of the Mare by Pauli[1] and Lehnhardt,[2] and by Herran[3] in the Goat. The latter authority made an autopsy of a Goat which had died from injuries inflicted on its head, and found in it twin fœtuses, the bodies of which were completely infiltrated.

Cause.

The cause of this dropsical condition is not well ascertained. In some cases it may be due to uterine dropsy of the mother or to constitutional hydræmia; but in other instances it cannot be so, as the mother is in good health, and it would then appear to be owing to derangement of the fœtal circulation, and particularly of the venous system—probably congestion of the umbilical cord. At times, disease of such organs as the kidneys may produce it.

Franck[4] remarks, that the fact that sometimes a Cow will for a number of years bring forth these dropsical Calves (*Wasserkälber*) in succession, while other Cows in the same shed produce healthy Calves, shows that there is probably in these cases at least some anomaly in the uterine vessels; the fact, also, that sometimes along with general anasarca and ascites, there are rachitic alterations of the bones, points to mal-assimilation, or deficient supply of the protein substances and phosphorus salts, the deficiency being presumably due to disease on the part of the mother, or to some anomaly in the composition of the uterine milk.

The amount of difficulty met with during delivery in these cases will depend upon the quantity of fluid effused into the abdominal cavity, chest, or superficial connective tissue.

Sometimes delivery is possible with the aid of traction. But in the great majority of instances, when the head and fore-feet have passed through the os, further progress appears to be impossible. In these cases we have extreme distention, but even in some of them delivery by traction is not hopeless. Cazeaux[5] says of this condition in the human fœtus: "The abdominal parietes have been observed to yield in such a way that a large portion of the tumour remained above the inlet, while the trunk gradually descended into the pelvis; and when once a part of the abdomen had cleared the passage, the fluid escaped into it and towards the point where there was least resistance, the volume of the part still in the pelvis progressively diminishing, and delivery being finally accomplished naturally."

Saint-Cyr is of opinion that it is probable delivery has been effected in a similar manner, in those cases in which the dropsical fœtus of animals has been extracted without operation or mutilation.

Sometimes the walls of the abdomen give way, as in the case recorded by Courjon.[6] This veterinarian attended a Cow, three years old, which

[1] Gurlt und Hertwig's *Magazin*, vol. viii.
[2] *Ibid.*, vol. ix.
[3] *Journal de Vétérinaire du Midi*, 1864.
[4] *Handbuch der Thierärztlichen Geburtshülfe*, p. 429.
[5] *Traité Théoretique et Pratique de l'Art des Accouchements*, p. 659.
[6] Rainard, *op. cit.*, p. 485.

was in the act of parturition. The fœtus was in the natural position, and the head and fore-limbs were external to the vulva. Strong traction was employed to extract it, during which the abdomen ruptured, and it was estimated that more than twenty litres of fluid escaped. The Cow was in great danger for a month afterwards.

Diagnosis.

The nature of the obstacle can only be ascertained by vaginal or uterine exploration, though an examination *per rectum* may assist in leading to a correct diagnosis.

In vaginal exploration the great size of the abdomen in *ascites*, the distention of its parietes, and the fluctuation on pressure, should reveal the state of affairs. Not unfrequently, however, the body of the fœtus so completely blocks up the passage that it is impossible to pass the hand, and it may be necessary to remove the protruding limbs by embryotomy in order to diminish its volume. Hesitation in resorting to this operation is usually unjustifiable, as the fœtus is nearly always dead, and if alive it cannot exist after birth.

It has been recommended, in addition, to remove the two first ribs or divide them, in order to allow the hand to explore the interior of the fœtus. If the obstacle is due to ascites, the convex condition of the diaphragm, and the fluctuation of the fluid on the abdominal side of it, will be remarked.

When the dystokia is owing to *anasarca*, this will be distinguished by the general roundness of the surface of the body, owing to the presence of the subcutaneous fluid—which effaces all the prominences, and to the œdematous sensation communicated to the fingers by pressure.

Indications.

When the condition of the fœtus is once ascertained, the principal indication, if delivery by traction cannot be effected, is to diminish its volume by producing the evacuation of the fluid which distends it, as promptly and effectually as possible.

In *ascites*, puncture of the abdomen through the parietes of that cavity, if they can be reached, or puncturing the diaphragm through the chest, if they cannot, must be practised. In the first, a bistoury or any kind of convenient knife, or a trocar, will suffice ; in the second, a long trocar or long-bladed knife, wrapped round with tow to near the point, will answer the same purpose ; or if the hand can be introduced into the thorax, the fingers alone will rupture the diaphragm. As the fluid escapes, the abdomen collapses, and delivery is then easy.

When anasarca is present, the fluid must be got rid of by deep incisions through the skin wherever the hand can reach. The mechanical extraction of the fœtus should then be easy. In a case reported by Anacker,[1] however, the fœtus was so large that it had to be removed by gastro-hysterotomy.

An extremely rare cause of dystokia is due to congenital occlusion of the urachus, which leads to great accumulation of urine in the bladder, and consequent distention of the abdomen. A very good example is given in the yearly report of the Veterinary School of Hanover for 1872.

This condition will be diagnosed in the same way as ascites, and the same indications for extraction of the fœtus are to be observed.

[1] *Der Thierarzt*, 1868, p. 85.

Emphysema.

Emphysema of the fœtus is sometimes found to be a cause of dystokia. Leconte mentions that he has met with a case in which a living fœtus was partially emphysematous, the head and neck as far as the shoulders being involved.

This case is exceptional, however, as this condition is, as a rule, observed only after the fœtus has perished in the uterus. It sometimes happens that during parturition the "water-bag" is ruptured before the young creature has made sufficient progress, or it may be in a bad position. The uterus then closely contracts on it, over the whole of its surface, and it soon succumbs. In the course of two or three days its tissues have become softened and decomposed; the subcutaneous connective tissue becomes distended with gases—the result of this decomposition, and in a short time the entire carcase of the young creature is inflated. This inflation directly distends the uterus, and the fœtus sometimes increases so immensely in volume as to cause rupture of the walls of that organ.

On approaching an animal in which the fœtus is emphysematous, a powerful stench is perceived coming from the vulva, the lining membrane of which is of a yellowish-red tint. On introducing the hand into the uterus, the inflated fœtus crepitates on pressure and the gas can be moved beneath the skin; the hair is loose and easily removed; the skin itself is often dry, and the fluids small in quantity. Gases are not unfrequently disengaged in the fœtal membranes, and particularly in the amnion. Bossetto[1] mentions a curious case of this description, in which, after rupturing the membranes of a fœtus that had been dead in the uterus for some time, on withdrawing his hand from the vagina there was a rush of carburetted hydrogen; this became ignited by the flame of a candle held some distance from the vulva of the pregnant animal. The flame—ten to twelve inches long—burned for some time, and the Cow did not appear to suffer.

Indications.

The dryness of the skin and the large volume of the fœtus, as well as the inertia of the uterus, are the obstacles to extraction. Consequently, version and retropulsion cannot be beneficially resorted to here; but deep incisions may be practised on the surface of the body of the fœtus as far as the hand and knife can reach. The maternal passages, as well as the fœtus, should then be well lubricated with some fatty agent, and if the carcase is in a favourable position traction may be tried—cords and hooks being employed in a manner hereafter to be described. If the position is not favourable, it must be corrected.

Should mechanical extraction fail, then embryotomy must be practised. After the fœtus has been removed, thorough cleansing of the uterus will be necessary.

In these cases, the practitioner should take every precaution against danger to himself, as serious, even fatal, consequences have resulted from putrid infection. The hand and arm should be well smeared with lard, and thorough ablution ought to be practised immediately after the operation is over.

Polysarcia.

German authors only, so far as I can ascertain, make mention of this condition, in which there are abnormal accumulations of adipose

[1] *Giornale di Veterinaria Practica*, 1859.

matter in the subcutaneous connective tissue; so that at birth these fat deposits often cause the Calf to weigh more than a hundredweight. Such fœtuses are designated in Germany "lard Calves" (*Speck-kälber*).

Indications.

The indications for the extraction of these lardaceous Calves are, as might be presumed, the same as those for over-developed fœtuses in general.

CONTRACTIONS.

This designation has been given to the permanent contraction or retraction of certain muscles—and we might add tendons and ligaments—which, in becoming hard and rigid, are at the same time reduced in length and thickness, so as to form inextensible cords that

Fig. 103.

DEFORMED HEAD AND NECK OF A FOAL, DUE TO CONTRACTION AND PRESSURE IN THE UTERUS.

deform the part they are attached to, and prevent its assuming its natural position.

This state of contraction and rigidity only takes place slowly and progressively, and it chiefly, though not exclusively, affects the muscles of the neck and fore-limbs, giving these a vicious direction which it is very difficult to change, and which at parturition may become a rather troublesome cause of dystokia.

The causes of these deviations, which bring about actual alterations in the structure of the bones and muscles themselves, are very obscure. Bouley was of opinion that the lesion is solely due to the *passive* influence of a false position which the fœtus assumes and maintains for a long time, and to which the muscles and bones finally accommodate themselves. Rainard thought the cause might be of a mechanical nature, and due to the pressure exercised on the fœtus by the colon of the mother—particularly its pelvic portion—when filled with hard fæcal

matters, the residue of fibrous provender. He also considered it possible that it might be of a convulsive kind, owing to disease of the nerve centres.

When the neck is affected, it is bent round to the side, the nose being buried in the flank, or even resting on the hind quarters of the fœtus; and so rigidly is it curved, that not only does it resist all attempts to straighten it in the uterus, but even when extracted and the fœtus is dead, the neck cannot be made to assume a rectilinear direction.

The period of gestation at which this deviation occurs is, of course, difficult to arrive at; but Rainard and Saint-Cyr are of opinion that it takes place early, as the bones of the head and neck are more or less deformed in some cases (Fig. 103), the head being more especially distorted and curved laterally, and moulded, so to speak, to the parts on which it has rested during intra-uterine existence.

This distortion appears to be more frequent in Solipeds, the neck of which is longer than that of Ruminants or other domestic animals; and according to French writers, it appears to be more common in some localities than others, and to be frequent in certain years—particularly in those of scarcity or bad forage. Houssard reported that in Franche-Comté he had seen the majority of brood Mares abort near the termination of pregnancy, or experience great difficulty in foaling, from this abnormal distortion of the neck. Courjon, another veterinary surgeon practising at Meyzieux, Isère, has remarked on the frequency of this accident under the influence, it was presumed, of the same causes. Schaack informed Saint-Cyr, that in his long experience he had met with several cases of this kind, one of which was in a Calf that lived, notwithstanding the deformity.

Contraction of the limbs also appears to be more frequent in Foals than Calves, and varies in degree: from slight bending at the knees—which generally more or less disappears after birth, and as the animal acquires strength—to extreme flexion; so that ligaments must be ruptured, and perhaps bones broken, before the distortion can be corrected. The accident is alluded to by Favre,[1] Gaven,[2] Lemaire,[3] Véret,[4] and Cartwright.[5]

Indications.

The indications for delivery are the same as those which will be given for extraction of the fœtus in malposition of the limbs and head.

Not infrequently recourse must be had to embryotomy; and the limbs more particularly require attention in this operation, as by dividing the muscles, tendons, or ligaments of those which are contracted, they may be straightened and delivery effected. A careful examination should be made of the presenting limbs in all cases in which they are found to be flexed, in order to discover whether the joints are movable; and great care ought to be exercised in using traction before they are straightened or removed by the knife; as rupture of the uterus, or severe laceration of the other soft parts, may be the result.

[1] *La Vétérinaire Campagnard*, p. 290.
[2] *Journal de Méd. Vétérinaire*, 1850, p. 201.
[3] *Recueil de Méd. Vétérinaire*, 1858, p. 444.
[4] *Ibid.*, 1837, p. 289.
[5] *The Veterinarian*, vol. xvi., p. 487; vol. xx., p. 365.

Tumours.

Tumours of various kinds, situated either externally or internally, may prove an obstacle to birth; though the cases recorded are very few. Some of the former are cysts which, in some instances, may be looked upon as due to a second undeveloped ovum which has grafted itself on the fœtus (Fig. 121). Hygromata are not very uncommon, and some of these are often ruptured during birth. Sometimes the tumours are fibro-adipose; in other instances they have been distended cavities—as the guttural pouches; and even scrofulous tumours have been described.

Indications.

The indications will depend upon circumstances. Puncturing the tumour if it contains fluid, removing it if it be accessible and solid, and embryotomy if neither of these operations is likely to be successful, are the only measures which can be recommended.

Death.

Many practitioners are of opinion that the death of the fœtus renders parturition difficult. In certain circumstances it may do so, but, as a rule, provided the creature is in a proper position and perfectly developed, its death has but little influence on this act. We have already alluded to the death of the fœtus at p. 259.

CHAPTER III.

Monstrosities.

The designation "Monster," "Monstrosity," or *Lusus Naturæ* (French, *Monstre, Monstruosité;* German, *Missgeburt;* Italian, *Mostro;* Spanish, *Monstruo*), is generally applied to a creature which exhibits some vice in conformation—some remarkable anomaly or organic deviation in form or structure, or both, in one or more parts of its body.

Monstrosities have been conveniently divided into two kinds—those which are *anatomically* so, and those which are so by reason of their *vicious conformation.* The first present no modifications externally, and there is no disturbance of function, but merely a change in the number or position of certain organs—a change only discoverable by *post-mortem* examination. The second includes those defects or deformities which more or less seriously impair the value of the young creature, either by destroying the symmetry of its shape, or rendering it more or less useless by the absence or incompleteness of certain organs.

The term "monstrosity," however, is usually reserved for a creature which presents the most serious kind of organic alterations, and which involve one or more organs—external or internal—these being modified in form, structure, and relations. In this class we may have a deficiency in one or more limbs, head, part of the head or trunk, or fusion more or less incomplete of two or more individuals, etc.

It must be admitted, however, that the limits between these groups of anomalies or organic deviations are not well defined, and that they merge into each other imperceptibly; so that it is not always possible to say where the one class ends and the other begins, and we can only fix upon the types of each of these artificial groups.

In ancient times the appearance of monstrosities were ascribed to the influence of enraged gods, and they were regarded with fear or horror; or they were looked upon as prodigies or freaks of Nature, and described as marvels or curiosities.

Indeed, it was not until the end of the last and commencement of this century that they began to be studied in a scientific spirit, and their anomalies shown to be only simple modifications or irregularities in the development of organs. Haller and Meckel commenced this new era, but it was not until the philosophical study of this subject had been pursued by Etienne and Isidore Geoffroy Saint-Hilaire, that the science of *Teratology* was founded on a true basis. Then it was clearly demonstrated that monstrosities themselves do not escape the general laws of organisation, but own their sway and prove their universality, and that Nature, in its widest divergencies, never ceases to be faithful to the decrees which the Creator imposed upon it at the commencement.

In 1827, E. G. Saint-Hilaire proposed a scientific classification of monstrosities—those beings which had hitherto been looked upon as combinations of different characters or individuals; and on this basis was raised the science of Teratology by his son Isidore. The labours of these men have been largely supplemented by the researches of such authorities as Meckel, Gurlt, Otto, Bischoff, Leyh, Martin-Saint-Ange, Förster, Dareste, Panum, Lombardini, and others. The labours of these investigators are unknown to English veterinary literature—indeed, the entire subject is nowhere mentioned;[1] it will, therefore, be our duty to notice it somewhat fully, not only from its novelty in this respect, but also from its importance in a physiological and obstetrical point of view.

Classification.

Various classifications of monstrosities have been proposed at different times by investigators, who generally based their classification either on the notions they entertained as to the mode of formation of these creatures, or on some physical peculiarity presented in their organisation. Buffon divided them into three classes—1, monstrosities by excess; 2, monstrosities by defect; 3, monstrosities by irregularity in structure or situation of parts. To these classes Meckel added a fourth, which included the hermaphrodites. Martin-Saint-Ange divided them into: 1, monsters by excess, comprising the union of several fœtuses—double monsters, in fact; 2, monsters by excess of growth; 3, monsters by absence of one or more parts; 4, monsters by general defect, as dwarfs: 5, hermaphrodite monsters.

The two classifications which have generally been adopted by Continental veterinarians are those of Gurlt and Geoffroy Saint-Hilaire; that of the former—the eminent Berlin veterinary professor—being preferred by the Germans, Italians, Dutch, and Danish, and that of the latter by the French.

Gurlt's classification and nomenclature are good and explicit, and in some respects to be preferred to Saint-Hilaire's; while those of the latter offer advantages which might lead us to give them the preference, apart from the fact that it is they on which the science was based.

[1] A monstrosity is generally only alluded to as such, or as a *Lusus Naturæ*; a scientific classification has not been attempted in this country.

Gurlt[1] arranges monstrosities into two classes—*Simple* and *Compound*. The first comprises eight orders, twenty-six genera, and seventy-three species; the second includes six orders, twenty-six genera, and fifty-nine species.

As some veterinarians may prefer Gurlt's classification to that of Saint-Hilaire, and particularly for its practical utility, we give it here:

CLASS I.

SIMPLE MONSTROSITIES.

This class is occupied with a single individual, and refers to an absence of or addition to parts, exaggeration of them, or alteration in their form or position. It comprises 8 ORDERS, 26 GENERA, and 73 SPECIES.

ORDER I.—SIMPLE MONSTROSITIES THROUGH ABSENCE OF PARTS:—

1. AMORPHUS.—Absence of conformation; 1 species: *A. globosus.*
2. ACEPHALUS.—Headless; 2 species: *A. unipes*, *A. bipes.*
3. PEROCEPHALUS.—Head defective; 7 species; *P. pseudocephalus* (apparently without a head), *P. aprosopus* (head without a face), *P. microcephalus* (small head), *P. agnathus* (head without a jaw). Varieties: *a*, *P. agnathus hypostomus* (mouth a longitudinal fissure beneath the ordinary situation): *b*, *P. agnathus microstomus* (small mouth): *c*, *P. agnathus astomus* (without a mouth), *P. brachyrhynchus* (short face or nose), *P. anomatus* (without eyes), *P. aotus* (without ears).
4. PEROSOMUS.—The whole of the body defective; 4 species: *P. hemicephalicus* (body defective and head absent), *P. horridus* (horrid deformity), *P. elumbis* (loins absent), *P. pseudoscelus* (body defective, with posterior limbs incomplete).
5. PEROCORMUS.—Trunk defective; 3 species: *P. oligospondylus* (defective vertebræ), *P. ecaudatus* (without tail), *P. anacdoca* (without external generative organs).
6. PEROMELUS.—Limbs defective; 6 species: *P. apus* (without limbs), *P. achirus* (without anterior limbs), *P. monochirus* (with only one anterior limb), *P. ascelus* (without posterior limbs), *P. monocelus* (with only one posterior limb), *P. micromelus* (limbs shortened); with the varieties, *P. micromelus microchirus* (anterior limb short), *P. micromelus microscelus* (posterior limb short).

ORDER II. — SIMPLE MONSTROSITIES THROUGH SMALLNESS OF PARTS:—

7. NANOSOMUS.—Limbs and trunk small—dwarf; 2 species: *N. pygmæus* (short and low, but without disproportion of parts), *N. caticeps* (cat-faced dwarf).
8. NANOCEPHALUS.—Small head; 3 species: *N. micromatus* (eyes too small), *N. brachyotus* (ears too short), *N. brachygnotus* (lower jaw too short).
9. NANOCORMUS. — Short trunk; 2 species: *N. rectus* (vertebral column straight, but very short), *N. curvatus* (vertebral column short, and curved to one side.)
10. NANOMELUS.—Limbs short; 5 species: *N. brevipes* (all the limbs

[1] *Pathologische Anatomie*, Berlin, 1833. Article: "Missbildungen." Also *Ueber Thierische Missgeburten*, Berlin, 1877.

short), *N. brachychirus* (anterior limbs too short), *N. campylochirus* (anterior limbs short and crooked), *N. chiropterus* (anterior limbs short, with cutaneous folds resembling wings), *N. compyloscelus* (posterior limbs short and crooked).

ORDER III.—Simple Monstrosities through Abnormal Division of the Body :—

11. Schistocephalus.—Division of the head ; 5 species : *S. hemicephalus* (cleft in the middle) ; with the varieties : *a*, *S. hemicephalus partialis*, or *hydrencephalocele* (partial hernia of the brain, with hydrocephalus) ; *b*, *S. hemicephalus totalis* (absence of all the cranium) ; *c*, *S. hemicephalus complicatus* (cleft cranium, face defective) ; *S. bifidus* (face divided), *S. fissipalatinus* or *rictus lupinus* (cleft palate), *S. fissilabrus* or *labium leporinum* (cleft or hare lip), *S. megalostomus* (wide mouth).

12. Schistocormus.—Divided trunk ; 6 species : *S. fissicollis* (neck cleft), *S. fissisternalis* (sternum divided), *S. schistepigastrico-sternalis* (division of the sternum and anterior portion of the abdomen), *S. exomphalus* (divided umbilicus), *S. fissiventralis* (the whole of the abdomen divided), *S. fissispinalis* or *spina bifida* (division of the spinal column).

13. Schistosomus.—Division of the head and trunk ; 3 species : *S. reflexus* (division of the body and inversion of the spinal column), *S. contortus* (division of the body and torsion of the vertebral column), *S. microchirus* (division of the body and anterior limbs shortened).

14. Schistomelus.—Cleft limbs ; 2 species : *S. fissimanus* (division of the anterior limbs), *S. fissungulus* (division of the phalanges).

ORDER IV.—Simple Monstrosities through Absence of the Natural Division of Parts :—

15. Atretocephalus.—Absence of openings in the head ; 1 species : *A. astomus* (mouth absent).

16. Atretocormus.—Absence of the natural apertures in the body ; 2 species : *A. aproctus* (anus absent), *A. anurethra* (urethra absent).

17. Aschistodactylus.—Phalanges undivided ; 1 species : *A. solidungulus* (absence of division of the phalanges and claws in those animals which usually have them divided).

ORDER V.—Simple Monstrosities through Fusion or Coalition of Organs :—

18. Cyclops or Monophthalmus.—One eye in the middle of the face, and a proboscis in addition ; 3 species : *C. megalostomus* (large mouth), of which there are two varieties ; *a*, *C. megalostomus rhynchænus* (large mouth and proboscis) ; *b*, *C. megalostomus arhynchus* (large mouth, but no proboscis) ; *C. prostomus* (irregular mouth), in which are two varieties : *a*, *C. prostomus arhynchus* (irregular mouth and no nose) ; *b*, *C. prostomus rhynchænus* (irregular mouth and nose) ; *C. astomus* (without mouth), with two varieties : *a*, *C. astomus arhynchus* (mouth and nose absent) ; *b*, *C. astomus rhynchænus* (proboscis present, but mouth absent).

ORDER VI.—Simple Monstrosities through Abnormal Position and Form of Parts :—

19. Campylorrhinus.—Curvature of the nose ; 1 species ; *C. lateralis* (lateral curvature of the nose).

20. Camylorrhacchis. — Curvature of the vertebral column; 2 species: *C. scoliosa* (lateral curvature of the spine), *C. contorta* (torsion of the spine).

ORDER VII.—Simple Monstrosities through Excess in Formation:—

21. Megalocephalus.—Head abnormally large; 2 species: *M. hydrencephalus* (with hydrocephalus), *M. polycerus* (head with large horns).

22. Diphallus.—Double penis; 1 species: *D. imperfectus* (double penis, incomplete).

23. Megalomelus.—Limbs with supernumerary parts; 1 species: *M. perissodactylus* (with supernumerary digits).

ORDER VIII.—Hermaphrodites:—

24. Hermaphroditus.—Double sex, with predominance of organs belonging to one sex; 2 species: *H. lateralis* (genital organs to one side), in which there are two varieties: *a*, *H. lateralis masculinus* (with predominance of the male organs); *b*, *H. lateralis femininus* (with predominance of the female organs); *H. transversalis* (the external generative organs belonging to one sex, and the internal to the opposite sex), including two varieties: *a*, *H. transversalis masculinus* (external genital organs male, internal female); *b*, *H. transversalis femininus* (external genital organs feminine, internal male—often imperfect).

25. Pseudo-hermaphroditus. — False hermaphrodites; 4 species: *P. megalomasthus* (male with large mammæ), *P. microphallus* (penis unusually small), *P. hypospadiatus* (with the urethra divided inferiorly), *P. femininus* (false feminine hermaphrodite).

26. Androgynus.—Double hermaphrodites, the male and female organs existing in a single individual, one sex being incomplete and the other predominating; 2 species: *A. masculinus* (the external organs are masculine, with a small penis, the internal organs being male and female—though the one set is more complete than the other), *A. femininus* (the external organs are feminine, with abnormally large clitoris, the internal being male and female, with predominance of the one over the other).

CLASS II.

TREBLE AND DOUBLE MONSTROSITIES.

In these monstrosities there is a union of two or three individuals, neither of which is complete, but which are united at various points often with a completely-developed body is united a portion of a second individual. It comprises 6 Orders, 26 Genera, and 59 Species.

ORDER I.—Trigeminal Monstrosities, in which are united one or more parts or organs of three Individuals:—

1. Cephalotridymus.—Three heads united to a single trunk; 1 species: *C. unicorporeus* (with a single body).

2. Cormotridymus.—Posterior part of the trunk triplicate, with more than four limbs; 1 species: *C. tricaudatus* (three croups with three tails, but only one anus and four posterior limbs).

3. Melotridymus.—Posterior part of the body double, and more than eight limbs; 1 species: *M. decapus* (ten limbs of unequal length).

4. SOMATOTRIDYMUS.—Triple body; 1 species: *S. sternalis* (three chests united).

ORDER II.—MONSTERS WITH TWO HEADS—*Cephalodidymi:*—

5. DIPROSOPUS.—Double face; 3 species: *D. sejunctus* (the two faces separate), *D. distans* (the two faces diverging), including three varieties; *a*, *D. distans distomus* (a mouth in each face); *b*, *D. distans monostomus* (a mouth in one face only); *c*, *D. distoma hemicephalicus* (without a cranium); *D. conjunctus* (two faces united,) has two varieties: *a*, *D. conjunctus distomus* (double mouths); *b*, *D. conjunctus monostomus* (with one mouth).

6. MONOCRANUS.—Single cranium; 4 species: *M. mesognatus* (the lower jaw included in or united to the other from the commencement of the branches), *M. dignatus* (lower jaw double), *M. heteroprosopus* (diverse faces), *M. bimandibularis* (upper jaw double).

7. HETEROCEPHALUS.—Double heads, one of which is complete, the other very incomplete; 2 species: *H. interpositus* (between the two branches of the lower jaw of the complete head is interposed the lower jaw of the incomplete one), *H. oppositus* (the lower jaw of the complete head is depressed in front, and on its upper surface—anterior extremity—it is united to the corresponding part of the second jaw, with which it forms an acute angle).

ORDER III.—DOUBLE-HEADED MONSTROSITIES, WITH THE TRUNK WHOLLY OR PARTIALLY DOUBLE:—

8. DICEPHALUS.—Two separate heads; 7 species: *D. biatlanticus* (double head and two atlases), *D. subbicollis* (double head with apparently two necks), *D. bicollis* (double head and two necks), with two varieties: *D. bicollis omocephalus* (both heads alike), *D. bicollis heterocephalus* (one head perfect, the other imperfect); *D. subbidorsualis* (double head, with apparently a double back), *D. bidorsualis* (double head with double back), *D. bilumbis* (double head and double loins), *D. bispinalis* (double head and vertebral column), has two varieties: *a*, *D. bispinalis quadrupes* (with four limbs); *b*, *D. bispinalis achirus* (without anterior limbs).

9. DICRANUS.—Double cranium; 1 species: *D. bispinalis* (cranium and vertebral column double).

ORDER IV.—MONSTROSITIES WITH A SINGLE HEAD, BUT THE TRUNK OR LIMBS MORE OR LESS COMPLETELY DOUBLE—*Cormo-melodidymi:*—

10. DIPYGUS.—Double croups; 3 species: *D. bidorsualis* (double croup and back), *D. subbidorsualis* (double croup, with half the back doubled), *D. bilumbis* (croup and loins doubled), containing two varieties: *a*, *D. bilumbus teleocephalus* (with head regular); *b*, *D. bilumbis cacocephalus* (with head irregular).

11. HETERODIDYMUS.—Unequally-developed twins, the body of one being large and regularly or irregularly formed, the other being small and slenderly attached to some part of its fellow; 3 species: *H. octipes* (with eight feet), containing two varieties: *a*, *H. octipes emprosthochirophorus* (the anterior limbs of the parasitic twin situated in front); *b*, *H. octipes pleurochirophorus* (the anterior limbs of the parasitic twin situated at the side); *H. tetrasulus* (with four posterior extremities), also containing two varieties: *a*, *H. tetrasulus monopygus* (with one croup);

b, *H. tetrasulus dipygus* (with a double croup); *H. triscelus* (with three posterior limbs).

ORDER V.—Monstrosities with a Single Head and Trunk, and more than Four Limbs—*Melodidymi*:—

12.—Opisthomelophorus.—An animal regularly formed, but which bears on its back or croup a supernumerary limb or limbs; 3 species: *O. trichirus* (with an anterior limb on the back), *O. tetrachirus* (with two anterior limbs on the back), *O. tetrascelus* (with two posterior limbs on the croup).

13. Emprosthomelophorus.—With a supernumerary limb or limbs on the neck, thorax, or beneath the pelvis; 5 species: *E. octipes* (with four supernumerary limbs beneath the thorax), *E. trichirus* (with an anterior limb on the thorax), *E. tetrachirus* (with two anterior limbs on the neck), *E. triscelus* (with a posterior limb beneath the pelvis), *E. tetrascelus* (with two posterior limbs beneath the pelvis).

14. Pleuromelophorus.—With a supernumerary limb or limbs situated on the side; 4 species: *P. octipes* (with four limbs on the side), *P. tetrachirus* (with two anterior limbs on the side), *P. trichirus* (with an anterior supernumerary limb), *P. triscelus* (with a posterior supernumerary limb).

ORDER VI.—Monstrosities with the Head, Trunk, and Limbs more or less completely Double—*Somatodidymi*:—

15. Octopus.—With eight limbs; 4 species: *O. janus* (two faces placed opposite each other, and eight limbs), *O. quadriauritus* (eight limbs and four ears), containing two varieties: *a*, *O. quadriauritus monoprosopus* (with a perfect face); *b*, *O. quadriauritus aprosopus* (face absent); *O. biauritus* (eight limbs and two ears), *O. synapheocephalus* (eight limbs, and the heads joined externally only by the skin).

16. Tetrachirus.—With four anterior limbs; 2 species: *T. symphocephalus* (four anterior limbs, two lateral and two incomplete, on the back, and heads joined), *T. choristocephalus* (four anterior limbs, and heads separate).

17. Tetrasculus.—With four posterior limbs; 2 species: *T. symphocephalus* (four posterior limbs, and heads united), *T. bifacialis* (four posterior limbs, and the two faces separate).

18. Gastrodidymus.—Twins united at the abdomen; 3 species: *G. quadrupes* (twins united at the abdomen, and furnished with four limbs), *G. tetrachirus* (with four anterior limbs), *G. octipes* (with eight limbs).

19. Gastro-Thoracodidymus.—Twins united at the thorax and abdomen; 1 species: *G. thoracodidymus octipes* (with eight limbs).

20. Epigastrodidymus.—Twins united at the thorax and epigastrium; 1 species: *G. octipes* (with eight limbs).

21. Thoracodidymus.—Twins united at the thorax; 1 species: *T. octipes* (with eight limbs).

22. Schelodidymus.—Twins united at the posterior extremities; 1 species: *S. heptamelus* (with seven limbs, the posterior pair being united into one, the next pair at the side, and the other four in front).

23. Ischiodidymus.—Twins united at the pelvis; 1 species: *I. examelus* (with six limbs, four anterior and two posterior).

24. Omphalo-Chronodidymus.—Twins united at the umbilicus and the head; 1 species: *O. disomatus* (the bodies separate).

25. Pygodidymus.—Twins united at the croup; 1 species: *P. aversus* (bodies united at the ischia and sometimes at the buttock, and in opposite directions).

26. Cryptodidymus.—Inclusion of one twin within the other; 2 species: *C. abdominalis* (twin included in the abdomen), *C. subcutaneus* (incomplete fœtus included beneath the skin of the complete one).

Such is the classification adopted by Gurlt, and it will be seen that it is very complete, while the nomenclature scarcely leaves anything to be desired. Nevertheless, as Saint-Hilaire's classification and nomenclature are also employed, and are in some respects advantageous to know, we will now allude to them, though not in such detail as we have done those of Gurlt, following the summary given by Zundel. Saint-Hilaire separates monstrosities from vices of conformation, which he distinguishes as *Hemiteries*, or simple and trifling organic anomalies, and *Heterotaxies*, or mere changes in the situation of organs, and nearly always without alteration in relative position and connections. For the *Hermaphrodisms*—due to the union of the sexes or some of their characters in the same individual—he forms a separate class, which he again divides into two sub-classes, according as there is an absence or excess in the number of parts; he distinguishes male hermaphrodism, female hermaphrodism, and neutral hermaphrodism; mixed; complex—masculine or feminine; and bi-sexual—perfect or imperfect. The monstrosities—properly so called—exhibiting anomalies which are more or less serious, either because of the injurious influence they exercise on the functions of the individual, or the vicious conformation they give rise to—are divided into two classes: *Simple Monstrosities* and *Composite*, *Double*, or *Triple Monstrosities*.

The first class comprises three orders: 1. *Autositic Monstrosities* (αὐτος, *self*, σῖτος, *nourishment*)—whose organs are capable of maintaining them for a variable period after birth. Only one or more regions of the body are involved, the majority being little, if at all, different from the normal standard; the circulatory apparatus is always more or less complete, particularly the heart; the lungs, nearly all the digestive viscera, and at least a portion of the head, are present; and all the anatomical and physiological characters are manifested externally by the general conformation, which, in the greater part of the body, remains symmetrical and almost normal. 2. *Omphalositic Monstrosities* (ὀμφαλὸς, *umbilicus*, and σῖτος, *nourishment*)—those which live imperfectly, being maintained by the nourishment derived from the mother through the umbilical cord, and dying as soon as the cord is ruptured. These *omphalosites* are deficient in a large number of organs, and those which are present are generally very imperfect; externally all the regions appear to be anomalous, and the symmetry is imperfect, or even effaced. 3. *Parasitic Monstrosities*—the most imperfect of all, and generally inert, irregular masses, composed of bones, adipose tissue, etc., destitute of umbilical cord, and attached to the generative apparatus of the mother, at whose expense they maintain an obscure parasitic existence, by means of a vascular pedicle.

The double monstrosities are divided into *autositarian* and *double parasitic*. The first are composed of two individuals more or less intimately united, and somewhat equal in development; this equality indicating that they both have been equally nourished, and that their functions have been alike complete. The second are composed of two

distinct individuals, very unequal in development, the smallest being the most imperfect; testifying that it, like a parasite, has lived at the expense of the other. It would appear that the triple monstrosities have not been met with in sufficiently large number to establish a trustworthy classification.

Each of the orders of Saint-Hilaire, like those of Gurlt, contains several families, subdivided again into genera and species, according

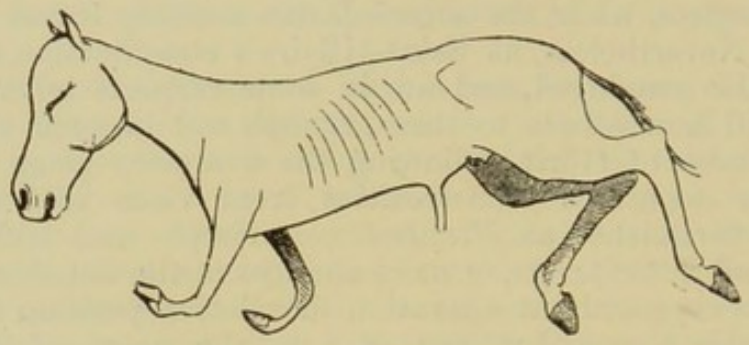


Fig. 104.

Ectromelian Monstrosity (Saint-Hilaire); *Nanomelus Campylochirus* (Gurlt): Horse.

to their affinities, and which include all the monstrosities he had met with. With regard to these families, it may be mentioned that among the single autositic monstrosities, there are the *ectromelians* (ἐκτράω, *to make abort*, μέλος, *limb*), in which we have a more or less complete deficiency in the development of the limbs, either anteriorly or posteriorly, and involving one or more of these (Figs. 104, 105).

Fig. 105.

Ectromelian Monstrosity (Saint-Hilaire); *Nanomelus Campylochirus* (Gurlt): Goat.

The *Symelian Monstrosities* (σὺν, with, μέλος, limb) are those which Gurlt includes in his first Class and Order, there being an absence of parts, with fusion of others (Fig. 106).

The *Celosomian Monstrosities* (χήλη, *hernia*, σῶμα, *body*), more frequent, perhaps, than any others, are those which Gurlt places in his third Order—*Schistocormus*, and are chiefly characterized by the absence, more or less complete, of the abdominal parietes, and the abrupt

curvature of the spine backwards, downwards, or to one side; so that the pelvis and posterior limbs are directed forwards, to one side, or over the back, while the abdominal cavity being open, allows its viscera to float about unprotected. There are many degrees of this deformity. Sometimes the abdominal cavity is open, the thorax being undeformed and closed in posteriorly by the diaphragm, and the ribs attached to the sternum (*Schistocormus fissiventralis*, Gurlt, Fig. 107). Sometimes the posterior end of the spine is curved forward to the middle of the

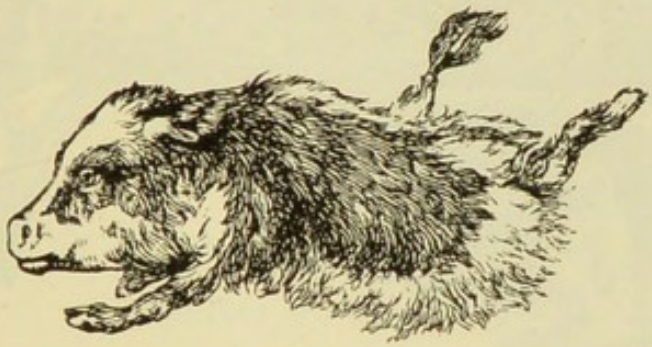


Fig. 106.

SYMELIAN MONSTROSITY (SAINT-HILAIRE); *Perosomus pseudoscelus* (GURLT): PIG.

back (*Schistocormus reflexus*, Gurlt); the ribs follow in the same direction, but instead of bending downwards to enclose the chest, they spring upwards towards the dorsal spines; the sternum is absent or divided throughout its length (*Schistocormus fissisternalis*, Gurlt, Fig. 107), with evisceration of thoracic organs—most frequently the heart (*Ectopia cordis*, Fig. 108); the diaphragm is not present, the

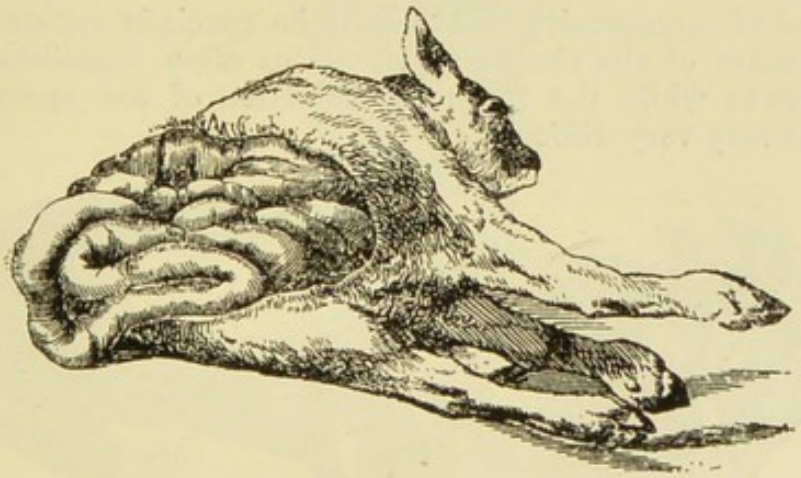


Fig. 107.

CELOSOMIAN MONSTROSITY (SAINT-HILAIRE); *Schistocormus fissiventralis* (GURLT): CALF.

chest is as widely open as the abdomen, and the viscera of both cavities are external to the body (*S. Schistepigastrico-sternalis*). At other times the spine is twisted, and the body and head divided (*Schistosomus contortus*); or other deformities of a similar kind, and more or less complex, may be found. The skin follows the displacement of the various regions—the external surface being generally in contact—while the lining membrane of the chest or abdomen, or both, becomes external; sometimes to such an extent is this inversion of the

body carried, that it is turned, as it were, outside in: the skin forming a kind of internal sac—the hair to the interior—and containing the head and limbs of the fœtus. With such a deformity, of course other serious malformations or displacements co-exist: distorted pelvis, wasted or undeveloped limbs, atresia of the anus, more or less complete absence of the generative organs, etc.

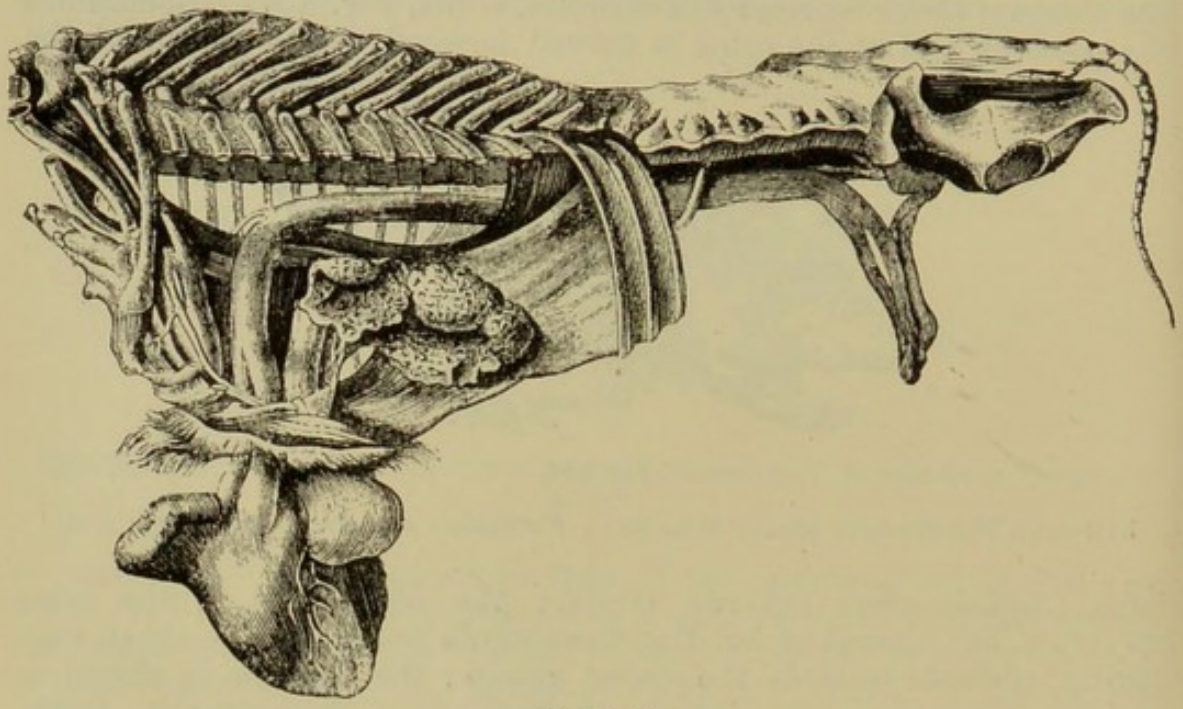


Fig. 108.

Ectopia Cordis: Schistocormus fissisternalis.

This kind of monstrosity will have to be specially noticed hereafter, the eventration of the viscera of the fœtus often considerably baffling the obstetrist; while the frequent distortion of the spine and limbs renders delivery very difficult.

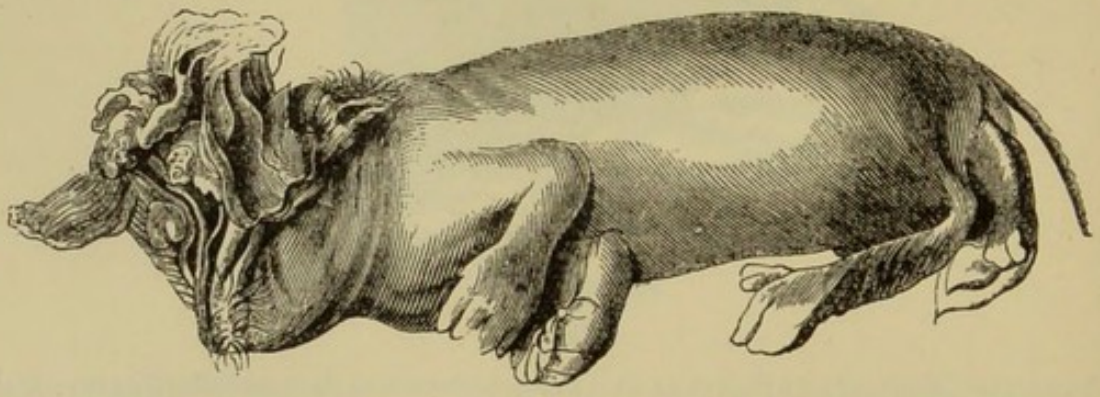


Fig. 109.

Pseudencephalian Monstrosity; *Perocephalus pseudocephalus* (Gurlt).

The *Exencephalian* monstrosities, belonging to Gurlt's third Order in the first Class, are those which have the brain defective, deformed, and external to the cranial cavity—itself more or less imperfect.

The *Pseudencephalian* monstrosities belong to the third Order of Gurlt's first Class, the encephalon being absent and replaced by a variable-sized bright red tumour, composed of a multitude of small

bloodvessels; this tumour rests on the base of the cranium, the roof of which is absent (Fig. 109).

The *Anencephalian* monstrosities—Gurlt's first Order, first Class—are destitute of the encephalon or anything to represent it, and the roof of the cranium is entirely absent.

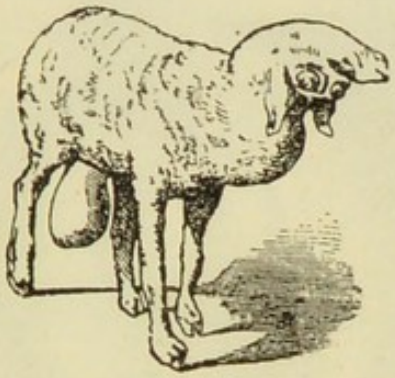


Fig. 110.

CYCLOPEAN MONSTROSITY: RAM.

The *Cyclocephalian* monstrosities (χύχλος, circle, κεφάλη, head)—Order five, Class first of Gurlt—are characterised by the approximation, or more or less complete fusion of the eyes into one organ, with absence, displacement, or deformity of the nose and mouth; but the ears are

Fig. 111.

CYCLOPEAN MONSTROSITY; *Cyclops megalostomus archynchus* (GURLT): ASS.

usually in their natural position, or perhaps are lower than usual. Not unfrequently the nose is absent and the mouth greatly enlarged, while the fusion of the eyes may not be complete (Figs. 110, 111).

The *Acephalian* monstrosities—Gurlt's first Class and first Order—are more or less destitute of head, and sometimes of neck, thorax and thoracic organs (Fig. 112).

The *Anidian* or *zoomylian* monstrosities, we have already described at p. 178; so we need not again refer to them.

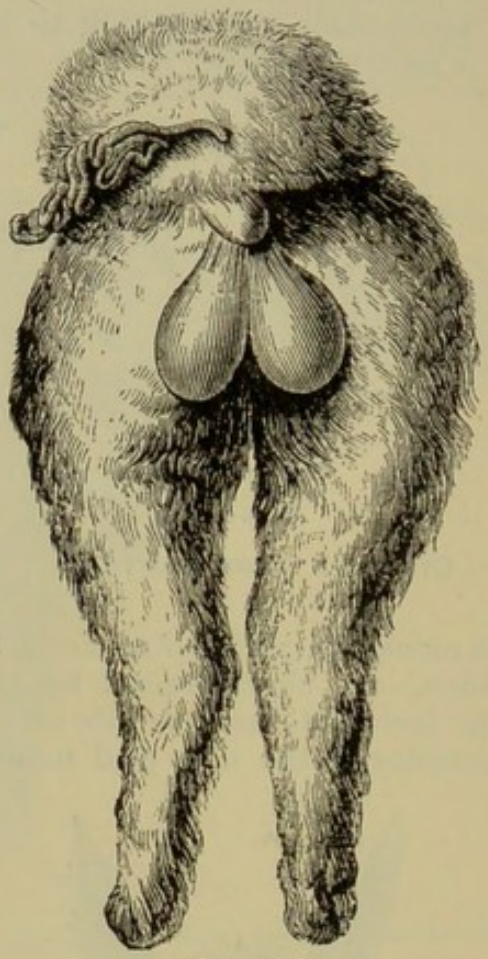


Fig. 112.

Acephalian Monstrosity; *A. perosomus hemicephalicus* (Gurlt).

Fig. 113.

Schistocephalus fissislabrus or *labium leporinum* (Hare-lip).

The *Schistocephalian* monstrosities (Gurlt) have the head or face cleft: most frequently the face, the division being sometimes limited to the nose and upper lip.

Those monstrosities which are characterised by the abnormal situation and form of different parts — and which are included in Class first, Order six, of Gurlt — are not exceedingly rare, and in some instances are probably due to muscular contraction, or malposition for some time in the uterus (Fig. 114).

Saint-Hilaire divides the double monstrosities into two orders: *Autositaric* and *Parasitic;* the former being constituted by individuals more or less intimately united and somewhat equally developed, each concurring to the mutual existence; while the second is made up of those monstrosities which, though united, have one being more or less complete—being reduced in fact to a limb, jaw, or other fragment of a body implanted or subsisting on an individual which is fully developed. These are included in Gurlt's second Class.

In the autositaric order we have the *Eusomphalian* and *Monomphalian* monstrosities: these have the common character of two heads and four

Fig. 114.

Camylorrhacchis contorta.

pairs of limbs; the first have, however, a distinct umbilical cord to each of the united fœtuses; while in the other—the *Monomphalian*—there is only a single umbilical cord and umbilicus.

The *Eusomphalian* monstrosity consists, then, of two pretty equally developed fœtuses, each with its own umbilical cord, the two being usually joined together by some soft part at any region of the body; so that they may be separated by a surgical operation without the existence of either being compromised. This is included in the third Order of Gurlt's second Class.

With the *Monomphalian* monstrosity, on the contrary, there being only one umbilicus and one cord, the fœtuses are joined at the ventral surface, and have usually several organs in common—notably the liver, to which the umbilical vein passes (Fig. 115).

The *Syncephalian* monstrosities have two bodies either completely separated, or only divided above the umbilicus, and surmounted by a

more or less incomplete double head: the two heads being fused, as it were, into one (*Dicephalus heterocephalus* of Gurlt—Fig. 116).

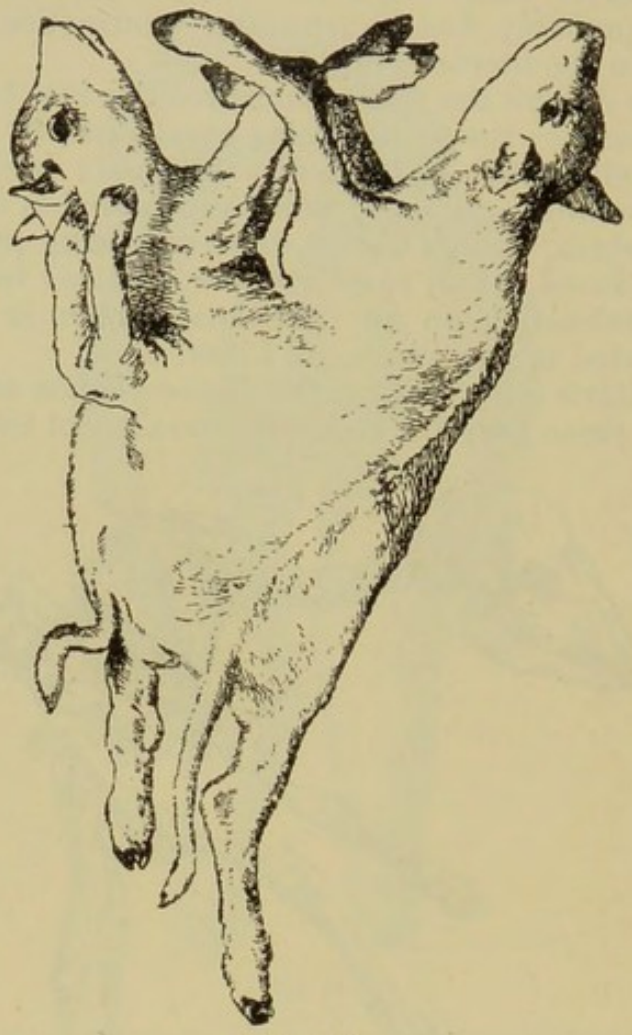


Fig. 115.

MONOMPHALIAN MONSTROSITY: *Cephalo-cormodidymus* (GURLT).

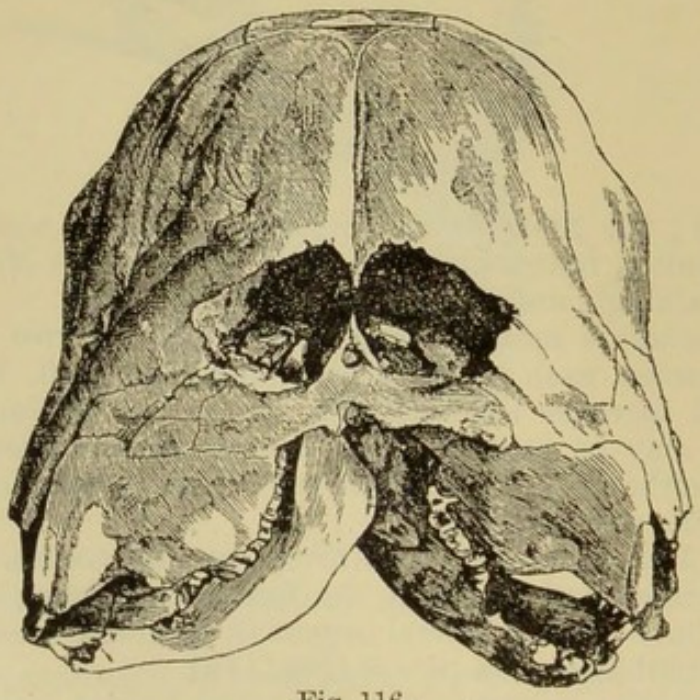


Fig. 116.

SKULL OF SYNCEPHALIAN MONSTROSITY.

The *Monocephalian* monstrosities, as the name implies, differ from

the last in having only one head, but a double body, the separation of the two usually taking place below the umbilicus (Fig. 117).

The *Sysomian* monstrosities (Fig. 118) have two heads on apparently a single body, though a closer investigation will prove that the unicity is merely superficial, and that at least some parts are double. Gurlt describes a full-grown Sysomian lamb he examined, and which had, apparently, a single body and only four feet, but two necks, two heads, and two tails, and the skin normally covered with wool. The trunk, though somewhat small, gave no indication of its duplicity. It had, nevertheless, two vertebral columns, the inner ribs attached to each being shortened and fused together, while the external ones were attached in the usual way to the single sternum. The viscera were generally double, though they were confounded at certain points. A single heart sufficed for two pair of lungs, one pair of which, however, were only rudimentary. The two livers were combined into one, and

Fig. 117.

MONOCEPHALIAN MONSTROSITY: *Cormo-Melodidymi* (GURLT).

Fig. 118.

SYSOMIAN MONSTROSITY: *Dicephalus bicollis* (GURLT).

in some parts the intestines merged into a single tube, again to become double, and finally to terminate in one rectum.

The *Monosomian* monstrosities have, in reality, only a single body, the duplicity generally commencing towards the neck, in the cervical region, not unfrequently at the atlas, and sometimes as far as the facial region (Fig. 119).

Among the double parasitic monstrosities, we may mention Saint-Hilaire's *Heterotypians*, in which the smallest of the fœtuses is attached to the anterior part of the body of the other, at or near the umbilicus; the *Heteralians*, in which the parasitic fœtus is very incomplete, and perhaps reduced to a single region—as a head without a body—attached some distance from the umbilicus; the *Polygnathians*, in which the parasite is reduced to the mere fragments of a fœtus—the jaws and some cephalic remains adhering to the jaws of the other fœtus. All

these are included in Gurlt's classification, which we would advise the veterinary obstetrist, as a rule, to employ.

The Polymelian (*μέλος, limb*) monstrosities—Gurlt's *Melodidymi*—comprise those creatures which are so frequently exhibited in public, and in which there is only a single body and head, but supernumerary

Fig. 119.

Monosomian Monstrosity; *Dicephalus bi-atlanticus* (Gurlt): Calf.

limbs. These limbs may vary in number, and be attached to various parts of the complete fœtus; there may also be present, in addition to the supernumerary members, an unformed kind of tumour resting on the back or shoulders, which in one case has been recognised to be

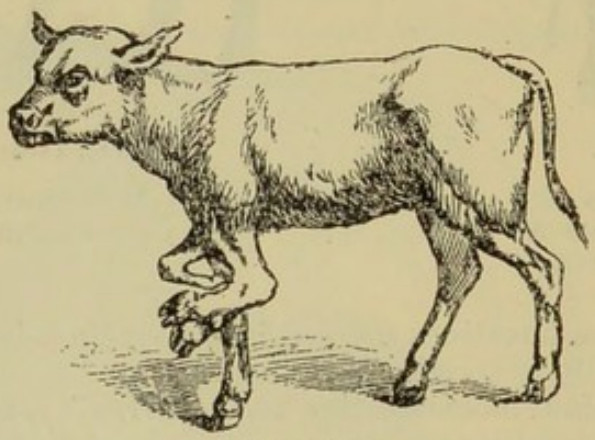


Fig. 120.

Polymelian Monstrosity; *Emprosthromelophorus* (Gurlt): Calf.

composed of the heart and lungs of a second fœtus (Fig. 121). In other instances, the tumour is alone observed, without the additional limbs.[1]

[1] It is not improbable that the "Nadeah" bullock of India is an animal with a parasitic monstrosity attached to it. A Bull of this kind has been described, by an amateur, as having "an excrescence of skin, covered with white hair, hanging from the top of the hump, about seven inches long and of a soft nature, in appearance resembling

The *Endocymian* monstrosities are those double fœtuses of which one, or part of one, is included within the other. They are the *Crypto-didymi* of Gurlt's second Class.

Origin of Monstrosities, and the Laws of Teratology.

The causes which operate in the production of what we have designated "monstrosities" appear to be numerous.

Putting to one side, as unworthy of notice, the superstitious ideas which long prevailed with regard to the formation of these monstrosities—because they can all be explained by the laws of teratology—we come to the period when Régis started the hypothesis that the germs of these must have been originally produced with those of normal beings, and that they were developed in the ordinary course of generation. This hypothesis, or something like it, was accepted by Winslow, Duvernoy, Haller, and others, up to the time of Meckel. Geoffroy

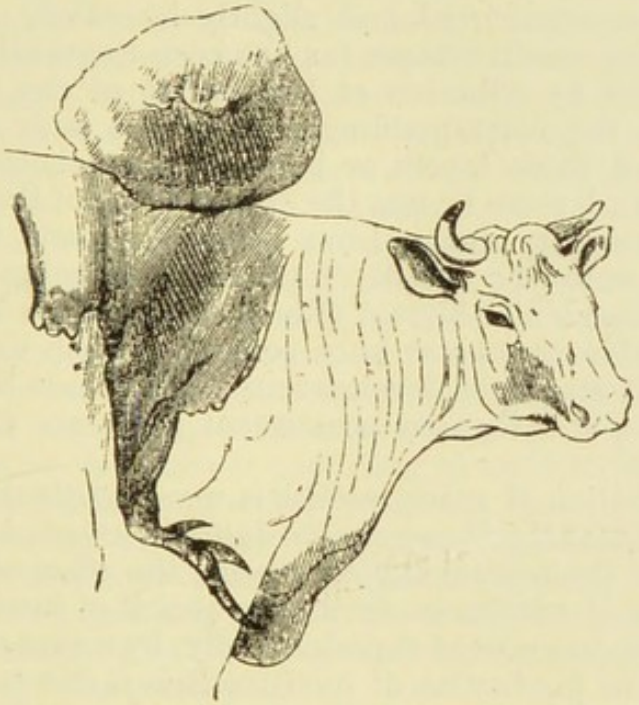


Fig. 121.

DOUBLE PARASITIC MONSTROSITY; *Polymelian notomelus:* COW.

Saint-Hilaire, however, successfully combated it, and demonstrated that these anomalies in organization are not primary, but accidental; that embryos which, had they been placed in ordinary circumstances, would have been developed in a normal manner, and had, in fact,

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a child's stocking, dangling from side to side as the animal moved, but in no way unsightly or repulsive to look at."

Such animals are worshipped, and not put to any work; they are usually exhibited covered with a kind of earth-coloured cloth trimmed with cowrie-shells, and the owners derive a livelihood by exhibiting them. The "fakeers" or holy mendicants usually obtain possession of them. These double or polymelian monstrosities receive their sacred designation from the god Mahadeo, who is believed by the Hindoos to have ridden upon a bull called "Nadeah," which was capable of changing its shape, and producing as many legs or horns for offensive or defensive purposes as it might find necessary. Thus it happens that any animal with unnatural or extraordinary marks is supposed to have some affinity to the great "Nadeah" of Mahadeo, the founder of Hindoo teratology.

begun to be so developed, only became anomalous and monstrous because their development was disturbed. Therefore these anomalies did not exist previous to impregnation, but were the result of some perturbation occurring during the development of the embryos, which were at first perfectly normal.

The opinion which at present prevails with respect to these malformations, is to the effect that the embryo or fœtus has been submitted to some kind of alteration *in utero*, and that this has been produced during the interval between conception and birth. It is a matter of ordinary observation that sometimes a fall, blow, sudden fright, or a powerful mental impression will, in woman, disturb the ordinary course of pregnancy, and give rise to more or less unusual symptoms, and even premature birth of an imperfect fœtus. It has been attempted to explain the action of these influences, by supposing that the sudden physical or mental shock produces an abrupt contraction of the vascular system and, coincidentally, of the uterus; so that the fœtal membranes are thus all at once constricted and slightly lacerated. Consequently, a part of the liquor amnii escapes (as has been frequently observed), and this is succeeded by adhesion of the margin of the laceration in the membranes to the corresponding part of the body of the embryo; thus are formed those layers or bands which, whether temporary or permanent, disturb more or less the development of the young creature, either by preventing organs from occupying their natural cavities, hindering the union or fusion of parts, or opposing or delaying the formation of those which should afterwards appear. That this opinion is not improbable may be at once conceded, when we remember that during the early stages of development the ovum is little more than a semi-fluid mass, and that its constituent parts are extremely impressionable.

But the formation of monstrosities is more particularly due to what has been designated the *theory of retardation* or *arrested development;* the deviations from the normal standard being the effect of disturbance and arrested supply of nutriment during the period of intra-uterine growth. G. Saint-Hilaire has proved experimentally, by means of eggs artificially hatched, that the production of monstrosities is due to the interruption or accidental suspension of development which had commenced in a regular manner; while Meckel has shown the striking analogy there exists between many anomalies and various transitory conditions of embryonic organization.

It has been well remarked that the majority of the malformations due to defect in the higher animals represent, in a more or less perfect manner, the normal conformation of the inferior classes. For instance, the imperfection or absence of limbs is the natural condition of fishes and some reptiles; the heart is not present in zoophytes; when it has but one cavity in the higher mammalia, it only resembles the single heart of crustaceæ; and when the auricular septum of the heart remains patent, it is like the reptilian heart. All this is explained by the fact that the embryo of the domesticated animals, in arriving at its ultimate development, appears to pass through all the degrees of organization which mark the different types in the zoological series. And by means of the knowledge we possess of the organization of these types, we are sometimes able to say when a particular monstrosity began to deviate from the normal condition, the nature of the deviation, and its cause.

An excess of general development is less frequent than the opposite

condition, and partial excess of an organ or region is not infrequent; while excess of parts is far from rare, and may be noted in the vascular system, in internal organs, and externally; more particularly is it remarked in the extremities, when we have in some species "polydactylism," and in others "hyperdactylism." It is often observed that an excess in development in one part coincides with defective development in another, as if the balance in formative organization must be maintained throughout the body.

With regard to *double* monstrosities—the result of two fœtuses being accidentally joined together, and fused, as it were, into each other—G. Saint-Hilaire proposed a special law which he designated the *law of similar union* or of *mutual affinity*. The result of this law is the production of symmetrical development in a double monster in as perfect a manner as in a single and normal individual; the two creatures which, by their union, form either a partial or complete double monstrosity, are always joined by the homologous faces of their bodies—side to side, front to front, or back to back. And not only are they united by their homologous surfaces externally, but internally they are allied by homologous organs: each part or viscus of one corresponding to a similar part or viscus of the other; so that each vessel, nerve, or muscle on the plane of union of one, notwithstanding the apparent complexity, is joined to the corresponding vessel, nerve, or muscle of the other: just as the two moieties of a single and central organ, originally distinct and lateral, become naturally fused together at a certain period, and in obedience to the laws controlling their formation and development. A double monster is, therefore, only a being composed of four more or less complete moieties instead of two, as in the single individual.

With regard to more complex monstrosities, we find that, instead of two moieties, as in the normal condition of an individual, or the four moieties as in the double monstrosity, we may have six, eight, or even more; but yet the law of similar union prevails, and the moieties combine in twos. Therefore it is that a triple monstrosity is only a double monstrosity doubled, and a quadruple one a triple monstrosity doubled also—all the phenomena of the compound monstrosity being accounted for on the same general principle.

The formation of double monstrosities has given rise to some discussion, and at present there are two chief theories which are worthy of notice. According to one of these, there have been originally two ova, which may have been derived from one or from two Graafian vesicles or follicles rupturing at the same, or nearly the same time, and, passing down the oviduct together, towards the cornu, becoming fused by pressure in their passage. The other theory supposes the existence of only one ovum, by whose division or cleavage the double monstrosity is formed.

The first view is that which has found most favour, though recently it has been considered as quite exploded by Dittmer,[1] who is inclined to adopt the latter theory, and believes that the double monster is only an instance of bilateral symmetry carried too far. According to him, in the primitive germ of the normal embryo a longitudinal groove is formed, which afterwards represents the middle line, the two lateral parts developing symmetrically. But if this groove is too deep at one or both ends, the two halves will there be separated; and the separated extremities have the power of producing the wanting lateral

[1] *Reichert and Du Bois-Reymond's Archiv*, 1875.

half of each. The separation of the two halves may occur at one extremity or at both, and it may extend to any depth. According to these differences, we should have the various forms of double monster—from such creatures as the Siamese twins to cases of a small supernumerary leg. There may even be a further stage of this process. One of the separated halves may present a similar exaggeration of bilateral symmetry, if it again separate into two halves like the original germ.

Thus may be explained monsters with three heads or three tails.

Some objections might be raised to this theory, but this is not the place to enter upon their discussion. We may, however, point out that it will scarcely apply to included monstrosities, in which we have one creature, more or less perfectly developed, contained within another. We can scarcely doubt of the existence of two ova, the included one being the oldest, and that this inclusion has probably been effected at a very early period of germ development.

To return, however, to the long-accepted theory. If we descend from the complex phenomena of double monsters to single ones, and from these to simple anomalies, we find again that every anomalous union between organs takes place by homologous parts. What have been designated "Symelian" monstrosities are characterized by the fusion of their more or less atrophied abdominal limbs; in the "Cyclocephalian" monsters the eyes are more or less fused into one organ of vision; while with the "Otocephalians" the ears themselves are joined, and often intimately confounded. The union of the kidneys, testicles, cerebral hemispheres, and other double organs, is often observed in creatures otherwise normal in conformation; and all these anomalies occur under the reign of the same law—that of "similar union"—which for organs, as for entire individuals, operates on homologous parts.

With regard to the remote or proximate causes which lead to the production of monstrosities, it is very probable that the most prominent are irregularity or inequality in the nutrition of the fœtus, physical injury, undue pressure, alterations in the membranes, or diseased conditions of the young creature. G. Saint-Hilaire and Valentine, by disturbing the development of the embryo of the fowl during the early stage of incubation of eggs—through shaking, jarring, and pressing them, perforating the shell, or covering it with wax—could almost create monstrosities at will. And an accident during gestation—a blow, a fall, a displacement of the uterus—will produce the same results in animals. Lafosse observes that it is perhaps because of the pressure to which the fœtus of Ruminants is exposed, owing to the accumulation and fermentation of food in the rumen, that must be attributed the greater frequency of anomalies in the species of this order than in the other domesticated animals. The quantity and quality of the food, as well as the work to which the mother is subjected, have an undoubted influence on the nutrition of the embryo.

A circumstance which appears to have some influence in the production of anomalies in animals, is the great disparity in size between the male and female. Lafosse endeavours to prove this by showing that the frequency of certain vices of conformation—such as hypospadias, umbilical hernia, want of proportion between the jaws, etc.—is most notable in the mule.

We are also convinced that excessive consanguinity (breeding "in and in") likewise leads to the frequent production of monstrosities; we have witnessed some startling instances in the Cow and Pig.

Weakness of the procreative powers may also tend to the development of monsters.

A too small uterus may likewise act mechanically in distorting the fœtus; while the health or disease of the organ, or of the fœtal membranes, must exert a powerful influence on its development and conformation. It is not improbable that the Celosomian monstrosity (*Schistosomus reflexus*), observed only in the Bovine species, is due to the form of, or pressure in, the uterus; and to the same cause may also be ascribed the greater frequency of double and triple monstrosities in this species than in any other.

The amputation of limbs, or portions of them, may be due to the action of the umbilical cord, which, in the Mare at least, is perhaps sufficiently long for this purpose.

Hereditary influence is here undeniable. In the human species it has often been remarked, and scarcely less frequently in animals. Hornless Cattle, double-headed Puppies, tail-less Cats, and other anomalies, are commonly reproduced. Franck[1] mentions the case of a Mare which constantly had Foals whose lower jaw was so short that they could not suck; consequently they died. Gurlt alludes to a Bitch which brought forth four litters of Puppies; the first litter consisted of six, two of which were minus their fore-feet and were hare-lipped; there were five in the second litter, four of which were monstrosities; in the third litter there was the same number, and the fifth Puppy, which was otherwise normal, had a hump in the middle of its back; four Puppies were produced in the fourth litter, three of which were anomalous.

A psychical or mental influence has often been invoked to account for certain monstrosities, and the vulgar opinion since Old Testament times is certainly entirely in favour of its existence; but, on the other hand, it has often been denied. While there can be no doubt that the popular mind has greatly exaggerated this influence, yet it would appear from the interesting observations collected by Tréhonnais, as well as the curious instances recorded by Buhler, Weber, Herbst, Bagge, Rueff, and others—and which we regret we have not space to quote—that it does operate to some extent in animals; fear especially, as has been already said, will react on the embryo or fœtus.

Disease of the fœtus itself, or maladies transmitted from the mother, may play an active part in the production of anomalies and monstrosities.

Frequency of Monstrosities.

Monstrosities are far from being rare in the domesticated animals, but they do not occur with the same frequency in all the species. Gurlt[2] tabulates 740, which shows the proportion furnished by the different animals. This is as follows:—

Ass	3
Mule	3
Goat	24
Mare	56
Cat	71
Bitch	78
Sow	87
Ewe	179
Cow	239

[1] *Handbuch der thierarztlichen Geburtshülfe*, p. 434.
[2] *Pathol. Anatomie*, vol. ii., p. 5.

Baumeister and Rueff mention that in the King of Wurtemberg's private stud, of 2,340 Foals produced there were only nine monstrosities, or one abnormal to 260 normal Foals. In the Hohenheim dairies, among the Cows the monstrosities were only one-half per cent. (1 per 200); Swine came next in frequency, then Goats and Sheep. Among the latter there was only one monster in 768 Lambs.

Saint-Cyr collected 71 instances (not including hydrocephalic or synocephalic monsters), which were apportioned in the following manner:—

Calves - - - - -	45
Lambs and Kids - - -	16
Pigs - - - - - -	4
Kittens - - - - -	4
Puppy - - - - -	1
Foal - - - - - -	1

Though monstrosities are not rare in animals, yet all do not give rise to difficult parturition; for in some cases the deformity does not interfere at all with birth; in others in which the deformity is of such a nature as would impede delivery, birth often occurs prematurely when the fœtus or fœtuses are small and soft; while even when fully developed, double and triple monstrosities have been occasionally born without assistance.

Nevertheless, there is ample proof that triple, double, and even single monstrosities, often require to be removed artificially, and may be productive of serious consequences to the mother. These we will now allude to.

Distorted Monstrosities.

The distorted monstrosities which Gurlt has designated *Camylorrhacchis contorta*, and which are characterised by abnormal situation and form of different parts (Fig. 114), may occasionally, from their crooked shape, prove a source of difficulty during birth. The distortion may be due either to muscular contraction in the fœtus, or to extraneous uterine pressure, and if we glance at the figure which illustrates one variety of this malformation at p. 407, we will readily perceive that the obstetrist may indeed have a serious task before him if he is required to remove such a misshapen fœtus. The remarks we have made with regard to dystokia from muscular contraction are applicable to this form of monstrosity; and in the majority of instances it will be found that embryotomy, or even the Cæsarian section, must be resorted to.

Cyclopean Monstrosity.

A cyclopean monstrosity would not, so far as the visual deformity is concerned, give any trouble to the obstetrist; but in conjunction with this condition we not unfrequently find other anomalies existing, which have to be considered.

Pseudencephalian Monstrosity.

The head of the fœtus may prove a cause of protracted or difficult parturition, as we have seen when treating of hydrocephalus as a source of dystokia, as well as in other kinds of anomalies when it is either greatly deformed or double. We are cognisant of only one instance in

which a pseudencephalian monstrosity (*Perocephalus pseudocephalus*, Gurlt) gave rise to difficulty in birth.

Double-headed (Monosomian and Sysomian) Monstrosities.

The occurrence of double-headed monstrosities is more common, perhaps, than any other anomaly; they are observed more particularly in Ruminants, though instances are recorded of their appearing in the Pig, and even in the Cat species.

We have collected reports of some three dozen cases, the large majority of which refer to this anomaly in the Calf, and not one to the Equine or Asinine species. Only two of these cases appear in English literature. We have already shown, in classification of monstrosities, the kind

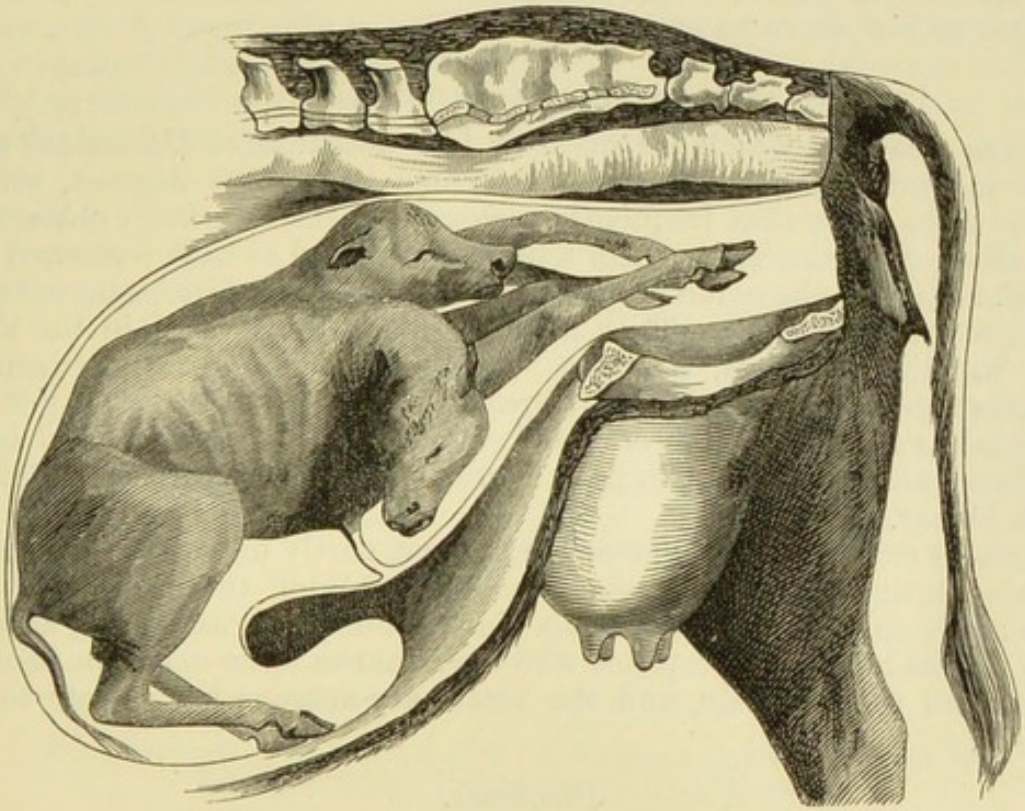

Fig. 122.

Sysomian Monstrosity: *Dicephalus bicollis* (Gurlt).

and degree of division there exists between the heads, and we have only now to deal with this anomaly from an obstetrical point of view.

It may be observed that many of these creatures have been born alive, and have continued to live for some time. Canu mentions a double-headed Calf which survived its birth fifty days, and Bert gives a good description of another which he examined when it was fifteen months old; but in the latter instance the anomaly was limited to the lower part of the head, the jaws only giving evidence of duplicity.

The existence of this anomaly renders birth more or less difficult, or even impossible, according to the size of the heads, their point of junction—whether at the face or cranium, or towards the neck, and also according as the presentation of the fœtus is anterior or posterior. In very many of the cases recorded, the mother died or had to be killed, while in others birth occurred without assistance and with but little

difficulty—rather a matter for wonder, considering the width of two fœtal heads joined towards the upper part of the neck. In this respect the Monosomian must prove more troublesome sometimes than the Sysomian monster. In the majority of cases the presentation is anterior.

An examination will reveal the existence of this condition, when the obstetrist will adopt the measures necessary for extraction. In very many of the cases embryotomy will have to be resorted to, or even the Cæsarian section. Decapitation of one or both heads may sometimes suffice. In other cases judicious manipulation and well-timed traction will effect delivery. When the heads are united at the cranium (as in Figs. 116 and 119), and it is impossible to decapitate, the obstetrical saw, chisel, or bone forceps may be usefully employed to disunite them at their junction.

With double necks, amputation of one head and neck should be effected as low down as possible.

Celosomian Monstrosities.

Those creatures which are more or less destitute of abdominal and thoracic parietes, and otherwise deformed in various degrees, would appear to be somewhat frequently met with by the veterinary obstetrist. The above designation for them will be recognised as that bestowed by G. Saint-Hilaire, the name proposed by Gurlt being *Schistosomus reflexus* or *contortus* (Fig. 107). They also are found more often in the Cow than in other animals, the Sheep being next in order of frequency. Of seventy-one monstrosities referred to by Saint-Cyr, twenty-three belonged to this order, and of these twenty-one were Calves, and only one Lamb and one Kid. Our own figures place the proportion of Calves much higher.

Perhaps this relative frequency is at least partly due to the fact, that the singularity of the malformation is so striking that observers are more ready to publish cases of this kind; while parturition being always more or less laborious, empirics who may chance to be called in cannot understand the anomaly, and the veterinary surgeon has at last to be sent for.

Diagnosis.

The diagnosis of this malformation is not difficult to the practised obstetrist. If the fœtal intestines are apparent at the genital orifice of the mother, their small size indicates at once that they are those of the fœtus; while an exploration of the vagina and uterus will discover the distorted body, with the viscera unprotected and floating freely about. When nothing is visible externally, of course the diagnosis is more difficult; and this difficulty is increased with certain presentations and positions of the fœtus. When, for instance, this is anterior, and the spine is greatly distorted, the hand will first meet the head, and around it all the feet (Fig. 123); it will be in vain for the obstetrist to attempt to separate these and push back the posterior limbs in order to put the fœtus in a good position, as the rigidity of the crooked spine prevents this being accomplished. In other cases the presentation may be abdominal or posterior, and then the hand encounters a confused, soft, floating mass of viscera, the nature of which is not easily ascertained. However, the *feel* of the intestines should lead to a suspicion of the case, while the twisted spine, deformed pelvis, and general distortion ought

to lead to a correct diagnosis. In some cases the exposed heart can be seized by the hand, and if the fœtus is alive the contractions of this organ will be distinctly perceptible.

Prognosis.

The prognosis in these cases of dystokia will greatly depend upon the distortion and size of the fœtus, as well as upon its position. In thirty-nine observations collected by Franck, twenty-eight—or 72 per cent.—of these monstrosities were born without injury to the mother, and a number of them without assistance; the remaining eleven Cows had to be slaughtered. In thirty-two instances, twenty-eight—or 93 per cent.—of the fœtuses presented by the abdomen; only four cases —13 per cent.—presented anteriorly, with the head and all the feet towards the genital canal. The latter were the most serious, as in three of them the Cows died. Of the twenty-eight abdominal or visceral presentations, twenty-three births took place without permanent injury to the mothers, the other five being killed. One was delivered by the Cæsarian section. In some of the cases in which birth occurred without assistance, the young creature was born alive.

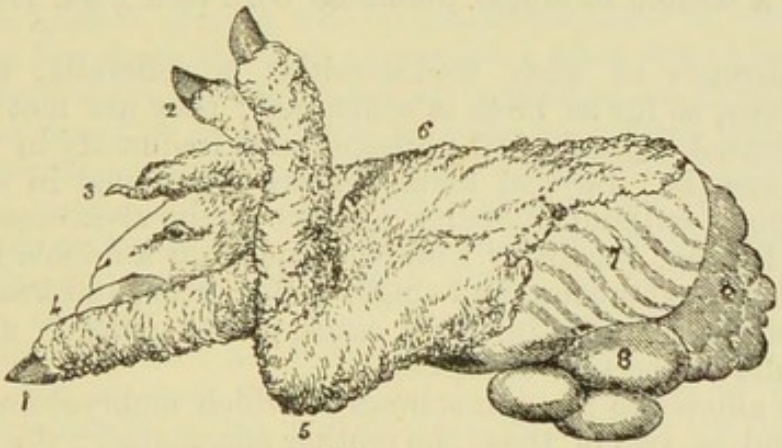

Fig. 123.

CELOSOMIAN MONSTROSITY: LAMB.

1, Hind Foot; 2, Fore Feet; 3, Tail; 4, Tongue; 5, Elbow of Left Fore Limb; 6, Stifle; 7, Ribs everted; 8, Viscera.

Extraction.

As we have seen, the prognosis in the large majority of cases is favourable, and particularly when the presentation is abdominal. Here careful manipulation will effect delivery, and often the only mutilation necessary is the removal of the fœtal viscera. These being got rid of, hand or cord traction made on the most convenient parts, or the insertion of a hook behind the spine into the pelvis or any other likely and accessible part, with gradual pulling will effect delivery; if not, the vertebræ should be divided.

But when the head and all the feet present, then the case is much more serious. If the fœtus is only moderately developed, even in this position it has been removed by traction. But in nearly all these cases embryotomy must be adopted. Some practitioners have succeeded in extracting the Calf by cording the head and fore-limbs, and pulling at these, while the hind-limbs were being pushed forwards into the uterus, and so dislocating the spine and straightening the body. If the spine does not give way, it may be cut or sawn through.

In removing the body of the fœtus by instalments, the limbs are amputated one after the other, according to the rules to be prescribed for this operation; and it may be necessary to excise two, three, or all of the legs, and even the head of the fœtus, before delivery can be completed.

Double and Triple Monstrosities.

We have already alluded to monstrosities which have the head double; we now come to the consideration of those which have the body more or less double, or even triple, and which have been designated by G. Saint-Hilaire *Eusomphalian*, *Monomphalian*, and *Monocephalian*, according to the degree of separation of the bodies, and whether two are united to a single head—the double-headed creatures being designated *Syncephalian*.

From an obstetrical point of view, there is little need to distinguish between the Eusomphalian and Monomphalian monstrosities; for, as already explained, they consist of two distinct fœtuses joined together at some part of their body, the character distinguishing them being the presence of a double or single umbilical cord (see Figs. 115, 117, 118, 119).

The occurrence of such monstrosities is generally, though not always, serious, so far as birth is concerned; they are met with in all the domesticated animals, but perhaps most frequently in the Bovine and Ovine species. Several instances are mentioned in which birth has taken place without difficulty, and the young creatures have lived. Holzner of Erding, quoted by Franck, states that a double Lamb, with eight feet, double abdomen, and single breast, neck, and head, was born without assistance. But in other cases, unless relief is afforded the gravest results are certain to ensue.

Saint-Cyr alludes to three instances in which embryotomy had to be practised, and in two of these the mother succumbed; the third, however—a Mare—recovered.

Diagnosis.

The diagnosis of these monstrosities is often very difficult, as they may be mistaken for ordinary twins. Franck has drawn attention to the circumstance that there is very frequently a difference in the presentation of the merely double-headed fœtus and the double fœtus, particularly the double croup; the first being mostly in the anterior presentation, the latter in the posterior.

In the case of the double fœtus, its presence may be suspected when one cannot be moved without moving the other; when one is brought into a good position with regard to passing through the pelvic inlet, and it cannot be advanced beyond a certain point, though the passage appears to be sufficiently wide to permit easy delivery, because the other lies across the inlet; when the hand is passed between the two fœtuses and is stopped at the point where the skin is carried between them at their junction; and when they are united by homologous parts, as already explained. With regard to the latter, we may be positive. If, for instance, two fœtuses lie together at the inlet in the same presentation—anterior or posterior—there is nothing to be inferred from this as to their being monstrosities or merely twins, as the presentation may be the same for these latter; but if one is in the anterior

and the other in the posterior presentation, then we may be certain that they are *not* united. Heterologous parts do not unite.

The diagnosis in the case of Monocephalian monstrosities is comparatively easy when the head presents. But much care and attention are necessary in forming a diagnosis in such cases, and the examination of the bodies should lead, if possible, to an exact notion of their condition.

Extraction.

In some cases, though they are very rare, extraction may be possible by manipulation and judicious traction; but as a rule, embryotomy, or even the Cæsarian section, has to be practised. If it were possible to separate the two individuals by excising the parts which unite them, then birth would probably be as easy as with twins; but it can rarely be practicable, for the simple reason that the point of union is generally beyond reach: it is too extensive to be cut through, or the junction is of an osseous character. Nevertheless, cases may occur in which the knife and the obstetrical saw or bone forceps may be most effectively employed in accomplishing disunion.

When the monstrosity is in the anterior presentation, should it prove to be double-headed, then it will be found advisable to remove one of the heads as low down the neck as possible; after this is done, removal of two or more of the anterior limbs by subcutaneous section, will often diminish the diameter of the body to such an extent that traction on the head and remaining skin of the limbs will sometimes effect delivery. If not, then eventration of the thorax and abdomen will be necessary. When the two croups cannot be made to pass through the pelvis together, it will be imperative to divide each across, as far back as possible, extract the anterior halves, push the posterior into the uterus, turn them, and deliver them as in the posterior presentation. Sometimes excision of one or more of the hind limbs, in order to diminish the volume of the double croup, will be necessary before the operation can be completed. With Monocephalic monstrosities, of course the head and neck are not interfered with, only the body and limbs requiring attention.

When the presentation is posterior, the procedure must be carried out in a similar manner; but in all cases the task is a long and fatiguing one, and the tax upon the endurance and sensibility of the mother is heavy indeed.

CHAPTER IV.

Dystokia from Multiparity.

At p. 164 allusion was made to the relative position of the young in multiple pregnancy, and at p. 262 we described the manner in which twin births take place. We need not again refer to these, but we must notice those cases—rare, it is true—in which difficulties are encountered from pathological conditions in twin parturition. As has been shown, in ordinary cases one fœtus occupies the body of the uterus, the other one of the cornua, or both may be in the cornua; and both may present either anteriorly (Fig. 47), posteriorly, or one in the first and the other in the second presentation (Fig. 66). One alone must pass through the genital canal, then the other, as there is not space for both at once;

and birth is usually quite as easy as if there were only one fœtus. Indeed, it is sometimes easier, from the fact that parturition either occurs before the full period of gestation has expired, and the progeny are therefore not so largely developed; or if the usual term has been reached, it nearly always happens that the twins are smaller than in uniparous births. When the most advanced fœtus is expelled, a variable period elapses before the birth of the second takes place. During this interval the uterus is accommodating itself to its altered conditions, and preparing for the expulsion of the remaining fœtus; while the parent remains restless, pays little, if any, attention to the young creature already born, and manifests a particular anxiety, which is an almost certain indication that parturition is not completed. When the uterus has got rid of its occupants, the mother then turns its attention to the offspring.

This is the ordinary course of affairs; but it is not always so fortunate. In some instances, after the expulsion of the first fœtus the uterus is seized with a kind of inertia, and labour may be suspended for hours, even for days, and sometimes more than a week.[1] During this suspension the parent at times gives indications of uneasiness by pawing, looking at the sides now and then, straining at intervals perhaps, and not infrequently exhibiting symptoms of colic, while the milk retains all the characters of colostrum until the other fœtus is born.

Retention of the second fœtus after a certain time is fatal to its existence; even in animals with a multiple placenta—such as the Cow, whose fœtus retains its vitality much longer than that of those whose placenta is single, like the Mare—the retained fœtus has never, according to Saint-Cyr, been known to exist forty-eight hours after the birth of the first.

This suspension of labour in twin birth, and which is not at all infre-

[1] This uterine inertia, scarcely noticed by veterinary writers as occurring in multiparous animals, we have often observed. One of these cases may be alluded to. A medium-sized Bull-terrier Bitch, belonging to a brother officer, required my assistance the previous year, through being unable to pup. The animal had been in labour for some time, and the head of a Puppy was in the vagina. This was easily removed by an instrument hereafter to be described, as was another which we contrived to seize immediately afterwards. These were all that the uterus contained, and they certainly were not too large for the genital passage; the uterus could not expel them.

Some time afterwards, this officer, who had in the meantime removed to Portsmouth, wrote to inform me that the Bitch was again pregnant, and owing to my having made him acquainted with its uterine peculiarity, he was anxious to know what he should do when its time was due for pupping. Recommending certain hygienic precautions, I advised that nothing special should be attempted unless birth was delayed, as on the previous occasion; then a dose of tincture of ergot of rye was to be administered, followed by another if necessary. Subsequently, I had a letter stating that on the Thursday night the Bitch had four small Pups, but there was no sign of milk. A dose of castor oil was given, as symptoms of constipation were exhibited (due, in all probability, to fœtal retention); the following day the animal was in pain, "and as she was strong and well in herself, I did not like to give the ergot of rye yet. However, on Saturday morning she became very ill, and was scarcely able to stand up, and yet there was no milk. So about ten o'clock, I gave her a drachm of tincture of ergot of rye (our prescription), and about five p.m. she passed a *dead* pup, followed shortly by *five live ones*. She is now (Tuesday) all right, but all the live puppies died, save two."

This case is interesting, as showing the tendency in some animals to uterine inertia; as testifying to the great value of ergot of rye—at least, with the Carnivora—its ecbolic action on animals being denied by many veterinarians; as proving that the death of one fœtus *in utero* does not always imperil the existence of the others; and as demonstrating that, contrary to what occurs in the Mare and Cow, fœtuses will exist in the uterus of the Bitch for forty-eight hours after the expulsion of others, without succumbing, even when one of their number is dead.

quent, is ordinarily due to malposition of the second fœtus; and this cause of dystokia is one which nearly always demands the attention of the veterinary obstetrist.

This malposition of the single fœtus will be noticed presently; we have now to consider difficult birth due to multiparity. Dystokia from this cause always happens when the two fœtuses are about the same distance from the os uteri, and both present together at the pelvic inlet; the uterine contractions carry them simultaneously into the opening, but of course they cannot possibly pass through the canal at the same time; hence the difficulty in birth—a difficulty which varies according to the relative situation of the two fœtuses to each other.

The fœtuses may be so situated that when the hand is introduced into the vagina or os, it will either encounter the head of one fœtus

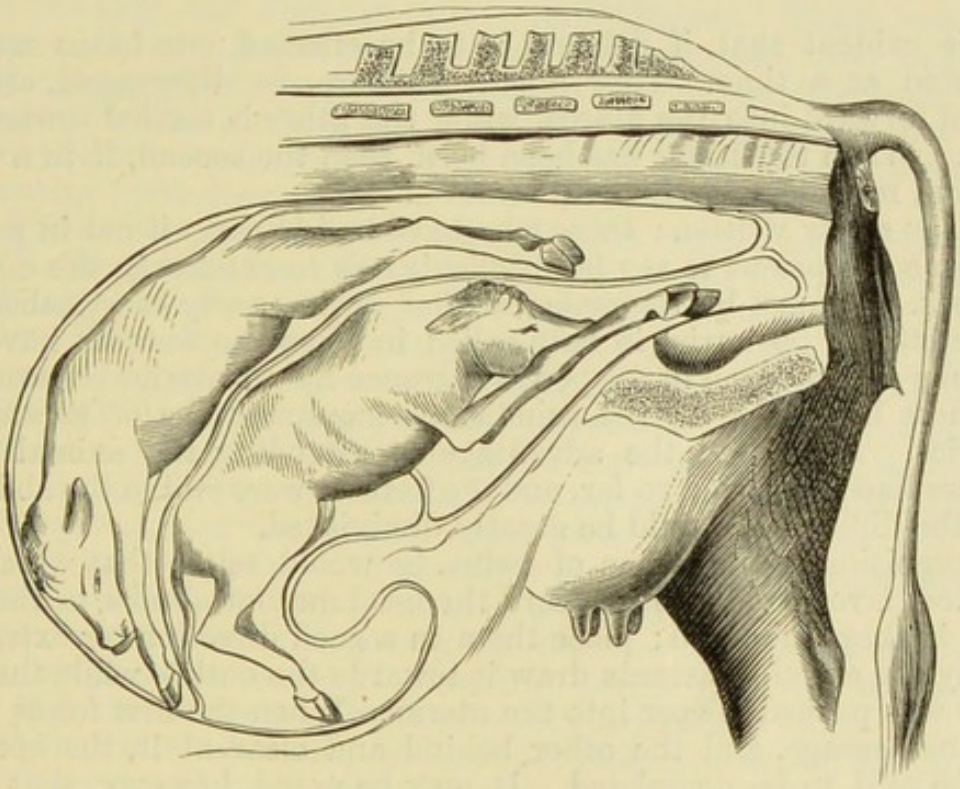

Fig. 124.

Twin Fœtuses, in Different Presentations, passing into the Genital Canal.

with the fore-limbs of the other; four anterior or posterior limbs, two hind and two fore limbs (Fig. 124); two, four, or six feet; a head and a tail, etc.

The cause of this malposition is in all probability due to the relative smallness of the twins, and the changes which occur in their position during birth; and it will be apparent that the obstetrist must, in some cases at least, find it difficult to distinguish between such presentations of twins and some of the monstrosities or deformities we have described.

Diagnosis.

In such cases the obstetrist has to ascertain:

1. Whether individual twins are present; 2. To distinguish, among

the parts which present, those which belong to each fœtus. This can only be done by a most careful manipulation, and even then at times the obstetrist will find himself embarrassed. For instance, when the fore-feet of one fœtus present along with the head of the other, the operator may be led to believe that there is only one animal to extract; and as the position is seemingly favourable, and the difficulty only due to excessive size of the fœtus, powerful traction is resorted to for its removal. This, however, fails to effect its object; and when another exploration is made, it is discovered that the attempt has so fixed the fœtal parts in the pelvis, that the most energetic and skilful manipulation will scarcely move them in order to alter their position.

In other instances, we find the limbs of the fœtuses so interlocked (*locked fœtuses*) that they are with the greatest difficulty disengaged.

Extraction.

It is evident that, if delivery is to be effected, one fœtus must be extracted at a time. They must, therefore, be disengaged, and one pushed forward into the uterus, while the other is carried towards the vulva. When the latter has been born, then the second, if in a wrong position, must be adjusted and removed.

This is easily written; those who have had to carry it out in practice are alone competent to say how difficult it is to execute in the majority of cases. It must be remembered that, as in nearly every other case, the veterinary obstetrist is only called in when the fœtuses have been for some time wedged in the pelvic entrance by the uterine contractions, and most likely also by the injudicious manipulations of amateurs or empirics. If he had the advantage of attending the animal before matters had proceeded so far, and the fœtuses were still in the abdomen, then the difficulties would be greatly diminished.

Recognising the presence of twins, he would select that which is in the most favourable position, cord the head and fore-limbs, or the hind-limbs if they presented; place them in a good direction for extraction, and by the aid of assistants draw it towards the outlet, while the other fœtus was pushed deeper into the uterus. When the first fœtus is well into the passage, and the other behind and clear of it, the operation may be said to be completed. It may be noted, however, that owing to the obstacle offered by the first fœtus, the one remaining in the uterus is very often in a wrong position, and the uterus contracting upon it after removal of the other, may fix it in that position, and thus necessitate adjustment and other assistance being rendered.[1]

[1] It is often astonishing how multiparous animals bring forth their young under extraordinary circumstances. Cases are on record of Cats having Kittens attached to each other in such an unusual manner that the space allowed each for birth seemed too limited to permit this to take place. Morot alludes to six Kittens, for instance, which were born alive, and all of which were joined by the end of their umbilical cords, owing, it was surmised, to the placenta, chorion, amnion, and allantois being single.

GROUP II.

DYSTOKIA FROM MALPRESENTATION OR MALPOSITION OF THE FŒTUS.

THOUGH the impediments to birth in the human female are not infrequently due to the fœtus being in such a position that it cannot pass through the pelvic canal, yet it is very questionable whether, in animals, this cause of dystokia is not much more common, much more complicated, and very much more difficult to be rectified. In woman the difficulty in this case chiefly occurs when the axis of the fœtus does not coincide with that of the uterus—when, for instance, the head or the breech cannot pass through the pelvic inlet, and the presentation is more or less oblique or transverse. It is exceedingly rare indeed that the neck or limbs offer an obstacle to birth.

With the Calf and Foal the case is very different. These creatures have the neck and limbs long and very flexible, and even the body itself is comparatively long and readily curved in any direction. The consequence is that the limbs or neck may be bent under, to one side, or above the trunk; while the latter may be flexed in such a manner as to become quite distorted.

The Cow is the animal of all others which suffers most frequently from difficult parturition, and several of the causes which give rise to this difficulty are not met with in the females of other species; this is no doubt chiefly owing to the fact that, among uniparous creatures, this has proportionately the narrowest pelvis, and therefore deviations of the head and limbs, or any unusual presentation or position of the body, which would be of little moment in the case of Solipeds, lead to trouble. As for multiparous animals, the young are generally so small when compared with the genital canal, that they can generally pass through it in presentations and positions which would be most difficult, if not impossible, in Solipeds, and more so in Bovines.

For these reasons, we have a great number of more or less complicated malpresentations and positions, which give rise to varying degrees of dystokia, some of them of a very formidable kind.

It will therefore be readily understood that, even when the axis of the young creature's body coincides with that of the uterus and pelvic canal, and the latter is normal in dimensions, birth may not be possible without assistance; and this establishes a wide difference between the obstetrics of the human, and the Equine and Bovine species. Added to this, the veterinary surgeon has the difficulties before mentioned to contend with—powerful and often irritable animals; a long genital canal and deep uterus; uterine contractions so energetic that they fatigue and paralyse the hand and arm; the disadvantages of position in the parturient animal; the late period at which professional assistance is sought for; and the damage that may have been inflicted by amateurs and empirics.

Considering the frequency of the causes of dystokia, and their oftentimes serious character, they deserve the most careful study in order that they may be successfully overcome.

The following synoptical table shows the various causes of fœtal dystokia dependent on abnormal presentations and positions:

- ANTERIOR PRESENTATION.
  - NATURAL ... ...
    - Abnormal Positions
      - Dorso-pubic.
      - Dorso-supra-cotyloidean (right or left).
    - Obstacles due to the Hind-Limbs ...
      - The hind-limbs are extended and retained at the stifles.
      - The hind-limbs are flexed beneath the body and enter the pelvis with it.
  - CAUSES WHICH MAY BE MET WITH IN ALL POSITIONS ... ...
    - Obstacles due to the Fore-Limbs ...
      - The limbs are on the neck.
      - The limbs are incompletely extended in the pelvis.
      - The limbs are flexed at the knees.
      - The limbs are completely retained.
    - Obstacles due to the Head ... ...
      - The head is flexed downwards.
      - The head is flexed beneath the chest.
      - The head is turned to one side of body.
      - The head is extended on the back.
    - Combined Obstacles due to the Head and Limbs ...
      - The head is retained with one or both fore-limbs.
      - The head is retained, or one of the fore or hind limbs has entered the pelvis.
- POSTERIOR PRESENTATION.
  - NATURAL ... ...
    - Abnormal Positions
      - Lumbo-pubic.
      - Lumbo-supra-cotyloidean (right and left).
    - Obstacles due to the Head or Fore-Limbs ... ..
      - The neck is contracted.
      - The fore-limbs are under the chest, and enter the pelvis with it.
  - CAUSES TO BE MET WITH IN ALL POSITIONS ...
    - Obstacles due to the Hind-Limbs ...
      - The limbs are incompletely extended in the genital canal.
      - The limbs are flexed at the hocks.
      - The limbs are completely retained.
- TRANSVERSE PRESENTATION.
  - DORSO-LUMBAR POSITIONS
    - Cephalo-ilial (right and left).
    - Cephalo-sacral.
  - STERNO-ABDOMINAL POSITIONS ... ...
    - Cephalo-ilial (right and left).
    - Cephalo-sacral.

CHAPTER I.

Dystokia depending on the Anterior Presentation.

IT will be seen from the preceding table, which is that followed by Saint-Cyr—the tables of Franck and other veterinary obstetrists differing somewhat—that the causes of dystokia due to the fœtus are numerous and varied. In each of the presentations there may be difficulties, as well as in the positions, many of which may be more or less vicious and complicated, whether as regards the whole mass of the body or only parts thereof—as the limbs, head and neck, etc.

In this presentation the obstacles are somewhat numerous; for while it may be normal the position may be reversed, or the hind-limbs may impede birth; or the presentation itself may be abnormal and combined with one of the positions described.

Rainard, looking at the subject from an obstetrical point of view, considered the head and limbs of the fœtus as appendages which, from their wrong direction, may more or less hinder its expulsion. Thus the head, one or both of the fore-limbs, or even the posterior limbs in the anterior position, may cause the most varied complications, one or more of which may be found in the same animal, and even compli-

cating each other. Thus, with a vicious position of the head we may have a wrong direction of the fore, and perhaps also of the hind, limbs. But as the double or triple complications are difficult to describe, and as the practical value of the descriptions might consequently suffer, it is deemed the best course to study each complication separately: the complex cases arising from their combination being then easily understood, and the indications for overcoming them being also simplified.

These complications are very often found in the Mare and Cow, less frequently in the Sheep and Goat, and rarely in the Bitch, Sow, or Cat. We have no means of arriving at a knowledge of their relative frequency in any species.[1]

A. Normal Anterior Presentation.

In this presentation the extended head and the outstretched fore-limbs are towards the genital canal.

SECTION I.—DYSTOKIA FROM ABNORMAL POSITIONS.

Here we have three abnormal or reversed positions—a *dorso-pubic*, and two *dorso-supra-cotyloidean.*

Dorso-Pubic Position.

This position is difficult when the depth of the fœtal chest exceeds the vertical diameter of the pelvic inlet of the mother—a circumstance more frequent, evidently, in the Cow than the Mare—being, according to one practitioner, as twenty to one. In the natural or dorso-sacral position, the fœtus readily accommodates itself to the canal, but when it lies on its back its shape does not lend itself readily to enter the pelvis, it having a tendency to jam against the upper surface, and the feet to penetrate the soft tissues there. On exploration the hand detects the position by the fore-feet being upwards, and the fetlocks bending in the same direction as the knees; while if the head is within reach, the nose and lower jaw can be distinguished.

To rectify this position, rotation of the fœtus must be practised. The lower jaw and fore-feet should be corded, the head pushed away from the pelvic inlet, and the body turned withers upwards by the hand; then gentle traction is to be made on the cords, so as to bring the head and feet into the pelvis, the hand guiding them into the canal in the first position, when delivery can be effected.

[1] Zippelius, quoted by Franck, in 108 cases of dystokia found them to be due to the several causes in the following proportions:

Abortions	31
Occlusion of the os uteri	30
Torsion of the uterus	10
Lateral inclination of the head and neck of the fœtus	16
Lateral inclination of the head and misdirection of the fore-limbs	4
Head and neck under the fore-limbs	3
Head bent up on the back	2
Torsion of the uterus with posterior presentation	1
Posterior presentation with misdirection of the hind-feet	2
Limb over neck	1
Lumbo-pubic position	3
Posterior and transverse presentation	1
Rachitis affecting the pelvis of Cow and Calf	1
Hydrops amnii	1
Mummification of the fœtus	2

In the Mare and other animals there is more room for the passage of the fœtus in this position, and with the first-named delivery may be accomplished in some cases by guiding the limbs through the genital canal, so as to prevent injury to its walls.

Dorso-supra-Cotyloidean Positions.

In these positions the fœtus lies on its right or left side, and they must be altered to the dorso-sacral position before birth can be completed. This change is effected in the same manner as in the preceding position.

SECTION II.—DYSTOKIA DUE TO THE HIND-LIMBS.

As Saint-Cyr remarks, it is somewhat surprising to find the hind-limbs an obstacle to birth in the anterior presentation. The difficulty may arise from the hind-limbs being retained by the stifles, the irreducible mass of which is greater than the inferior bis-iliac diameter of the inlet; or the hind-limbs may be bent under the body and enter the pelvis along with it, instead of being extended and following it. In both conditions the anterior part of the body presents in a normal manner, and nearly always in the dorso-sacral position; and birth appears to be progressing favourably—the fore-limbs, head, neck, and even the chest and body as far as the flanks, may have cleared the vulva—and when the act is apparently almost completed, all at once there is a check, and notwithstanding the most vigorous straining of the mother no more of the fœtus can be expelled, neither can external traction remove it. As has been stated above, the retention may be due to one of two causes.

The Extended Hind-Limbs are retained by their Stifles.

This kind of dystokia has been hitherto supposed by writers and practitioners to be due to the hind-legs of the fœtus being in a state of extreme abduction; but more careful study has shown it to occur when these limbs are in a state of extension, and their stifles so voluminous as to check progress. This occurrence should be rare in the Mare, unless the pelvis is unusually narrow or the fœtus is very large; but in the Cow it must be more frequent, as the pelvis is not so wide and the shafts of the ilia are more parallel than in the Mare, so that these joints are more likely to be retained when arrested in this way. It is remarked, also, that they are large calves which are being born slowly and with difficulty, that are so fixed when the greater part of their body has got beyond the vulva.

This cause of difficult birth can be ascertained by exploration with the hand, but the almost complete expulsion of the fœtus and the sudden check to its progress, which no amount of traction can alter, should give rise to suspicion of its existence. The obstacle is a serious one to overcome, and it not infrequently happens that the young creature is lost—sometimes the mother also. A successful result depends not only upon the skill and patience of the practitioner, but also upon the size of the fœtus when compared with the dimensions of the pelvic inlet, and whether amateurs have been previously at work attempting delivery.

Indications.—When both stifles are together they form too large a mass to pass through the genital canal, and must therefore be brought into the inlet separately—one after the other. With this object in

view, Saint-Cyr recommends very oblique traction on the fœtus—to the right or left side, so as to force one stifle farther into the canal than the other; and this has always proved successful when the creature had not been already too much pulled at, as when such has been the case the stifles are firmly and immovably wedged in the inlet. Then it is necessary to push the fœtus forward into the uterus, if this be possible, or at least one of the stifles, and if this be effected, then have recourse to oblique traction, so as to get one stifle into the passage in advance of the other.

If the Cow is lying on one side and exhausted, the same authority advises that the practitioner take the body of the calf in his arms, and pull it up vertically; if not successful on this side, have the Cow turned on the other side, and again try vertical traction. On every occasion in which this procedure was adopted the result was satisfactory.

Another method of overcoming the difficulty is by slightly rotating the body of the fœtus. This can be accomplished by passing a double cord around its loins, as near to the maternal vulva as possible, and passing a strong stick through the loop, so as to give the cord two turns and make it tight round the body; the fœtus is held up on a level with the vulva, and on the word being given its body is twisted from left to right, simultaneously with a turn of the lever in the same direction, when the obstacle is overcome and delivery can be completed.

When it happens that unskilful people have been exercising great force before the arrival of the practitioner, and the hind-limbs are so firmly fixed that it is impossible to move them, then embryotomy must be had recourse to; the body being divided at the loins and the posterior portion pushed into the uterus, where it can be turned, and the stifles carried into the genital canal one after the other.

The Hind-Limbs, flexed under the Body, pass with it into the Genital Canal.

This malpresentation, known to the German veterinary obstetrists as the "vertical-abdominal" or "dog-sitting position" (*Bauch-Vertikallage, Hunde-Sitzige Lage*), is not very common, and is one of the most formidable, perhaps, which can be encountered. First described by Canu in 1837,[1] it has been alluded to by a number of veterinary surgeons, and it has also been mentioned in every work on veterinary obstetrics published on the Continent.

Since that time it has been met with in the Mare, as well as the Cow, and consists essentially in the advance of the hind-limbs of the fœtus into the pelvic canal, at the same time as the anterior part of the body, the position of the young creature being consequently more or less vertical, the body being posteriorly bent at the loins. How it gets into this position is not accurately known, but the hind-feet must be closely applied to the abdomen as the chest is entering the inlet; and probably the compression the fœtus then experiences causes it to struggle with the posterior limbs to free itself from the discomfort.

As in the preceding deviation, nothing is at first known of the existence of the displacement. Parturition commences and appears to be going on favourably; the fœtus, in the dorso-sacral position, arrives at the inlet, the head and fore-limbs in advance as in normal birth. Progressive expulsion may continue until the head of the young animal is

[1] *Recueil de Médecine Vétérinaire*, 1837, p. 445.

beyond the inlet, and as far as, or even external to, the vulva—sometimes the head, fore-limbs, neck, and even half of the body hanging outside the vagina. But further progress is checked, and neither the most energetic straining on the part of the animal, nor the most violent traction by those persons who may be with it, can advance the fœtus beyond this point.

The obstetrist has great difficulty in ascertaining the cause of delay in birth—the difficulty varying, and depending upon the volume of the fœtus, and whether its body more or less completely fills the pelvic canal. The hand can generally only be introduced after much trouble and tact into the passage, and having got to a certain distance it encounters either under the body or head (Fig. 126), to one side of the neck or head, or even projecting upwards above the head (Fig. 125), first one, then a second foot or limb, which are recognised by a careful examination to be those of the hinder part of the body. Sometimes the feet and metatarsal bones have alone entered the pelvis, the other parts

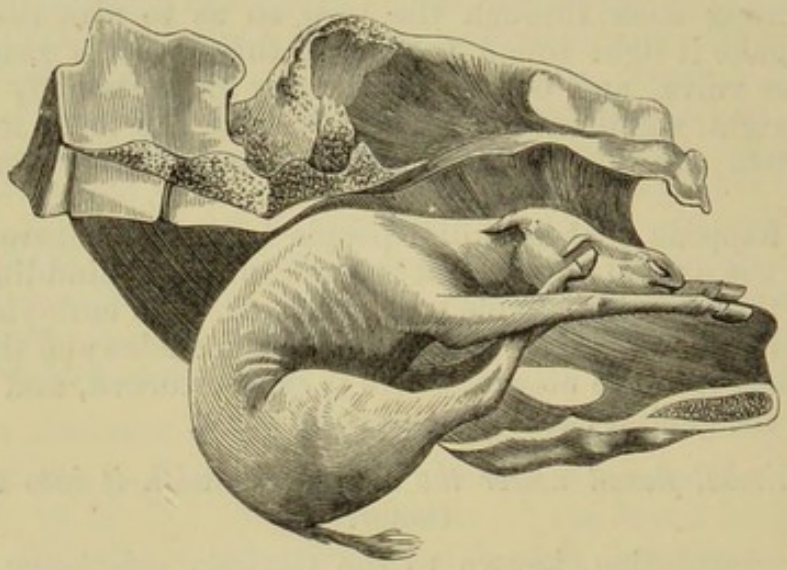

Fig. 125.

DEVIATION OF THE HIND-LIMBS IN THE PELVIS IN THE ANTERIOR PRESENTATION.

of the limbs being in the uterus (Fig. 126); in other cases the hocks may be in the inlet, or even well through the passage—depending upon the size of the fœtus and the capacity of the maternal pelvis; more rarely the stifles have cleared the inlet, and the hind-feet are at the vulva. The more advanced the hind-limbs are the more are they flexed, and so the more is the body of the fœtus bent on itself, until it is like a dog in a sitting posture. It is needless to remark that unless the fœtus is exceptionally small in proportion to the pelvic capacity, it cannot be extracted in this position, when the hind-limbs, and especially the stifles and hocks, add so largely to the volume of the body; traction will probably kill the creature, and in all likelihood injure the mother. Some cases are recorded in which delivery was effected, however, but then circumstances were favourable, both as to time and the position of the fœtus. The greatest care is therefore necessary, in order to ascertain the exact state of affairs; indeed, in all cases of dystokia it cannot be too often impressed on the mind of the young practitioner, that a careful examination is absolutely essential before attempting

extraction. In this particular form of dystokia, the life of the mother may be preserved by timely and rational intervention; while violent and improper interference, even at the earliest period, may be followed by serious, if not fatal, consequences.

The distinction between this form of dystokia and the last is, according to Saint-Cyr, not difficult. When the fœtus is expelled as far as the loins, then it is the stifles which are the cause of obstruction; but when only the anterior part of the thorax appears at the vulva, we may be certain it is not these articulations. When the feet are not visible, then a manual exploration is necessary.

With regard to preserving the fœtus, the prognosis must generally be unfavourable. The Foal is, in nearly every case, certain to perish at an early period, from compression of its body or the umbilical cord; and though the Calf is more tenacious of life, and may continue to exist for

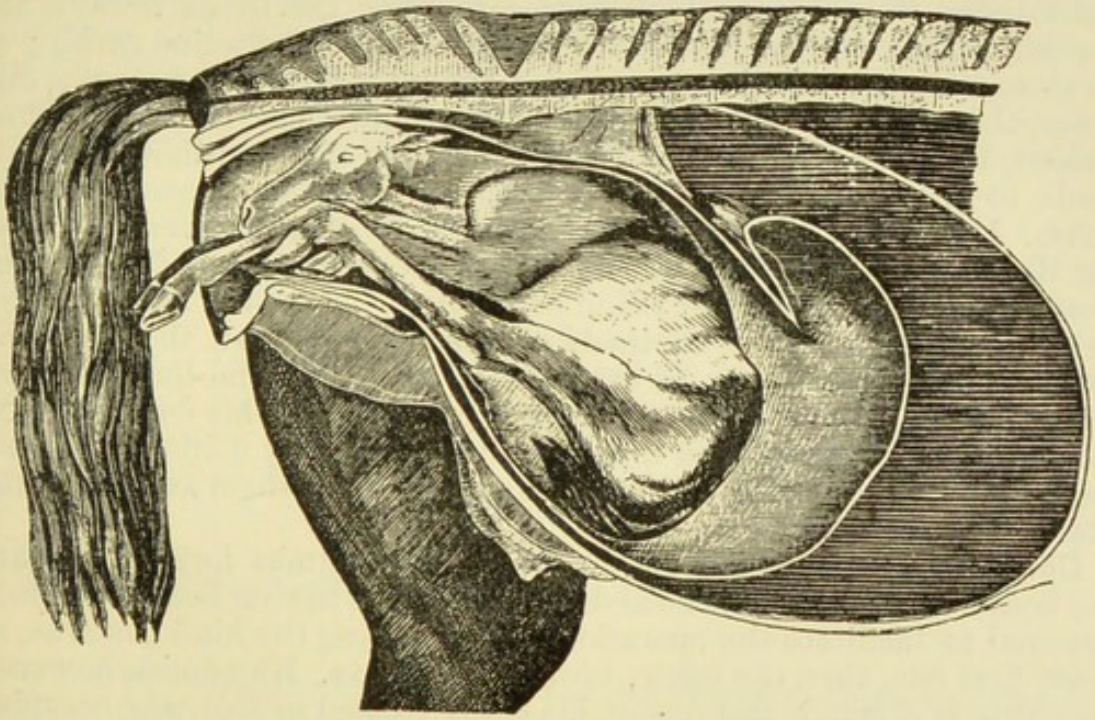

Fig. 126.

HIND-LIMB DEVIATION: ANTERIOR PRESENTATION.

some time, yet in the majority of cases it succumbs, or it has to be sacrificed to save the mother, which, if the practitioner can render aid sufficiently early, may survive.

Indications.—In nearly every case the preservation of the mother is the first object to be attained, the life of the fœtus—if it be living when the veterinary surgeon is called in—being quite a secondary consideration; though it must be admitted that if he is present when it is still vigorous and not much engaged in the pelvic cavity, there is no reason why it should not be extracted alive. The indication is, of course, to rectify the deviation of the hind-limbs; and if the fœtus is not too far advanced in the genital canal, this may be accomplished by pushing it, if need be, towards the uterus, and introducing the hand between it and the wall of the vagina (often a most difficult matter), to carry the hind-feet back—one after another—into the uterine cavity, either by the hand or

with the aid of the repeller; then the head and fore-limbs being in a good position, birth can readily be effected. In this manner Carsten Harms has extracted a Foal. But in carrying the limbs into the uterus, care must be taken to lift the feet off the floor of the pelvis, one after the other, by flexing the hock and holding the hoof in the hand while it is carried beyond the inlet. When the front part of the fœtus has not advanced far into the pelvis, and the deviation has been ascertained in good time, the anterior presentation has sometimes been successfully converted into a posterior one, so that birth could take place.

But such cases are rarely met with in practice; and, as a rule, the veterinary obstetrist finds that parturition has made much progress, the fœtus being fixed in the genital canal and occupying its entire diameter, and its hind-limbs well forward under the body, each labour-pain wedging it more firmly; and the case is perhaps complicated and aggravated by the indiscreet manipulation of amateurs. In such circumstances, it is needless attempting to push the fœtus towards the uterus, neither can the hind-limbs be thrust into the uterine cavity; as no sooner are they carried from under the body for ever so short a distance, than a succeeding pain brings them into their former position. Indeed, it is sometimes most difficult to reach the hind-limbs to apply cords to them, and so by straightening to bring them parallel to the body. In some cases it has been possible to effect delivery by cording the hind-limbs if they are not advanced very far, and then *pulling them upwards* until the feet reach below the wings of the atlas, but not beyond; traction now being made simultaneously on all the limbs and the head, the fœtus may be extracted. With one hind-limb engaged, the same procedure can be adopted. In a case of this description in the Mare, Obich[1] succeeded in extracting the Foal by cording the hind-feet (which were under the body), and pulling at them as well as the head and fore-feet.

Donnarieix recommends pulling the posterior limbs forward beneath the body, the contents of the abdomen and chest having been previously removed to facilitate the operation; then cording the hind-pasterns, to draw first one, then the other, towards the vulva. He admits, however, that this is difficult, and one of his cases treated in this way occupied four hours; he was even compelled to excise one of the limbs at the hock, before he could straighten it. The Mare, however, lived.

Canu, in 1837, gives another method in which embryotomy may be carried out. The illustrative case was that of a Mare, the Foal—which was dead—being born as far as the half of the chest. As it was not possible to push it back, the body of the young creature was divided as near the hind-quarters as possible, by making an incision from the sternum to the spine, behind the last rib on each side; then the abdomen was emptied of its contents, and the spine cut through between the last dorsal and first lumbar vertebra, the amputation being facilitated by an assistant holding the lips of the vulva as far apart as possible. The Mare, which was very exhausted, did not offer much opposition when the croup was pushed into the uterus, and the hind-limbs being corded, version was easy, and the operation soon finished. The Mare was at work within twenty days afterwards.

Canu's method of extraction has often been practised, both in the Mare and Cow, by veterinary surgeons; and it has been proved to be both rational and successful—so far as the mother is concerned. In

[1] *Wochenschrift für Thierheilkunde und Viehzucht.*

practising it, the following directions have been given, and their observance is important:

1. Find the hind-limbs and secure them by cords around the pasterns; 2. Cord the head and fore-limbs, and pull these out as far as possible beyond the vulva; 3. Remove the abdominal viscera, and divide the spine as near the lumbar region as possible, taking the precaution to leave a good piece of skin attached to the loins, so as to cover the exposed bones and prevent the maternal organs being injured during the subsequent steps in extraction; 4. Obtain a solid bearing on the divided spine, either with the hand or the repeller, and push steadily and firmly against it so as to direct it into the uterus, when the cords on the hind-pasterns being pulled by assistants, guided by the hand of the operator, the remains of the fœtus can be removed. This part of the operation is the most difficult and fatiguing for the obstetrist, as well as the most dangerous for the mother, and requires both strength and dexterity to push back the loins and pelvis of the fœtus while advancing the hind-limbs, thighs, and croup towards the outlet; 5. Nothing now has to be done but to exercise moderate traction, and terminate, in the lumbo-pubic position of the posterior presentation, a birth commenced in the dorso-sacral position of the anterior presentation.

Dietrich recommends eventeration of the fœtus, removal of one of the hind-limbs, and the adjustment of the hinder parts through the abdominal opening; if this cannot be effected, then these parts are to be drawn into the vacant cavity of the abdomen.

When only one hind-leg is in the pelvis, retropulsion of the body may be tried, the fore-legs and head being corded, and the misplaced hind-limb finally extended backwards in the uterus. If this cannot be accomplished, the hind-leg must be drawn forward and amputated at the hock or beyond, and the thigh then carefully pushed towards the uterus.

Removal of the abdominal viscera favours these manœuvres.

When this malpresentation occurs in the Sheep or Goat, embryotomy will generally be necessary, as there is not sufficient room to attempt delivery in any other way.

B. Abnormal Anterior Presentation.

In dystokia accompanying the anterior presentation, the obstacle may be due to the fore-limbs or head, or to both, as well as to the hind-limbs; and it may be met with in any position the fœtus can occupy in this presentation, though it is most frequent in the dorso-sacral position, which we will commence with.

SECTION I.—DYSTOKIA DUE TO THE FORE-LIMBS.

In the anterior presentation, and what we have designated the "normal position," the two fore-limbs of the fœtus are extended in front towards the pelvic inlet, the head being also extended and resting either upon or between the legs, the distal extremities of which extend beyond its nose—the whole forming a wedge-shaped mass. Consequently, the fore-feet should be the first parts to pass through the

genital canal; and if only one appears along with the head, or if the latter alone offers, then one or both of the anterior limbs are in a wrong direction, and birth may be hindered if they are not adjusted. The directions they may assume are generally four: 1. *They may be incompletely extended in the pelvis;* 2. *They may be crossed over the neck;* 3. *They may be bent at the knees;* 4. *They may be extended completely under the fœtus.* Each of these misdirections may be met with in the four principal positions of the anterior presentation, and, as has been mentioned, one or both limbs may be involved; if the latter, then the direction may be the same or different.

The cause of misdirection of the limbs is not well ascertained. In many cases it may be due to insufficient dilatation of the os uteri, which hinders their advancing with the head: the joints of the limbs readily flexing when the feet come in contact with the cervix, while the uterine contractions propel the more rigid head and neck into the vagina. The misdirection may also primarily occur during intra-uterine existence, and before parturition sets in, and particularly if the fœtus dies before birth, when its position is not the same as at that period. There can be no doubt, however, that the accident generally happens during parturition.

One or Both Fore-Limbs crossed over the Neck.

This complication is not very uncommon in the Mare, but is less frequent in the Cow; it usually occurs when the fœtus is in the dorso-sacral position. One or both limbs may be carried over the neck, but it is generally only one.

It is undoubtedly, in many instances, an obstacle to parturition, as the shoulders are no longer lodged in the hollow space at each side of the neck, but are fixed at the side of the chest, the transverse diameter of which they increase. The obstacle is still greater if one or both of the limbs should chance to cross towards the summit of the head. At all times the complication is more serious if the labour pains are violent and irregular—as they generally are in the Mare when there is any impediment to birth; then there only too frequently results laceration of the roof of the vagina, perforation of the rectum, rupture of the perinæum, etc. In the most favourable cases, labour is protracted and more severe, and contusions of the genital canal are almost unavoidable. In some cases birth may, and does, take place without assistance. Rainard alludes to the case of an Ass in which spontaneous delivery occurred, notwithstanding the existence of this complication.

The obstacle is discovered by exploring the genital canal, when the hand will encounter in the vagina the head of the fœtus and one limb in the usual situation (if only one be misplaced), and the other limb feeling as if shorter, higher up, and crossing the neck towards the fetlock-joint. This is the usual state of affairs.

Indications.—When only one limb is crossed, reduction is not difficult, and may be effected in the pelvis. The leg is seized a little above the fetlock, raised, drawn to its proper side, and extended in the genital canal. Delivery may then take place without help, or gentle traction on the head and limbs may be necessary.

When both fore-limbs are crossed, and the fœtus is not too far advanced in the pelvis, cords should be fixed to the pasterns, and the

trunk pushed into the uterus; assistants then pull moderately at the cords, and in such a manner as to bring each limb to its own side, if the hand of the operator cannot effect this in the uterine cavity. In this way a kind of rotation of the limbs is effected, and they are brought each to its proper side, and a little beneath the head.

When the fœtus is firmly fixed in the pelvis, and retropulsion is impossible, the limbs must be amputated, one after the other. Such an operation must, however, be very exceptionally required in this complication.

Fore-limbs incompletely extended.

This accident would appear to be most frequent in the Cow, and is due to the legs not advancing with the head in the ordinary way, after

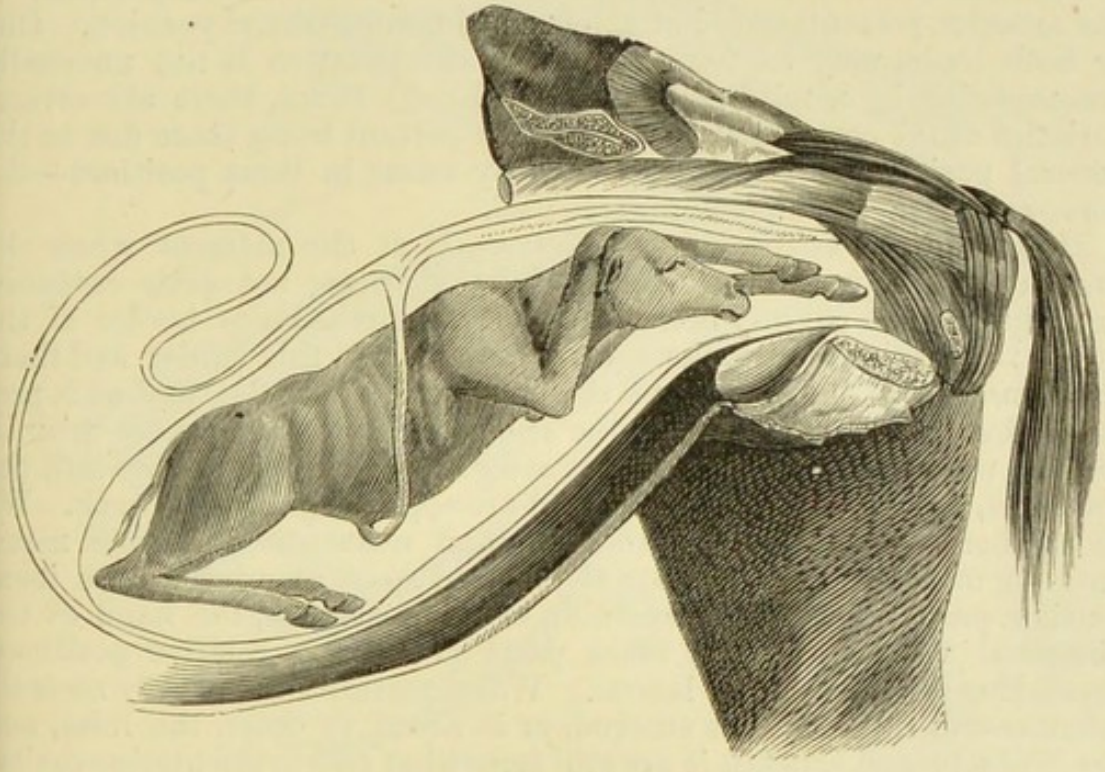

Fig. 127.

Anterior Presentation: Fore-Limb crossed over the Neck.[1]

they have entered the inlet; so that the elbow-joints, instead of being in front of the thorax, are alongside of it, and they and the chest are intercepted at the inlet. It occurs when the fœtus is in the vertebro-sacral position, and should not be considered serious if the case has not been tampered with. Its occurrence is recognised by the nose and the feet being together, or the former may even be in advance of the latter.

Indications.—To bring the legs straight into the vagina is the object to be attained; and if the body and limbs are not firmly fixed in the maternal pelvis, this can be accomplished without much trouble. But when they are tightly wedged in the passage, then there is more

[1] In this figure the anterior limbs, especially the right one, are inaccurately drawn by the artist. They are too long, and the right leg should be shown as crossing the neck at the fetlock-joint.

difficulty in releasing them. In any case, the lower jaw and feet should be corded; this being done, the chest is pushed forward into the uterus, when the upper parts of the limbs accompany it. The hand can now fully extend the legs and bring them into the vagina along with the head, and traction will complete the delivery.

One or Both Fore-Limbs flexed at the Knees.

The fore-limbs flexed at the knees, and fixed under the neck and chest, are a very frequent and often troublesome complication. It is generally found in the Mare and Cow; when it occurs in the Sheep and Goat it is rarely of any importance, as delivery can usually take place without assistance; in the young of Carnivora, the metacarpal bones are too short to offer any obstacle when the knee is flexed.

This misdirection of the fore-limbs may occur in all the positions of the anterior presentation, but chiefly in the dorso-sacral position. One or both limbs may be flexed, and the complication is not unusually accompanied by a misdirection of the head; hence, there are several varieties of the complication, the most important being those due to the general position of the fœtus. It may occur in three positions—the *dorso-sacral*, *dorso-pubic*, and *dorso-ilial*.

Dorso-Sacral Position of the Fœtus.—If at the moment when the limbs of the fœtus enter the pelvic inlet, they are not quite extended and the feet are slightly below the level of the anterior border of the pubis, the uterine contractions push them against this border, and there they remain; at the same time the head enters the inlet, and as it proceeds the limbs become flexed, the knees are bent and advance with it, but the metacarpals and phalanges are directed backwards beneath the forearms, and the limbs thus doubled are applied against the neck. We have therefore the head, fore-arms, and metacarpals in one mass, entering or being propelled into the limited space afforded by the inextensible pelvic circle, and, according to circumstances, the hand of the obstetrist will meet with these parts in varying relative positions, depending on the stage of labour. When parturition has only recently commenced, the head has entered, or is about to enter, the inlet, and the limbs placed beneath it are still somewhat free in the uterine cavity, while the fœtus itself is not immovably fixed if the waters have not long escaped. But when labour has been progressing for some time, the head is well advanced in the passage—sometimes as far as the vulva; but considerably behind it are the limbs, imbedded on each side of the neck—the knees towards the head, the feet at the elbows.

With the smaller Ruminants, as already remarked, birth may take place spontaneously even now, as they often have more than one fœtus, and these comparatively small, compared with the pelvic diameter; while the bones are elastic and yielding. But with such animals as the Cow and Mare the fœtus is nearly always single and voluminous, and its skeleton is rigid and unaccommodating, and can only undergo a very small reduction in size during its passage through the pelvis.

Therefore it is that, in the larger domesticated animals, such a deviation of the limbs is always a serious cause of dystokia—not so much from the increased volume that the doubled-up limbs gives to the neck, as because the arms, incompletely extended on the shoulders, retain

the latter against the thorax, and prevent their being lodged in the depression at the base of the neck—thus augmenting the vertical and transverse diameter of the chest, while at the same time the projecting elbows press against the border of the pelvis.

It may happen that only one limb is flexed at the knee, and then, of course, the case is not so serious.

Indications.—The indications are in this case also obvious: Find the retained limbs, extend the fore-arm of each on the arm, and extend them in the pelvic cavity, as in normal parturition.

These indications are not so difficult to carry out when the obstetrist is called in sufficiently early, and the head has made but little advance into the pelvis.

We will suppose both fore-legs partially retained in the abdomen,

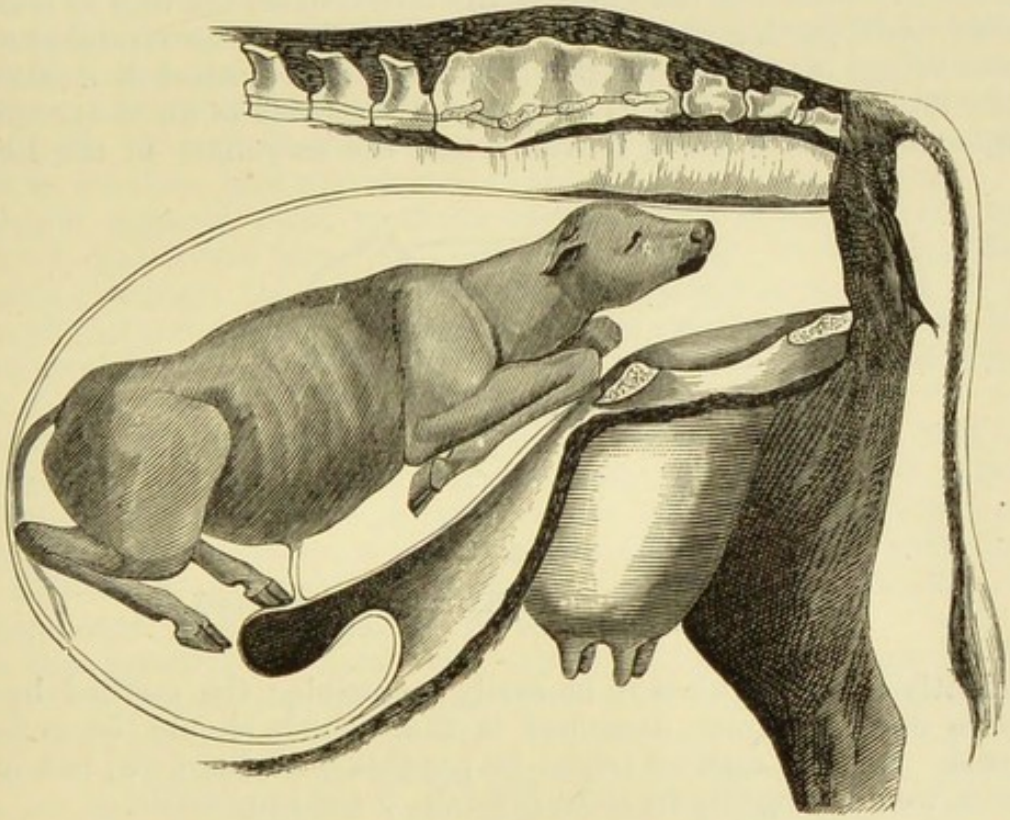

Fig. 128.

ANTERIOR PRESENTATION, DORSO-SACRAL POSITION : FORE-LIMBS FLEXED AT THE KNEES.

and flexed at the knees. The exploration which has led to this discovery has perhaps also indicated that one limb is not so much flexed as, or is more accessible than, the other. If this is the left limb, then the left hand and arm must be employed ; if it is the right leg, then the right hand and arm will be most convenient ; but if both limbs are alike implicated and accessible, then it is immaterial which is first manipulated, so long as the corresponding hand and arm are employed. The same directions are applicable to both, keeping in mind that the right and left hands are opposite. The object is to adjust the direction of the fore-limbs, so that delivery can be accomplished. This adjustment is effected in four movements :—1. The hand is passed alongside the neck of the fœtus, the fore-arm is seized in the middle, the radial border of the hand being upwards, the cubital downwards; then bending the hand,

the knee of the fœtus is drawn towards the pelvis, while the elbow is pushed upwards and backwards ; 2. The body of the fœtus being thrust away from the pelvis, the metacarpal bone is seized as the fore-arm was, and moving it in the same manner, the knee is raised as high as, or higher than, the point of the shoulder (Fig. 129, *a* to *b*), and the foot to the level of the maternal pubis ; 3. The foot is grasped in the hand, flexed strongly on the fetlock and pastern, and drawn into the genital canal ; 4. The limb is then extended towards the pelvic outlet, and if necessary a cord is placed around the pastern, the other limb, if also flexed, being then sought for and treated in a similar manner.

Lecoq has described another method. This consists in passing the arm alongside the head, and, putting the hand in a state of supination, seizing the foot in such a way that the pastern faces the palm and the fetlock the wrist. The operator then pushes the limb away from him, at the same time flexing the fore-arm on the arm as much as possible, until getting the pastern as high as the os, he straightens the leg and brings it towards the pelvic canal. This method of straightening the limb *en masse*, and at once, is only possible in quite exceptional cases,—when the fœtus is movable, and the extremity of the limb is

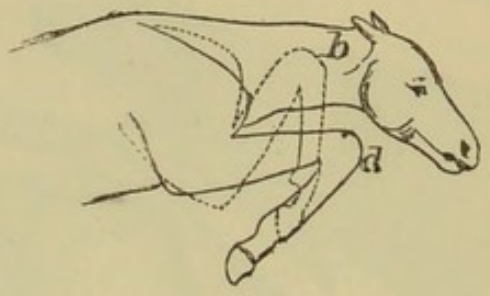

Fig. 129.

Anterior Presentation : Extending the Fore-Limb.

sufficiently near the pelvis to be easily accessible ; the method by progressive extension just described is that which should be generally adopted. Lecoq's method might be possible with the Cow, but in the Mare it would certainly be most difficult, if not impossible.

This correction of knee-joint presentation is easy enough when the fœtus has not advanced far into the pelvis, but when it is completely engaged the operation is much more difficult. Retropulsion may be necessary, and extension of the limbs is sometimes only possible when the fœtus is clear of the inlet. Thomas,[1] while pointing out that it is possible, and often easy, to extend the limbs in the Cow's pelvis, and that the dimensions of the head of the fœtus allow sufficient space for these manœuvres, insists that the point of traction should be at the lower end of the radius, and not the knee ; while Schaack's head-collar should be employed to extract the head at the same time. The cord for the limbs should have a running noose.

After labour has been in progress for some time, the "waters" have long escaped, the head is gradually propelled towards the vulva, the nose may appear between the labia, the uterus, applied closely to the body of the fœtus, contracts powerfully, and futile attempts at retro-

[1] *Journal de Médecine Vétérinaire*, November, 1876.

pulsion fatigue the operator. Another procedure must then be adopted. The hand, carrying a pliable cord, must be passed alongside the head as far as one of the bent knees; then the end of the cord is to be passed behind the joint and brought outside the vulva, where it is tied to the other end, the cord forming a loop around the knee. The second knee, if flexed, is to be secured in the same manner, and a cord is also to be fixed on the head; thus there will be three points on which traction can be employed as vigorously as may be necessary. Some practitioners employ blunt hooks instead of cords, but it may be doubted whether they are so useful; hooks are also sometimes resorted to for straightening the limbs by seizing the pasterns, and in some cases they may prove serviceable. The "repeller" or "crutch" may also be most profitably utilised in retropulsion, and in keeping the fœtus forward while the necessary manœuvres are carried out; it should be applied to the head or chest. Harms advises, in the case of one limb bent at the knee, that if this cannot be extended it should be pushed forward under the abdomen by the crutch, which is applied to the humerus, the other limb and the head being corded, and then traction employed. If both limbs are bent and irreducible, this plan might be tried in the Cow, and particularly if the fœtus is not very large.

Should none of these methods succeed, then embryotomy must be adopted, the limbs being removed at the knees, or the shoulders if possible; though the advantages of this operation are not so great as might be anticipated when the limbs are only removed at the knees, while removal at the shoulder is frequently a most tedious and fatiguing task when it can be accomplished.

Dorso-Pubic Position of the Fœtus.—It is rare that this complication is found in the pubic position, and only a few instances are recorded. The fœtus is lying on its back, and the head either presents at the inlet, or is more or less advanced in the pelvis, while the fore-limbs occupy the sacro-lumbar region of the mother, more or less flexed, and often crossed on the sternum.

In this position the fœtus is much less likely to become so firmly wedged in the pelvis as in the one just described, and it is consequently more easily extracted. If, however, the uterine contractions are violent, or care is not observed in attempting delivery, the fore-feet, projecting towards the utero-vaginal parietes and the rectum, may cause grave mischief. Extraction should therefore be set about early, and with every precaution.

Indications.—Having ascertained the position, it is generally a good plan to empty the rectum before proceeding to extract the fœtus. If the head is in the genital canal, it may be advisable to secure it by a head-collar; then the limbs can be sought for and adjusted—an operation much facilitated by a hand in the rectum. Delivery may now be accomplished by guiding the legs forward into the pelvis—cording them, and exercising traction if necessary. It is sometimes very useful, in more difficult cases, to throw the animal on its back. Version is rarely required.

Right or Left Dorso-Ilial Position of the Fœtus.—This complication of the limbs appears to be rare, and it does not offer anything particular, except that the undermost limb is difficult to reach and adjust by the hand of the operator. It is therefore recommended, after extending and cording the uppermost limb, to attempt rotation

of the fœtus, in order to bring it into a more favourable position—the dorso-sacral, if possible—before proceeding to the adjustment of the other leg, which is to be effected in the manner already indicated.

One or Both Fore-Limbs completely retained.

The complete retention of one or both fore-limbs of the fœtus in the uterine cavity is often met with in the domesticated animals, but perhaps more frequently in the Mare than the Cow or other creature. It is always a serious cause of dystokia, and may occur in either of the four anterior positions, though it is usually observed in the dorso-sacral position. It is, no doubt, produced during birth, and in the

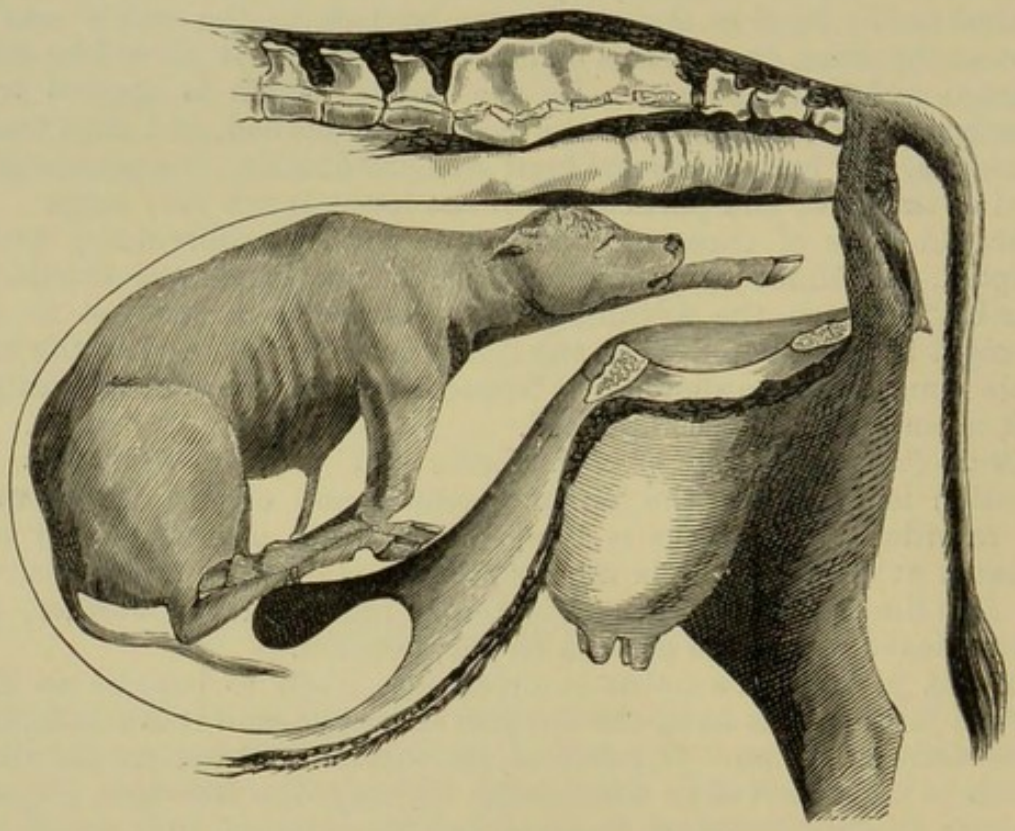

Fig. 130.

ANTERIOR PRESENTATION, DORSO-SACRAL POSITION: ONE FORE-LIMB COMPLETELY RETAINED.

same manner as knee flexion; its more frequent occurrence with the Foal than the Calf is, in all probability, due to the former having longer limbs than the latter. Under exceptionally favourable circumstances, as Franck remarks, the Foal or Calf may be born with the fore-limbs under the chest and abdomen, and without injury to the mother or offspring. This is much more likely to occur when the fœtus is small, the maternal pelvis roomy, and only one limb misplaced.

But when the fœtus is large and the pelvis narrow, then birth, especially of the Foal, is impossible. Not only this, but unless extraction is soon accomplished, the fœtus runs great risk of dying from asphyxia—indeed, the Foal is nearly always delivered dead in this complication; so that death of the fœtus may be said to be the rule in

shoulder presentations. With the smaller Ruminants, owing to the formation of the pelvis, birth is not often impeded. With the Sow and Carnivora—multiparous animals—this might almost be designated a normal presentation.

It will readily be perceived how one or both of the anterior members bent back under the body will prove an obstacle to the passage of the fœtus, after what has been said with regard to the relative dimensions of the young creature and the pelvis of the mother. The shoulder or shoulders, and the muscles in this region, are the cause of dystokia—more especially the *flexor brachii*, which constitutes a thick and somewhat tendinous elastic mass between the scapula and upper end of the fore-arm. This muscular mass forms a very prominent obstacle on

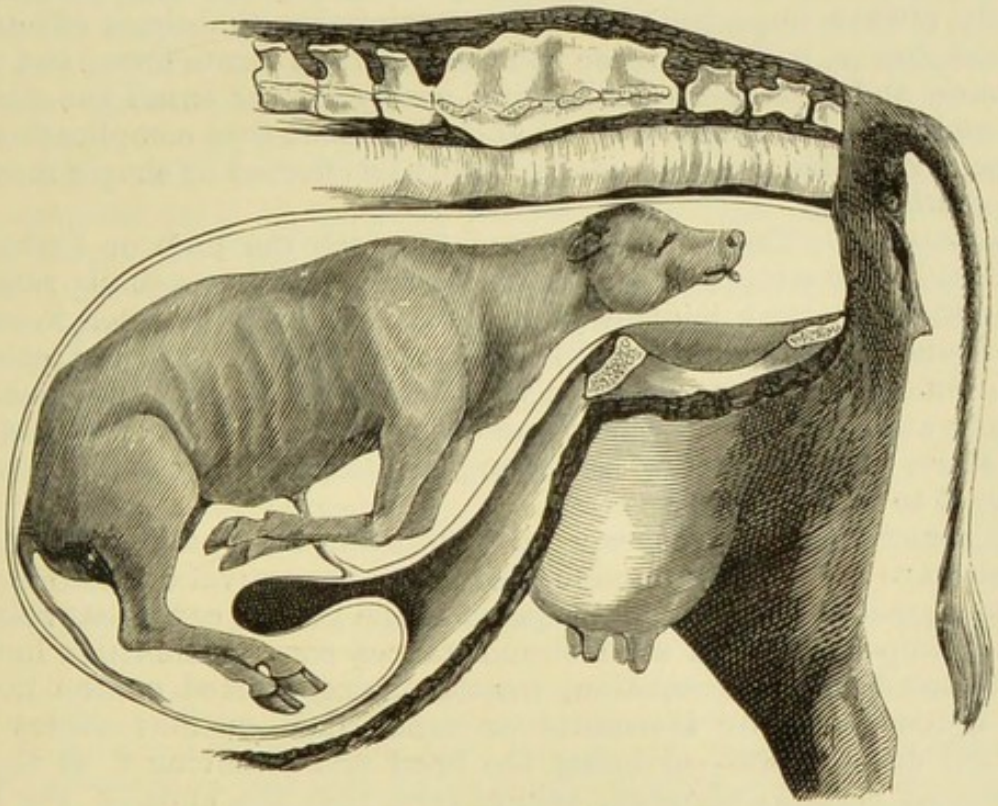

Fig. 131.

ANTERIOR PRESENTATION, DORSO-SACRAL POSITION: BOTH FORE-LIMBS COMPLETELY RETAINED.

the side of the chest when the limb is thrown back. There is also the large *levator humeri* muscle adding to the increased volume of the thoracic region, as well as the elbow and fore-arm.

On exploration in this complication, the head is found to be in a good direction, the hand encountering it either in the pelvis or towards the inlet, or it may even protrude into the vulva, according to circumstances. The fœtus, if a Calf, may be yet alive; if a Foal, it is nearly always dead. If only one limb is completely retained, the other will be in a normal position—alongside or under the head (Fig. 130). If both limbs are retained, though the head may appear in the genital canal or at the vulva, yet nothing can be discovered of them in the pelvis, they being entirely lodged in the uterus. At each pain the

head of the fœtus is propelled outwards, but as soon as this ceases it recedes again, as if thrown back by a spring.

With small-sized Cows, the hand introduced deeply into the uterus may find the extremity of the fore-limb; but in large Cows, and in the Mare, particularly if the abdomen be pendulous, this is rarely, if ever, the case; indeed, sometimes the limbs can only be reached with the greatest difficulty, though there is generally no trouble in introducing the arm. When the limbs can be felt, they are usually found to be in one of three positions: directed nearly vertically downwards, the fore-arms resting against the brim of the pubis; lying beneath the abdomen (Fig. 131); or closely applied against the walls of the chest and the flanks. In many of these cases, the head is also in a vicious position.

In the larger animals, when the two limbs are retained birth is nearly always impossible; it may certainly be sometimes effected by violent means, but then these are the resort of brute force, and not of humane and intelligent device, and nearly always entail the death of the mother. With the smaller animals, when this complication is a cause of dystokia, delivery can generally be effected by simple measures and *gentle force*.

Indications.—The indications are to reach the limb or limbs with the hand—resorting to retropulsion if necessary, to gradually raise and bring them forward, joint by joint, into the pelvis, and then to extract the fœtus by judicious traction. These indications are not attended with difficulty in those cases in which the head is yet in the abdomen, or only at the pelvic inlet, and are easier carried out in the Cow than the Mare. The method of rectifying the direction of the limbs will be referred to hereafter.

It sometimes happens, especially with the Mare, and with Heifers which have been rudely manipulated before the arrival of the veterinary surgeon, that the fœtus is so engaged in the genital canal that retropulsion is impossible. In such circumstances some authorities have recommended forced extraction, traction being exerted on the head of the fœtus either by assistants or mechanical means; others have advised decapitation—skinning the head and removing it at the first or second cervical vertebra, taking care that the ends of the bones are covered by the skin of the skull, to prevent laceration; then retropulsion is possible, the limbs can be extended, and extraction may be effected.

With regard to forced extraction, there can be no doubt that if both fore-limbs are retained, the life of the fœtus is endangered, and that of the mother also; though it may be successfully practised with the Sheep, Goat, and other small animals. When only one limb is retained in the Mare or Cow, forced extraction may, nevertheless, succeed; and Rueff, Harms, Darreau, and other practitioners, have proved that it is possible, traction being employed on the head and normally-presented leg. Amputation of the head will not always prove advantageous in retropulsion; indeed, it will often be found that it is a disadvantage.

The most rational and hopeful operation is detaching the shoulder from the trunk; or the *flexor brachialis* muscle may be cut through by means of the curved finger-knife (to be hereafter described) in its thickest part at the shoulder-joint, or above the elbow-joint. Then extraction may be

again attempted. If the fœtus does not come away, evisceration of the chest and abdomen may be practised. Should delivery be still impossible (which is unlikely), the limb must be detached at the shoulder and the trunk withdrawn from the uterus, the leg being extracted afterwards.

When one limb protrudes with the head, it may be removed subcutaneously at the shoulder, as it is easier accomplished than amputation of the retained limb.

SECTION II.—DYSTOKIA DUE TO THE HEAD.

Obstacles to parturition from a wrong direction of the head are quite as frequent as, and more serious than, those due to misdirection of the fore-limbs. It is stated that they occur oftener in the Mare than the Cow, but this is questionable; though in the former animal they are more embarrassing, as in consequence of the longer neck of the fœtus the head can be carried back much farther—even as far as the flank, while with the Calf it seldom goes much beyond the shoulder.[1] The complication is all the more serious in the Mare from the fact, as has so often been stated, that obstetrical manœuvres in this animal are much more difficult than in the Cow: the straining being far more violent—paralysing arms and hands—while the impatience and restlessness are generally so great, that it is often necessary to throw it down before anything can be done in the way of adjustment.

Misdirection of the head usually takes place immediately preceding or during parturition, under the influence of irregular and energetic uterine contractions before the os is sufficiently dilated; it is supposed sometimes to be due to premature escape of the "waters," to injudicious manipulation of the fore-limbs, maltraction, etc. Some of the cases, however, have doubtless occurred long before the period of parturition,

[1] Since allusion was made to dystokia from excess in volume of the head of the fœtus (p. 374), Colin, of Wassy, has published an instructive paper on the subject (*Journal de Méd. Vétérinaire et de Zootechnie*, Nov., 1876, p. 529), which deserves notice here. Observing that in very bony Cows the size of the Calf's head is often an obstacle to parturition—especially in primiparæ and in the *Jurassique* breed of cattle—while it is rare in improved breeds, in which the head is small, he describes the nature of the obstacle, and remarks that, if traction is ventured upon to extract the fœtus, it must be very violent, and therefore likely to produce serious, if not irreparable injury. To avert this, he insists on putting Schaack's head-collar on the fœtus, or a cord placed behind the ears, then each side looped round the lower jaw, to answer the same purpose. The head being thus secured, the protruding limbs are pushed forward into the uterus, after a cord has been fixed to each pastern. If the genital passage is dry, oil is plentifully injected into it. Traction being then exerted on the head, this readily clears the inlet of the maternal pelvis, its dimensions being no longer increased by the addition of the limbs; it is drawn well into the pelvic cavity, and then the fore-limbs are easily brought through the inlet, now only occupied by the neck of the fœtus. The head and feet are afterwards simultaneously drawn towards the vulva, and it is rare, if the traction is judicious, that delivery is not promptly effected.

Through having neglected the precaution of first pushing the fore-limbs into the uterus, Colin, at the commencement of his career, in 1853, lost two Cows. Since that time, in more than two hundred cases, he has been successful in delivering the Calf without resorting to embryotomy. Success is always certain, provided incompetent persons have not previously rendered it impossible. He recommends the same procedure in spasm of the cervix uteri, after reduction of torsion of the uterus, and in fœtal hydrocephalus. In the latter, puncture of the cranium is easier if the fore-limbs have been previously pushed into the uterus.

and are of the nature of deformity of the neck or head, or both; we have alluded to them when treating of "Contractions," at p. 392.

It will readily be understood why misdirection of the head should prove a serious obstacle to delivery, when we remember the part the nose and cranium play in dilating the os and genital canal, and how largely this voluminous region must add to the bulk of the neck, and render expulsion impossible.

Deviations of the head may be met with in the four principal positions of the anterior presentation; and they may occur alone, or be complicated with misdirection of the fore-limbs. These will not again be referred to, but the head will be studied in three different deviations from the normal direction: 1. *Downward deviation*, the nose being

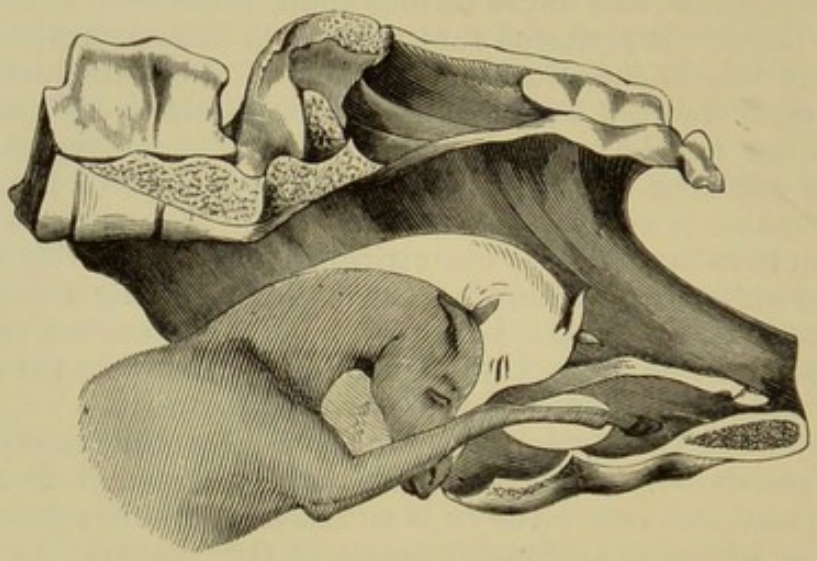

Fig. 132.

Anterior Presentation, Dorso-Sacral Position: Downward Deviation of the Head.

towards the trachea, and the "poll" or upper ridge of the neck presenting; 2. *Bent under the body*, the neck being flexed; 3. *Lateral deviation* to the right or left side, the head being carried towards the shoulder or flank of that side, the side of the neck presenting; 4. *Upward deviation*, the head being bent upwards and backwards in the direction of the withers, or twisted to the right or left side of the chest, with the throat—either straight or twisted—presenting.

Downward Deviation.

This is usually the deviation of the head met with in hydrocephalus, though it is not very uncommon when the cranium is normal and the fœtus well formed. It is usually met with in the dorso-sacral position, though it is not infrequent in the dorso-pubic; it perhaps occurs oftenest in the Cow.

The cause is usually ascribed to premature rupture of the fœtal membranes, the deviation occurring when the fœtus is entering the pelvis. If the head is not exactly in the axis of the inlet, but inclines a little downwards and is at the same slightly flexed, the nose comes in contact with the brim of the pubis, and is retained there; while the

uterine contractions, pushing on the body, propel the fore-limbs, if they are in a favourable direction, into the genital canal. Thus it will be understood that, if the expulsive efforts continue, the head becomes more and more flexed as the fœtal mass is carried towards the vulva (as is delineated in the shaded and unshaded fœtuses in Fig. 132), until, from vertical and oblique, the face becomes horizontal, and rests on the floor of the pelvis of the mother, the lower jaw against the trachea; the neck becomes proportionately flexed, and as labour goes on the head is retained, as well as the cervical portion of the former; so that when the obstetrist introduces his hand into the genital canal, the feet are found presenting towards the vulva, but far in front of them (or *behind* them, as the explorer stands); this may be designated a *neck* or *poll presentation* (*unshaded* fœtus in Fig. 132).

The *diagnosis* of this deviation is not difficult. When the anterior limbs are in a proper direction, the feet and upper part of them are readily found, and their inclination should be noted; but in a slight complication the whole of the head cannot be discovered—only the ears, eyes, nape of the neck, and the forelock and mane if a Foal. With the Calf, which has a shorter neck, it may be possible to reach the head or nose. The upper ridge of the neck is always a safe guide to follow in discovering the direction of the head.

Indications.—There is no difficulty in adjusting the head, if the obstetrist is called in time, and it is movable towards the pelvic inlet, but not engaged in that opening. It is merely necessary to glide the hand along the floor of the vagina into the uterus, pass it between the maternal pubis and the forehead of the fœtus, downwards to the nose, which is to be received into the hollowed palm and raised above the pubic brim, by flexing the wrist and drawing it towards the vulva. When the nose is brought into the genital canal, nothing more is to be done than to pull the head into the passage and complete delivery in the usual way. With the Calf, whose muffle is wider and cannot be so readily received into the palm of the hand, it is better to introduce the fingers into its mouth, using them like a blunt hook, or to seize the nose by pushing the index finger and thumb into the nostrils, so as to throw the lower part of the head upwards.

When, however, through delay or unskilful attempts at delivery, the nape of the neck is firmly engaged in the inlet, there is no room to adjust the head, the lower part of which is jammed against the maternal pubis below, and the vertex against the sacrum above. In such a case delivery has been effected by passing the running noose of a cord round the nose or the upper jaw of the fœtus, and while an assistant pulled at this, the operator, by pressing strongly against the top of the head, made this swing backwards, the nose rising into the passage; birth was then accomplished in a few minutes.

And even with this degree of head deviation, delivery of the Foal without adjustment is not impossible; for Lecoq gives an instance in which the upper part of the head and poll were so firmly fixed in the pelvis, that it was impossible to push the fœtus into the uterus. This was attempted, however, by squeezing the head closer to the neck, the hand being passed alongside the cheek and the nose gradually raised; at the same moment the Mare strained doubly hard, and gentle traction being applied, the Foal was expelled with its head in this position, but without injuring the perinæum of the mother. The latter soon recovered,

but the Foal, as is usual in such cases in the Equine species, was dead.

In this degree of deviation, as well as in the others, great assistance will be afforded by raising the hinder parts of the mother to the extent of one, two, or more feet. Lecoq, Rueff, and others have recommended placing the animal on its back. It is perhaps better, however, to elevate the hind-quarters, and resort to retropulsion either by the hand or the crutch; then, after injecting warm water or oleaginous fluids, to either extend the head or to attempt forced extraction. The blunt hooks fixed firmly in the orbits of the fœtus, will be found most useful in the latter operation.

In the dorso-pubic position, propulsion is necessary to adjust the

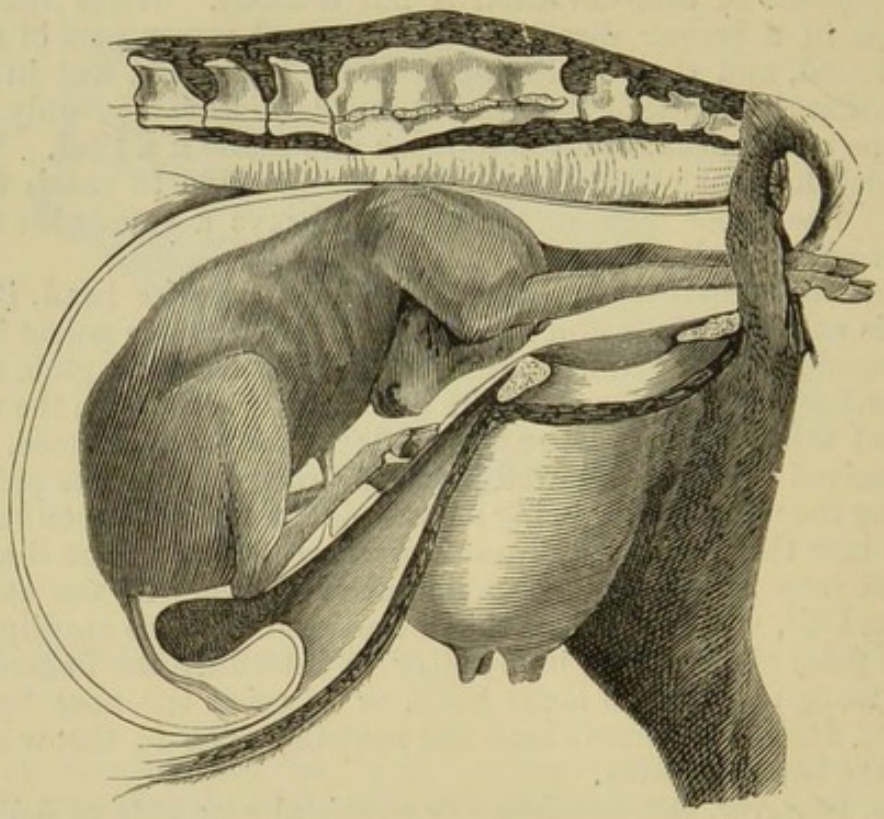

Fig. 133.

Anterior Presentation: Extreme Downward Deviation of the Head.

body for extraction; the head being pushed into the uterus, efforts must be made to place the fœtus in the dorso-sacral position, which, being accomplished, renders delivery possible.

The same procedure is necessary with the Sheep and Goat; while with the Bitch and Cat delivery must be effected by means of forceps.

Head bent under the Body.

This is an exaggerated, but much more serious form of head and neck flexure, especially in the Mare, and it occurs in a similar manner to the preceding—the fœtus in the anterior presentation advances to the inlet with the neck flexed, and, consequently, the lower part of the head below the floor of the pelvis; this misdirection increases as the uterine contractions force the fœtus backwards, and the head is pushed lower

and more under the neck until it gets beneath the chest, and even the abdomen (Fig. 133), where it may deviate to one side. The fore-limbs are, of course, in the genital canal.

The accident is discovered by manual exploration; the fore-limbs being followed by the hand, the crest of the neck is found pressed against the pubis, while the head can be traced by the ears and the orbits, the face being towards the floor of the uterus; or the hand may discover the nose and mouth inclined upwards at one side of the chest, behind the elbow. In this condition birth is impossible, as straining and traction only make matters worse.

Indications.—When the upper part of the neck alone presents, reduction is still possible, provided no great delay has occurred, nor mismanagement by unskilful people has been allowed. But when the "waters" have been long expelled, the legs pulled at by amateurs, and the uterus closely applied to the body of the fœtus, the case is most difficult; as then manipulation and retropulsion cannot effect much in many instances.

The doubled neck is too voluminous to enter the pelvis, and the longer the pains continue, so the farther is the head pushed forward from the inlet, and therefore away from the reach of the obstetrist.

The contractions of the closely applied uterus also render attempts at delivery almost impossible, by their paralysing the hand and arm.

Large quantities of warm lubricating fluids must be injected, retropulsion attempted by one or two crutches applied to the shoulders of the fœtus—not to the neck; while the hand manipulates, aided, if need be, by the finger-hook. A blunt hook inserted on each side of the lower jaw—when this can be reached, towards the root of the ear, or into the orbits; a cord round the neck—if it can be passed; and other devices, may be tried. If they all fail, then the animal should be thrown on its back; indeed, the success which has attended this change of attitude in so many recorded instances, should induce the obstetrist to adopt it without much delay. Very often the altered position of the mother at once disengages the head of the fœtus from its deviation; if this does not happen, then the other means may be tried as in the standing position. Pelvic version may be resorted to in some cases, the anterior presentation being converted into a posterior one.

When reduction cannot be effected, and delivery of the entire fœtus cannot be accomplished, then the obstetrist has no other course left open to him but the adoption of embryotomy. Indeed, it should be resorted to early if the fœtus is dead, which is nearly always the case in the Mare. The head may be amputated through the presenting part of the neck, or the fore-limbs removed subcutaneously at the shoulders —the latter is to be preferred in the majority of cases, at least before incision of the neck is begun. This gives more room for manipulating the body and effecting extraction.

In many cases the removal of one fore-limb will permit delivery. Whether one or both be removed, it is generally necessary to pass a cord round the bend in the neck and pull it so as to bring the head nearer the inlet, where it may be possible to turn it into the genital canal, or at least to amputate it more easily.

Lateral Deviation to the Right or Left.

The lateral deviation of the head to the right or left side of the body, whereby the left or right side of the neck presents at the pelvic inlet, is a very serious obstacle to birth, and is only too frequently one of the most difficult to be overcome. It is also one of the most frequent deviations, Saake observing it in 39⅓ per cent. of his cases of dystokia; it occurs much more often in the Mare than the Cow or other animals. With regard to its origin, as well as to its adjustment, a wide distinction must be drawn between it as it exists in the Foal and other young creatures.

The cause of lateral deviation of the head is not well ascertained in all cases. It is not improbable that, in very many instances, it is due to precipitate or tumultuous birth, when the os is either imperfectly or not at all dilated. In such circumstances, the uterine contractions propel the head of the fœtus, otherwise in a good direction, towards the pelvis; but as the os is not open, and as the impelling force continues, the body pushes the nose against either the pelvis or the occluded os, and it turns to one side; then the deviation becomes increased with every contraction. Premature rupture of the fœtal membranes and escape of the "waters," spasm of the cervix uteri, torsion of the uterus, and other anomalous conditions, may all more or less occasion it. As with the downward deviation, if the nose is not in the axis of the pelvis, or indeed of the os—even though the latter is partially dilated, misdirection may occur, and all the more rapidly should the fore-limbs chance to pass into the vagina.

The accident appears to be most frequent with primiparæ. In 108 cases of lateral deviation of the head, Saake found 84—or 78 per cent. —in animals pregnant for the first time. The remainder were noted in animals which had previously bred, but in which labour was protracted through imperfect or tardy dilatation of the os.

This deviation is more serious when the fœtus is dead than when it is alive; and when the deviation is only slight, the head fitting into the concavity on the side of the neck, birth may even -though indeed rarely —occur without assistance, particularly with the Foal, which has a longer and thinner head than the Calf. Some authorities have remarked that the deviation is more frequently to the right than the left side, and others the contrary.

In some instances there can scarcely be any doubt that the deviation has taken place some time before gestation is completed, and is the result of a long-continued malposition of the fœtus. In many Foals at birth the neck cannot be straightened, and the head is distorted from being pressed against the neck or side of the body (Fig. 103)—bones, muscles, and ligaments being involved. We have referred to these in describing "Contractions" of the fœtus as a cause of dystokia.

It is not difficult, as a rule, to distinguish the existence of lateral deviation. Usually both fore-feet are in the genital canal, but birth does not progress. But an important fact to remember is that one limb —that belonging to the side to which the head is bent—seems to be shorter, or less advanced, than the other. The hand, on being passed beyond these towards the inlet, comes in contact with a convex mass, more or less occupying the whole of it, and rendering access to the uterine cavity difficult. Patient exploration, however, discovers this to be the bent neck; and if it be a Calf, owing to the shortness of this part, the

head is soon found, and recognised by the ears, eyes, and often the muffle turned towards the shoulder (Fig. 134)—with this Bovine fœtus, in fact, the greater part of the head in the majority of cases lies against the shoulder.

With the Foal, it is only too often otherwise. The much longer neck of this creature and the more violent uterine contractions of the Mare, generally result in the head being pushed towards the side of the thorax, the abdomen, or even the flank or croup, where it cannot be reached. This difficulty is greatly increased if the abdomen of the mother is very pendulous. Occasionally this is also the case with the Cow, though it is rare that in this animal the ears, or even the eyes, cannot be reached by a fairly long arm (Fig. 135). If the animal, be it Mare or Cow, chances to be lying, and the deviation is only to the

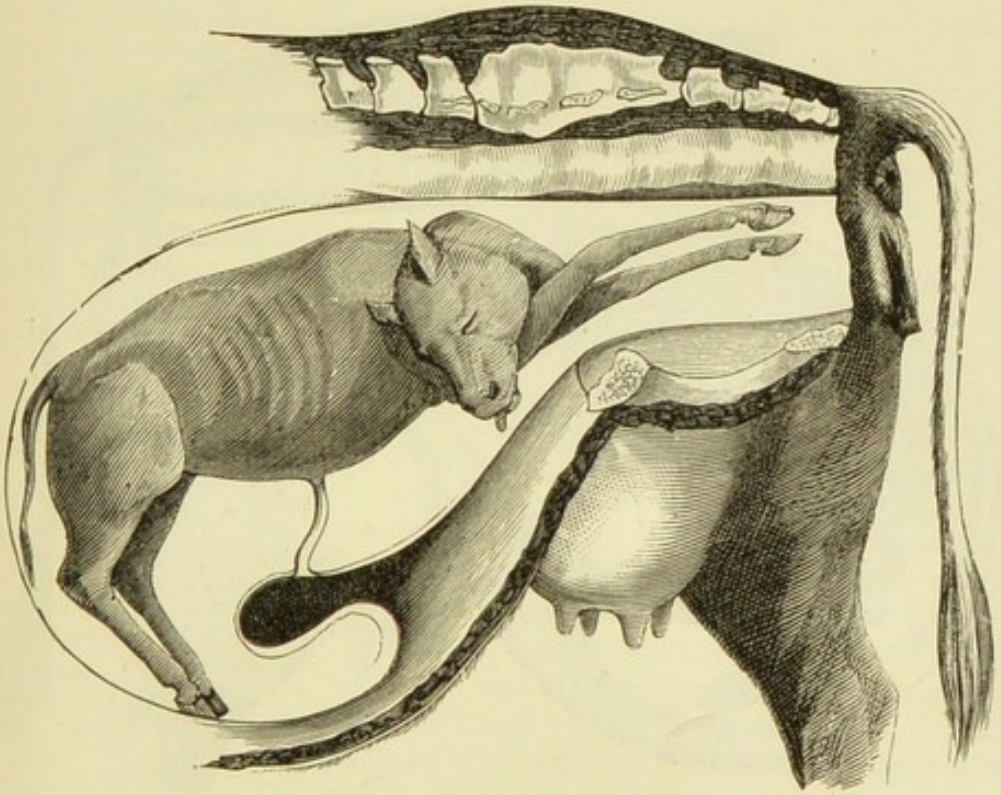

Fig. 134.

ANTERIOR PRESENTATION, DORSO-SACRAL POSITION: LATERAL DEVIATION OF THE HEAD TOWARDS THE SHOULDER.

shoulder, it is most difficult to reach the nose of the fœtus should it be inclined to the side on which the parent lies—*i.e.*, if the Mare is on the left side and the deviation of the Foal's head is to the right.

The head may be raised as high as the back, or lie as low as the under part of the chest or abdomen. The fœtus is usually in the first (or dorso-sacral) position, though the deviation may also occur in the second (dorso-pubic) or third (dorso-ilial) positions; in the latter position the neck may be bent *upwards*—the head towards the maternal sacrum, or *downwards*—the head resting on the floor of the uterus.

This complication is not only a very frequent, but, as has been said, a very serious one for the obstetrist, and it may be truthfully asserted that birth is not possible without his assistance; indeed, it has been well remarked that "it taxes all his strength, patience, and ingenuity."

With the Calf, the neck of which is comparatively short, the head is in most cases no farther back than the shoulder, though it may be as high as the withers or as low as the sternum. It is, therefore, possible to reach it; and though its relatively large size is a great obstacle to reduction, yet in the majority of instances this adjustment can be accomplished, and especially if the young creature is alive, as its spontaneous movements aid the operation; for this and other reasons already alluded to, the Calf is more frequently extracted alive than the Foal.

As a rule, reduction of the displacement is indispensable in delivery, the head and neck, or shoulder, forming too voluminous a mass to pass through the pelvic canal; though rare instances are recorded in which birth took place with the neck bent.

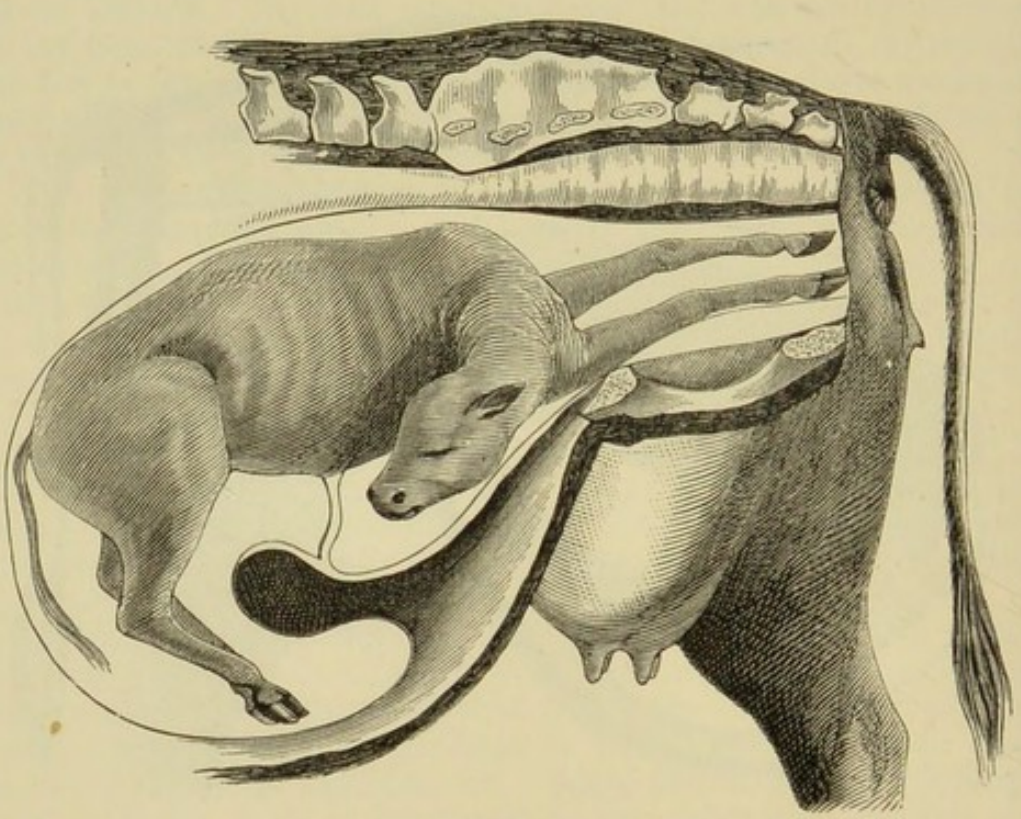

Fig. 135.

Anterior Presentation: Lateral Deviation of the Head towards the Abdomen.

With the Foal the head may also not go beyond the region of the shoulder, and the case is then generally not so serious as with the Calf, the head being smaller and the displacement more easily reduced. But, as has been pointed out, owing to the long and flexible neck of this creature, the head is most frequently deeper in the uterine cavity—towards the side of the chest, abdomen, flank, or even the croup. Here the hand cannot reach it, and reduction is nearly always impossible; besides, the fœtus succumbs soon after the commencement of the labour-pains—death being due in many, if not in all, cases to premature separation of the maternal and fœtal placentæ. However, owing to the thinner and more flexible neck and the smaller head, when the latter was lodged in the flank the fœtus has been delivered by energetic traction.

Indications.—The principal indication in this deviation is, of course, to get hold of the head, if possible, adjust and bring it into a favourable position in the genital canal, and then effect delivery. This is on the supposition that the head is accessible; but when such is not the case, then it is difficult, if not impossible, to straighten the neck, and especially if the curvature is due to contraction. When we come to treat of obstetrical operations, reference will be made to this straightening of the neck.

When it is found impossible, or not advisable, to attempt adjustment of the head and neck, then recourse must be had to *forced extraction* or *embryotomy*.

With regard to forced extraction in the Cow, though instances are recorded in which it has been successfully practised, yet it should never be resorted to by the humane practitioner.[1] The great length and essentially bony structure of the Cow's pelvis, and the large volume and shape of the Calf's head, prove such an obstacle to forced extraction in this lateral deviation, that, if persisted in, it will not only cause the death of the mother, in all probability, but also that of the fœtus, unless it is unusually small and the pelvis of the Cow very wide. In fact, those who have attempted it testify to its barbarity and fatality.

With the Mare, the case is somewhat different. When the head of the Foal is deeply buried towards its flank or croup, reduction is most difficult, and requires long and laborious manipulations, which so irritate the organs and exhaust the strength of the mother, that death not infrequently results. In most cases, too, the obstetrist is called in when the Foal is dead, so that there is no necessity for scruples with regard to it. On the other hand, as we have previously said, the long, thin, and flexible neck and narrow and tapering head readily allow the latter to become embedded in the flank, and thus to offer much less resistance than with the Calf; while the wider pelvis of the Mare offers further facilities. Numerous instances are given in which forcible extraction of the Foal with the head so deviated, has been attended with complete success—Darreau had eight out of ten cases—and without much suffering on the part of the Mare. Indeed, so successful and prompt is it, that Donnarieix, who has devoted much attention to this procedure, says it should, as a rule, be adopted in these cases, as it is not possible to restore the head to its normal position; delivery by vigorous traction is, if not easy, at least most frequently followed by success.

Donnarieix operates as follows: The Mare is thrown down near the stable door, the thighs propped against the threshold, and a breeching and side-line, fixed to the wall or held by assistants, may be employed to keep the animal in position. Each fore-limb of the fœtus is corded at the pasterns, the cords being confided to assistants, the number of which will vary according to the amount of resistance—four at least are necessary, and sometimes six or eight. On the word being given, these men pull slowly, steadily and gradually, without jerking, but

[1] Franck (*op. cit.*, p. 373) gives an instance in which two empirics attempted to deliver a Cow that could not calve. They mistook this deviation for a breech presentation, as they could not find the head, and they thought the fore-feet in the vagina were hind ones. They consequently, other means failing, set about extracting the Calf by force, and eight men pulled at the cords attached to the feet; the young creature was removed, but it was dead. The Cow was unable to get up for eight days, but eventually recovered.

strongly and equally on both cords. The Foal enters the inlet, but it often happens that, at a given moment, it stops there, owing to the uterus forming a double or ring at this part and opposing progression. Traction must then cease, but the fœtus is to be held firmly in the position to which it has been advanced; the hand is to be introduced between the latter and the uterus—the back of the hand to the fœtus, palm to the mucous membrane—the fold sought for, and dispersed by raising the back of the hand. Then the tractions are to be renewed, and in the course of fifteen, ten, or even fewer minutes, the Foal is extracted. It is well to empty the rectum before commencing extraction.

When practised with care and discretion, this forced removal of the Foal may certainly be commended, especially if it is of small size and the Mare is not exhausted; but when the fœtus is large and the mother has suffered much, then there is certainly danger, and embryotomy should be performed. But we should prefer, when circumstances will permit, to give a trial to the methods already enumerated; seeing that this procedure is not always successful, and may be followed by untoward consequences. Eberhard gives an instance[1] in which forced extraction was attempted in a Mare, and was followed by rupture of the abdominal muscles, through the powerful traction resorted to.

With regard to *embryotomy*, this must be looked upon as preferable to forced extraction—even in the Mare, but particularly in the Cow; nevertheless, it must always be considered as an extreme measure. The operation will be described hereafter, but we may note in this place that the head or presenting limbs, or even both, may be removed. Decollation is, however, a most difficult business when the head cannot be reached; if it is accessible the operation can scarcely be necessary. The limbs should be removed subcutaneously, the most advanced being first excised, and with the shoulder if possible. Not infrequently removal of one limb will be sufficient to allow the fœtus to be adjusted—especially in the Mare; or it may permit forced extraction, without adjustment, to be easily accomplished.

With the Calf, both limbs have usually to be removed. In this operation, the long sharp crotchet will be of service.

The parturient animal in which this head-deviation of the fœtus occurs, has sometimes a very pendulous abdomen, and manipulation is greatly retarded by this conformation. Placing it on its back will generally give greater facilities for obstetrical operations of this kind.

Lateral deviation of the head is usually encountered when the fœtus is in the first, or dorso-sacral, position. It may nevertheless be met with, though rarely, in the dorso-pubic position, or in the right or left dorso-ilial position, which is still more rare.

These positions, however, do not modify the indications for extraction to any considerable extent, except that in the last, after correcting the deviation of the head, rotation should be practised, and the fœtus placed in the dorso-sacral position, if possible, before delivery is attempted. When the head is doubled beneath the body of the fœtus in these lateral positions, it will be found most advantageous, in order to reach it, to throw the mother down on the side that will ensure the head of the young creature being uppermost. Version may be advisable in some of these positions.

[1] Gurlt and Hertwig's *Magazin für Thierheilkunde*, 1851, p. 269.

This lateral deviation of the head is liable to be complicated by misdirection of one or both of the fore-limbs, which may be flexed at the knee, entirely retained, or crossed on the sternum. Such a complication of course greatly adds to the gravity of the case, and renders it much more formidable.

Here it will be necessary to adjust the limbs before interfering with the head; though the latter, if it can be reached, and there is any benefit to be derived from doing so, should be secured by either a head-collar, or a cord round the neck or jaw. The feet should always be secured by cords, so that if it is requisite to push them into the uterus, they may readily be withdrawn again.

In one instance of this kind,[1] the sacro-sciatic ligament of a Cow was divided, and the dead fœtus removed through the opening. There was very little hæmorrhage, and the Cow soon recovered.

With the smaller animals—such as the Sheep and Goat—this deviation must be remedied by forced extraction with the short blunt hook or finger-hook, the fore-limbs of the fœtus being manipulated so as to push away the unencumbered shoulder into the uterus, and bring forward that round which the neck bends. The smallness of the genital passages in these creatures is an obstacle to manipulation, but an intelligent boy with a small hand may be of much service when acting under the direction of the obstetrist.

With the Bitch and Sow these deviations are extremely rare. When they do occur it will be found that forceps will generally effect forced extraction; or a piece of strong catgut, or brass or copper wire, may be passed round the bend of the neck. Traction on this will either remove the fœtus, or by cutting through the neck permit it to be extracted by the forceps hereafter to be described. Placing the Bitch in a warm bath for a few minutes, and then laying it on the side opposite to that to which the head of the puppy is inclined, will be found advantageous.

Deviation Upward and Backward.

The deviation of the head more or less upward and backward—the inferior borders of the lower jaw being vertical or turned towards the maternal sacrum—appears to be an extremely rare complication, and is chiefly met with in the Mare, in which it has led to rupture of the uterus and rectum, and delivery by the latter.

The cause is probably the same as in the other deviations of this region.

On exploration, if the fœtus is in the dorso-sacral position, the fore-limbs may be found more or less advanced in the vagina, and beyond them, at the inlet, the hand meets the sternum, while above it is the front part of the neck, with the trachea leading upwards to the head, which may be bent more or less back on the withers or loins (Fig. 136), or inclined to one or other side of the fœtus, the lower jaw always facing the lumbo-sacral region of the mother, or twisted slightly round (Fig. 137).

Indications.—Retropulsion is the first indication, and this alone will often bring the head into its normal position; it should be practised on the sternum. Should the head not drop down to the pelvic inlet, then,

[1] *Veterinarian*, vol. xxx., p. 20.

still continuing the retropulsion, the hand may be introduced, the lower jaw seized and brought towards the os, in carrying it downwards and a little to one side if necessary, by a slightly screwing motion. A cord

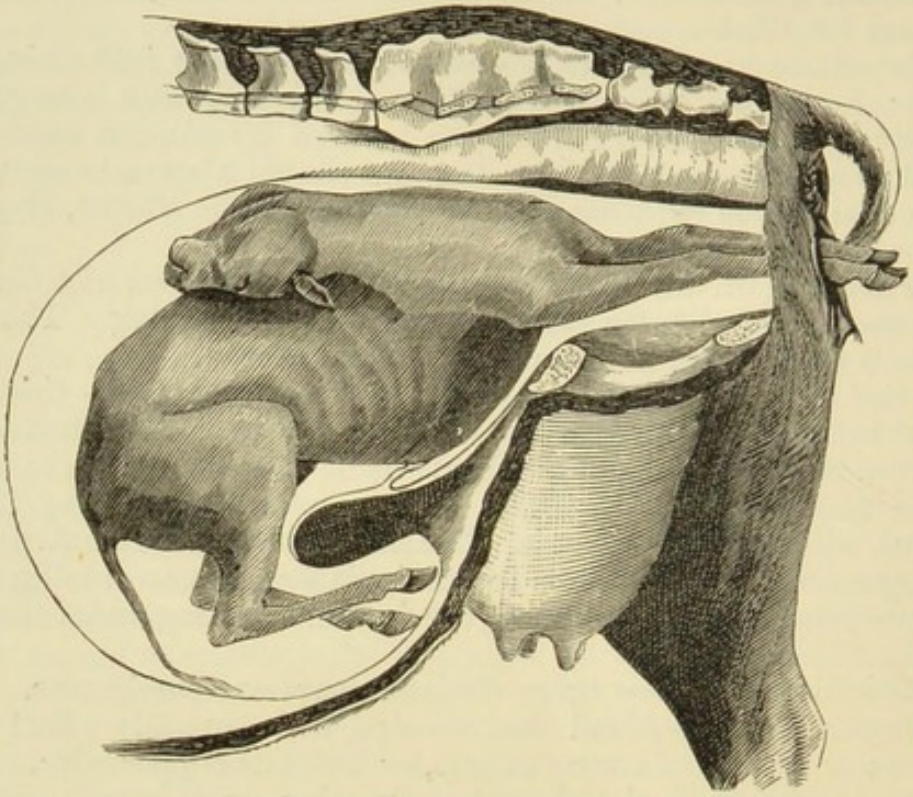

Fig. 136.

Anterior Presentation, Dorso-Sacral Position : Deviation of the Head Upwards and Backwards.

on the lower jaw, or around the head, may be useful if it can be applied. Rueff recommends compression in the rectum, previously

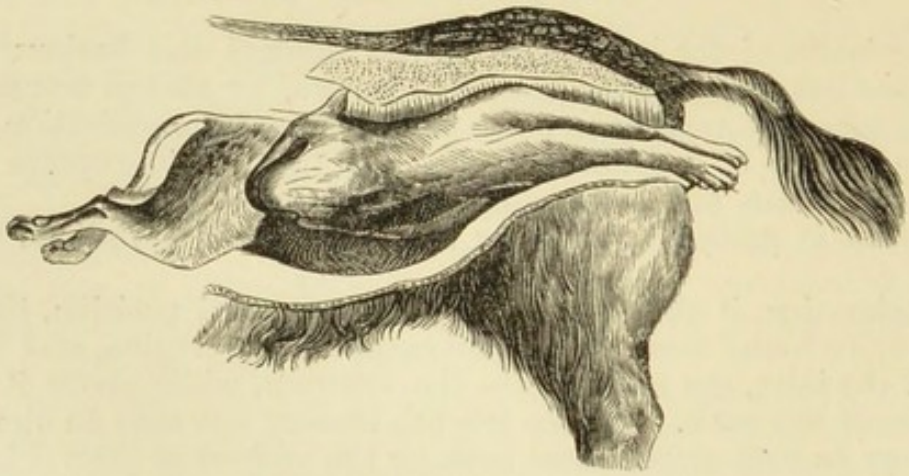

Fig. 137.

Anterior Presentation : Deviation of the Head Upwards and Laterally.

emptied, by the hand of an assistant, while the operator manipulates in the uterus. If the animal is lying, it must be made to stand.

When this deviation has been found in the Cow, placing the animal on its back has been found of great service in rectifying the displacement.

Embryotomy is rarely necessary.

In the smaller animals—at least in the Bitch—delivery has been effected without reduction of the deviation.

SECTION III.—DYSTOKIA DUE TO THE HEAD AND FORE OR HIND LIMBS.

Saint-Cyr speaks of complicated cases of dystokia in the anterior presentation, due to the head and fore or hind limbs, which are sometimes met with, and the principal of which are the following.

Head retained, and with it One or Both of the Fore-Limbs.

No matter what the abnormal direction and position of the head and neck may be, the difficulty may be complicated—and very frequently is—by retention of one of the fore-limbs, which may be either flexed at the knee or detained in the abdominal cavity; the detention of both fore-limbs, though very rare, yet is not impossible.

In such a case the deviated parts are successively rectified, usually commencing with the limbs, as their presence in the genital canal does not interfere with the manipulation of the head; but it sometimes happens that it is more advantageous to begin with the head—for instance, when it is much forward in the uterus. But it is really of no great moment which part is first dealt with, so long as the precaution is taken first to cord those which are deviated. How they are to be rectified will be explained presently—but it may be remarked that such rectifications succeed most frequently in the Cow, from which the Calf may be extracted alive; but the fœtus of the Mare usually dies so soon that there is no time for their adoption, so that—putting forced extraction aside as dangerous—version should be tried if circumstances will admit, before resorting to embryotomy.

Head or One of the Fore-Legs retained, and One or Both of the Hind-Legs in the Genital Canal.

It may happen that one or more of the anterior parts of the body are retained, and yet one or both of the hind-legs enter the genital canal, this depending upon the manner in which the fœtus originally presented itself—the presentation being generally sterno-abdominal, with either hind or fore limbs, or both, in the inlet, and a change occurring in the position subsequently.

When a fore-limb is retained and a hind one is in the passage, the former may be bent at the knee or be under the chest. If possible, it should be straightened and brought into the passage, and the hind-limb also pulled towards the head of the fœtus, the foot as high as the ear, and traction made on the head and feet. If delivery cannot be accomplished, then propulsion may be attempted, and, if successful, the position rectified—though this attempt is likely to prove futile. Then it will be necessary to remove one of the fore-limbs at the scapula, or cut through the trunk of the fœtus.

When the head is retained and one of the hind-legs has entered the genital canal, in the dorso-sacral position, an endeavour should be made to push the hind-leg into the uterus, and even the head may be pushed forward. But if for certain reasons this cannot be done, it may be advisable to proceed to embryotomy—removing both fore-limbs entirely, which will then admit of retropulsion of the trunk and adjustment of the head and neck.

There are other complications of a similar kind in this presentation, to remedy which the practitioner must exercise his judgment by resorting to rectification of the misplaced parts, so as to effect delivery in the anterior presentation; to version, so as to bring about a posterior presentation and then deliver; or to embryotomy, in order to reduce the size of the fœtus, and thus have more room for manipulation and removal of the body.

CHAPTER II.

Dystokia in the Posterior Presentation.

THOUGH parturition may take place spontaneously and terminate favourably when the fœtus presents posteriorly and in a normal position, yet as in the anterior presentation so in this—the presentation

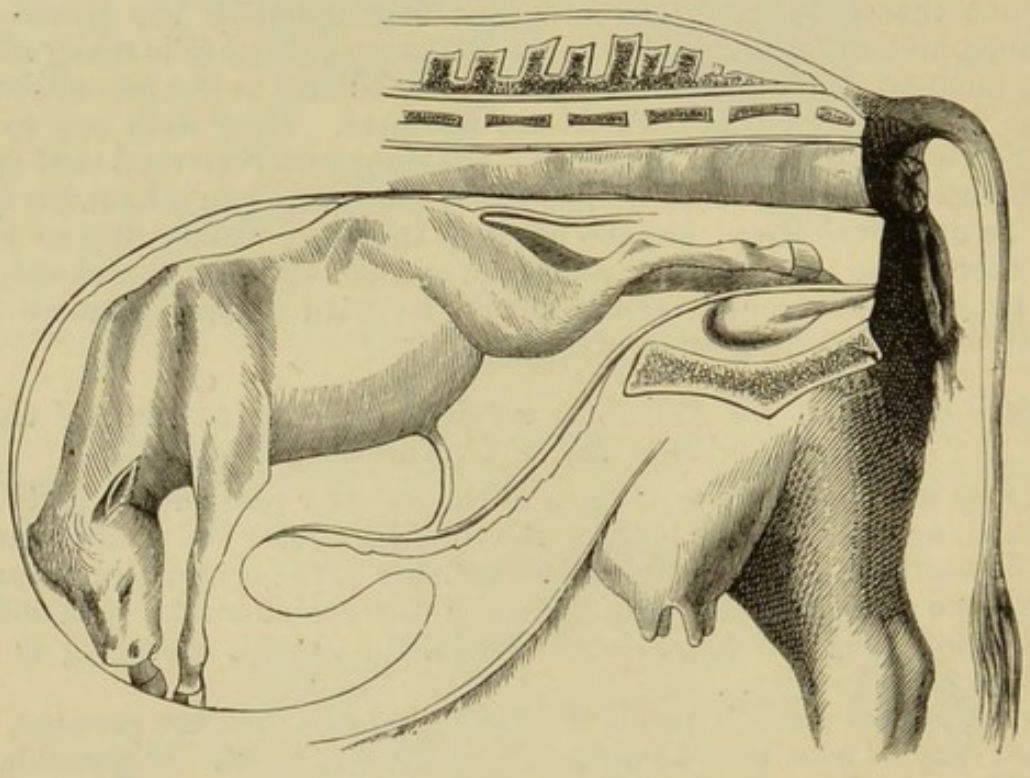

Fig. 138.

LUMBO-SACRAL POSITION.

may be natural but the position abnormal; or, though both be normal, yet delivery may be interfered with by deviation of some part—such as the fore-limbs or head. Not only may this be the case, but the presentation itself may be unnatural.

Several authorities alluded to by Saint-Cyr mention deviation of the tail of the fœtus as offering an obstacle to birth in this presentation, lumbo-pubic position; and it is admitted that such may be the case if that organ gets below the thin margin of the pubis, and becomes bent down towards the croup; but this should be easily remedied.

When treating of the mechanism of parturition (p. 250), it was

remarked that of the positions in the breech or posterior presentation, only one is compatible with spontaneous and natural delivery—the *lumbo-sacral;* but this is only possible when the hind-limbs are fully extended backwards, and are the first to enter the genital canal, so as to gradually dilate the channel for the passage of the voluminous and rounded croup. Birth in this position, and without assistance, is more frequent in the Bovine than the Equine species, and the young creature is nearly always born alive. With the Mare, parturition is always longer and more laborious, and the Foal quickly perishes after rupture of the membranes. It therefore results that, even when the latter is in the lumbo-sacral position, and everything is favourable, delivery should be hastened if it is desired to preserve the life of the young creature.

The other three posterior positions—lumbo-pubic and right and left lumbo supra-cotyloidean—are unnatural, and demand the intervention of the obstetrist.

Besides, these positions, as well as the lumbo-sacral, may be complicated by a vicious direction of the limbs or neck, which may lead to as great, if less varied difficulties, as those encountered in the anterior presentation.

A. Normal Posterior Presentation.

We have just referred to this presentation and described what it implies.

SECTION I.—DYSTOKIA FROM ABNORMAL POSITIONS.

As has been mentioned, these are three in number—the *lumbo-pubic* and two *lumbo-supra-cotyloidean* positions.

Lumbo-pubic Position.

In this, the posterior reversed position, the fœtus is lying on its back, its croup and loins towards the floor of the abdomen or the pubis of the mother, with its feet and belly towards the sacrum.

As a consequence, the hind-limbs, which soonest enter the pelvis, are inclined upwards and backwards into the genital canal, and are therefore the parts that first meet the hand in exploration. Saint-Cyr points out what might be a cause of error in this exploration, in the following terms: "As the anterior face of the hoof or claws is directed upwards and the plantar surface (sole) downwards, the explorer might be inclined to think that it was an anterior vertebro-sacral presentation; but in pushing the exploration further, and following the cannon-bone with the hand, the *hock* is met with—recognisable by its *flatness* on each side, the *point of the calcis* downwards, the *bend* being upwards in the same direction as the wall of the hoof; whereas the bend of the knee is in the same direction as the sole of the foot. Beyond the hock the hand also comes in contact with the croup and the tail, lying towards the maternal pubis."

The obstacle to birth lies chiefly in the thighs and buttocks, while the hind-feet project against the mother's sacrum, and, in addition to increasing the resistance, threaten to lacerate the organs interposed between them—the vagina or rectum, or both—and that bony mass. Besides this, the body of the fœtus itself forms a curve exactly the

reverse of that of the pelvis; so that it cannot readily accommodate itself to the bony canal through which it should pass. From all these causes, this position is not only unfavourable to birth, and must be remedied, but it may also lead to serious accidents.

The position appears to be more frequently met with in the Mare than the Cow, Donnarieix having witnessed it at least a score of times in the first-named animal. This authority, however, is of opinion that it is altogether a secondary position; the fœtus at the commencement being in a normal position (lumbo-sacral), and still alive, is retained at the pelvic inlet by its croup, and soon dies; then obeying the laws of gravity, at a moment when the uterus is relaxed, it turns upside down. And he gives what he considers a proof, in the fact that breeders, in consequence of what he was always telling them—to the effect that in the posterior presentation the Foal does not live for longer than half an hour—were always successful in bringing the young creature forth alive when they at once resorted to traction in such cases, all informing him that the *croup was above and the belly below;* while in all the instances in which he had to interfere, *the belly was uppermost and the back downwards*. In the latter cases Donnarieix never found the Foal living.

Saint-Cyr, however, thinks this explanation is not quite satisfactory, that the opinion is too absolute, and that in the Mare, as well as in the Cow, the lumbo-pubic position of the fœtus may very well be *primary*. Donnarieix himself admits as much, from a case recorded by Rochard, in which a living Foal was extracted—an extremely rare event in the Equine species.

Indications.—The majority of authorities recommend that rotation of the fœtus should be practised in this position, so as to convert it into a *lumbo-ilial* or even a *lumbo-sacral* position; while others, and notably the French veterinary obstetrists, do not think of changing the position, but readily effect delivery when other causes of dystokia do not complicate it—indeed, they look upon these cases as the easiest to remedy, and rarely requiring more than a quarter of an hour.

With the Cow, however, and especially if the Calf is of large size, version is necessary before delivery can be effected; and this may be also required with the Mare, though the comparatively larger pelvis of this animal may permit delivery without changing the position. In attempting this, the most important matter for attention is the direction of the hind-feet during delivery; these should be carefully guided through the genital canal until they are external to the vulva, so as to avoid those lacerations and ruptures which are only too readily produced.

In order to accomplish delivery, the pastern of each hind-limb should be corded; then the hand must be passed along the flexor tendons until the point of the hock is reached, this part usually jamming against the brim of the pubis; the hock is now raised, and at the same time the corresponding cord is pulled gently backward and slightly downward, so as to bring the calcis into the vagina; this operation is to be repeated on the other limb, and then both feet are to be directed by the hand through the canal. This being accomplished, the cords should then be pulled upwards, so as to raise the croup and facilitate its entrance into the inlet; after which steady traction, proportioned to the amount of resistance, must be employed during the labour-pains until the young creature is completely extracted.

Lumbo-supra-Cotyloidean Positions.

These positions—right and left—are so like the corresponding positions in the anterior presentation, that the same remarks are applicable to them. When simple, the hind-limbs—perfectly extended—first enter the genital canal. Such positions are very rare, and they do not offer anything very noteworthy; they are recognised in the same way as the lumbo-pubic position, and the indications are the same. As a rule, parturition is easier in these positions than in the lumbo-pubic, as only one haunch is jammed against the brim of the pubis; the other, being in contact with the mother's sacrum, can enter the inlet without much difficulty. Judicious traction on the hind-pasterns is all that is needed after the position has been rectified.

The same observations apply to the *lumbo-ilial* positions, which are sometimes, though rarely, met with, and are a cause of difficulty.

SECTION II.—DYSTOKIA DUE TO THE HEAD OR FORE-LIMBS.

Obstacles occasioned by the head and fore-limbs in this presentation are less frequent, and not so serious as in the anterior presentation when the hind-legs enter the genital canal. The head, when not hydrocephalic, is usually a cause of difficulty when the neck is contracted and brings it round to the side of the body.

Head and Contracted Neck.

The head itself does not so readily constitute an obstacle to birth, though in the posterior presentation, being the last portion of the fœtus to enter the passage, its widest part may become fixed, either in the pelvic inlet, or be retained by the cervix uteri when this has happened to contract earlier than usual. This sometimes occurs with the Calf and some of the smaller animals, but more especially Puppies. Indeed, it is not very uncommon to witness Bitches with the hind part of the body of a Puppy hanging from the vulva, the head being firmly wedged in the passage.

Very few instances of contracted neck are recorded, and they occurred in the Mare, with other complications—such as a transverse presentation, or a misdirection of the limbs. The head is bent round towards the haunch, and rigidly maintained there by the crooked neck; so that it is fixed against the border of the pelvis and cannot enter the inlet, which is already occupied by the hind-quarters. In these circumstances birth is impossible.

Care is necessary in arriving at a conclusion as to the nature of this difficulty, but in repelling the hind-quarters from the inlet the head will be found at one side; nothing else abnormal being discovered, it may be inferred that contracted neck is the cause of obstruction.

Indications.—When the head alone is the obstacle, traction will remove it from the genital canal, the body of the fœtus being at the same time moved from side to side and up and down, so as to engage the head in the passage by all its diameters. With small animals, such as the Bitch, an emollient hip-bath is very useful; as are also injections of warm water, oil, or glycerine into the vagina.

When the neck is bent or contracted, the hind-limbs should be

corded, placed straight in the genital passage, and traction made on them by the cords and the hand; if there is difficulty in moving the fœtus, traction should be made on one side, then on the other, by which means progress will be made, and delivery ultimately completed.

Fore-Limbs.

In the posterior presentation it may happen that the fore-limbs offer an obstacle to birth, by entering the inlet along with the chest of the fœtus. Donnarieix alludes to this accident in a presentation which he designates as *mixed*, and characterised by the entrance into the os of the four legs at the same time; this may occur in the anterior presentation, when the hind extremities are flexed beneath the abdomen and jammed in the pelvis, as well as when these are the first to enter the os. Other authorities also speak of this accident, which is not frequent. Sometimes the two hind-limbs and a fore one are found in the passage. It is probable that the presentation is secondary, and probably it was originally sterno-abdominal, with the feet engaged in the canal.

The hind-legs are found in the passage, perhaps projecting from the vulva, one or both of the fore ones being in the vagina, and probably towards the maternal sacrum; while the body of the fœtus may be parallel to that of the mother, but more frequently it is oblique.

Indications.—According to Donnarieix, retropulsion is impracticable in the Mare in this difficulty, as the limbs are jammed against the maternal pubis, iliums, or sacrum, and traction will lead to rupture of the uterus. He therefore advises amputation of the fore-limb or limbs at the humero-radial joint, after they have been withdrawn to near the vulva; he has always been successful in his cases by such treatment. With the Cow, however, he admits that the fore-limbs may be pushed forward into the uterus, and delivery then effected.

Dieterich and Darreau advise retropulsion of the fore-limb or limbs by means of the repeller.

Amputation of these limbs being a long and troublesome operation, Donnarieix's advice should not be followed until other measures have been tried. These should be: propelling the fore-limbs into the uterus, and if this cannot be effected, pushing the upper joints beyond the inlet. Canu recommends cording the hind extremities, grasping the fore ones above the knee and carrying them into the uterus, while the assistants pull the cords. If these attempts fail, then the fore-legs can be drawn as near the vulva as possible, and amputated either at the shoulder or scapula.

B. Abnormal Posterior Presentations.

The abnormal posterior presentations are chiefly due to deviation in the direction of the hind-limbs, and this is, in many instances, a very serious complication. Instead of being extended backwards into the passage, one or both may be bent at the fetlocks or the hocks—the leg against the thigh, these joints presenting; or they may be carried straight forward under the body, the buttocks alone resting against the inlet. So that, instead of a wedge-shaped mass offering its thinnest portion to gradually dilate the genital canal, the fœtus presents a large rounded mass—the croup and thighs—which is not at all adapted for

effecting a passage through the limited space. When to this bulk is added the flexed portion of the limbs, it will be seen that this cause of dystokia, generally most formidable in all cases, must be more so with primiparæ, and especially if some time has been allowed to elapse since the commencement of parturition, if the "waters" have escaped, and if amateurs and empirics have been interfering. With regard to this interference, however, it must be admitted that it is less to be dreaded in this presentation than perhaps in any other; incompetent people are, fortunately, at a loss how to act, as there is nothing to lay hold of, and the nature of the malposition or the manner of remedying it is obscure, perhaps unknown to them.

In the diverse complicated positions of the posterior limbs in this presentation, it may be remarked that they are more frequent and difficult in the Mare than in the Cow—the increased difficulty being doubtless due to the greater length of the limbs in the Foal than the Calf.

The malposition of the hind-limbs may be of three kinds: 1. Limbs incompletely extended in the genital canal; 2. Flexed hocks, the doubled limbs engaged more or less deeply in the passage; 3. Hind-limbs completely retained in the uterus, and applied more or less closely against the abdomen of the fœtus, the back part of the thighs and the croup presenting at the inlet.

We have mentioned that one or both limbs may be in a vicious position; even when the two are misdirected they may not be in the same deviation—one leg being perhaps flexed at the hock and the other extended forward towards the chest, one flexed at the fetlock while the other is bent at the hock, etc.

This presentation is somewhat rare, and though differing little from the natural one, yet frequently leads to death of the Foal, as birth cannot take place without assistance; though the Calf, having more vital tenacity, can live longer, and therefore has more chance of being born alive, even if help be not afforded for some time. It is generally due to the prominent stifles being arrested at the inlet by the thin margin of the pubis in the Mare, or the inclined plane this part forms in the Cow. When the hind-limbs become fixed the body of the fœtus continues to pass outwards, so that the femurs become more vertical, and this causes the croup to be raised against the lumbar region, and finally to be jammed there. The accident is much less frequent in the Cow than the Mare, probably because of the sloping border of the pubis.

Exploration discovers the soles of the hind-feet uppermost, with the shank incompletely extended on the tibia, which again is partially flexed on the femur; the stifles are also found pressing against the margin of the pubis, while beyond this the croup is jammed upon the sublumbar arch.

Indications.—These are: push the croup forward in the uterus during the intervals between the pains, while traction is made on the cords which have been attached to the lower part of the legs.

If the hind-legs chance to be incompletely extended in the reverse or lumbo-ilial position—which is possible, particularly in the Cow—the fœtus should be pushed forwards, its hind-legs extended, and the creature placed in the lumbo-sacral position, when delivery can be completed.

Hock Presentation.

The mechanism of hock presentations is supposed to be as follows:—The fœtus, in the posterior presentation, lumbo-sacral position, and impelled by the uterine contractions towards the cervix,

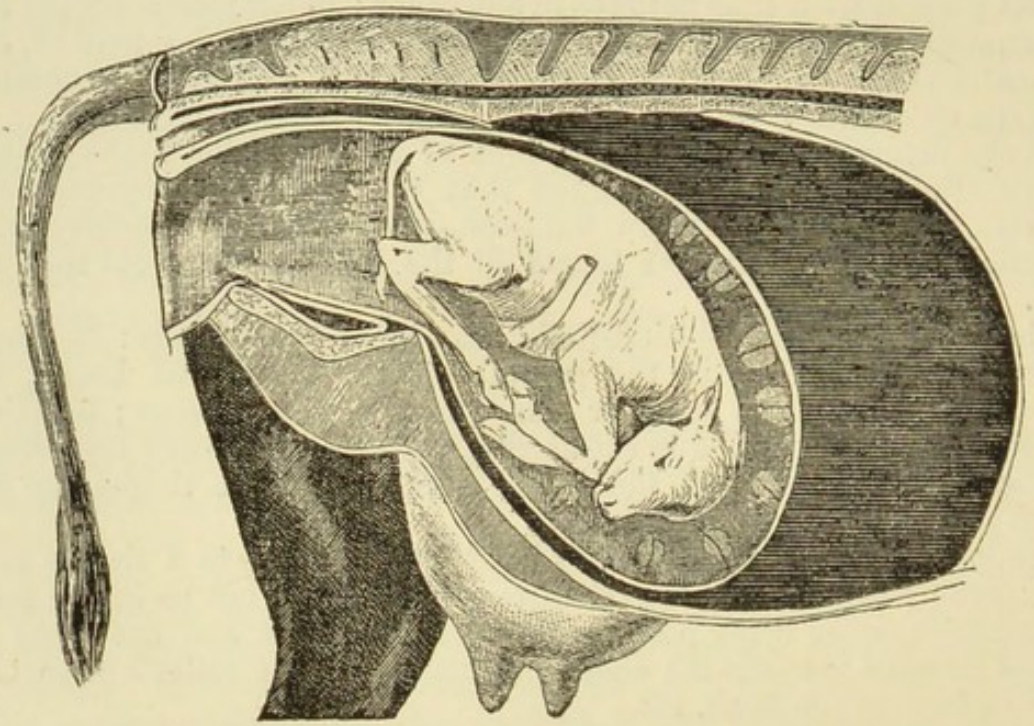

Fig. 139.

Hock Presentation: Calf.

reaches the inlet with the hind-limbs not quite extended, nor the axis of the young creature quite coinciding, perhaps, with that of the passage. Consequently, the legs come in contact with the pelvic brim below by

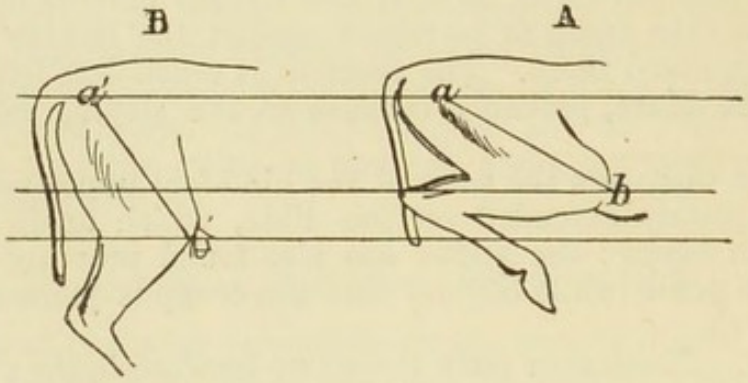

Fig. 140.

Diagrams of the Hind-Limbs in Hock Presentation.

the posterior surface of the shank, while the croup encounters the sacro-vertebral angle above.

The labour-pains continuing, the croup has a tendency to descend, and, with the points of the hocks, to advance through the os: the latter

joints become gradually flexed until at last the cannon-bones press against the thighs, and the doubled legs and croup, jammed in the inlet, form far too large a mass to advance further (Fig. 139). Labour is therefore suspended, and the animal becomes exhausted with futile straining.

The increase in volume is well exemplified in the annexed outlines (Fig. 140). In figure A, we observe that the direction of the femur (*a b*) is much more oblique than in figure B, which shows the limb extended, and that bone (*a' b'*) in its usual position. The consequence, in figure A, is apparent in the elevation of the stifle to the middle horizontal line, and the inclusion of the hock and greater portion of the metatarsal bone in the line below, which only touches the stifle (*a' b'*, figure B).

The mechanism is quite the same in the lumbo-pubic and lumbo-ilial positions, the parts of the pelvic brim against which the croup and limbs impinge being alone different. One limb only may be retained in this malposition, as already remarked, the other being extended in a normal manner; but this does not in any way alter the state of affairs —neither with respect to the mechanism, nature of the complication, nor measures to be adopted.

In hock presentation, the point of the os calcis is always the first part the hand encounters in exploration; but it may be found at various depths. Sometimes the hocks alone are in the canal, the body of the fœtus being still in the uterus; while in other cases they and the croup are within the inlet, and are wedged in the passage. But it is not so much these which form an obstacle to birth, as the phalanges of the hind-limbs, which, owing to the extreme flexion of the hocks, are flexed to a corresponding degree, and so form two hooks which cling to the edge of the pubis. Consequently, birth is impossible without extraneous aid.

Indications.—The difficulties vary according to circumstances. With the larger animals at their full period of pregnancy, birth cannot take place, as a rule, until the deviation has been rectified; and to attempt delivery before this has been done is to expose the Cow or Mare—particularly the latter—to great danger. With the Sheep, Goat, Sow, and Bitch, the fœtus can be, and often is, extracted in this malposition.

The indication is, therefore, with the Mare or Cow, to give the hind-limbs a favourable direction, by extending them in the genital canal; and this is more easily accomplished in the Cow than the Mare, owing to the smaller size of the croup and shorter limbs of the Calf. Some authorities are even of opinion that the latter may at times be extracted without the limbs having been adjusted; while others assert positively that delivery may be effected in the Cow by mutation of the fœtus, but that this is impossible with the Mare, unless a particular operation—to be noticed immediately—is adopted. Saint-Cyr, however, has, with more or less trouble, and the Mares not straining severely, succeeded on four or five occasions, when the Foal made a hock presentation, in extending the limbs in the genital canal, and effected delivery without resorting to this operation. He points out, nevertheless, that the Foal dies very quickly in this position, while very often the Calf is extracted alive, even after long and laborious manipulations. Other writers corroborate Saint-Cyr's opinion with regard to delivery.

The method of adjusting the hind-limbs is as follows :

1. *Push the fœtus as far as possible into the uterus.* This retropulsion can be effected without difficulty—even in the Mare—at the commencement of parturition, when the fœtus has not yet entered the pelvic inlet, or, at most, the points of the hocks are only engaged. But at a later period, when labour is more advanced, and the croup is in the passage and on the vaginal side of the inlet, the difficulty is greatly increased in the Cow, and retropulsion may even be impossible in the Mare. It should always be attempted, however, and in the Cow the attempt will be generally successful.

The hind-quarters must be raised as much as possible, and the hand should be applied against the buttock of the young creature, the thumb on one hip, the fingers on the other, and immediately below the tail. If the repeller is used (and it is very convenient in these cases), it should be placed across the thighs. The retropulsion should be made by steady pushes in the interval between the labour-pains; these pushes should be directed slightly upward, so as to raise the croup. At first the resistance seems to be insurmountable, but gradually the fœtus begins to move forward, and finally is entirely propelled into the uterus, and at a sufficient distance from the pubis to allow the limbs to be extended backwards.

When the animal persists in lying, the hind-quarters may be raised by trusses of straw ; and it has happened in some cases, especially with the Mare, that retropulsion could only be achieved and delivery effected by putting hobbles on the hind-pasterns, and drawing up the hind-quarters by means of the rope attached to them, and which was run over a beam in the ceiling.

Rainard points out that it often happens, during this retropulsion, that the fœtus is pushed into somewhat of a transverse position,—the head and fore-limbs approaching the pelvis, where they may be seized and version effected by moving them round into the anterior presentation, bringing them into the passage, and then completing delivery. This fortunate movement, however, must be extremely rare.

2. When the body of the fœtus has been pushed sufficiently far from the pubis to allow the limbs to be seized, the hand may then *fasten a cord on each pastern* (by means of the porte-cord, if necessary), in order to assist in extending the limbs at the proper moment, by a few moderate pulls in the desired direction.

3. *To extend the limbs in the genital canal*, the lower parts must describe the arc of a circle, the hock-joint being the centre, the limb below this being the ray; so that the foot, which is at first directed forward, may be brought directly back towards the vulva of the mother. The limb which is most convenient is first extended. Some obstetrists begin by seizing the hock, the fingers in front and below the joint, the palm and thumb on the calcis and shank ; the lower part of the limb is then drawn backwards, while the thigh is pushed forward, and by a turn of the wrist the leg is carried through the inlet and straightened. The same procedure is carried out with the other.

Other practitioners endeavour to *flex* the limb as completely as possible, commencing with the tibia and lifting it well up against the femur, then the hock is bent ; the limb is now seized at the lower end of the cannon-bone, or even at the fetlock, and is then lifted into the vagina. Schaack's method does not differ much from this. He flexes the leg on the thigh as much as possible, raising the point of the hock

as near the buttock as he can; this elevates the foot and brings it nearer. As the labour-pains usually push the fœtus too near the pubis, it must be thrust forward again by acting more particularly on the point of the hock, using it as a kind of propeller. When sufficient space has been gained, the hand descends along the cannon bone and grasps the front of the foot—the thumb and index-finger meeting round the coronet, so that the toe is in the palm of the hand; in this way the pastern and fetlock are forcibly flexed, when, by a vigorous effort—seconded, if need be, by the cord placed round it—the foot is raised above the pelvic brim, brought into the vagina, and the leg extended—an easy operation, generally. With the Foal, however, it sometimes happens that, owing to the length of the limbs, the calcis presses against the sacrum of the mother while the foot jams on the pubis. In such cases the pastern-cord is most useful, as the operator may allow the foot to pass from his hand, and press the point of the hock towards the uterus; while an assistant pulls at the cord with such an amount of force, and at such times, as the obstetrist may order. The other limb is to be brought back in the same way.

Cartwright mentions that, in those cases in which the limb cannot be sufficiently extended backwards, the hock should be drawn as far as possible into the passage, and the tendon of the flexor metatarsi divided above its point of bifurcation, in front and at the upper part of the joint; this allows greater mobility. If the fœtus is dead, of course there can be no objection to this section; if alive, it will require consideration.

This is the method to be recommended in every case; and it will very often be attended with success, even in the Mare, when the fœtus is not too firmly fixed in the pelvis, and can be pushed into the uterus. But it frequently happens that retropulsion is not possible; the hind-feet cannot be reached, and delivery cannot be accomplished in the way indicated. We must then adopt other methods applicable to the Mare and Cow.

With the *Mare*, when the fœtus is impacted in the pelvis, so that it cannot be moved forward, it may be presumed that it no longer lives, or that it will perish before delivery is completed. There can be no objection, then, in resorting to embryotomy, so as to relieve the Mare as quickly as possible.

The hind-limbs of the fœtus may be amputated either at the stifle or the hock—some authorities recommend the former, others the latter; while others, again, advise excision at the coxo-femoral articulations. Extraction of the fœtus has been effected after amputation in the three regions, but preference is generally given to division at the hock. This is effected by drawing the joint as far into the vagina as possible, either by the hand or a cord passed round the part (Fig. 141); if it can be drawn beyond the vulva, all the better, but this requires much force. The joint is then disarticulated, and the separated portion of the limb withdrawn from the passage. The other leg being served in the same way, delivery can be completed in the ordinary manner—the obstacle being now removed.

"Now and then," as Cartwright remarks, "we are not able to bring the legs straight into the passage, but have to get away the fœtus by means of cords around the hock or hocks, with one or both of the legs doubled forward against the thigh. In these cases it will be advisable to

divide the tendons (gastrocnemii) at the back of the legs, just above the point of the os calcis, and also the flexor tendons below the hocks, by which means the flexion at the hock-joints will be more perfect, and the leg and thigh approximate better. After we have done this, we may pull at the cords around the hocks pretty freely; but we must not omit forcing the breech into the abdomen, so as to allow the limbs or the stifles to become straightened, and prevent the latter wedging against the anterior part of the pelvis. . . . In some cases, I have known the fœtus to come away in a breech presentation, without the legs being straightened at the stifles; but it is bad practice. In some cases we may remove the leg-bone, by sawing it through, close up to the hock, and afterwards passing a cord above the os calcis to pull at, and then pushing the breech forward."

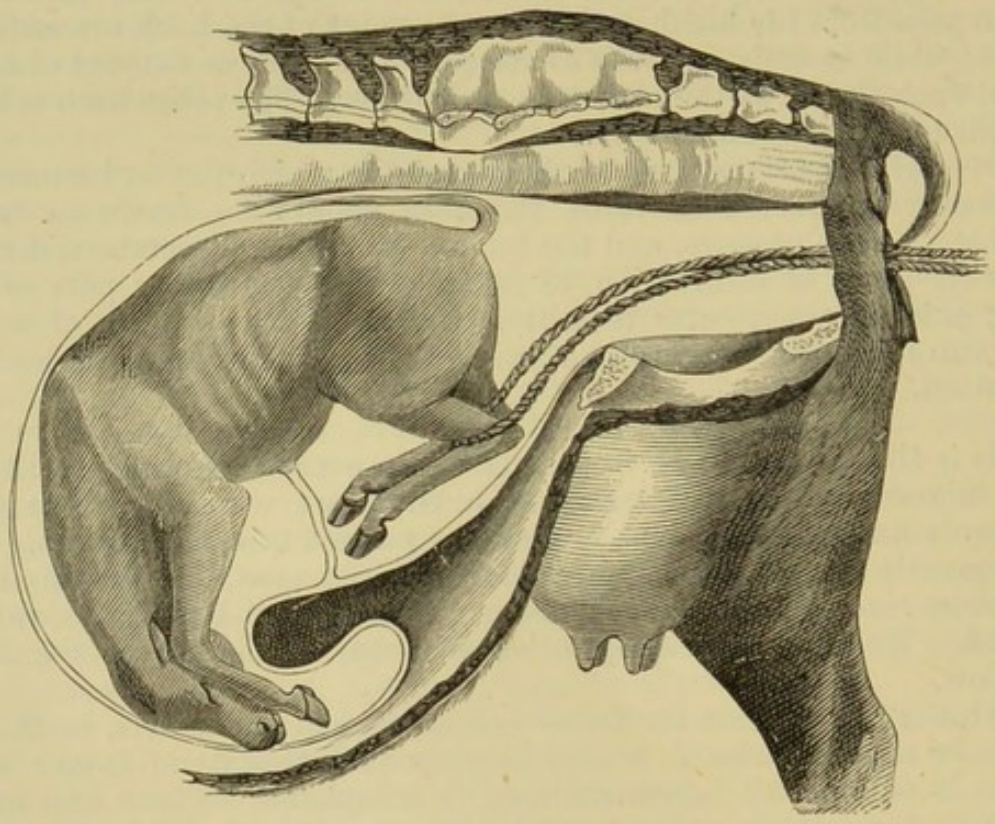

Fig. 141.

HOCK PRESENTATION: HOCK CORDED.

With the *Cow*, the Calf is very frequently alive, and an important consideration is how to deliver it in this condition. Should it be impossible to effect retropulsion, *forced extraction* in this malposition should be attempted; it has often proved successful, and particularly when only one limb was retained.

To effect forced extraction with one limb alone flexed, the leg extended in the vagina should be corded at the pastern, or above the hock if this can be reached. A cord is then to be passed around the bent hock by means of the porte-cord, and traction exercised during the labour-pains.

When both legs are flexed at the hocks, a cord must be passed round each, as in Fig. 141. The necessary force can then be exercised.

Should forced extraction not succeed, the limbs may be amputated at the hocks, as with the Mare.

It is well, in this malposition, when the hind-limbs have been either removed or adjusted, to ascertain the direction of the tail; as it is sometimes thrown back over the croup (as in Fig. 141), and may thus increase the difficulty to be surmounted. It may readily be brought back to its natural position by passing the hand from the root to its extremity, and bringing it into the vagina by withdrawing the arm. In some instances retropulsion may be necessary before the tail can be adjusted.

This hock presentation may occur in other than the lumbo-sacral position, and it certainly has been observed in the lumbo-ilial. The croup does not enter the inlet, but presses against it; so that, especially with the Cow, the fœtus can be pushed forward, the limbs extended, and through them the position changed to lumbo-sacral. With the Mare, however, the violent straining may prevent this measure being carried out

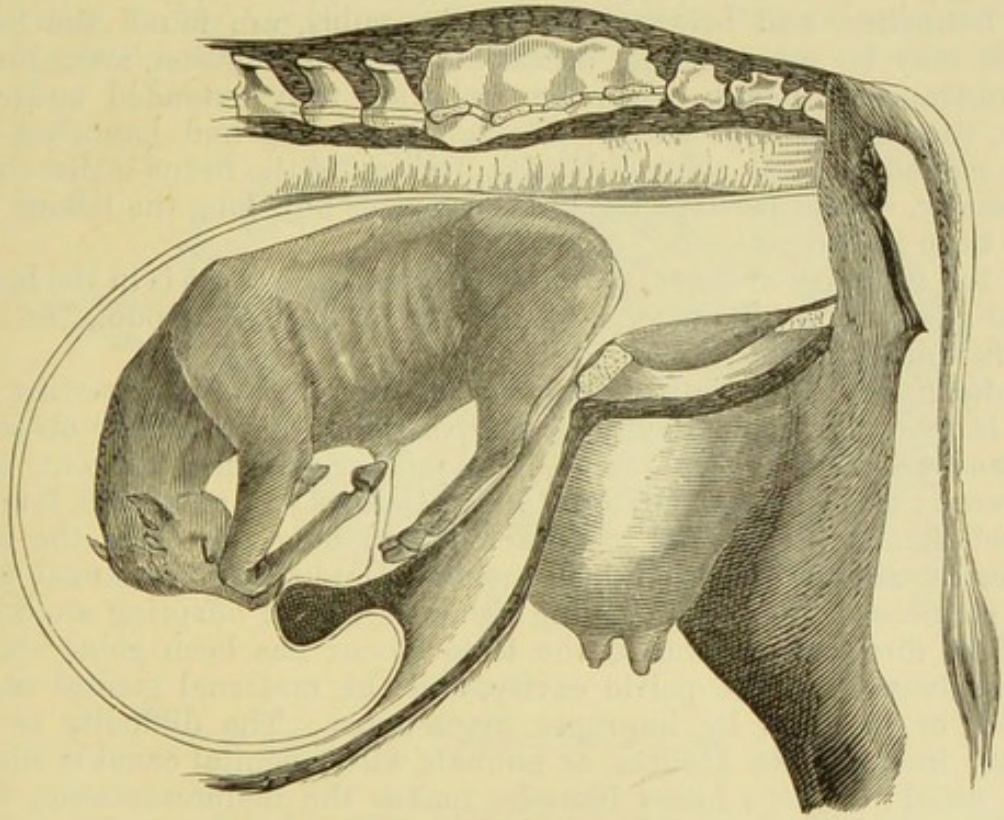

Fig. 142.

THIGH AND CROUP PRESENTATION.

until the fœtus is dead, when it may be removed by drawing the hocks into the vagina, dividing the gastrocnemii tendons, pushing the body into the uterus, rotating it into the lumbo-sacral position, and extracting it.

With the Sheep and Goat the same procedure is applicable, but the Bitch generally does not experience any difficulty in expelling the fœtus in this malpresentation.

THIGH AND CROUP PRESENTATION.

The cause of this malposition is the same as that operating in hock presentation; the deviation is not at all unusual in Mares or Cows with a very pendulous abdomen. The hind-legs are flexed more or less under the body.

When the thighs and croup alone present at the inlet, the joints of

the hind-limbs being partially or only very slightly flexed, it is evident that the voluminous mass cannot pass into the pelvis. Some part of the posterior region of the fœtus—as the hocks—jams against the pelvic border and cannot get beyond; while the points of the buttocks, placed in front of the inlet, are engaged somewhat in the passage. With the continuance of the labour-pains, this part gradually enters the pelvic cavity, while the retained hind-limbs are proportionately forced forward beneath or on each side of the abdomen of the fœtus, until at last they are closely applied to the body; the creature has assumed the position of an animal lying in a natural manner, and the posterior part of the trunk is firmly fixed between the sacrum and pubis of the mother (Fig. 142).

The tail and buttocks of the fœtus are, therefore, the first parts that the hand encounters in exploring the genital canal; then the croup and haunches, and below, beneath the pubis, are found the hocks, which may be more or less accessible to manipulation, according to circumstances; though, when the limbs are fully extended under the body, they are beyond reach. Though the croup and haunches may have passed into the pelvic inlet, yet nothing of the fœtus is discernible externally, except perhaps the tail, no matter how long the labour may have been in progress.

In the majority of cases, perhaps, the young creature is in the lumbo-sacral position; while in others it may be in the lumbo-pubic, or right or left lumbo-ilial positions.

Indications.—Authorities are generally unanimous in asserting that this is one of the most difficult malpositions the veterinary obstetrist can encounter. Very frequently the mother perishes without being delivered; and though sometimes a live Calf may be extracted, it is rare indeed that a living Foal is obtained, and only too often the Mare succumbs after parturition has been accomplished by manual force. The chances of success in saving either mother or offspring are diminished in direct proportion to the time labour has been going on, the fœtus advanced in the pelvic cavity, and the maternal genital organs injured or irritated by improper manœuvres. The difficulty is also greatly increased in Heifers, or animals whose genital canal is smaller than usual; a large fœtus likewise makes the malpresentation more serious.

The rational indication is, of course, to extend the limbs of the fœtus backwards, as in ordinary breech presentations, and to give these and the body a direction in harmony with the axis and dimensions of the pelvic inlet, so that birth may be effected by the combined efforts of the mother and the obstetrist. But this indication is often most difficult to fulfil; though in some instances, and even with the Mare, it is possible when labour is not too far advanced, and when the fœtus, still in the abdominal cavity, is movable, and can be pushed sufficiently from the inlet to allow the lower part of the limbs to be seized and brought into the vagina.

Pushing the fœtus as far into the abdomen as possible, one of the limbs is seized above the hock, and the thigh and leg flexed as completely as circumstances will permit, by lifting that joint towards the mother's sacrum. Still pushing the fœtus off by means of the repeller, the hand is passed down to the hoof or claws until the toe and front part of these rest in the palm of the hand; by adopting this precaution, danger of injury to the uterus or vagina is averted. Then the foot is

brought into the passage by flexing all the joints on each other. Again pushing the fœtus forward, the same manœuvre is repeated with the other limb, if necessary; though forced extraction has sometimes succeeded with only one leg in the passage, that which is retained finding space in the abdomen, and even facilitating the passage of the thorax, according to some obstetrists.

This manipulation is rendered more difficult than in hock presentation, from the fact that the hocks in this are deeper in the uterus, and jam against the brim of the pelvis, where they cannot be freed by the hand. The difficulty is surmounted by passing a blunt hook round them, or a cord as in Fig. 141, the two ends of this outside the vulva being twisted and drawn upwards and outwards by an assistant; while the operator, pushing at the croup, throws the body of the fœtus forward, and thus allows the point of the calcis to rise above the pelvic brim, when the leg can be extended backward as in hock presentation.

This method, however, does not succeed in every case; and when the

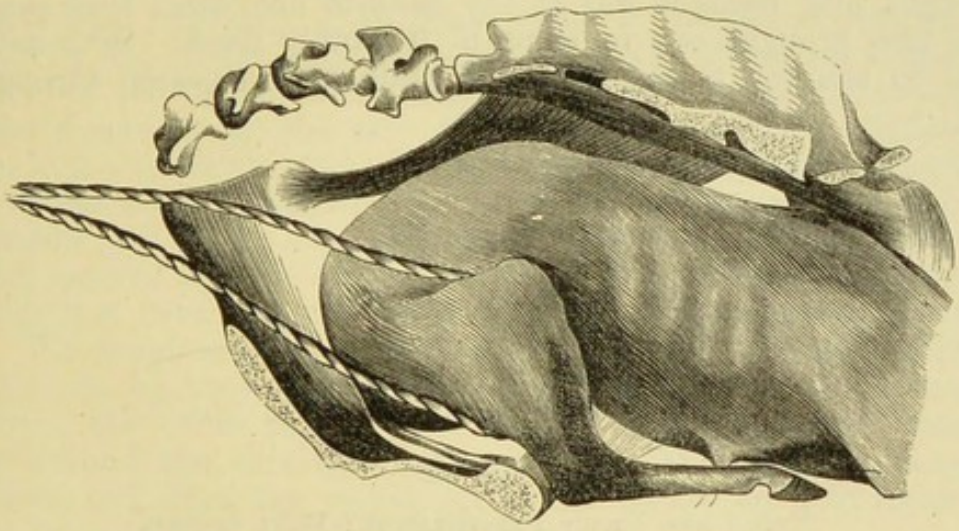

Fig. 143.

THIGH AND CROUP PRESENTATION: THIGH CORDED.

croup is firmly wedged in the pelvic canal and the thighs have cleared the inlet, it is only too often impossible to effect retropulsion. Consequently, there are but two courses open—extraction of the fœtus in this abnormal position, or removing it by embryotomy.

Forced extraction of the fœtus, without adjustment, is a very serious, because a very violent, measure, and is frequently fatal to the mother, as well as to the offspring. It should, therefore, not be lightly adopted, and every other measure of a milder kind should be tried if it has any probable chance of success. Throwing the mother on the back or side may effect a change for the better in the position of the fœtus; or if standing or lying, then raising the hind-quarters as high as may be without injury should be tried.

These failing, then Lecoq's method may be resorted to. This consists in passing the hand, furnished with a cord, between the wall of the pelvis and the body of the fœtus as far as the thigh of the latter; the cord is then pushed beneath the thigh as far as possible and left there, while the hand is passed above—between the leg and body, so as to bring the end of the line up around the stifle and back through

the vagina. In this way the thigh is encircled by a loop, as in Fig. 143. The other thigh may be secured in the same way by another cord, and this part of the operation will perhaps be much facilitated by using the long bent porte-cord (Fig. 171).

Saint-Cyr states that one thigh corded may be sufficient; but it is undoubtedly better to cord both, if possible, as traction on the two limbs keeps the body of the fœtus in a straight direction.

The ends of the cord being joined together outside, assistants, under the direction of the operator, pull with the necessary amount of force; while the hand of the operator assists in the vagina, either in guiding the fœtus, seizing on and pulling at any part that may offer, or smoothing down the folds of the mucous membrane in the canal which might otherwise increase the obstacles. The fœtus has been extracted alive by this procedure.

Saake's method[1] is somewhat similar, except that there is only one cord, and that encircles the body instead of the thigh. The cord has a ring or noose at the end, and this or the other end is passed between the thighs and brought out at the flank of one side; then the other end is also brought out in front of the other flank. Both ends are carried to the top of the back, the plain end is passed through the

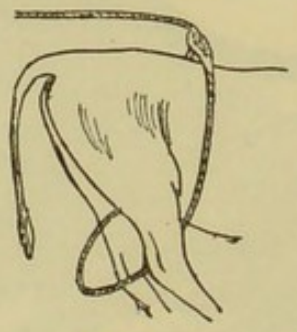

Fig. 144.

THIGH AND CROUP PRESENTATION: BODY CORDED.

ring (Fig. 144) and brought outside the vulva. The body of the fœtus is, it will be observed, enclosed in a loop, the upper part of which—that over the loins—is carried back over the tail to the buttocks, so that the cord now only encircles the flanks. The advantages of this method over the other are chiefly its simplicity, only one cord being required, and the better direction in which traction can be exercised.

In three cases this method was successfully employed by Saake.

Deneubourg makes use of the tail of the fœtus for traction.

There can be no doubt that the fœtus may be removed in this malposition, with both the hind-limbs extended forward under the abdomen. Cartwright says: "I perfectly recollect, in one instance, delivering a Cow of a very large Calf with both its hind-legs under its abdomen, and I never saw a Cow after calving do better." In those instances which are attended by success, it will generally be found, however, either that the fœtus is small or the pelvis large and well formed.

Some practitioners resort to the sharp crotchets, fixing them in the muscles of the croup, towards the hip-joint; but unless the hook has a bearing on the femur the hold is not very firm. In a case of this kind, Drouard found that the skin and muscles yielded, the femur was disarticulated, and the hind-limb itself entirely torn away from the

[1] Magazin von Gurlt und Hertwig, 1869.

body. Notwithstanding this diminution in the volume of the fœtus, delivery was still impossible; the other limb was torn away in a similar manner, after which a crotchet was fixed in each cotyloid cavity, and the fœtus was then easily extracted. In addition to the malpresentation, the young creature was affected with hydrocephalus.

The use of sharp crotchets in such cases is always attended with risk; should they slip during traction, or not be carefully implanted in the fœtus, they may do great, if not fatal, injury to the mother.

To escape the dangers which accompany the use of the crotchets in this way, another method has been proposed and practised by many veterinary obstetrists. The perineal region of the fœtus is largely incised, and the hand, armed with a crotchet, is passed into the pelvis by this opening, the crotchet being fixed either in front of the symphysis pubis, on one of the branches of the ilium, or, which is perhaps better, in one of the oval foramina. Two crotchets—one for each side—may be used. By this method, a more solid hold is obtained, and greater force can be easily exerted.

Cartwright observes: "In those cases in which we are unable to extract by the breech, through not getting the legs up straight by laying hold of the feet, or when bent at the hocks, we should make pretty free incisions through the skin about the ilio-femoral articulations or rump, and afterwards cut or tear the muscles around these asunder, and then we can secure cords around the iliac processes and coccygeal bones, and hooks against the edge of the obturator foramen, by which means we can remove the pelvic and coccygeal bones; and having done so, we can apply a cord around the head of the thigh-bones and pull them out. We must next make an incision into the abdomen and remove the viscera, as they are sometimes pushed forward, and prevent our removing the other parts of the fœtus. Then we must either pass cords around the skin that surrounds the thigh, or insert hooks into the skin, and draw the remainder of the fœtus out with its hind-legs under its belly, and so complete extraction."

Rueff proposes to detach the coxæ from the sacrum, by operating in the pelvis of the fœtus, and afterwards to extract the hind-limbs thus separated from the trunk. Others recommend symphyseotomy—an operation to be described hereafter.

When the fœtus is in the lumbo-pubic position, the same obstacles are encountered. Very often the hind-limbs are bent at the hocks, and these wedge against the floor of the sacrum. The same order of manœuvres has to be adopted. Retropulsion allows space to flex the upper joints, then extend the limbs. When extraction cannot be accomplished with the animal in a standing attitude, it should be placed on its back. When success does not attend the ordinary manipulations, then the hind-limbs of the fœtus must be disarticulated at the hocks, or higher.

In all manœuvres of this kind, great care must be exercised in preventing injury to the maternal organs by the feet of the young creature, or the jagged ends of bones; and while traction is being employed, the hand of the operator should be busy guiding these parts through the genital passage.

The smaller animals—Bitch, Sow, Ewe—may be delivered by the forceps, small crotchet, or the tube-noose to be hereafter described. The Cæsarian section may also, in extreme cases, be resorted to with the Bitch and Sow.

CHAPTER III.

Dystokia from Transverse Presentations.

The fœtus is said to be in a transverse position, when the hand of the obstetrist, instead of meeting with the anterior or posterior part of the body, comes in contact with the trunk, either at the shoulders, withers, sides, flanks, haunches, loins, back, sternum or belly, or (which is perhaps most frequent) all of the limbs collected together. The fœtus, instead of having its greater axis parallel to the pelvis of the mother, has it transverse, or more or less perpendicular to the antero-posterior diameter of the pelvic canal.

The possibility of the fœtus assuming a transverse position in the uterus has been denied on various occasions by Goubaux, who bases his objections on anatomo-physiological reasoning; contending that the uterus cannot contain the young creature when so placed, if the various dimensions of the latter be compared with those of the gravid organ. In the first place, however, it must be remembered that the uterus is not an unalterably-shaped body with rigid walls, but a membranous sac whose parietes are soft and yielding; and that its form may vary with the displacement of its contents—in a word, that its transverse diameter may be increased at the expense of its length. Besides, the fœtus itself is not a compact unyielding mass, but is so flexible that it may assume the most varied attitudes and shapes.

But the strongest proofs in favour of the possibility of such presentations are furnished by obstetrical experience—the facts published by a host of observers entirely demolishing the antagonistic theoretical notions. It may be noted, however, that though the presentations are justly designated transverse, yet the body of the fœtus is generally a little oblique in one direction or the other.

Though the transverse vertical or horizontal presentations are not altogether rare, yet they are much less common than the longitudinal presentations, and especially the anterior presentation. They do not appear to be primary, and they are more frequent in the Mare than the Cow—perhaps because of the more energetic contractions of the uterus in the former animal not allowing natural adjustment of the fœtus, should the latter not be exactly in a favourable position when labour commences. When the liquor amnii escapes prematurely, the deviation is still more likely to occur, and particularly if the os is not sufficiently dilated. Torsion of the uterus; spasm of the cervix; violent straining and disordered movements of the mother; deviation of some parts of the fœtus—especially of the head; hydrocephalus, monosomianism, etc., have all been noted at times as a cause of transverse presentations. Deformed head may also lead to this presentation, especially if it is distorted, as in Fig. 103.

These presentations are essentially dystokial; as it is evident that the fœtus, if of normal size, cannot pass crossways or sideways through the pelvic canal, which barely affords space for its passage longitudinally. Birth, therefore, cannot take place without assistance; version must be practised in order to change the presentation, and one or other of the extremities of the oval mass which the body of the fœtus represents must be brought towards the inlet. The malpresentation, through hindering birth greatly, endangers the life of the young creature, and especially if it be a Foal.

As mentioned at p. 247, the transverse presentations of the body may be limited to two kinds—the *dorso-lumbar*, in which some part of the back presents at the inlet; and the *sterno-abdominal*, in which the lower part of the body (belly) offers.

The fœtus may either be *horizontal* or *vertical;* when the former, it may be *direct* or *oblique* in direction—*i.e.*, placed perpendicularly or obliquely, with regard to the axis of the mother's body. Saint-Cyr remarks that the first is the most serious, because the extremities of the ovoid fœtal mass are equally distant from the inlet; with respect to the other intermediate presentations between the direct longitudinal and transverse, they are evidently less unfavourable because one of the extremities—anterior or posterior, as the case may be—is found nearer the genital canal, so that version is less difficult. The oblique presentations are almost the only ones compatible with the vertical position of the fœtus.

The direct horizontal presentations may be often suspected from the appearance of the mother, the abdomen showing great enlargement laterally; not unfrequently the movements of the fœtus can be seen on both sides—on the right as well as on the left.

SECTION I.—DYSTOKIA FROM THE DORSO-LUMBAR PRESENTATION.

This presentation is somewhat rare; the body of the fœtus is curved and the limbs are directed forwards. When it is lying horizontally, the fore part may occupy the right or left side of the mother; hence Saint-Cyr distinguishes them as *right* or *left cephalo-ilial* positions—though this does not imply that the fœtal head is necessarily in contact with the ilium, for it may be turned round to one side or bent downwards.

When the fœtus is vertical the head is usually uppermost, the hind-quarters being inferior, as in Fig. 147 — Saint-Cyr's *cephalo-sacral* position; though it may also—for all positions are possible—have this position reversed, the head being downwards and the croup towards the lumbar region of the mother—the *cephalo-abdominal* position.

Cephalo-Ilial Positions.

To diagnose this cause of dystokia—or back presentation—is not always easy. Labour has been going on for some time, the "waters" have escaped, and though the straining may be very energetic—even violent—yet nothing is seen of the fœtus. When the hand is introduced into the genital canal, in order to discover the situation of the fœtus and the nature of the obstacle which hinders birth, it encounters at first a more or less rounded surface, which does not offer any special character by which it might be recognised. The hand is then passed deeper into the uterine cavity, and turned in every direction over the body of the fœtus (for such it is), so as to find some parts which may be distinguished, and by which the position of the young creature in the uterus may be learned.

By this methodical exploration, the obstetrist recognises that the body of the fœtus is more or less curved in the back, one of the regions of which presents at the inlet; while the head and limbs, more or less entangled with each other, and more or less accessible to the hand, are

directed towards the fundus of the uterus (Figs. 145, 146). It now remains to discover the region which first met the hand, and the following memoranda will assist in achieving this point. The *withers*

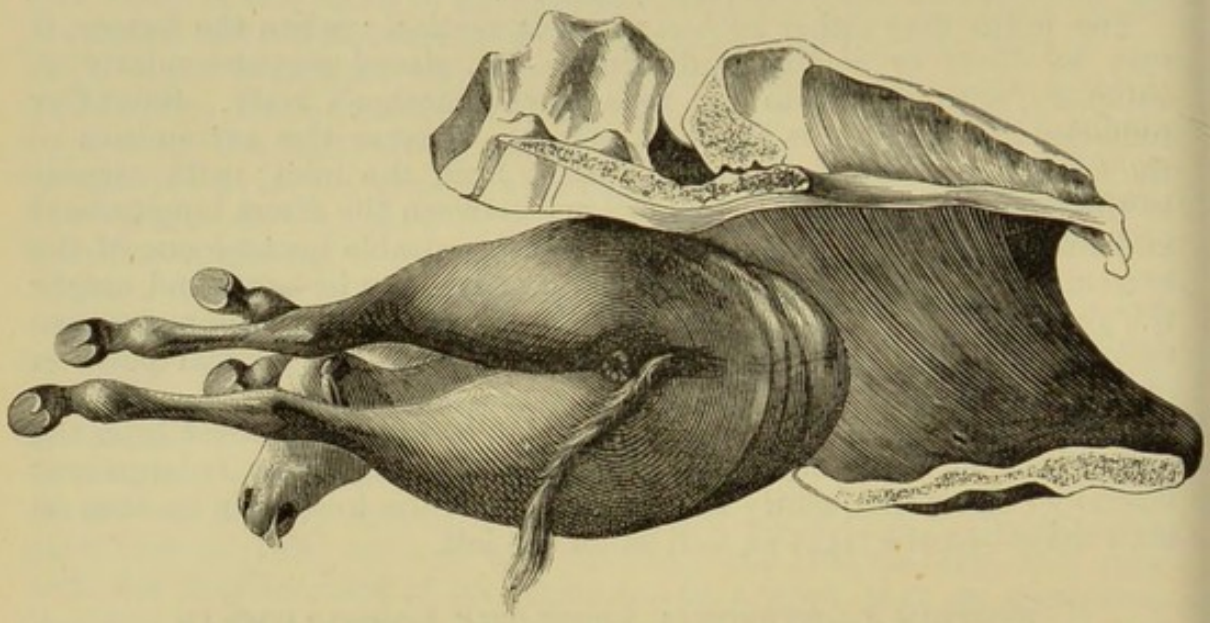

Fig. 145.

TRANSVERSE PRESENTATION : RIGHT CEPHALO-ILIAL POSITION—SIDE VIEW.

are recognised by the prominences which the spinous processes form at this part; the thin wedge-shaped outline of the part; and the hair of

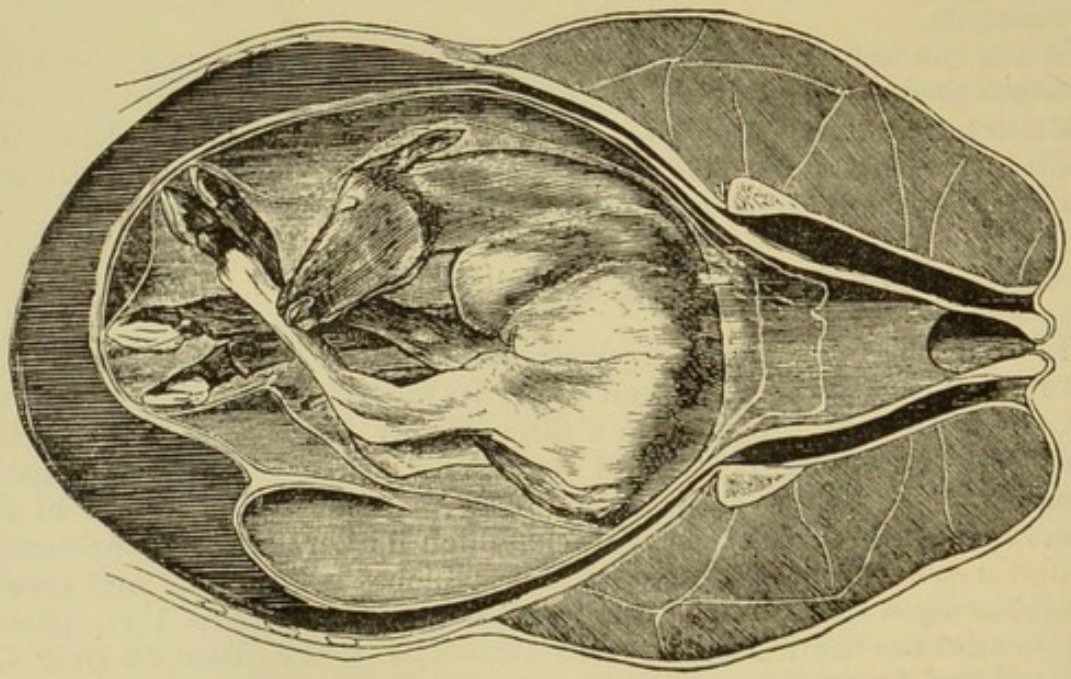

Fig. 146.

TRANSVERSE PRESENTATION : RIGHT CEPHALO-ILIAL POSITION—UPPER VIEW.

the mane, which, in the Foal, ends here. The *lumbar* region may be distinguished by the large and almost level surface it offers; the projecting external and internal angles of the coxæ in its vicinity; the

hollow of the flank leading to the thigh and stifle. The *dorsal* region, or *back*, is discovered by the arches of the ribs springing from each side, with the intercostal spaces.

Having diagnosed the presentation, the *position* must now be determined, and this is done by ascertaining the direction in which the head lies. With regard to this, we pointed out at p. 249 that there were three positions of the fœtus: The *cephalo-ilial positions*, two in number, in one of which the fœtus has the head directed towards the *right flank* of the mother (*right cephalo-ilial position*), and in the other towards the *left flank* (*left cephalo-ilial position*), the head and feet occupying the uterine cornua; while in the *cephalo-sacral position*, the fœtus looks as if seated on the *udder of the mother*, the head being directed forward, the mane towards the sacro-lumbar region of the dam.

It can scarcely be necessary to mention that the exact position of the fœtus should be ascertained before attempts at extraction are ventured upon; as this presentation is, in nearly every case, a very serious one, and only too frequently requires all the skill and judgment of the obstetrist to rectify. The gravity of the case will, however, much depend upon the period when the veterinary surgeon is called in, and the condition of the parturient animal. When sufficiently early in his attendance, however, a favourable result may often, if not always, be anticipated: the mother may be saved, and frequently the offspring —particularly in the Cow and Goat.

This favourable issue is due to the fact that the presentation does not admit of the fœtus entering the inlet, and it therefore remains in the abdominal cavity, where there is space to manipulate it, and thus remedy the presentation. The obstetrist, though he may have to contend with the paralysing and fatiguing uterine contractions, has not to overcome the wedging of the fœtus in the pelvic canal—so common in the defective anterior or posterior presentations.

With the Mare, however, the case is always more serious, because of the energetic contractions which—unless they can be controlled early in parturition by partial anæsthesia or other means—offer a formidable obstacle to mutation of the fœtus.

Indications.—The principal indication in such cases is to convert the dorsal into an anterior or posterior presentation, according to circumstances. Hippocrates has well said that the fœtus is like a cork which has fallen into a bottle, and which can only be extracted by one end or the other.

Certainly the presentation offers serious difficulties, from the fact that there is nothing about the fœtus to lay hold of advantageously, or to which cords can be attached. In the majority of instances, a long interval has elapsed since parturition began; the "waters" have escaped, the genital canal is swollen and congested from the attempts of amateurs at delivery, the interior of the uterus is dry and adhesive, the organ lies as close to the fœtus as a glove does to the hand, and the parent is exhausted with unavailing straining, and perhaps maltreatment—though the most trifling manipulation in the uterus will excite it to the most vigorous contractions.

It is ordinarily in these circumstances that the veterinary surgeon is required to save mother and offspring. What, then, is the first, most urgent, and indeed the chief indication? This must be *version*. The presentation *must* be converted into an anterior or posterior one, and

this at the expense of much patience, fatigue, and skill. But in what direction is version to be practised? Rainard lays it down, as a rule, that the extremities of the fœtus which are nearest the pelvis are those which should be brought into the inlet; and that if both ends of the fœtus are at about an equal distance from it, the anterior should be chosen, because it is the easiest for delivery. This rule, however, has not been recognised by the majority of the best authorities. On the contrary, experience and theory have demonstrated that in the majority of cases pelvic version is the most advantageous; inasmuch as, when this has been effected, there are only the hind-limbs of the young creature to deal with, whereas in anterior version there is the head in addition to the fore-legs, and this may offer difficulties which have not to be encountered in the posterior presentation—more especially if there is anything abnormal in the condition of the head. Not unfrequently, and particularly when the fœtus is yet alive and vigorous, a kind of spontaneous change is effected in an unexpected direction; for it has been found that, in acting on the croup of the fœtus, this has, by energetic movements of its own, and coincident with sudden contractions of the uterus, described nearly a half-circle; so that instead of the loins being under the hand, the withers and upper part of the neck are encountered, and delivery can be readily accomplished.

But this spontaneous mutation cannot take place if the fœtus is torpid or dead, and then version becomes imperative. Before this is attempted, the intra-uterine injection of emollient fluids should be practised; this is most essential if the waters have escaped for some time. Then retropulsion must be had recourse to. The fœtus must not be pushed directly forward into the uterus, but rather obliquely, and in a direction the opposite to that of the part we wish to bring before the inlet. The hand or repeller must be used for this purpose, and in proportion to the difficulty of effecting it, so must the intra-uterine injections be frequent.

The retropulsion and injection, together with the uterine contractions, have the effect, in many cases, of making the body of the fœtus glide around the inner surface of the uterus, until a convenient part presents. Then the limbs and head—if they are required, or only the hind-limbs, if it should be so decided—are brought into the genital canal by the hand or by cords. If the occasion demands it, rotation may be resorted to, in order to convert the vertebro-ilial position into the vertebro-sacral or vertebro-pubic. Delivery is completed by moderate traction.

The manipulations will, of course, vary with circumstances; but it will generally be found that, in all cases, raising the hind-quarters of the mother will render them much easier of accomplishment.

When these manœuvres have failed, embryotomy must be practised. The intestines and other organs can be extracted by an incision in the flank; the vertebræ may be divided at the presenting part, and the entire body cut through at this division; then each half can be extracted in the best and easiest manner possible.

The same indications are applicable to this kind of dystokia in the Ewe and Goat; though if version be impossible and embryotomy not practicable, the Cæsarian operation may be successful. In the Bitch and Cat, when other measures fail, the latter operation may be attempted with some prospect of a favourable result; though version by means of forceps or external abdominal manipulation is often effected.

Cephalo-Sacral Position.

As has been mentioned, in this position the anterior portion of the body is higher than the posterior, and the head may be either turned to one side or bent downwards. This accident is more rare than the preceding. On exploration the back is discovered to be more or less vertical, instead of horizontal, as in the cephalo-ilial positions; though it is seldom directly in front of the inlet, for one end or other of the body is generally nearest it—sometimes it is the posterior, when the presentation somewhat resembles the lumbo-sacral (Fig. 147); at other times it is the anterior, when it is like the dorso-pubic. It therefore happens that the hand will meet with the anterior part of the croup and may feel the base of the tail in the first case, and in the other it encounters the back, withers, and base of the neck.

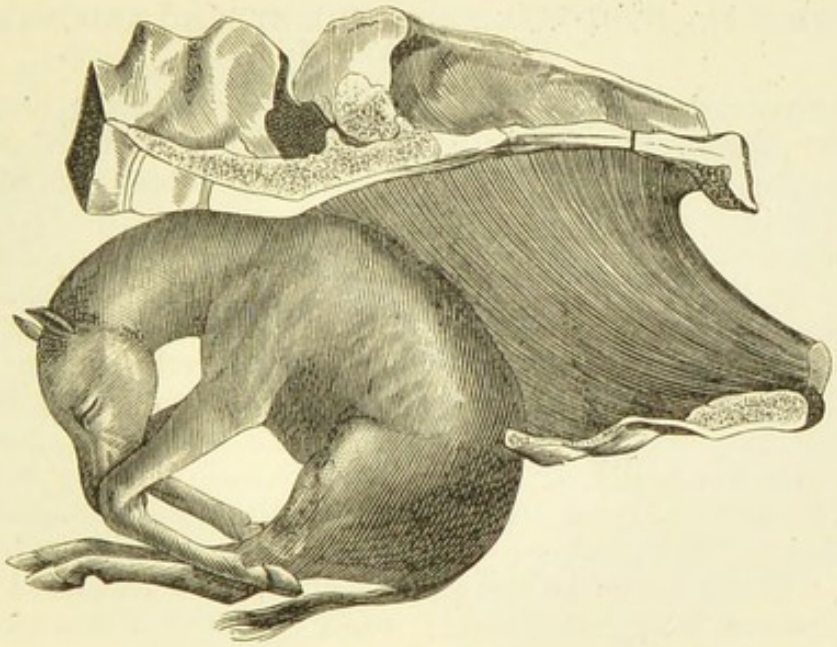

Fig. 147.

Transverse Presentation: Vertical or Cephalo-Sacral Position.

This position is not so difficult to deal with as the horizontal lumbo-sacral, as it approaches the longitudinal presentations.

Indications.—An endeavour must be made to bring one of the ends of the body of the fœtus to the inlet—that which is nearest this opening. Retropulsion is therefore necessary, pressure being made on the end farthest from the inlet. If the mother is placed in the dorsal position and the posterior parts of the fœtus manipulated through the abdominal walls, the task of the operator will be facilitated. When the posterior parts of the fœtus are nearest the inlet, an assistant should push against its lumbar region, so as to bring the buttocks and thighs in front of the opening, while the operator with his hand on the repeller pushes the dorsal region forwards.

When the anterior part of the body is nearest the inlet—the mother being in the dorsal position—the assistant pushes the hind-quarters forwards and downwards, while the operator endeavours to bring the neck towards him, using the crotchet if need be. The object is, of

course, to bring the fœtus into the posterior lumbo-sacral position, with the limbs forward and completely retained; or into the anterior dorso-pubic presentation, with the head and limbs retained. It can then be dealt with as has been described for these presentations.

No mention appears to be made in the literature of veterinary obstetrics of the cephalo-abdominal position (vertical dorso-lumbar presentation), though such is possible. The head of the fœtus would be towards the floor of the abdomen—though lack of space would prevent the body being directly vertical, and either forward or backward.

The measures necessary to remedy the position should be similar to those recommended for the cephalo-sacral position, except that the external manipulation would be exercised on the head of the fœtus, instead of its hind-quarters.

SECTION II.—DYSTOKIA FROM THE STERNO-ABDOMINAL PRESENTATION.

The sterno-abdominal presentation is a rather common one, particularly in the Mare. The fœtus is lying on its side, with the sterno-abdominal region and crossed limbs—either flexed or extended—presenting at the inlet or engaged in the passage, while the dorsal region is towards the fundus of the uterus.

There is no difficulty in discovering this malpresentation, the hand encountering the feet—usually all four—in the uterus, and generally two or more of them in the genital canal. Nevertheless, as there are two positions in the presentation, it is necessary to distinguish which of them we may have to deal with. The situation of the head, of course, defines the position; so that we may have a *right cephalo-ilial*, in which the fœtus is lying on its left side, the head directed towards the right flank of the mother; and a *left cephalo-ilial*, the reverse of the preceding. If the fœtus is vertically placed, with the head upwards, then the position is cephalo-sacral; when the head is downwards it is cephalo-abdominal.

Cephalo-Ilial Positions.

In these positions the fœtus is placed horizontally across the uterus, with the body curved—the back convex in the majority of cases—so that the abdomen is farther from the inlet than the back was in the dorso-lumbar presentation. The *left* cephalo-ilial position (Fig. 148) is, according to Saint-Cyr, much more frequent than the right.

Usually, one or more of the limbs enter the genital canal, and even protrude from the vulva; but occasionally they are doubled against the body and remain in the uterus, where they cannot be detected by the hand. The head may also enter the canal or be retained in the uterus, which is most frequently the case, and then it is either turned backwards, or placed above or below the body; when the latter, then it is either deformed or the neck is contracted.

When the limbs appear at the vulva, if they are the hind and fore, two—a hind and fore—are at the right side and two at the left, though they are sometimes crossed. When they project equally, then it is an indication that the transverse presentation is direct; but if they are unequally protruded it may be inferred that the fœtus is lying obliquely—more in the vertebro-ilial position. In some instances only *one* limb

appears; it may be there are *two*—either anterior or posterior, or one of each; or *three*—a fore and two hind, or two fore and one hind. In other instances, again, there is nothing of the fœtus to be found in the genital canal.

It is only by a careful examination of the presenting limbs—their conformation, number, direction, and degree of projection—that the practitioner can decide as to the position of the fœtus; though those parts of the body accessible to the hand will supply valuable information as to whether the limbs belong to one or more fœtuses or to a monstrosity; while the position of the head should be ascertained if possible, in order to decide which kind of version is most likely to be successful.

When the limbs are not visible, they may be found in the vagina or at the inlet, where they are usually crossed; though it sometimes happens—especially with the Mare—that the arm extended into the

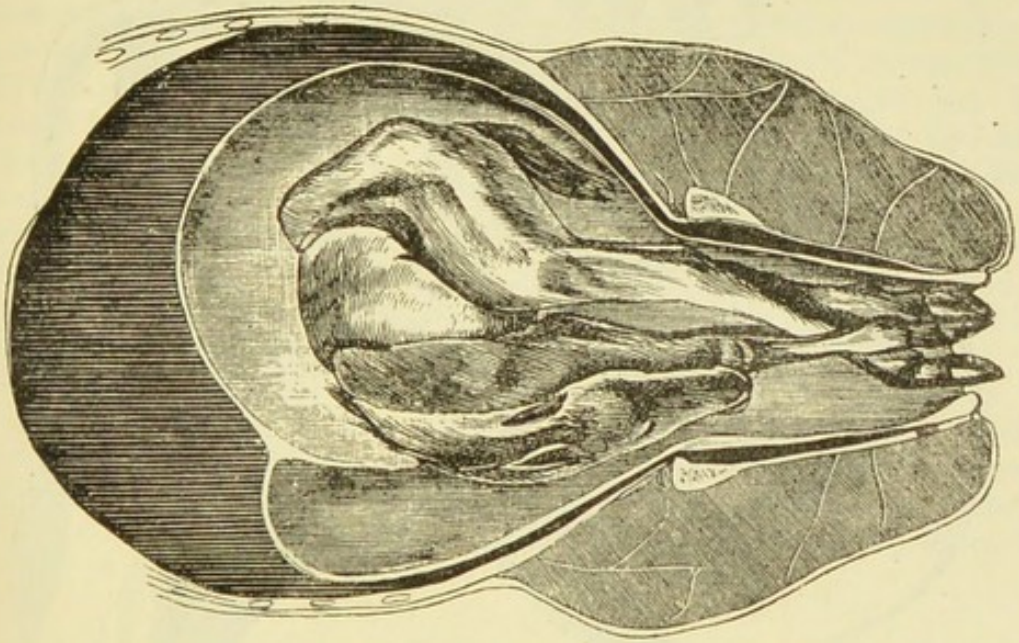

Fig. 148.

STERNO-ABDOMINAL PRESENTATION, HEAD AND FEET ENGAGED: FOAL.

uterus as far as possible, can touch nothing, even with the tips of the fingers, except the belly or sternum of the fœtus; or pushing the hand obliquely to one side of the cavity, the stifles may be felt, and on the other side the elbows. This may be all that can be discovered of the position, owing to the fœtus being curved and the limbs and neck bent in different directions; so that the difficulty in arriving at a correct notion as to the state of affairs is much greater than in the dorso-lumbar presentation. In the Cow, however, owing to the wider abdomen, the fœtus being also shorter, the latter is nearer the inlet, and therefore more accessible to the hand.

It is generally admitted that this presentation is one of the most difficult and serious the obstetrist can meet with; though when the limbs can be seized it is not, as a rule, so troublesome as the dorso-lumbar presentation. In order to effect delivery, the presentation must be modified, and it is often most convenient to resort to posterior version and bring the hind-limbs into the genital canal. The two fore-

legs in the passage make the case more difficult, and one only yet more so; while it is less embarrassing if all four limbs come together, or two hind ones and a fore one. This statement is made on the understanding that the presentation is either altogether transverse, or, if oblique, that the hind-quarters of the fœtus are nearest the inlet; but if the anterior part of the body is nearest, and if the head is engaged, or can be easily brought into the passage, the fore-legs there are an advantage to the operator, while the hind ones present at the same time would be baffling.

When the limbs cannot be laid hold of, the skill of the obstetrist is most severely taxed, and all the more if much time has elapsed since parturition commenced and amateurs have been at work.

Indications.—It has just been remarked that posterior version is most

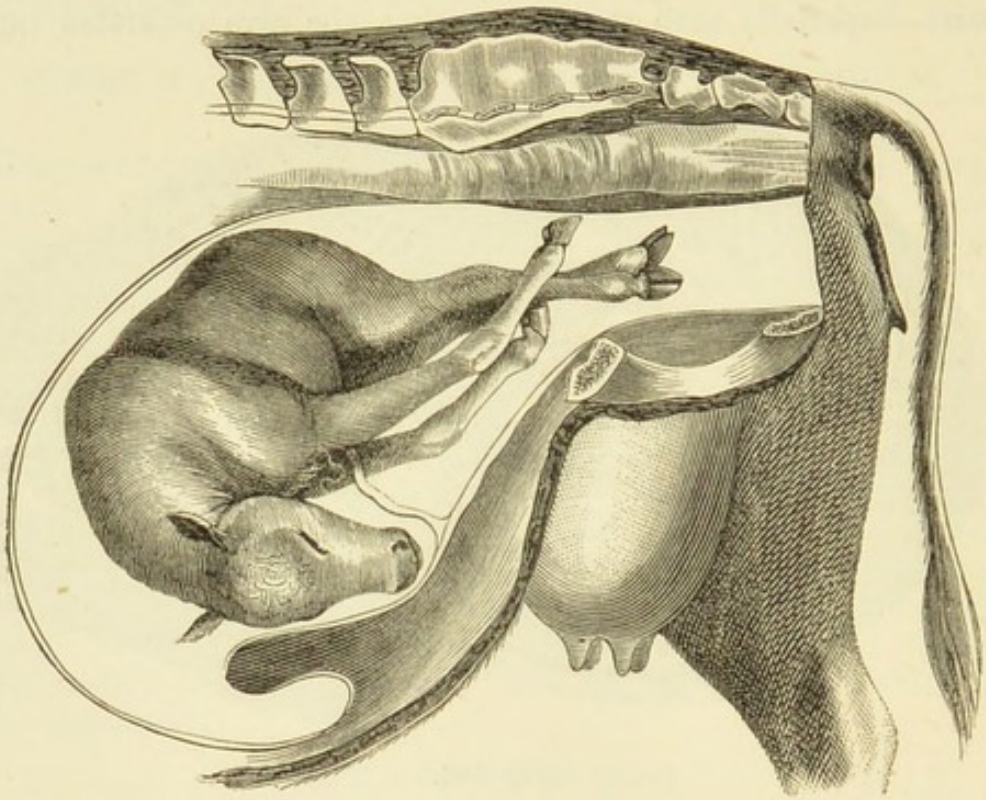

Fig. 149.

Sterno-Abdominal Presentation, Hind Limbs most advanced, Head retained: Calf.

favourable for delivery in this presentation, and with this object in view, the hind-limbs should be secured and corded at the pasterns—even one limb is often sufficient if the other is not attainable. Should the head be engaged, it must be pushed as far into the uterus as possible, and if the fore-limbs are likewise present they must also be repelled. This retropulsion is comparatively easy when there is plenty of room and the straining is not very severe; but in the Mare it is often the opposite, and some authorities assert that it is impossible or very dangerous to push the fore-limbs into the uterus, while others declare that it can be done if the repeller be employed. If they cannot be pushed into the uterus, then they must be amputated at the knee, elbow, or shoulder, and the fore-part of the fœtus thrust forward while traction is made on the hind-limbs; gradually these approach the vulva and pass through it, the hind-quarters follow—the body being

very often in the lumbo-ilial position, when it can now be changed into the lumbo-sacral. In order to prevent the hind-quarters jamming against the maternal ilium, the traction on the hind-limbs should be oblique—from right to left or left to right, according to the position of the fœtus—when bringing it into the inlet.

When the hind-quarters are too distant to be brought first into the inlet, then anterior version should be tried. The hind-legs are pushed into the uterus—though the fœtus may be delivered with one, or even both of these, flexed under the body—but it is well to have them corded before retropulsion is attempted. The head and fore-limbs should also be corded, and knots ought to be made on all the cords used in order to distinguish the parts to which they are attached. Then, while traction is made on the head and fore-limbs, the croup should be pushed forwards into the uterus; if the head cannot be got into a proper direction it, or one of the hind-legs on the side opposite to it, must be amputated. If the fœtus cannot be extracted from the uterus without risk of bringing that organ with it, then—provided the chest and abdomen can be reached—evisceration should be resorted to.

In those not infrequent cases in which the fœtus has the limbs doubled against the body, and can only be touched with the tips of the fingers, the hind-quarters of the mother should be lowered by placing her on a sloping floor—on the back if necessary; an assistant then manipulates the fœtus through the abdominal wall, so as to move it towards the inlet, where one or more of its limbs may be secured, and one or two repellers—or a repeller and crotchet—might now be utilized to effect either anterior or posterior version.

It must not be forgotten that, in some instances, the uterus itself in this presentation offers a serious obstacle to delivery, when its mucous membrane forms folds or bands towards the os, which prevent access to its interior, and imprison the limbs of the fœtus. Through these the hand must pass, and in trying to smooth or lay them down the legs must be freed.

Cephalo-Sacral Position.

In the sterno-abdominal presentation, this position is said to be less frequently noted than the last, and of the cases reported the greater number occurred in Mares. The fœtus is more or less in a sitting posture, the breech being towards the floor of the abdomen, and the withers and head in the direction of the sacrum, or to one of its sides. All the limbs are usually in the genital canal, and they may extend to or beyond the vulva, the soles of the hoofs being inclined downwards, though it may happen that only two or three are visible. When all protrude equally, it is evident that the position of the fœtus is vertical; but should the two fore or the two hind limbs project most, then the position is oblique.

It has been found that the fœtus nearly always succumbs in this position, though the mother may be saved.

Indications.—Here again version must be resorted to, and this should be posterior when all the limbs, or only the hind ones, protrude; the fore-limbs must be entirely, or to a great extent, pushed forward into the uterus, or, if that cannot be done, amputated at the knees or elbow-joints—if possible at the shoulders—then traction on the hind-limbs will complete delivery.

Should the fore-limbs be most advanced, anterior version must be attempted—this will bring the fœtus into the dorso-sacral position; but it is a troublesome operation, and necessitates retropulsion of the hind-limbs, or their removal wholly or partially, as well as straightening the head and neck. If neither of these measures appears advisable, the fore-limbs may be entirely removed or amputated at the elbow-joints, and posterior version adopted; evisceration of the fœtus, by diminishing its volume, will facilitate delivery.

A *cephalo-abdominal* position—vertical sterno-abdominal presentation—has been described, but it must be exceedingly rare, and the remarks that have been made with regard to the cephalo-sacral position are equally applicable to this.

A *lateral* or *costal* presentation has also been noticed by several writers. In this the fœtus, having the limbs doubled under the body, presents at the inlet by one of its sides, as it lies horizontally on its chest and abdomen. The limbs are more or less accessible to the operator, and therefore the mode of extraction is obvious after what has been said of the other presentations.

BOOK III.

OBSTETRICAL OPERATIONS.

In the various malpresentations and malpositions, as well as for the other causes of dystokia already enumerated, the indications for rectification and extraction were alluded to and described at sufficient length, and the means to be adopted for carrying them out were likewise mentioned. It was shown that, in many cases, it is sufficient to correct the abnormal presentation or position, and rectify the deviation of limbs, neck, or head, to effect delivery in the ordinary manner by means of the hand alone. For, as has well been said, the practised hand is the best and most perfect of all instruments, and it can effect in obstetrical operations what no instrument is competent to achieve. Therefore it is that an operator with a long and powerful arm, and a small hand with strong fingers, possesses many advantages as an obstetrist, and is in a better position to afford relief than one with a short arm and large hand—especially in the correction of those deviations which are so frequent, and oftentimes so baffling.

Extraction by the hand alone may be effected in many cases of difficult parturition, when these rectifications have been made; though even then it is essential that the os uteri be fully dilated, the vagina and vulva dilatable, and sufficiently prepared to allow the young creature to pass through; it is likewise necessary that such a relationship in proportions should exist between the volume of the fœtus and the capacity of the pelvis, that extraction can be accomplished without much difficulty. Finally, it is particularly desirable that the uterus retain its contractile power, and that its regular contractions should second the efforts of the operator.

In only too many cases of dystokia, however, one or more of these conditions are absent, and the unaided hand—no matter whether it be ever so well endowed and practised—fails to effect delivery; so that, in order to overcome the difficulties, recourse must be had to various surgical instruments and appliances, and there must be performed, either on the mother or fœtus, more or less complicated and serious operations which demand strength, expertness, and an accurate knowledge of anatomy and physiology, and even of mechanics, in addition to a thorough acquaintance with surgical pathology. Some of the obstetrical operations have been alluded to; but it is necessary to study them as a whole, in order to master their special features, and particularly the manner in which they are to be performed, as upon the exactness of our knowledge with regard to them will generally depend their successful results.

These operations have for their object either to supplement the forces of Nature, which are insufficient to secure the birth of the young creature; to rectify its presentation or position; to diminish its size when it is either too large, too deformed, or too deviated or distorted, to pass through the maternal passages; to enlarge the latter, or to extract the fœtus by an artificial passage when these last do not admit of extraction. This leads to a consideration of: (1) *Preliminary precautions and operations;* (2) *Rectification of presentations and positions of the fœtus;* (3) *Mechanical means for the extraction of the fœtus;* (4) *Embryotomy;* (5) *Vaginal hysterotomy;* (6) *Cæsarian section;*

(7) *Symphysiotomy*; (8) *Artificial premature birth*; (9) *Supplementary observations regarding mother and progeny*. In several of these the obstetrist requires the aid of assistants, who only too often have to be instructed in the part they are called upon to perform at the very moment their services are required.

Not only this, but far too frequently the veterinary surgeon is not called in sufficiently early, and the delay, and perchance the maltreatment to which the parturient animal has been subjected by unskilled attendants, has resulted in most serious complications, which the most competent assistants can afford little service in remedying.

CHAPTER I.

Preliminary Precautions and Operations.

A FEW observations may be made on certain precautions and operations which have to be attended to before any active measures are adopted in cases of dystokia. And first as to the animal which is to be handled.

With the larger creatures, and especially the Mare, the position of the veterinary surgeon immediately behind the posterior limbs might be considered perilous, did we not know that the most irritable and vicious animals are generally rendered tractable by the parturient pains; and even the hand and arm introduced into the vagina, instead of provoking resentment, appear only to increase the expulsive straining. But it is sometimes necessary to have a strong assistant to hold up a fore-foot—in the case of the Mare—while the hand is being passed into the genital canal. And while manipulation is going on it is advisable that the Mare's head should be held by a person the animal is accustomed to; while a strong man on one side of the hind-quarters steadies this part with one hand and holds the tail aside with the other, and another on the opposite side also steadies the quarter with one hand, and the other hand pinches the loins when the Mare attempts to strain or be restless.

But it sometimes happens that a twitch has to be applied to the nose, or side-lines or hopples put on the legs; for the Mare is, as has been already remarked, very often a most troublesome and dangerous animal to deal with, and unsteady in the extreme. Not so the Cow, which rarely requires any more constraint than a person holding the nose and horn; though it is advantageous to have a man on each side to act in the same manner as for the Mare.

Obstetrical manipulations are usually effected while the larger animals are standing, and this is undoubtedly the most convenient position. But it not infrequently happens that the veterinary surgeon is called when the animal has been in labour for many hours, and perhaps been roughly handled by novices; so that, being exhausted, it has assumed the recumbent position, and is disinclined to get up. This is more especially the case with the Cow, for the Mare can generally be induced to arise by mild persuasion; and it has been found that the sight of a dog will cause the first-named animal to start up when other means fail.

But it may be that the creature really cannot arise, or if it gets up it cannot stand; then the operator has to do as he best can while it is

recumbent, and must kneel, or even assume the horizontal position. With regard to the animal itself, the lateral and ventral positions are very unfavourable, because of compression of the abdomen, which greatly hinders manipulation and interferes with delivery. To obviate this, the animal ought to be placed on its back, and kept in that position by having previously had the feet brought together by means of a rope or hopples, and tying another rope to these by which assistants can steady the body; a truss of straw placed close on each side of the back will greatly aid in securing this position. In some cases it is most advantageous to have the front-part of the body raised by litter, so as to bring the fœtus nearer the pelvic cavity; in other cases it may be equally advantageous to have the hind-quarters raised either by litter or by suspension, the hind-feet being fastened together by a rope, the end of which is passed over a beam and pulled until the required elevation is obtained. This raising of the hind-quarters has been successfully employed, as we have remarked, in reducing torsion of the uterus; and it has been no less useful in cases of dystokia due to bending back of the head or neck of the fœtus.

Cases are met with now and again in which it is desirable to place the animal in the recumbent position, and then the greatest care is necessary to prevent its being injured in laying it down.

The Cow has been placed on its side by passing a bed-sheet, folded lengthways two or three times, beneath the abdomen, in front of the udder, two men holding each end and lifting up as if to carry the animal off its feet; the Cow immediately turns on its side and the hind-quarters fall softly on the litter, but the sheet must be kept tense. Another plan is almost as simple: A long rope is provided, with a noose at one end; this is passed around the horns, the rope is carried along the ridge of the neck, and a turn is made around the shoulders, another behind the shoulders, and a third around the abdomen, the rope being then brought along the sacrum. A slow and steadily increasing pull is made upon it, and the animal soon bends the fore-legs, then the hind ones, and lies down in the most gentle manner.

Sheep and Pigs are generally recumbent, and the operator has to kneel; but they are more easily handled than the Cow or Mare.

Dogs and Cats are also readily managed, and can be placed upon a bench or table, and moved about to any position required without restraint.

When about to deal with a case of dystokia, the practitioner has, of course, first ascertained its history, and satisfied himself as to the general condition of the animal before commencing his exploration. With the larger animals it is necessary that he divest himself of some of his upper garments—how many will depend upon the nature of the case; it may suffice to remove the coat and vest, and roll up the shirt-sleeves, or it may demand removal of everything save under-vest and trousers; indeed, for such cases it is well to be provided with a long sleeveless blouse, fastened round the waist by means of a band, and a pair of waterproof trousers.

Before introducing the hand and arm into the genital canal, they should be covered with olive-oil or grease, in order not only to facilitate their introduction, but to protect the operator against septic infection. It is very fortunate for him if he can use both hands alike, as the left hand is sometimes more convenient than the right, and in tedious operations the one relieves the other. The fingers are brought together

in cone-shape, and pushed into the vulva gently, then into the vagina, with a slight rotatory motion, while the animal is not straining; should it strain, the hand must not be pushed on, but wait until the animal is again quiet. In this way the vagina is explored, and if necessary the hand is carried into the uterus, should there be no obstruction. A careful exploration makes the practitioner acquainted with the state of affairs—the condition of the genital canal and the presentation and position of the fœtus, if the membranes are ruptured, as they nearly always are—and allows a diagnosis to be formed, from which indications for treatment can be arrived at.

It should not be necessary to add that all this procedure—much of which has also to be observed in cases of maternal dystokia—ought to be carried out carefully and methodically, and without undue haste; and to accomplish it satisfactorily a perfect knowledge of the obstetrical anatomy of both mother and fœtus—familiar to the hand no less than to the mind—is of the greatest value.

Mention has already been made of the necessity for employing some bland emollient fluid with which to lubricate the genital canal when this has become dry; as owing to the "waters" having escaped for some time, the uterus is applied close to the fœtus—which may have made some progress towards expulsion—and much manipulation may have already taken place before the arrival of the practitioner. Any oily or mucilaginous fluid will answer the purpose, but perhaps the best of all is what is known as "linseed tea," or "linseed jelly," mixed with some oil—olive to be preferred. When there is not time to prepare this, it has been found very serviceable to inject first a few ounces of oil, then tepid water, and, finally, another quantity of oil. The chief thing to be observed is to inject a sufficiency—say two or three gallons for the larger females, and from a few ounces to a pint for the smaller.

If the manipulations are long continued, it may be necessary to repeat the injection, and for the Cow or Mare it is most advantageous to introduce a long piece of india-rubber tubing well into the uterus, and inject the fluid through this by putting the nozzle of the syringe into the outer end. When neither syringe nor tubing is available, a bottle may be used, and in this case raising the hind-quarters of the animal will facilitate the introduction of the lubricant.

With the smaller animals much benefit is often derived from immersing the hind-quarters, or even the whole of the body, in warm water for some time, as this tends to relax the parts.

The expulsive efforts of parturient animals, and especially the Mare, when violent, are generally a great hindrance to the operator in cases of dystokia, and sometimes prevent him from attaining success in delivery. To modify, or partially or completely suspend them for even a short period, may be of the greatest service; so that various measures have been resorted to in these cases—such as, for the Mare, a twitch on the nose, and for the Cow, pinching the nasal septum, pressing on the loins, or raising the hind-quarters. Causing the Mare to walk on soft sloping ground or in a straw-yard, and not allowing it to stop, has been found to allay the pains for a sufficiently long period to allow what was required to be done.

The administration of narcotics is also frequently adopted with this object, and anæsthesia by ether or chloroform has been found of great service with the Mare. It is seldom necessary to place the animal in the recumbent position, as complete insensibility is not required—

indeed, is not desirable; for partial unconsciousness will allay the excitement and abnormal straining, but will not suspend the uterine contractions. The chloroform may be inhaled from a piece of sponge or lint placed in a basin or similar vessel and held under the animal's nostrils, a blanket being thrown over the head to keep in the vapour; or the sponge may be laid at the bottom of a nose-bag put on the head. The anæsthetic should be inhaled until the introduction of the hand into the vagina or uterus no longer excites the severe straining. Partial narcosis might also be tried in some difficult cases of parturition in the Cow, but then it must be remembered that in the event of slaughter the flesh will have the odour of the drug. With the smaller animals the production of this condition is often beneficial.

We will now consider the principal mutation movements required to effect a change in the position of the fœtus.

CHAPTER II.

Rectification of Presentations and Positions of the Fœtus.

We have seen how numerous and varied are the presentations and positions of the fœtus, and how, in order to effect delivery, some of these must be changed or modified; this can only be done by moving the fœtus itself, and so altering its relations to the adjacent parts of the mother. These movements are sometimes designated *mutations* by obstetrists, and the procedure necessary to effect them varies with circumstances; sometimes, for instance, the object may be achieved by merely altering the position of the parturient animal, or by sustaining its abdomen and manipulating externally; but in the great majority of cases it is necessary to introduce the hand into the genital canal, and operate directly on the fœtus.

The principal of these mutation movements are four in number: *Retropulsion*, *Rotation*, *Version*, and *Extension* and *Flexion*.

In order, however, that these movements may be effected, certain conditions are necessary. In the first place, it is essential that the os uteri be sufficiently dilated, or relaxed and extensible, so that the hand may reach the interior of the uterus; next, the body of the fœtus must be movable in the uterus—a circumstance not always noted, as the organ is often contracted closely on the fœtus when the liquor amnii has escaped, or the fœtus itself may be fixed in the genital canal. And, finally, the fœtal envelopes must be ruptured, as it is impossible to manipulate the young creature effectively while it is entirely invested by them.

Before any alteration in the presentation or position of the fœtus can be accomplished, these conditions must be assured.

Retropulsion.

When the fœtus, in a vicious position, has entered the pelvic cavity and become fixed there, or even when in the uterus and approaching the inlet, before the position can be corrected it is nearly always necessary to push the creature forward again into the uterus; as there only, from the greater space this organ affords, and the elasticity of its walls, can the impediment be overcome and adjustment effected.

"Retropulsion" is often necessary during protracted labour, even

when the fœtus is in a good position, to enable the obstetrist to attach cords to the limbs or some part of the head or body.

In the anterior presentation, for instance, the fore-limbs have often to be pushed forward from the pelvic cavity, in order that the operator's arm may find room to search for and seize the head; or the latter has to be pushed into the uterus to allow the limbs to be felt for; and even in this presentation retropulsion of the hinder limbs may be necessary. This procedure may also have to be adopted in the posterior presentation when these limbs are flexed in the uterus, and the body has to be pressed forward as far as possible, so that they may be extended and brought into the pelvic inlet; while it is also advantageous in transverse presentations when version has to be attempted.

This retropulsion is sometimes easy, at other times it is most difficult and laborious, and in certain cases it may even be altogether impossible.

The most favourable attitude for performing this operation, in the larger animals at least, is undoubtedly the standing one; but the body of the animal should not be perfectly horizontal, for a great advantage will be derived by raising the hind-quarters to a considerable degree, as we thereby throw the uterus and its contents forward, and away from the pelvic inlet. This elevation may be effected by straw or litter placed under the animal's hind-feet. In order to obtain this inclination promptly, the Cow may be made to kneel, two assistants keeping the fore-limbs flexed, while other two maintain the hind-quarters in an upright position.

When the animal is recumbent and cannot be induced to rise, there is little, if anything, to be gained by raising and supporting it by means of slings or other appliances; as the pressure which these produce on the abdomen opposes the manœuvres we have mentioned. Not unfrequently the sight of a strange dog, as has been mentioned, will cause the animal to get up.

When, however, the Mare or Cow is exhausted, and it would be injudicious or impossible to make it stand, then manipulation must be attempted in the recumbent posture. When this is decided upon, in the great majority of cases it will be found that a considerable advantage will be obtained by placing the animal on its back, propping it up in this position with trusses of straw placed on each side, and raising the croup by introducing another truss beneath the hind-quarters.

With regard to the smaller animals, such as the Bitch, they can be placed on their back on a table, and an assistant will raise the pelvis as high as may be deemed necessary. Retropulsion of the fœtus may be effected with the hand in the large animals, the operator supporting himself firmly on his legs; but the arm must be strong, and very often it has to be engaged in the genital canal as high as the shoulder. It may sometimes happen that both hands have to be employed as repellers, and the body of the operator pushed forward by assistants.

Seeing the difficulties attending this operation, and finding that the hand and arm are not always sufficient, Continental veterinarians have for a long time resorted to a "crutch" or "repeller" (French, *repoussoir;* German, *Geburtskrücke*), in conjunction with the hand.

This instrument is of iron, and is between two and three feet in length; it has a handle at one end, and a concave transverse piece, like the head of a crutch, at the other. This piece may be either solid or jointed (Figs. 150, 151, 152, 153). Provided the latter is sufficiently

strong at the joints, it possesses advantages over the solid instrument, the principal of which is its easier introduction into the vagina and uterus. The crutch end being carefully carried by one hand through

Fig. 150. Solid Repeller, with a Removable Spike.

Fig. 151. Simple-jointed Repeller.

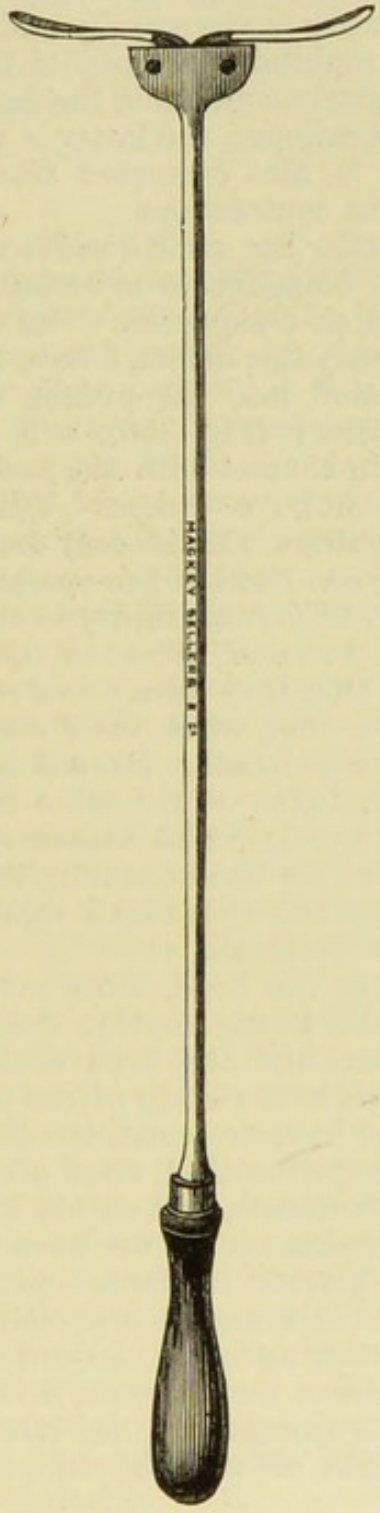

Fig. 152. Jointed Repeller: Open.

Fig. 153. Jointed Repeller: Closed.

the genital canal, towards the fœtus, is applied to the most convenient part of the latter; while the handle is seized in the other hand, and propulsion effected either by this hand, the breast of the operator, or by an assistant.

Many authorities speak very highly of this instrument, from the fact that it permits the displacement of the fœtus much further forward than the hand alone can effect, and thus allows a wider space between the pelvic inlet and the body of the young creature; consequently, adjustment of the latter is more easily and promptly accomplished.

An assistant can maintain the body of the fœtus some distance from the pelvis by this instrument, while the hand of the operator is making the necessary rectifications; the latter is therefore much relieved, and to some extent he is also exempted from the difficulty and fatigue caused by the uterine contractions.

The ordinary repeller has some disadvantages, the greatest of which, perhaps, is its being inapplicable to certain regions of the fœtus which may chance to be in an oblique line to its direction—such as the head, limbs, etc. To remedy this defect, I have added a short, pointed spike, which can be screwed into the middle of the crutch, opposite the handle, when necessary (Fig. 150), and this effectually prevents its slipping; the part in contact with the fœtus, when provided with this tooth or spike, resembles a trident. While the instrument is being employed—all propulsion should only be made during the intervals between the pains—one hand of the operator must guide and maintain it against the fœtus, to prevent injury to the maternal organs.

Some authorities, however, object to the employment of the repeller—or, rather, assert that they have never required its services. Brunet and Shaack observe that when their own strength is not sufficient, they are aided by an assistant. Brunet has the hand and arm of the latter acting on the fœtus at the same time as his own—both arms being in the genital canal; while Shaack gets his assistant to seize his right arm with one of his hands, resting the other on his left shoulder, and pushing him forward—Schaack's right arm and hand in this way playing the part of the crutch.

In order to propel the head, Binz invented an instrument like a goblet, furnished with a long handle; the hollow portion fitted on the muzzle of the fœtus, and the head could then be pushed forward. Solid rods to be fixed to the limbs of the fœtus, in order to push them out of the way, have been proposed, but their utility is questionable.

It must not be forgotten that, after all, the hand is the safest and most perfect of instruments, and should always be preferred—at least at first—to such appliances as we have described. For it *feels* the parts on which it is placed; it adapts itself more exactly to the surfaces with which it comes in contact; it perceives the resistance they offer, and warns the operator as to the amount of force necessary to effect a certain object; whereas the presence of a hard and rigid instrument increases the uterine contractions, and however well adapted it may be, it may suddenly glide off rounded and slippery surfaces, and cause serious injury.

Nevertheless, there may be, and often are, occasions when the hand cannot accomplish what is necessary in the way of retropulsion, and it is then that the repeller may be most useful; it will generally be found quite safe when employed by a careful and experienced operator.

The spasmodic contraction of the uterus, especially during the labour pains, is a great obstacle to every kind of manipulation in the interior of the organ; the way to subdue them has been referred to.

Retropulsion, as we have said, should only be effected in the

intervals between the "pains"; though during these the expulsive efforts should be resisted, so that what has been accomplished may not be lost. The propulsion should be done by *jerks*, which are far more effective than a continuous push, and they are not productive of any inconvenience.

It is nearly always necessary to secure some part of the fœtus which is to be repelled—head or limbs—by cords, so that it may be readily seized again and brought into the pelvic cavity. This will be alluded to presently.

Rotation.

"Rotation" of the fœtus consists in turning it more or less round its longitudinal axis, with the view of changing the relation between the presenting parts and the maternal pelvis, or modifying the *position* without interfering with the *presentation*. It is required occasionally in all the domestic female animals, and most frequently in the Cow, when the greatest diameter of the fœtus is presented to the smaller diameter of the pelvic cavity, as in the majority of the lateral positions.

After pushing away the body of the fœtus—but not its limbs, if they are well placed—from the pelvic inlet, the hand and fore-arm are introduced in *supination* and well forward between the body of the young creature and the floor of the uterus; then resting the arm on the pubis, it is employed as a lever in raising and turning the part of the fœtus in hand to the right or left, as may be. If the young creature is alive, this manœuvre is much more easily executed than when it is dead, as it seconds the effort. Boutrolle advises that the abdomen of the mother be raised by means of a girth or folded blanket, while rotation is being effected; and other authorities have recommended the employment of a lever between the fœtus and the uterus to effect this turning. Rainard recommends, when the limbs are in the pelvis, to tie them together, draw them beyond the vulva, put a piece of stick or any other convenient article between them, and to use this as a kind of lever to turn the body of the fœtus round to the necessary extent; or, which is preferable—as in the latter operation the limbs of the young animal may be seriously injured—to give the limbs to an assistant who, acting under instructions from the operator, turns them one over the other in a kind of twisting and swinging manner, in the direction indicated by the operator, whose efforts are in this way greatly assisted.

The operation of rotation is completed when the greatest diameter of the fœtus is coincident with the sacro-pubic diameter of the pelvic inlet—a right or left vertebro-ilial position, for example, being transformed into a vertebro-sacral position.

This modification need not always be so complete, and it frequently suffices to convert a lateral position into an oblique one, by making the dorso-sternal diameter of the fœtus correspond to the oblique diameter of the inlet—measuring this from the supra-cotyloid crest of one side to the sacro-iliac articulation of the other. The same observation is applicable to posterior presentations.

Version.

"Version," or "turning," in veterinary obstetrics signifies effecting a *change of presentation*, or, in other words, bringing towards the inlet a part of the fœtus other than that which presented spontaneously, and thus correcting a faulty presentation.

A longitudinal presentation is that in which spontaneous birth can be alone effected; transverse presentations render birth impossible, and these, consequently, give rise to dystokia. Version is therefore indicated in all transverse presentations, no matter what region of the body may first offer at the pelvic inlet; it may even be required in certain forms of anterior or posterior presentation; and in all cases it is necessary to repel the presenting part, so as to bring one or other of the ends of the oval mass formed by the body of the fœtus to the pelvic inlet.

Hence we have two kinds of version: one which has for its object the movement of the head of the fœtus towards the pelvic inlet—*anterior* or *cephalic version;* and the other the posterior part of the body to the same opening—*posterior* or *pelvic version*, corresponding to the *podalic version* in human obstetrics. Each of these versions has its advantages and disadvantages, according to circumstances; though the majority of authorities prefer *pelvic version*, for the simple reason that with this there are two mere appendages to care for—the hind-limbs, to which it is comparatively easy to give a good direction; while in *cephalic version* there are not only the fore-limbs to attend to, but also the head and neck, the unfavourable direction of which may give rise to much trouble in delivery.

Version can only be effected in the uterine cavity, and when the uterus is entirely in the abdomen; so if any portion of the fœtus has entered the inlet, retropulsion must be resorted to. Then the operation can be commenced. It is divided into two principal movements: *Repulsion* and *Evolution.*

In these manœuvres, the veterinary obstetrist, as in so many other instances, has not the advantages which the *accoucheur* of woman possesses with regard to manipulation, and especially that which can be practised outside the abdominal walls in conjunction with the version movements in the uterus.

Repulsion.—The hand—usually the right—being introduced into the uterus, reaches the presenting part of the fœtus, and by a succession of forcible pushes, moves it away from the inlet—in fact propels it; though this retropulsion should not be made directly forward, but *obliquely*, so as to press the region we desire to get rid of upward, downward, or to either side, according to circumstances. In this way, the opposite parts glide over the uterine walls—previously lubricated: they move round towards the hand, and are more easily reached.

Evolution.—When the parts which are sought for reach the hand, they are firmly seized by the operator and drawn towards him. The uterine contractions assist in this operation, the version movement is continued, the fœtus becomes lengthened, as it were, and unfolded, and when its larger diameter is brought into the axis of the pelvis the manœuvre is completed.

Version is not always successful when first attempted; indeed, it has often to be relinquished and again tried, until successful—notwithstanding the fatigue and demands on patience these repeated efforts entail.

Complete version is required in the transverse position of the fœtus, and is generally difficult; it, and indeed all degrees of turning, and all vicious positions of the fœtus, demands that the first thing to be done is to secure the most useful parts which present—as the limbs or head—by cords or other appliances, so as to be able to find and utilise them again if circumstances require that they should be used to assist in

delivery. Very frequently traction on one or more of these cords, and the manipulations of a hand in the uterus, will greatly facilitate turning.

As in so many other obstetrical operations, undue haste and violence are to be guarded against in these mutations, and gentleness, patience, and perseverance should be observed. We not unfrequently find that, when the presentation is anterior or posterior, and the limbs are in a favourable direction, though the body of the fœtus may be somewhat inclined to the right or left, the uterine contractions are sufficient to effect adjustment, gradual and well-directed traction being alone required from the operator.

Extension and Flexion.

Independently of the *general mutations* which have for their object the movement of the whole mass of the fœtus in the uterus, it is sometimes only required to resort to *partial mutations*—as in the adjustment of one or more of the limbs, head, neck, etc., these consisting of *extension* —as when the arm is extended on the shoulder, the fore-arm on the arm, the head on the neck, the latter on the trunk, etc., and *flexion*, in bending the various articulations—as those of the limbs, in order to place them or the body in a better direction ; and *rotation*. In all these manœuvres a rudimentary knowledge of mechanics will be of great advantage, and especially that pertaining to levers, which is particularly applicable to manipulations of the limbs that so frequently prove of the greatest service in obstetrical operations.

It only too often happens that the arm of the obstetrist is found to be sadly too short in version and other manœuvres, and these are consequently rendered more difficult of accomplishment. With regard to this, it is well to point out—what is not always known—that the obstetrist should always employ the arm corresponding to the side of the fœtus on which the limb, the part sought for or to be manipulated, is situated. For instance, if the fœtus is in the anterior presentation and dorso-sacral position, with the head bent round towards the left flank, or the left fore-limb (right hind-limb in a posterior presentation) doubled under the body, he will use his right arm ; but the left will be employed in the opposite conditions. By doing so, the operator gains in length of arm, particularly towards the shoulder, and can consequently reach deeper into the uterus.

Flexion and extension of a limb are often made simultaneously, and it sometimes happens that in extending such a part as the head to straighten it, it effects its own rotation. Extension alone serves to bring the limbs from under the chest or abdomen ; flexion is rarely resorted to, and chiefly when it is desired to return an extended limb again into the uterus. In these operations on the limbs, when the weight of the fœtus is an obstacle, the body of the creature is inclined to the side opposite to that of the limb to be manipulated ; thus, if the right limb is flexed under the body, and we desire to extend it, the fœtus is inclined from right to left, so that the right side being raised, the limb can be taken from under it. The body is turned in the way indicated for *rotation*.

We have casually alluded to the attitude of the larger animals during version, retropulsion, and rotation, and pointed out the advantage to be derived from elevating the hind-quarters, either by placing litter under the hind-feet, or causing the animal, if a Cow, to kneel on its knees. And we have also remarked that it is not always possible to obtain the

desired attitude, but that these manœuvres must sometimes be performed when the animal is recumbent. It may even happen that it will be advantageous to place the animal in a recumbent position. Leconte strongly recommends laying it on its sternum, and flexing the fore and hind limbs under the body; as in this attitude the uterine cavity can be more easily explored, and the necessary alterations made in the position of the fœtus—the operator lying extended behind the animal. Some obstetrists place the animal on the right or left side, the operator lying on either of his sides, according to the arm he intends to use.

Throwing down an animal for this purpose is always, however, to be avoided if possible; and if it is already down, it should either be placed on its sternum or compelled to get up. When the uterus is lying very low in the abdomen, should the latter be extremely pendulous, or when the fœtus—as in the Cow—is fixed beneath the brim of the pelvis, it may be found very advantageous to place the parturient creature on its back.

As for the operator, he must conform his attitude to that of his patient. We have already written on this point when treating of parturition, and we have nothing to add. If the animal is standing and the hind-quarters are raised, and particularly if the obstetrist is not tall—and more especially if the patient is a Mare—the plan adopted with much success by Dickens may be followed.[1] This consists in placing the animal, if the case is likely to be protracted, under an open shed, tying the head to the manger or rack, and supporting the body by two sacks passed under the belly and attached to ropes which pass over a beam above. A partition on the right side, to prevent swerving, is preferred, the assistant being placed on the left side. Immediately behind the animal is put a strong, four-legged wooden cow-crib, which serves many purposes. Firstly, it prevents the Mare backing; secondly, the operator standing in it is perfectly safe from injury during his manipulations, while it gives him a great advantage in the elevation it affords—especially with tall animals; thirdly, it forms a convenient stage whereon to place cords, instruments, medicinal agents, etc.

We will briefly notice some of the occasions when these movements have to be effected, though reference may have been made to one or two of them already.

Extension or Straightening of the Head and Neck.—This is resorted to when these are not in a proper direction, and the fœtus must always be pushed into the abdomen in order to carry out the operation.

The *head may be flexed at the occiput*, so that the chin is applied to the lower border of the neck, and if it has not entered the pelvis and can be moved somewhat, extension is easily effected by passing the hand into the cavity, insinuating it between the pubis and the forehead of the fœtus until the nose is in the hollow palm, with the fingers if possible under the chin, or the thumb in the mouth and the fingers in the intermaxillary space; then it is lifted sideways above the margin of the pubis, when it can be brought straight into the genital canal by gentle traction.

When the neck has entered the pelvic inlet, then it is imperative that it be pushed into the abdominal cavity; before this is attempted, however, cords should be passed round the fore-feet (though these are not to be pulled at first), and another around the neck of the lower jaw or the under part of the head; this cord the operator holds in one hand or

[1] *Veterinarian*, vol. xxxiv., p. 260.

gives to an assistant, while he presses the neck forwards and to one side, raising the nose by means of the cord and hand when there is sufficient room.

An exaggerated and more difficult form of this condition is the *head and neck flexed beneath the chest*, but it can be remedied if the labour has not been protracted. The lower jaw should first be corded, the cord being pulled by an assistant while the operator pushes the body back until the head is somewhat relieved, when the propulsion ceases, and the hand seizes the lower part of the head and raises it and the forehead; and so pushing away the body and guiding the head alternately, the latter is brought into the canal. When, however, the practitioner is not called in—which is usually the case—until after the waters have escaped some time, attempts have been made at delivery by amateurs, the genital passage is dry, and the uterus is applied close on the fœtus, then adjustment of the head and neck is a serious affair; as the prolonged straining and pulling have put the head farther beyond reach—pushed even beneath its abdomen; so that the tips of the fingers can scarcely touch the nose, much less grasp it, while the contractions of the uterus—closely enveloping the fœtus—paralyse the arm, which has to be bent downwards in search of the head. In such a case retropulsion is futile, and the first thing to be done is to inject a large quantity of strained linseed-jelly, or some other mucilaginous fluid, into the uterine cavity, to compensate for the absence of the waters—unless it be decided to place the animal on its back, which is decidedly advantageous in this embarrassing case, when the injection should not be administered until the animal is cast. Having had the passage well lubricated and the uterus separated from the fœtus, this may now have the fore-legs secured by cords, and the front-part of the body pushed forward, downwards, or sideways, so as to reach the head, which may be seized by the ears, orbits, or lips, until the neck of the lower jaw can be grasped and corded, when, with steady manipulation and traction, the head and neck can be adjusted. Pulling at the limbs, then pushing the body forwards, so as to effect displacement of some kind, will often assist the operator when the head is beyond his hand. Such cases in the Mare are nearly always impossible to rectify, and even in the Cow they are most formidable, and not always satisfactory in their termination.

When the head is bent upwards and backwards—the opposite condition to the last—somewhat similar measures must be adopted. The fore-limbs should be corded, as well as the neck of the lower jaw if it can be reached. Then the body is to be pushed away from the brim of the pelvis—employing mucilaginous injections, if necessary, before attempting this, and by means of the hand in the uterus and alternate traction on the head-cord and retropulsion, the fœtus can generally be got into a proper position for delivery.

A somewhat frequent misdirection is *the head bent round to one side*—extending to the shoulder, or even as far as the chest or flank. When only slightly inclined to one side, reposition is easily effected by seizing the lower part of the head, raising it upwards and bringing it round to the genital canal. It must not be forgotten that the hand employed to bring the head round must correspond to the side on which it lies: for instance, if the head is bent to the right, then the left hand must be used to manipulate with.

When the head is as far back as the elbow, even, it may often be

brought straight by first cording the fore-limbs, then reaching the neck of the lower jaw over the shoulder, and cording that also—retropulsion and manipulation, with traction in the intervals of the straining, will effect the rest. The case is very different, however, when the head is carried as far back as the flank or hind-quarter, and especially if the uterus is retracted on the fœtus, and the interior is dry and adhesive. In the Mare this is always a most formidable affair to deal with. Here the mucilaginous and emollient injections are indispensable, and should be at once resorted to. Then the fore-limbs must be corded, and pushed into the uterus if they are in the way (using Darreau's porte-cord if necessary), the hand passed along the convexity of the neck, and between it and the uterine wall, until the lower jaw is seized and corded. Pressure is now made on the breast of the fœtus, so as to push it away from the pelvic brim and towards the side of the uterus opposite to that on which the head lies, so as to bring this nearer to the inlet. Then the hand turns the lower jaw upwards by placing the fingers in the submaxillary space, and pulling the head round by means of the cord, the hand in the uterus keeping the body away from the pelvis and to the opposite side, as well as protecting the uterus from injury by the incisors. If there is a tendency to twisting of the neck, this must be overcome by manipulation of the head, which must be brought gradually and carefully round.

But it only too frequently happens that the hand cannot reach the head, or can only touch the ear-tips, and then the difficulty is very great—it may even be insurmountable. Various plans have been tried, such as exciting the fœtus to move if it be alive; raising the abdomen of the mother, elevating the front part of the body or placing her in the dorsal position; or implanting hooks in the fœtal orbits. But there is no certainty in any or all of these methods, and the only one which has hitherto been most successfully employed is that introduced by Delafoy, more than sixty years ago. Having satisfied himself as to the state of affairs, he passed the end of a strong rope, about twelve feet long, with a knot at the end to prevent it slipping from his hand between the neck and chest of the fœtus; this end he passed downwards, seized it at the lower side of the neck, and brought it out of the vaginal canal, so that the middle of the cord was inside the bend in the neck. Again introducing his hand into the uterus, he pushed the loop of cord by the tips of his fingers as near to the head as possible when he directed an assistant who held the two ends to twist them round and round each other, until the cord was quite tight around the part on which it was placed; at the same time his hand prevented any of the placenta or cotyledons from getting into the twists. This having been accomplished, the hand was placed on the breast or one of the shoulders of the fœtus, and while he pushed it towards the fundus of the uterus the assistant exercised steady traction on the cord. In this way, by good management the head was brought towards the cervix uteri, where it was immediately accessible, and could be placed in its normal position. A small weight of any kind attached to the end of the cord, instead of the knot, would carry it more readily between the neck and shoulder or chest, and the porte-cord might also be used to pass the cord if the hand could not be extended sufficiently far (see Binz's porte-cord).

Extension of the Limbs.—The limbs are not unfrequently a cause of difficulty in parturition, and have to be adjusted before delivery can be

effected. The difficulty is usually due to their being flexed at the knees or hocks, or completely retained in the uterus.

With regard to the *fore-limbs*, their adjustment is more difficult in the Mare than the Cow, in consequence of the different segments of the leg being longer.

When *flexed at the knees*, if they have entered the genital canal or are at the entrance to the pelvic inlet, they must be pushed forward into the uterus before they can be extended, and it may be advantageous to cord the lower jaw or head previous to this being attempted. Then the fore-arm is brought into a horizontal position, if it was not so before, the shank is seized and smartly extended on it, its lower end being adducted and the knee directed upwards and outwards, so that the pastern is opposite the inlet; the hand is now passed to the fetlock and hoof, which is held in the palm, the pastern-joints are well flexed, the lower part of the limb is pulled into the genital canal and the whole extended there. With the Calf flexion of the phalanges is not so necessary, as they are shorter than those of the Foal, and they may be immediately extended; but the hoofs should be covered by the hand to prevent laceration of the genital mucous membrane.

The other limb is adjusted in the same way, if it be at fault, and the head is then brought into the inlet by means of the cord and the guidance of the hand.

Should ~~S~~tropulsion be rendered very difficult because of the condition of the uterus, injection of mucilaginous fluid must be made, the limbs corded at the pasterns or shanks, and an assistant pull on these cords while the operator raises the knees upwards and outwards, at the same time pushing them forwards; this manipulation is alternated with attempts to bring the phalanges into the inlet by the hand, and straightening them there, at the same time guarding the maternal mucous membrane from damage by the hoofs.

When the *fore-limbs are completely retained*, the head or lower jaw is first corded, then steadily pushed forward towards the fundus of the uterus; if the fore-arm can be grasped, it is flexed, so as to bring the knee upwards, and—provided parturition has not long commenced—the lower part of the limb can be extended in the canal. But if the fore-arm cannot be firmly seized, so as to alter its direction, a cord must be passed between the leg and the body—as with the head doubled back on the side—the two ends being twisted outside and held by an assistant, while the loop around the fore-arm is brought as near to the knee as possible by the hand. Then the upper part of the leg and the body are pushed forward by pressure on the point of the shoulder, while the assistant pulls steadily on the cord until the knee is in the pelvic cavity, when the limb is extended in the manner just described (see p. 438).

With regard to the *hind-limbs*, the same remark applies as to the greater difficulty in adjusting them in the Foal than the Calf, in consequence of their greater length; and as they are proportionately longer than the fore-limbs, while the movements of the principal joints are so interdependent that one cannot be bent without influencing the others, their rectification is much more troublesome and laborious.

When the hocks present in a flexed state in the Mare, it is generally considered hopeless to attempt extension, especially as the fœtus is nearly always dead; therefore it is advisable, in order to spare the

Mare pain and exhaustion, to divide the gastrocnemii tendons, and so straighten the limbs.

With the Cow the case is not so serious, and the Calf may be delivered alive. Retropulsion of the hind-quarters and hocks is absolutely necessary; this can be effected by persistent effort and the exercise of patience, the pushing forward being done by jerks in the intervals of straining, until the fœtus has been removed some distance from the brim of the pelvis. Raising the hind-quarters of the Cow is very serviceable in this measure. Then the tibia is placed in a horizontal direction, the pastern or shank is corded—as with the fore-limb, and the hock being kept as far away as possible from the inlet, and towards the maternal flank, the lower part of the leg is carried backwards by cord and hand until it is in the canal. In doing this the operator uses the point of the calcis to push the hock, the body of the fœtus being kept obliquely, and care being taken that the points of the hocks do not damage the uterus, by covering them with the palm of the hand—a procedure which must also be adopted with the hoofs.

When the hind-limbs are retained in the maternal abdominal cavity of the Mare, the case is quite as serious as when the hocks present; but in the Cow it is not so formidable, and a similar procedure must be adopted as in the hock presentation. The body of the fœtus is propelled forward as far as possible, and the tibia is flexed on the femur, so as to bring the hocks up towards the inlet; this is not very difficult if the fœtus can be readily moved, for the hand can be then passed to the stifle and the limb drawn towards the pelvic cavity, when, seizing the tibia, this is flexed on the thigh. A cord may be passed round the thigh and brought down to the hock, or as near it as possible, in particularly difficult cases; and in propelling the buttocks into the uterine cavity the assistant steadily pulls the cord, the hand of the operator not only pushing, but also guiding the direction of the lower part of the limb and preventing injury to the uterus, until the hock has reached the inlet, when the leg should be extended in the manner before described. In this difficult and fatiguing operation, a repeller used by a second assistant will be found most valuable.

CHAPTER III.

Mechanical Means for the Extraction of the Fœtus.

Mechanical means for the extraction of the fœtus are required when the expulsive efforts of the parent, and perhaps the hand of the obstetrist, are insufficient to produce delivery. These means are employed to effect change in the position of the fœtus, or to apply force sufficient to overcome the resistance offered by the obstacle to birth; they comprise a number of articles, the chief of which are *cords* and *bands*, *halters*, *crotchets* or *hooks*, and *forceps* of various kinds. The uses and advantages of these we will now notice. But before doing this, we must again point out the great advantage, should the "waters" have escaped, and the genital canal and interior of the uterus be dry and tenacious, of moistening these parts well before resorting to mechanical operations.

SECTION I.—CORDS AND BANDS.

Cords and bands are, of all mechanical means, the most useful in veterinary obstetricy, and are more to the animal obstetrist than forceps are to the human practitioner. They have the additional advantage that they are readily procurable, are cheap, very portable, and can be employed where and when other means are inapplicable. Owing to their pliability, they can be pulled in any direction desirable, without much danger of injury to the maternal organs. In all cases of difficult parturition, it is an axiom with the experienced veterinary obstetrist that the first thing to be done is to cord the presenting limbs; or if they do not present, to seek for and cord them as soon as possible. When this is done, then they may be returned to the uterus, or put out of the way, as the cords will always bring them to hand again when required. While they are admirably adapted for exercising traction upon the fœtus, they may also in certain cases be of great utility in changing a malposition.

They are used with the view of applying traction to the fœtus, and they can be attached to the head, body, limbs, or tail, according to circumstances. The limbs are more particularly the parts upon which they can be most usefully employed, because of the length and solidity of these, the facility with which they can be seized, and the prominences of the joints and hoofs, which prevent the cords from slipping. For the Foal they are most advantageously fastened around the pastern, but with the Calf above the fetlock-joint is better. The head cannot be so advantageously "corded," though it is a most important region of the body to secure in certain cases; the neck of the lower jaw affords a fairly good hold, and if the fœtus is alive the cord, made into a halter, can be put over the head. For the jaw the cord should be rather thin and soft, but strong. The neck can be corded, as can also the loins and croup, as already shown. In embryotomy cords are also of great service, as they can be fixed to parts of the body, and even to shreds of skin, to aid in removal.

The cords vary in thickness and length; they are usually about five or six feet long, though they may be nine or ten feet and, if spun rope, from a quarter to half-an-inch or more thick. At one end may be a small loop or iron ring, by which to form a running noose (Figs. 154, 155, 158). Some practitioners recommend strands of Manilla hemp, and in particular instances, as when a somewhat rigid loop is required, it is very useful to have a long piece of copper wire twined in the cord or hemp. Other obstetrists prefer a leather band.

The Manilla hemp, and web or leather band, are resorted to in order to prevent damage to the fœtus during traction—the cords, from their hardness, thinness, and strands, being liable to cut. But this accident need not be much feared, and the durability, convenience, and other advantages possessed by the cords, are greatly in their favour. They retain their hold better than anything else, and particularly if they have only a simple loop at the end, instead of an iron ring.

If it is desired to render a hard cord softer, it may be partially untwisted at the part intended to go round the tissues of the fœtus.

Some practitioners have cords ready prepared, which they use for a long time; but unless precautions are adopted they may become a source of danger, as they readily absorb septic matter. They should therefore be thoroughly cleansed after each operation.

When running knots or loops are made, these should be so tied that there is no chance of their becoming untied through slipping, when they come in contact with lubricating fluids and are strained.

Whatever is used for this purpose should be very pliable, and yet sufficiently strong to withstand energetic pulling. A very good pattern of cord is that used by Schaack (Fig. 155).

This is merely a cord with a running noose at one end, and a small piece of round wood at the other, to give the assistant a better hold, and enable him to use more force.

When cords are employed on the limbs, they are generally applied to the pasterns of the Foal, as these parts are most accessible, and afford the most secure hold. They can also be applied above the knees and hocks, when it is necessary to amputate the limbs at these joints. The head may be secured around the lower jaw, but it is sometimes better

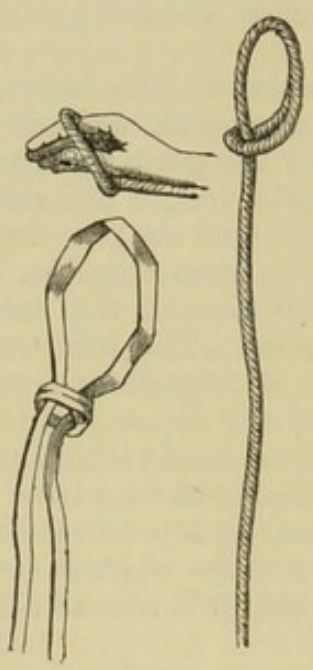

Fig. 154.
TRACTION CORD AND BAND, AND THE MANNER OF APPLYING THEM.

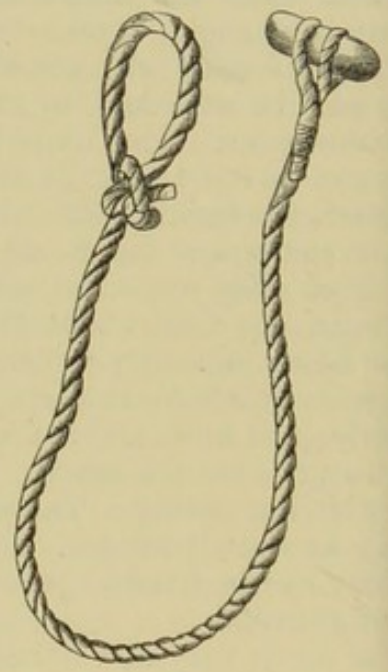

Fig. 155.
SCHAACK'S TRACTION CORD.

to pass the noose into the mouth and around the top of the head, like a gag-rope.

When the cords are to be applied to the limbs, either of two modes can be resorted to with this object. If the limb is bent, it must be extended and brought opposite the inlet, or into the genital canal, as the case may be. Then Rainard recommends that the fingers be gathered together and slightly bent, so as to form a kind of cone, on which the running noose of the cord—sufficiently wide to pass over the foot of the fœtus—is placed, as in Fig. 154. The noose is kept in its place on the fingers, in tightening the cord, by the free portion which passes along the under side of the hand and arm; unless this precaution is adopted, the noose will be pushed back over the hand when introduced into the vagina, and cannot easily be got forward again. The hand and cord being oiled, are introduced into the passage, and when the foot is reached it is seized in the fingers; these are then suddenly bent, so as to shorten the cone and cause the noose to run on to the pastern by

a gentle pull of the cord, which can then be tightened and given to an assistant.

The other method, which is Schaak's, and by some obstetrists considered preferable to that just described, consists in placing the middle of the noose on the dorsal aspect of the ends of the two middle fingers, the finger on each side holding it against these, while the thumb keeps it in the palm of the hand (Fig. 161). The left hand maintains the cord sufficiently tense to assist in keeping the noose on the hand; and if the part of the cord which runs through the loop is placed towards the thumb, the latter can readily increase the size of the noose. The hand is passed into the vagina sideways, the little finger downwards, and when the foot is reached, the thumb and index-finger are placed within the noose, which they enlarge in separating from each other, while the remaining fingers, flexing on the hand, are passed around the foot, and cause the noose to glide over the hoof on to the pastern. The fingers now press on the loop, while the other hand, drawing at the cord outside the vulva, tightens the noose around the limb.

When the limb is flexed and cannot be extended, as at the knee or hock, the looped cord may be employed; though a long cord, doubled, will be found to answer very well. This is passed round the flexure, the doubled end pulled to the vulva, and the other end passed through the loop; this done, the loop may be tightened, passed up to the elbow or stifle, or down to the pastern.

The lower jaw is "corded" in a similar manner; the mouth of the fœtus being opened, the noose is passed around the neck of the jaw, and the knot or loop placed beneath the chin.

In embryotomy cords render good service, as they can be attached to any part within reach; after decapitation of the fœtus, for instance, a cord passed through a thick fold of the skin on the upper part of the neck affords an excellent means of traction.

When long cords are used, and energetic traction is likely to be employed, it will be found convenient to have knots at intervals, to prevent the hands of the assistants slipping.

Halter, Head-Cord, or Head-Collar.

In addition to the limbs and other parts, we have stated that the traction-cord can often be advantageously applied to the lower jaw. Indeed, in the anterior presentation, even when the fore-limbs are "corded" and the head is in a favourable position, it will generally be found very useful to apply traction to the head in addition, as not infrequently pulling at the fore-limbs alone only fixes them more firmly in the passage.

We have also mentioned that the interdental space, or "neck" of the lower jaw, is the most convenient for the attachment of the cord; but nevertheless it will be found in practice that this does not afford nearly so firm a hold as the limbs, and that if the noose does not slip off the jaw, which is often the case, should the traction be at all energetic the bones will probably be smashed, the fœtus, if alive, irreparably damaged, and an important accessory means to extraction lost; besides, traction on this part throws the head too much upwards. Should the head be turned back towards the side, cording the neck does not reduce the deviation, but only allows it to be brought in a doubled condition into the genital canal.

It is, therefore, most important that means be at hand to secure the

head firmly and solidly, either with a view to correct deviation when this part is in malposition, or to exercise traction upon it when it is adjusted, and when the fœtus remains immovable by pulling at the fore-limbs.

We have suggested that the noose of the cord, sufficiently widened, instead of being placed on the lower jaw, should be first passed into the mouth of the fœtus, then carried up over the head and behind the ears —the loop of the noose remaining, of course, tightly drawn in the mouth, as this must be the direction from which the traction is exercised; if pulled at from behind the ears, the noose would be drawn off. In placing the noose in this position, the straight porte-cord—and especially Mr. Cartwright's pattern—will be found very useful.

Instead of this simple noose, which can readily be made when needed, various kinds of head-stall have been proposed by veterinary obstetrists

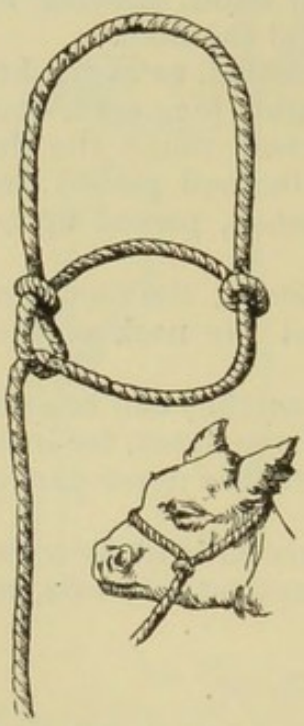

Fig. 156.

BINZ'S SIMPLE HEAD-COLLAR.

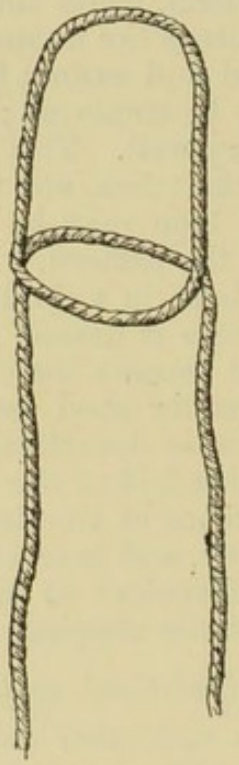

Fig. 157.

RUEFF'S HEAD-COLLAR. No. 1.

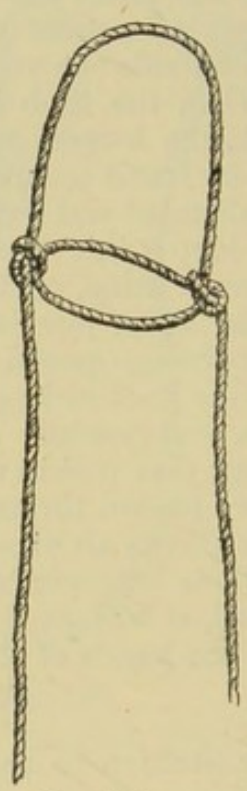

Fig. 158.

RUEFF'S HEAD-COLLAR. No. 2.

from time to time, and some of these possess certain advantages. Günther, many years ago, pointed out the advantages of a head-band like that represented in Fig. 154, the upper part of which was passed behind the ears, while the inferior part with the running knot lay between the branches of the lower jaw. Binz soon after proposed a kind of head-collar, or halter, which could be adapted to different-sized heads (Fig. 156). It is made from a long piece of cord with a loop or eyelet at one end, and at a certain distance from this—from fourteen to sixteen inches—a second loop. The other end of the cord is passed through the first loop, so as to make a noose which goes round the neck of the fœtus; then through the second loop which goes round the lower part of the head, and may be made large or small. The remaining portion is used for traction. This improvised halter is held at its upper part by the index-finger and thumb, passed into the genital canal

or uterus, where it is placed on the head of the fœtus and the sides applied to the cheeks; the lower portion, which was open, is now closed by running the end of the cord through the second loop, by which the head is firmly secured, as in the figure (156).

Instead of having the first loop at the end of the cord, Baumeister makes it nearly in the middle, with the second loop at the same distance as in the other halter. This allows of two cords—one on each side of the head—to pull at (Figs. 157, 158).

Binz has devised a special head-apparatus (Fig. 159), to which he has given the name of "Forceps-band" (*Zangenband*). This is a band of flax, silk, or some other woven material, which is at its widest part about four inches broad, and in length about six or seven feet. At one end is a moderately large opening, while the other is divided into two portions to within some distance from the loop; these last pass through a round, movable, cork-shaped piece of wood, metal, or leather. The head of the fœtus is passed between the divided ends of this band, which are then tightened behind the jaw by running the keeper close up to the chin, the undivided portion being brought over the forehead towards the nose, and the divisions passed through the loop. In this

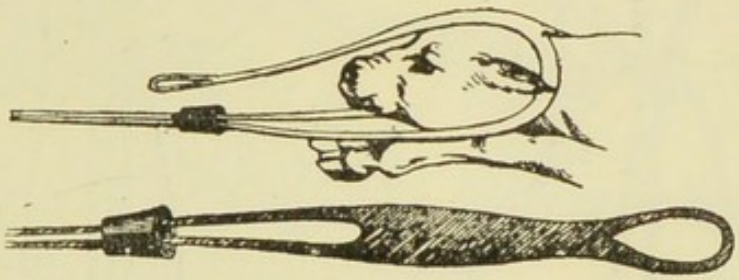

Fig. 159.

BINZ'S FORCEPS-BAND.

way the head is firmly held, and powerful and direct traction can be made on the head, above and below, by means of the upper part with the hole at the end, and the two portions beneath. It has been found particularly useful in cases of hydrocephalus.

Schaack, in 1848, introduced another kind of head apparatus, which he designated a "sliding head-stall" (*têtière à coulant*), but which is perhaps better known in France as a "forceps halter" (*licol-forceps*), by reason of its shape and use. It is composed of two doubled cords, one of which (Fig. 160, 1, 1) forms the *head-stall*, while the other (3, 3) makes the nose-band. The two are united by a metallic runner (5) which allows the apparatus to be increased or diminished in size at will. The *runner*, which forms the key of the apparatus, is a piece of brass or pewter a little more than an inch in length, about an inch in breadth, and half an inch in thickness. It is perforated by three holes, two of which are parallel and pass through the wider part of the metal, while the third, placed between them, runs through its narrower surface. The two ends of the head-stall loop go through the parallel holes, the cord composing this being nine or ten feet long and one-third of an inch thick, the loop itself being intended to lie behind the ears of the fœtus. One side of the loop is fixed in the runner, by rings of waxed pack-thread

above and below the hole; this waxed thread being also run up on the loop, to give it a certain degree of rigidity. The other half of the cord is freely movable in its hole in the runner, and a knot tied near its end allows it to be distinguished from the fixed half. The *nose-band* (3, 3) is made of two strong but soft strips of leather sewn one within the other, and doubled in the middle to constitute a loop eight to ten inches long: the two portions being made into a single cord (4) between three and four feet long, and which passes through the single hole across the runner. The middle part of the nose-loop has a kind of shield or button of thin leather, to prevent the loop slipping through the hole.

This was the apparatus first devised by Schaack, but recently he has somewhat modified and simplified it, by dispensing with the nose-band

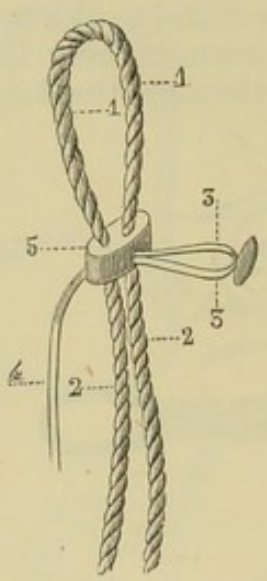

Fig. 160.

SCHAACK'S FORCEPS-HALTER.

1, 1. Head-stall; 2, 2. Two Cords, its continuation; 3, 3. Nose-band; 4. Single Cord forming a continuation of the Loop constituting the Nose-band; 5. Metal Runner, uniting the several parts of the Halter.

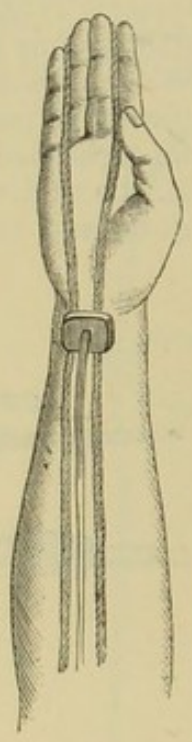

Fig. 161.

MANNER OF PLACING SCHAACK'S HALTER.

altogether, as he found that the nose of the fœtus could be better guided and held by the hand. Experience has proved that this simplification allows the halter to be more easily applied.

The manner in which the original halter was employed is described as follows:—The head of the fœtus being in front of the inlet and readily accessible to the hand, the nose-loop is pulled through the runner until stopped by the leather button, while the head-stall loop is made sufficiently wide. The middle of the latter is placed at the end of the middle fingers, the movable part of the cord being between the middle and index-finger, the fixed side between the ring and little finger (Fig. 161). The apparatus is at first held by the index and middle fingers against the other fingers, as well as by the thumb, which keeps both cords in the palm of the hand; and finally by the left hand,

which, drawing lightly on the three cords, keeps them sufficiently tight. The runner should be at the wrist, the button of the nose-loop towards the hand.

The apparatus being so disposed, the hand is introduced sideways (little finger downwards) into the vagina, until it arrives at the head of the fœtus ; then the nose of the latter is passed into the head-stall loop, which is pushed forward by one side of the face—say the right—towards the neck and over the ear ; the other half being now carried on the opposite side towards the left ear, and then the runner is seized below the jaw. In this way the hand has passed round the length of the head-stall from its fixed to its movable part—the latter readily allowing the loop to enlarge and pass over the salient portions of the head, the loop being nevertheless kept sufficiently tense by the right hand pushing the runner up towards the throat ; while the left hand, pulling at the movable cord—recognised by the knot at its end—tightens it as much as may be necessary. The nose-loop is placed by introducing the

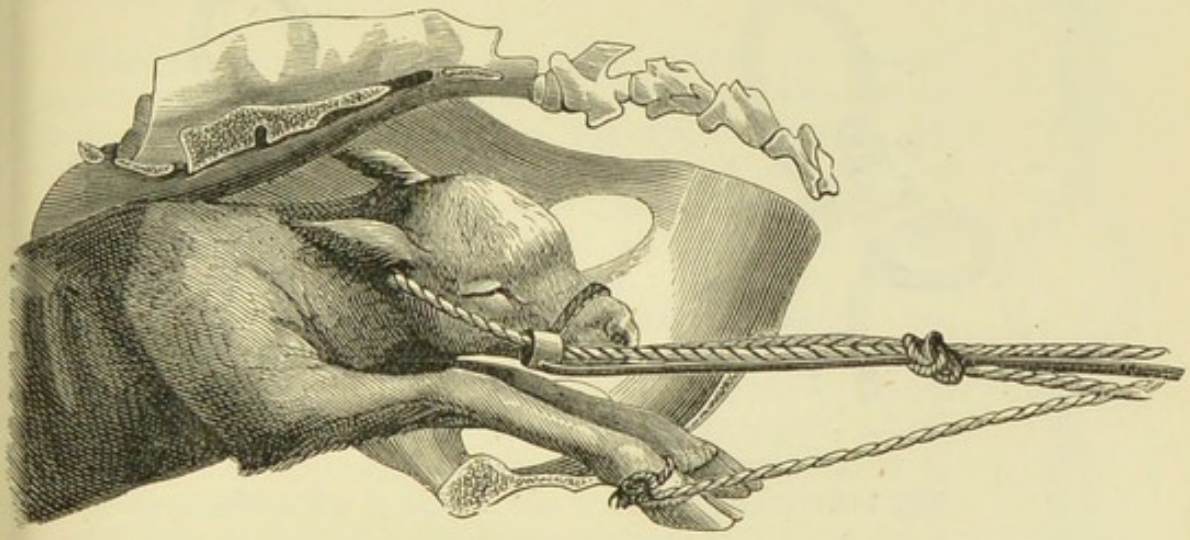

Fig. 162.

SCHAACK'S HALTER PLACED ON A CALF'S HEAD, THE RIGHT FORE-PASTERN BEING ALSO CORDED.

index-finger of the right hand under the button, and drawing the loop through the runner to a sufficient length, the left hand keeping the other two cords tight ; the end of the nose is passed into the loop, which is lifted as high as need be. This done, the right hand is withdrawn from the uterus and vagina, along, while keeping tight, the three cords. These are tied together in a knot outside the vulva, and the head is thus securely and solidly fixed.

Saint-Cyr and others highly recommend this apparatus, which in its modified form differs but little from that described by Binz some years previously. He remarks that its extreme simplicity, its trifling cost, the facility with which it can be placed after a little practice, its solidity—which enables it to withstand any amount of traction—and its absolute innocuousness, all combine to render it one of the best and most precious instruments required in veterinary obstetricy. In the first place, when it is properly applied it cannot slip, and all the amount of force necessary under the circumstances may be employed without

fear; next, being formed of small and flexible cords, which are well oiled before use, it cannot injure the maternal organs in any way; thirdly, from the manner in which it acts on the neck, the lower jaw, and the face, and the impossibility of its becoming tighter when once it is fixed, it is absolutely inoffensive, so far as the fœtus is concerned; and, finally, owing to the nose-loop, it always keeps the head in a good direction, prevents it from deviating, and compels it to follow the course most favourable for its extraction: in the words of Schaack himself, "Without exaggeration, the forceps of the *accoucheurs* could not answer better for the human fœtus." As an agent of prehension and traction—but particularly the latter, Saint-Cyr asserts that he does not know of anything superior to this apparatus.

Shaack's halter is more especially applicable to the Bovine fœtus, the head of which is so much larger and squarer than that of Solipeds,

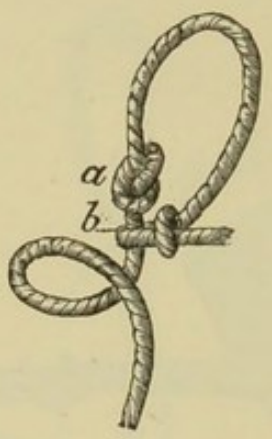

Fig. 163.

HALTER WITH A SINGLE TRACTION CORD.

a, Check-knot; *b*, Running Knot or Loop.

Fig. 164.

HALTER WITH TWO TRACTION CORDS.

a, *b*, Two ends of the Cord; *c*, Check-knot on the *a* portion; *d*, Running Knot or Loop on the *b* portion.

and sometimes requires very energetic pulling to remove it from the pelvis.

It is not always an easy task, however, to place anything like a formed halter over the head, especially if this is in the genital canal; so that it has been found more convenient to make the halter on the head. Detroye[1] takes a cord about ten feet long, in the middle of which he makes a simple knot—a check-knot; this is passed by the hand or porte-cord around the neck behind the head, and the knot withdrawn to the vulva; a loop or running-knot is made on the cord at a certain distance from the check-knot, and the shorter portion of the cord is passed through it, the loop being tightened and run up until it is close to the knot (Fig. 164). The length of cord between the two knots should be sufficient to encircle the upper part of the neck, and form a kind of halter without the nose portion; the loop may be made previously, when it is possible to make it glide on the head.

[1] *Recueil de Médecine Vétérinaire*, 1889, p. 309.

After drawing the portion with the check-knot on it sufficiently tight to place the head-piece in its proper situation, the same portion should be passed or hitched round the lower end of the head; the knots ought to lie between the branches of the lower jaw. If it is desired to have only one traction cord, the running-knot or loop should be made at one end, and the check-knot a calculated distance from it (Fig. 163).

This forms a very simple and solid apparatus for exercising any amount of traction on the head, without much risk of danger to the fœtus.

A still simpler method is passing the middle of a ten or twelve foot cord behind the ears of the fœtus, carrying the sides down behind the lower jaw, and then twisting them outside the vulva until the two ends form one portion between the branches of the jaw. This, however, has rather a tendency in some cases to tilt the nose too much upwards.

With the smaller animals, cords cannot be passed around the head of the fœtus in the same manner as in the Mare or Cow, because of the want of space; and on the same grounds forceps are objectionable. For anatomical reasons, it is essential that the traction force should be applied behind the head, as if the sum of the expulsive efforts were directed there. With this object, Defays devised an apparatus which fulfils this indication, and is very simple and easily applied. It consists merely of two very pliable copper or brass wires—twisted picture-frame wire I have found to answer admirably—about sixteen inches in length, and looped in the middle, so as to be applied to the fœtus in the following manner: The first finger of the left hand being passed into the vagina, serves to guide one of the loops towards the summit of and behind the fœtal head; and it then conducts the loop of the other wire beneath the head behind the jaw. This done, the two wires on each side are twisted by a little machine (Fig. 165) composed of a thin iron rod in a handle, the other end of which is thickened and pierced by holes running nearly parallel to the stalk. Into these holes the two wires of one side are passed; the machine on each side is pulled up as close as possible to the head of the fœtus, and then, each being turned round three or four times, the neck is enclosed in a kind of noose or collar formed by the two wires (Fig. 166).

The rods are now withdrawn from the latter, and the fœtus can be extracted by exercising traction on the ends of the four wires outside the vulva. By this contrivance, delivery is effected without injury to the Bitch, and, unless it is much decomposed, without separating the head of the fœtus.

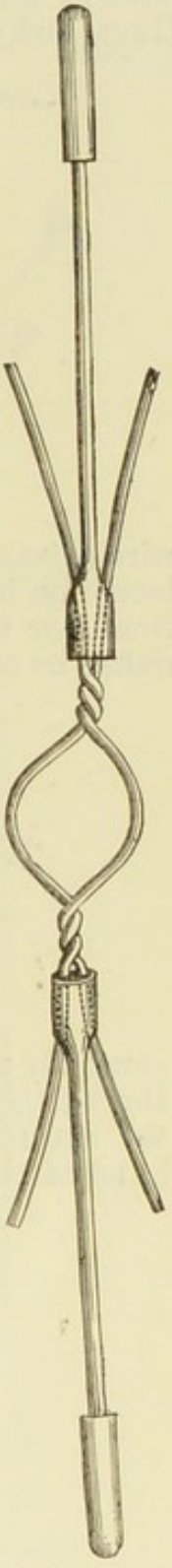

Fig. 165. DEFAYS' WIRE-EXTRACTOR WITH THE TORSION RODS.

We have tried Defays' apparatus, and can speak highly of it; not infrequently we have succeeded in extracting the Puppy alive, and when the use of forceps would have been impossible.

A much simpler, readier, and perhaps more successful apparatus (so

far as our experience enables us to speak), is that devised by Breulet, of Marche, Belgium, which meets every requirement in the accouchement of small Bitches, and might be successfully employed with Sows, Ewes, and Goats. This apparatus is the same in principle as Defays'

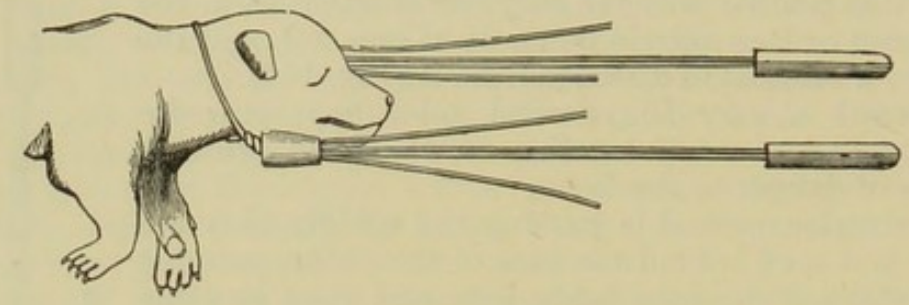

Fig. 166.

Defays' Wire Extractor applied.

wire extractor, but there is only one wire. The principal part of the invention is a noose-tube, consisting of a tubular piece of round wood, from four to six inches long, and half an inch thick. The wire may either be of copper, brass, or iron, about sixteen inches long (we have

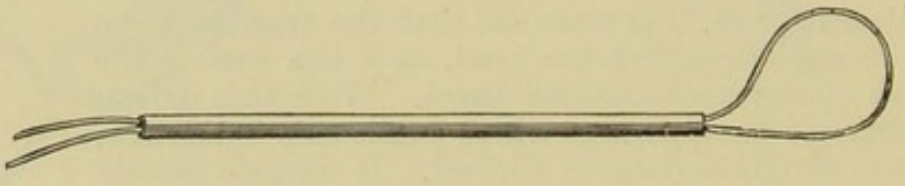

Fig. 167.

Breulet's Tube and Noose.

generally used a piece of catgut, and prefer it); this is doubled, passed through the tube to a certain extent, so as to form a loop or noose at the end (Fig. 167). When it is to be used, the first finger of the left hand carries the loop into the vagina of the Bitch, and slips it behind

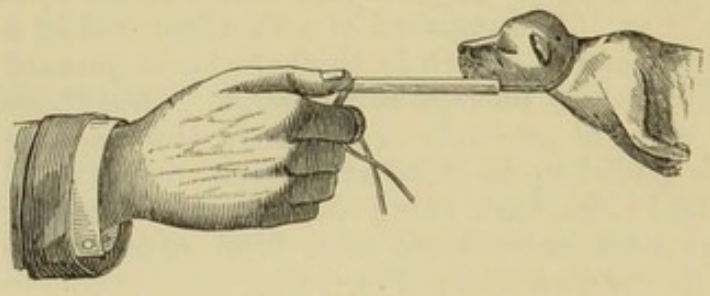

Fig. 168.

Breulet's Noose fixed on the Fœtus.

the occiput of the Puppy; then the two ends of the wire are passed through the tube, and this is pushed into the vagina under the chin of the fœtus; the operator now tightens and secures the wire, by giving it a turn round the first finger of his right hand, placing his thumb at the end of the tube (Fig. 168). A little traction then extracts the fœtus, and without doing it or the Bitch the least damage. I have

employed this instrument in canine obstetricy, and my success has always been complete, even with the tiniest toy terriers. When sought for in time, I have generally managed, expeditiously and easily, to extract the Puppies alive.

It will be seen that the noose is not unlike the "fillet" used in human obstetrics.

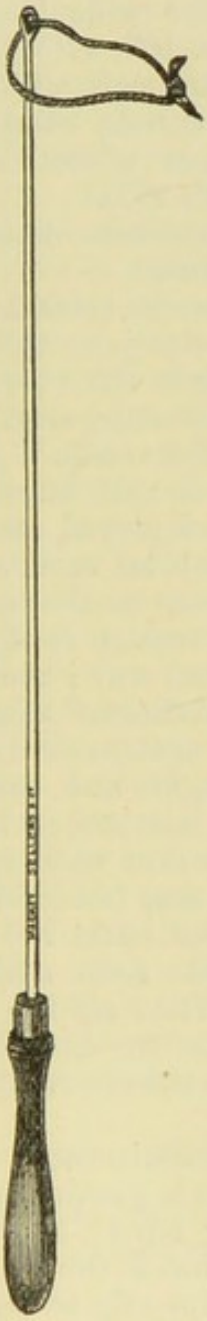

Fig. 169.

CARTWRIGHT'S PORTE-CORD.

Fig. 170.

DARREAU'S PORTE-CORD.

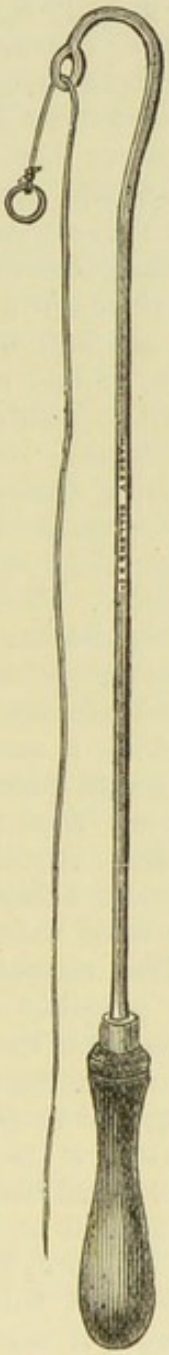

Fig. 171.

GÜNTHER'S CURVED PORTE-CORD AND BLUNT CROTCHET, ARMED WITH A CORD AND RING.

Fig. 172.

DARREAU'S CURVED PORTE-CORD.

SECTION II.—PASS- OR PORTE-CORDS.

When treating of certain presentations, it was remarked that though the use of cords is urgently indicated in some cases, the arm is not

sufficiently long to pass them to the region where they might be most effectively fixed; while the energetic uterine contractions paralyse the hand of the operator, and often prevent it manipulating accessible parts which it is desirable to secure by these means. In such circumstances the *porte-cord*, or *pass-cord*—which has been sometimes referred to—is of great service. The instrument is of two shapes, *straight* and *curved*.

The *straight porte-cord* is usually a rod of $\frac{3}{8}$ inch iron, furnished with a wooden handle at one end, and an eyelet or double opening at the other to receive the cord (Figs. 169, 170).

Fig. 173.

DARREAU'S REPELLER.

The *curved porte-cord* has the end through which the cord passes more or less bent, and in certain cases it is more useful than the straight one, from which it only differs in having this curvature (Figs. 171, 172).

Different forms of these instruments have been described, but in principle they are all really the same.

The straight one can be used to pass the traction cord around the limbs, or the neck of the lower jaw, and may act with the cord in pulling these towards the vulva; or, if properly constructed, it may also be most serviceable as a repeller in pushing them forward into the uterus. A very good and simple pass-cord of this kind is that introduced by Darreau (Fig. 173), which can be employed as a retractor and repeller. Two of these may be used at the same time, on two limbs. For instance, in the sterno-abdominal presentation, when posterior version is decided on, the hind-limbs are corded in the usual way; then this repeller, armed with a noosed cord of sufficient length, is introduced, the noose passed on to the pastern or knee of one fore-limb, and the cord drawn tight and fastened around the handle. Another pass-cord is attached in the same manner to the other fore-limb, so that each instrument becomes a solid fixture to the leg, and is confided to an assistant. The operator then pushes back the fore-limbs as far as possible by hand, while each assistant seconds his efforts with the repellers. When all has been conveniently adjusted, traction is made on the hind-limbs, the repellers being still employed to overcome the resistance of the fœtus and follow its movements.

The curved pass-cord has its uses in certain cases when the straight one cannot be serviceable—as in passing a cord round the head or bent neck, thigh, or loins; there are also several patterns of this instrument, but if the straight one is made of iron, it may be bent sufficiently to answer the purpose in the case of flexed limbs or bent neck. An ordinary walking-stick with a crook handle may, on an emergency, be made to serve this purpose by making one or two holes in the handle for the reception of the cord. Or when this cannot be procured, an excellent substitute will be found in a piece of iron or lead attached to the end of the traction cord, the weight of which greatly facilitates the passage of the cord around the straight or bent neck, hocks, or knees.

Tyvaert[1] has for a long time made profitable use of a simple porte-

[1] *Annales de Médicine Vétérinaire*, 1876, p. 320.

cord. This is composed of a somewhat short piece of iron wire, about the thickness of a goose-quill, and bent a little round, the length and curve varying with the part to be secured. One end is turned to form a small ring, while the other is bent to make a hook, a little longer than wide. A cord being attached to the ring end, the wire is passed round the part it is sought to seize; the hook end remains free, and afterwards receives the traction cord, serving to form a running noose on the part. This porte-cord is very simple, and may be made on the spot when required; it has proved most useful for securing the neck or hocks.

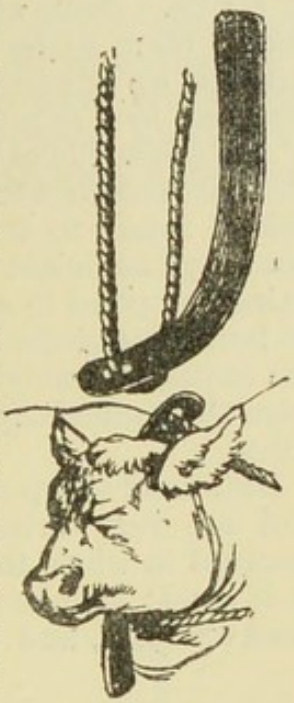

Fig. 174.

BINZ'S PORTE-CORD.

Binz's pass-cord (Fig. 174) is much used in Germany. It is sufficiently large to pass round the doubled neck of the fœtus, while its shortness allows it to be easily manipulated in the uterus. It is from twelve to sixteen inches long, and made of wood or iron; at the bent end is an opening through which the cord passes. The instrument (named a *Geburtssonde* by the Germans) is passed to the middle of the cord, and may then be introduced into the uterus, where, from its curvature and its shortness, it can be pushed behind or between the limbs, in the double of a bent neck, etc. The hand seeks the half of the cord on the opposite side of the part, and pulls it into the vagina; the instrument is then withdrawn, and the part is ready to be pulled at by the cord left encircling it.

The ordinary curved pass-cord is introduced into the genital canal in the same manner as the other form, but with only a loop or ring—no noose—at the end of the cord; the curved portion is pushed around the part to be secured, and the hand, leaving it, is passed to the opposite side of the part, where it searches for the loop or ring, which, when found, is drawn into the genital canal. The instrument is then withdrawn, the cord remaining around the part; the free end of the cord is passed through the loop or ring, and being pulled at, the limb, neck, body, or whatever it may be, is secured in the noose so formed, and traction can in this way be directly exerted upon it.

SECTION III.—CROTCHETS OR HOOKS.

Obstetrical *crotchets* or *hooks* are iron or steel instruments of variable dimensions, more or less curved at one end—which is blunt, sharp, or

Fig. 175.

SHORT BLUNT CROTCHET.

Fig. 176.

BLUNT FINGER CROTCHET.

pointed—the other end having a ring (Fig. 176) or eyelet (Fig. 175) if short, a handle if long. The latter is from thirty to thirty-six inches

in length (including the handle), and acts directly on the fœtus without any other appliance intervening; while the short hooks have cords attached to them, or they may fit on the finger of the operator by means of a ring. Some sharp crotchets are jointed at the end curve, so as to permit them to be more readily and safely introduced into the genital passage by bringing the sharp point near the stalk, the curve being restored by a spring when the fœtus is reached. But the advantages of the jointed hooks are very few, while their strength is impaired and their expense increased. In using the long or short pointed crotchets, risk of injury to the maternal organs may be obviated, if the hand is not found sufficient to guard the instrument during its introduction, by fixing the point in a piece of cork or soft wood, to which a long piece of twine is attached; when the crotchet is required to be implanted in the fœtus, this shield may be removed from the point, and withdrawn from the genital organs by pulling at the end of the twine outside the vulva.

Blunt and sharp crotchets are much employed in veterinary obstetrics, and are very valuable. The blunt crotchets are more particularly resorted to when the fœtus is alive, and it is hoped to extract it before it is dead; they are most serviceable in correcting deviations of the head or limbs, and the long crotchet is especially useful in finding and

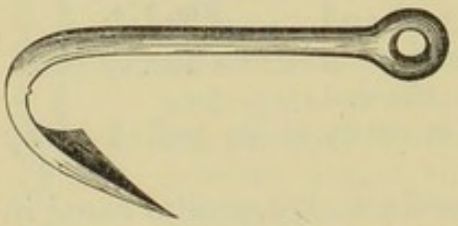

Fig. 177.
Short Sharp Crotchet, with Broad or Flanged Point.

Fig. 178.
Short Sharp Crotchet, with Round Point.

straightening the latter. The curve should be about four inches wide. The finger crotchet may be usefully employed when the hand is fatigued or paralysed by the uterine contractions. Blunt crotchets of a much smaller size than those required for the larger animals can be most successfully employed in delivering the Sow, Sheep, Goat, Bitch, or Cat.

Günther's long porte-cord (Fig. 171) can be most effectively used as a blunt crotchet and at the same time as a carrier of the cord. A German long blunt crotchet has a concealed sharp blade in the concavity of the curve; by means of a spring in the handle this blade can be projected, and the instrument will then do good work in embryotomy.

With the sharp crotchet, the curve should certainly not be very wide; the smaller it is the more readily it can be passed into the genital passage, and the less chance of injury is there to the mother or operator; it should not be greater than the hand can cover. At the same time, if the curve is too small, the crotchet does not obtain sufficient hold of the fœtus, is readily torn out, and for this reason may be most dangerous. The point should be so bent as to readily penetrate the part in which it is determined to fix it, and the angle of the curvature should be such that the more the crotchet is pulled at, the deeper and more firmly the point will enter.

So it is that the point should not be turned round in a semicircular manner, but rather at an acute angle, as in Figs. 181, 182.

There is rather a diversity of opinion with regard to the preference to be accorded to the crotchets; some practitioners preferring the short ones, as they can be readily carried into the uterus guarded by the hand and moved about there, so as to be implanted in the most convenient part of the fœtus; while the cords attached to them allow traction to be made in the most favourable direction. Other obstetrists prefer the

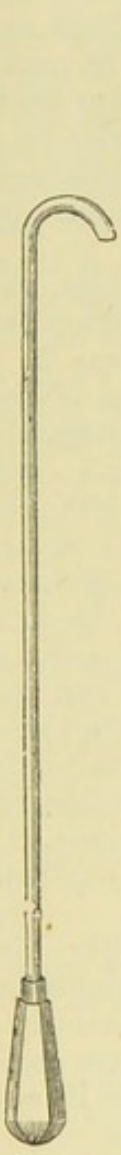

Fig. 179.

LONG BLUNT CROTCHET.

Fig. 180.

LONG POINTED CROTCHET.

Fig. 181.

LONG POINTED CROTCHETS, DARREAU'S PATTERN.

Fig. 182.

long rigid crotchet, which they affirm is more easily placed—one hand guiding the point through the passage, the other hand acting on the handle.

These preferences depend very much upon whether the operator is more practised in the use of one or other of the crotchets, and also, doubtless, upon circumstances peculiar to each case requiring the employment of such instruments. Both long and short crotchets are most useful, and the obstetrist should have several of each, of various

forms and dimensions, so as to be able to select that which is best adapted to meet the requirements of particular cases.

It must be observed, also, that many practitioners are not in favour of crotchets, and decry their use. But there is something unreasonable in this, and the experience of almost every day goes to prove that these instruments afford a simple and ready means of getting hold of the fœtus in regions of its body which the hand cannot possibly reach, or if it did, where it could do very little service either from the shape of the part, its slipperiness, or the paralysing effect of the uterine contractions on the hand and arm of the operator. They can also be profitably employed in cases in which cords and halters are useless; for not only will they serve in allowing traction to be made on parts which actually present at the inlet, but they can also be utilised in effecting those mutations which are necessary in order to bring particular parts of the young creature in front of the pelvic opening or through the genital canal, and which the hand could not seize or move.

It is no doubt true that the sharp or pointed crotchets have certain disadvantages which must not be lost sight of, and which lead to preference being given to the cords or halter when they can be employed. In the first place, their introduction into the uterus is not such an easy matter as it might appear without trial or consideration; for the contractions of this organ may paralyse the hand which carries the instrument and cause it to escape, or its point to wound either the mother or the operator. Their employment often produces serious lesions in the body of the fœtus, which are certainly of no importance when it is dead, but may be of much consequence should it be alive. Then, again, the tissues into which they are implanted are not very firm or resisting, so that only a moderate degree of traction can be expected from them, and which is often insufficient to overcome the resistance that prevents the birth of the fœtus. In such a case, if, through forgetfulness or maladroitness of the operator, the tissues suddenly give way and the crotchet slips into the maternal organs, serious, if not fatal, injuries may be inflicted; or the hand or arm of the operator may be the part to suffer.

These are undoubtedly disadvantages of a weighty kind; nevertheless, the veterinary obstetrist has always to contend with disadvantages in cases of dystokia, and must overcome them by prudence, patience, and skill. When using the crotchet the same qualities must be brought to bear. His hand must diligently guide it, and note its effects and movements; while, at the same time, he must vigilantly exercise his judgment in directing his assistants as to the amount and direction of the force they are to use, so as to proportion it according to the resistance of the tissues in which the crotchet is fixed, and to desist from traction as soon as there is a likelihood of the instrument breaking away or slipping. With the evidence before us as to the numerous and incontestable advantages offered by these appliances, and the knowledge that their disadvantages can be overcome by intelligent watchfulness, there is every reason to recommend their adoption in those cases which call for their employment.

"In all cases where the head of the fœtus is back," Cartwright says, "I am very partial to using the long sharp-pointed hook in the orbit; even if the head is at the *extreme* distance, with care we can insert it in the orbit and get the head in the passage. Of course, it requires great

care in watching that the hook does not break loose and do mischief. I have found that we may pull by the hook in the orbit with great force, without tearing the skin of the Calf, provided the latter is not in a decomposed state. From my experience, I can speak highly of the hooks; indeed, you cannot get the head up without them sometimes." And in embryotomy they may be most usefully resorted to for many purposes.

Reference will now be briefly made to the parts of the fœtus upon which the crotchets can be most effectively employed, and the manner of employing them.

PARTS INTO WHICH THE CROTCHETS MAY BE IMPLANTED.—The parts into which the crotchets may be implanted are numerous, but those which are selected by the obstetrist will not only depend upon the nature of the malpresentation or malposition, but also upon the simplest indications for the adjustment of these. When the desirable part has been reached, the point of the crotchet is inserted in such a way that the instrument is directed towards the source of traction—the assistant. When blunt crotchets are employed, except in cavities, it will be necessary to make an incision through the skin before they can be inserted. Cartwright states that sometimes the sharp crotchets cannot be used without making these preliminary incisions; but then the instruments must be rather blunt. The best parts for implantation are (1) the *muscular tissues*, (2) the *head*, (3) the *spine*, and (4) the *pelvis*.

1. *The Muscular Tissues.*—These tissues are not advantageous for the employment of the crotchets, for although they are easily inserted, they are as easily torn out. Nevertheless, these instruments, when fixed in certain muscular regions, such as the croup, thighs, loins, and neck—more especially the latter, may render useful service in rectifying deviations, as the skin offers a good amount of resistance. But, from the fragile and yielding nature of the textures, it must be borne in mind that the hand of the obstetrist should never leave the crotchet while traction is made on it, and that its position in them must be most attentively noted, in order to guard against accidents arising from its tearing away.

2. *The Head.*—The head offers many good points for implanting the crotchets—such as the symphysis of the lower jaw, the palate, and the orbit; as well as the ear and angle of the inferior maxilla, on particular occasions.

It must be observed, however, that all these points are not of equal value. The *maxillary symphysis* is convenient, but not very firm; moderately strong traction will rupture it, and damage may then occur. Still, there are times and occasions when this part may be advantageously seized by the crotchet, which may be inserted in two ways: the point of the instrument may be passed from below the chin into the mouth, or from the cavity of the latter through the mucous membrane beneath the tongue, to below the chin. The first is generally preferable. When traction begins, the operator must be on the look-out for tearing away of the two branches of the jaw.

The orbital cavity is the best part of the head for a solid hold. Some authorities have expressed doubts as to the propriety of fixing a crotchet in the ocular cavity of a living fœtus, from a belief that the eyeball must be damaged, and Rainard goes so far as to advise that it should only be done when the creature is dead; though he adds that, if there is no other means of remedying a deviation of the head in the

living Calf, it is well to attempt it, "as it is better to have a living, if blind, Calf, than a dead one with both its eyes intact."

But it is rare indeed that the eyes are seriously damaged by fixing the crotchet in their socket; and innumerable instances testify that, if the fœtus is alive, the ocular globe is retracted to the bottom of the cavity when the instrument begins to be inserted, and so escapes injury. Schaack, who has freely resorted to this mode of adjusting the head or neck—in the Sheep and Goat more particularly (the smallness of the pelvis not allowing any other means to be employed)—describes his manner of operating as follows: "The crotchet I use," says he, "is a solid (or long) one; the point is blunt and slightly flattened (Fig. 183). When it is desired to pull at the head of the fœtal Goat or Lamb, the left hand at first seizes the nose, and the crotchet is fixed in the right orbit; with the right hand the other instrument is passed into the left orbit, the thumb of the left hand keeping the hook in the other orbit by pressing the stalk against the cheek. In this way I can pull with the two hands on both orbits, so as to keep the nose in a good direction." He has never seen the point of the crotchet cause the slightest injury to the globe of the eye, although he has had, in the majority of cases, to pull very hard. The means has answered very well. And Cartwright states that "it is astonishing how wounds heal up in the cheek where hooks have been in the orbit. I have had two or three men pulling at the rod (of the crotchet), and the hook did not break out."

Fig. 183. Schaack's Crotchet.

This immunity from injury in the case of the living fœtus, does not, however, absolve the operator from exercising all due care in fixing and pulling at the crotchet. The inner aspect of the orbital cavity is the most favourable, and if the fœtus is alive, the blunt instrument must be first tried, the sharp-pointed one being kept in reserve until this has failed; or it may be used at first when the young creature is dead.

The *palatine arch* affords a very solid and useful hold for the crotchet, and many obstetrists have successfully utilized it in extracting the fœtus; some authorities—among them is Schaack—asserting that hooking this part is easier, and the results more certain and direct, than fixing the instrument in the orbit. The stalk of the crotchet is somewhat long; the hook end is passed sideways into the mouth of the fœtus, and over the tongue until it gets beyond the palate, when it is turned point upwards and seizes the base of the vomer. A very strong degree of traction can be made on this part without inconvenience to the young creature. It appears to be an excellent situation to plant the crotchet in the Calf—particularly if it be dead, and it is desired to effect extraction as quickly as possible. It may be also employed in the Foal, the only risk being more or less disunion of the palate, which may render sucking difficult or imperfect for a short time after birth.

Of course, the head must be in a good position either in the inlet or in the genital canal before the crotchet can be placed behind the palate. Traction must also be moderate and steady, and the usual precautions observed.

3. *The Spine.*—When embryotomy is practised, or the fœtus is dead, the bodies of the vertebræ or their transverse processes, or the ribs,

afford excellent hold for hooks, though care must be observed in placing them securely, and guarding them when they are being pulled at.

4. *The Pelvis.*—In posterior presentations, when cords cannot be employed to the hind-limbs, the loins, or the croup, or when they have not sufficient power, then crotchets must be resorted to; and with this view the fœtal pelvis offers several very advantageous points. After removal of one or both hind-limbs, the *cotyloid cavities*, by their depth and the hardness of their walls, are admirably adapted for receiving the hooks and withstanding energetic pulling. If both limbs are amputated from the hip-joints, then a hook may be placed in each cavity; if ablation of only one limb has been effected, then one hook will be most useful.

The *pubic arch* and the *oval foramina* of the pelvis are likewise well suited for crotchet traction in the posterior presentation, when the fœtus is dead. In some cases the sharp-pointed crotchet may be passed directly through the rectum, and pushed forward so as to seize the border of the pubis, the margin of one of the oval foramina, the base of the sacrum, or the shaft of the ilium; care being taken that the point does not pass through the skin. Or the crotchet may be passed from without inwards—the safest method—after the pelvic bones have been denuded as much as possible of their soft tissues. This is, perhaps, the most practicable method, if the hind-limbs have been already removed. But if they have not, then all the soft tissues of the fœtus—from the root of the tail to the ischial arch—should be largely incised, and the hand passed through the incision into the pelvis, to remove the viscera. The crotchet is then pushed into it, and planted either on the brim of the pubis or in the oval foramen.

SECTION IV.—CROTCHET-FORCEPS AND FORCEPS.

The introduction of forceps into human obstetricy marked a new era in the *accoucheur's* art, and has been productive of the greatest benefit in difficult cases of parturition in women. But they have not yielded much service to the veterinary obstetrist, except with the smaller animals; notwithstanding that Hurtrel d'Arboval, at the commencement of this century, asserted of the forceps that there are circumstances in which great advantages might be derived from them, and that their use is perhaps the best means of completing parturition when it cannot be terminated naturally, etc. Attempts have been made at various times to introduce them into general use for the larger domesticated animals, and various models—more or less modifications of the human patterns—have been proposed, but with very little, if any, success.

The forceps used by the accoucheur of woman are, as is well known, composed of two branches or blades, which are nearly or quite alike, and form levers of the first order; they are united at the middle by a fixed or sliding joint, and one end—the "bow," or widest part—which is intended to grasp the fœtus, is *fenestrated*, or perforated by a wide opening; at the other end is the handle.

The reason why forceps have never come into general use in veterinary obstetrical operations—except with the smaller animals—is not so much from a prejudice against novelties and innovations, as because they are really not adapted for this kind of practice, unless in a very

modified form, to be presently noticed. Rainard[1] remarks: "Medical men will be astonished that I have not mentioned the *forceps*, from which they derive such great advantages. This instrument, which can seize a round head, like that of a child—when each blade fits exactly throughout its whole length—will have much less hold on that of animals, which is elongated, flattened at the sides, and otherwise but little yielding. When the forceps is applied to the Foal or Calf, it slips and is useless. Otherwise, the readiness with which cords can be attached to the head and limbs renders these in every way preferable to this instrument. What the forceps cannot do, the cords can; and

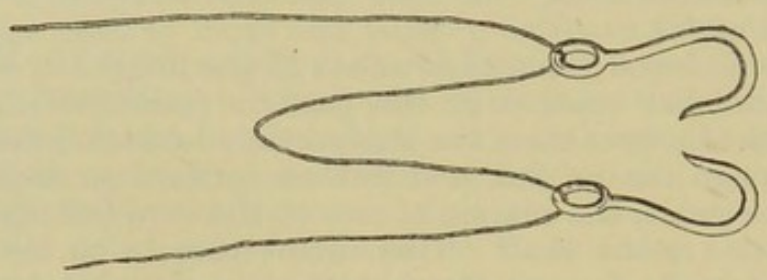

Fig. 184.

Simple Short Crotchet-Forceps.

they have the additional advantage that they scarcely occupy any space in the pelvic canal. The pelvis of our animals is nearly rectilinear; with the cords we pull in a straight line; what more could the forceps do? The entire hand can be introduced freely into the pelvis, and moved about easily. This cannot be done in human accouchements." There is no known forceps capable of affording such a solid purchase, and at the same time one so harmless, as good cords fixed on the pasterns, or a halter properly placed on the head.

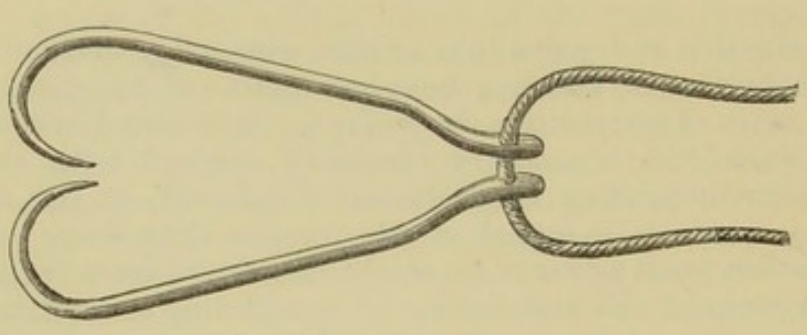

Fig. 185.

Long Simple Crotchet-Forceps.

Though an instrument resembling the human forceps is not at all adapted for extracting the fœtus in such animals as the Mare or Cow, and though in the cords and halter an excellent substitute is found; yet modified forceps, which might be designated—if not from their shape, at least from their action—*crotchet-forceps*, have been long employed by veterinary obstetrists, and with much advantage in certain cases. The simplest of these consists merely of two short crotchets, the points opposite each other, and a cord passing through both eyelets (Fig. 184). The hooks can be inserted near, but opposite to, each other, on each side of the spine, pelvis, head, flanks, etc., the cord,

[1] *Op. cit.*, vol. ii., p. 98.

when tightened, bringing them closer together, and so concentrating the traction. A longer crotchet-forceps (Fig. 185), with a wider curve at the points, is not infrequently used with success in breech presentations with the hind-limbs retained; the points are inserted towards each flank, penetrating as far as the shaft of the ilium.

Günther has spoken highly in favour of a long, blunt crotchet-forceps

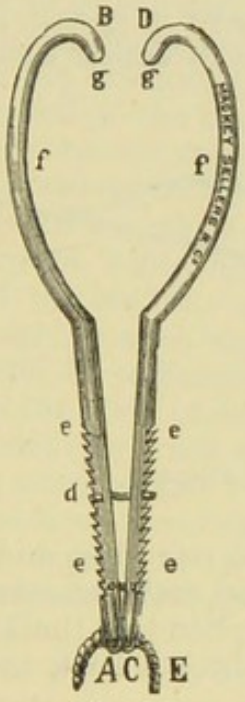

Fig. 186.

GÜNTHER'S LONG CROTCHET-FORCEPS.

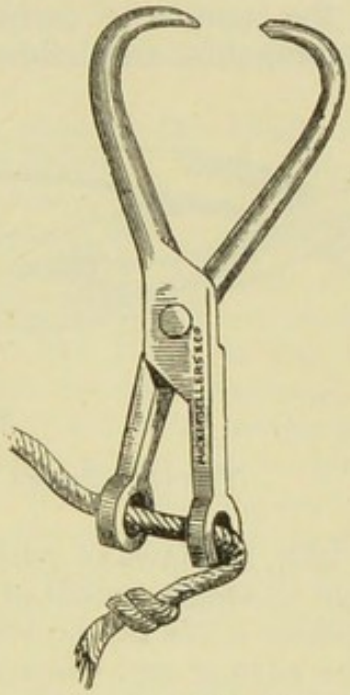

Fig. 187.

JOINTED CROTCHET-FORCEPS.

to answer the same purpose, and which has what is considered an advantage—a series of notches on each side towards the traction-rope, on which runs a clip that binds them together, and prevents their flying outwards while the assistants are pulling (Fig. 186). The two crotchets A B, C D are brought together at A C by the cord E, which passes

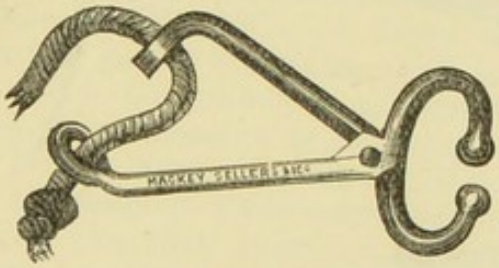

Fig. 188.

NELSON'S BLUNT CROTCHET-FORCEPS.

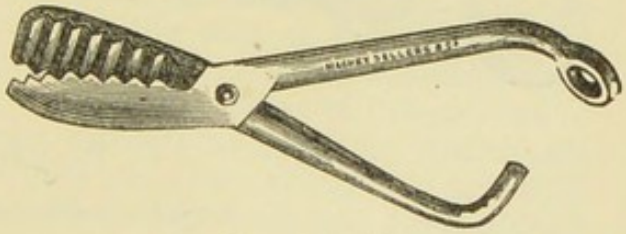

Fig. 189.

NELSON'S SERRATED CROTCHET-FORCEPS.

through their eyelets; *d* is the clip on the ratchet *e e*; *f f*, the curve of the crotchets; and *g g*, their blunt points.

To render their hold more secure, these crotchet-forceps are sometimes jointed; and in this form they are preferred by some practitioners. Fig. 187 represents a very useful model, the points being sharp, and one point lies in a slight notch on the opposite one, to render their introduction into the uterus more safe, and also to prevent accidents,

should the tissues in which the points are implanted give way. A cord passes through eyelets at the extremities of the blades, as in the other models; but sometimes the eyelets are in opposite directions, and the ends of the branches in which they are pierced are bent towards each other; this variation is supposed to be accompanied by certain advantages, as in Nelson's blunt and serrated forceps (Figs. 188, 189), some of the uses of which have already been noticed.

Some of the models of crotchet-forceps have a spring introduced between the branches, and behind the joint, as in Tallich's short instru-

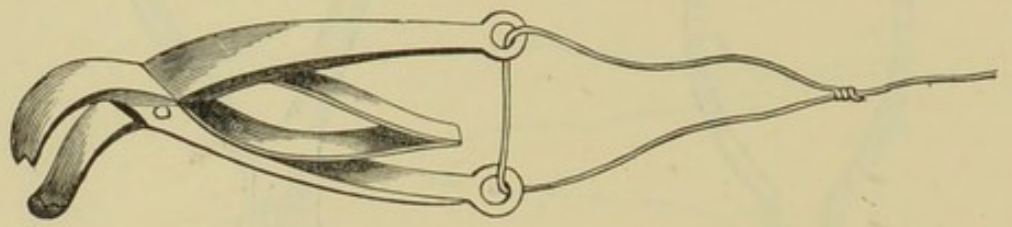

Fig. 190.

TALLICH'S SHORT BENT CROTCHET-FORCEPS.

ment (Fig. 190), the jaws of which are bent to one side, and toothed; it is intended to secure a hold of the fœtus, and make traction on parts to which neither cords nor crotchet can be applied—as the skin of the cheek, or the nose or ear, when the head is thrown back towards the flank in the anterior presentation.

Another instrument of this description has been devised by a Belgian veterinary surgeon, André, which he designates a *pince-forceps* or *accroche-fœtus*. This is not unlike the instrument fixed in the nose of

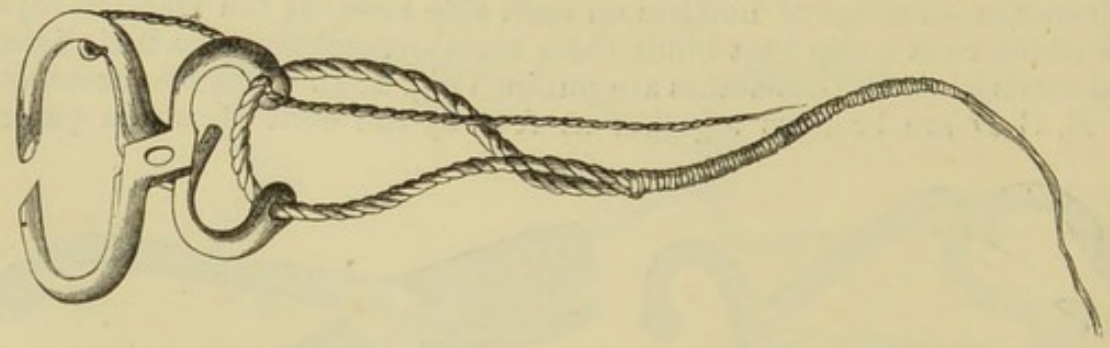

Fig. 191.

ANDRÉ'S CROTCHET-FORCEPS.

a Bull in order to lead the animal. The points of the jaws are bevelled to fit into each other, the bevel being grooved. In one of the jaws is a small hole, into which is fixed a string that passes through the eyelet at the end of the opposite branch, and which is pulled at when it is desired to open the forceps. The two branches behind the joint are very short, and through the eyelet of each passes a strong cord, the two ends of which soon unite into a single piece (Fig. 191). When this is pulled at the jaws close, as in the other jointed examples, and they remain all the more firmly closed as the traction is great. In order to use the instrument, it is passed by the hand into the uterus; the jaws

are fixed on the part to be drawn at, by first pulling, outside the vulva, at the string which opens them, pushing the points against or over the part ; then, when this is between the points, drawing at the single cord which closes them. This is acknowledged to be rather an instrument for holding or fixing a certain region, and not for exercising tractile force upon. André has often applied it successfully to the lower and upper jaw, or to the ear, to bring the head into a good position ; to the *tendo Achillis* in order to raise a hind-limb, which the hand alone could not do ; to the fore-limbs, etc.

With regard to the smaller animals, such as the Bitch, Sow, Sheep, or Goat, in them we may often use the crotchet, small ordinary forceps, or a small-sized model of the human forceps, with advantage. Various patterns are in use, some of them fenestrated, others not ; some resemble polypus-forceps, while others again are grooved, serrated, or toothed at the ends of the blades. An essential which should not be lost sight of in the forceps for such small animals as the Bitch or Cat, is that the blades should be sufficiently long to seize not only the head, but much, if not all of the body of the fœtus. If they are short in the blades, they cannot be made to grasp sufficient of the fœtus to remove it ; while the joint being close to the vulva, or even within the vagina, is likely to pinch the mucous membrane and cause the mother considerable pain.

A useful instrument is a small and slightly modified form of the human forceps for Bitches ; there is a spring between the branches of the handle (Fig. 192).

Weber has proposed a forceps for these small animals, and it has been preferred by some authorities to the ordinary model. It is a modification of one for a long time employed by Leblanc, which again was fashioned after an instrument designed by Hunter. This is composed of an iron stalk about ten inches in length, with a wooden handle at one end, and two blades or bows at the other. On this stalk glides a long enveloping metal tube, which, near the handle, has a wide ferule or shield that allows it to be pushed along by the thumb of the hand holding the instrument, and thus to bring the blades together. A nut or female screw, running on a screwed portion of the stalk near the handle, is intended to assist the pressure of the thumb, when this is insufficient (Fig. 193). A finger of the other hand introduced into the vagina, guides the instrument, and allows the part of the fœtus to be seized to be reached by the operator, either with the view of extracting the young creature or changing its position, according to indications.

But, it must be observed, it is very difficult to apply an instrument of the shape of those employed in human practice ; it ought to be something like that described by Palfin. It is most difficult, Defays truly says, to apply an instrument in shape like the accoucheur's ordinary forceps, owing to the neck of the fœtus in Carnivora being so thick, and the difference in volume between it and the head far less than in the human fœtus. So that, when the forceps is used, the bow of the blades presses on the neck, slips under the throat, and the head escapes from them. To remedy this imperfection, he has made forceps with the extremity of the blades notched or hollowed out (Fig. 194), while the end of one of the branches has a piece of metal with a slot in it attached by a hinge, and which is intended to hold the blades together when the fœtus is seized.

Though this forceps has sometimes proved of service, yet cases occur in which it is not so useful.

When the Bitch is large, or of moderate size, forceps may be employed with advantage, though they must be of various dimensions.

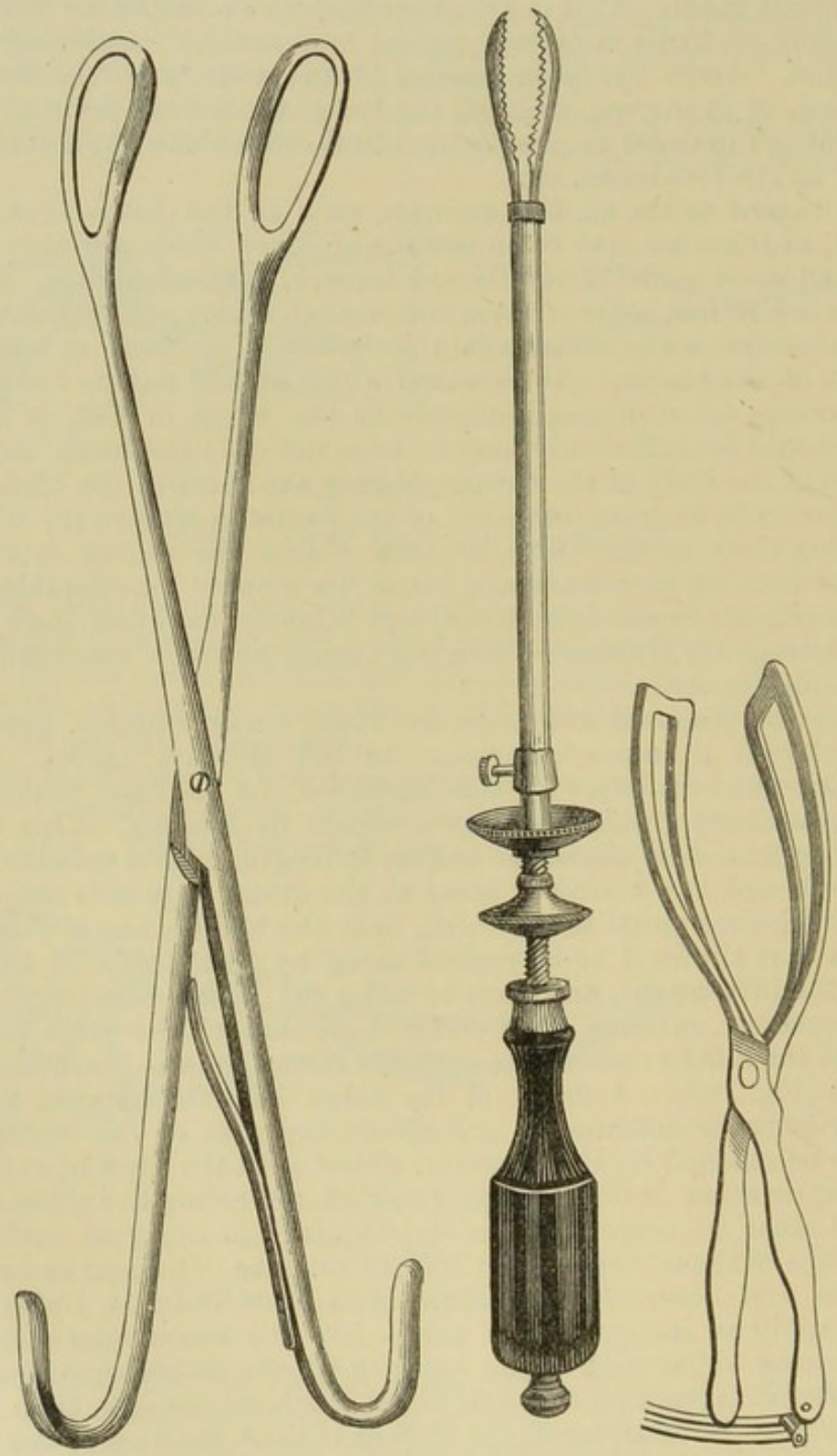

Fig. 192.
Bitch Forceps.

Fig. 193.
Weber's Forceps.

Fig. 194.
Defays' Forceps.

But when the animal is very small, as is usually the case in difficult parturition in this species, the space occupied by the bows of the forceps —if they are ever so thin—so increases the volume of the mass which

has to pass through the pelvic canal that this instrument cannot be used.

As was pointed out when studying the anatomy of this region, the pelvis is cylindrical in Carnivora, and if we suppose its diameter to be three inches, and that of the head of the fœtus a trifle less, it will be seen that birth must necessarily be difficult; and this difficulty will be increased if the vagina is narrow and rigid. When the forceps is used, the difficulty is further exaggerated; for when the blades are passed on the head, the fœtus is then augmented in size by a quantity equal to their breadth multiplied by their thickness—the whole constituting a mass greater than the pelvic cavity will permit to pass through it; so that delivery becomes impossible. Forceps, therefore, in small Bitches increase the difficulties of parturition, and these difficulties are all the more embarrassing as the animal is diminutive. Recourse to this instrument is consequently contra-indicated, and if delivery is to be effected, a means must be substituted which presents less inconvenience. As a rule, the loss of one or two Puppies is not a matter of much moment, the principal object being to save the mother by bringing the act of parturition to a prompt termination. Therefore it is that Defays' or Breulet's appliances (p. 507) are to be preferred in nearly all cases.

CHAPTER IV.

The Employment of Force in Dystokia.

In connection with obstetrical operations, a rather important question to be considered is the employment of *force* in the artificial extraction of the fœtus. For, as has been shown, more or less energetic traction is very frequently needed to remove it from its parent; and those who do not understand, or are inexperienced in animal obstetrics, are sometimes astonished, if not horrified, at hearing of the amount of pulling which the fœtus has to undergo and the parent sustain, before delivery can be effected in some cases. Yet force is, as a rule, absolutely necessary, even in embryotomy; and though some of the various points with regard to it are not yet sufficiently ascertained, and differences of opinion exist with regard to them, yet it is a subject well deserving the attention of the obstetrist, and especially the junior practitioner.

The indications for forced extraction have been given in preceding chapters; they are chiefly to be found in the smallness or deformity of the maternal genital canal; excessive development of the fœtus—wholly or partially, or distortion; malposition of parts which cannot be remedied; or morbid conditions that hinder birth. Forced extraction is usually preferable to embryotomy and Cæsarian section in those cases in which the passage of the fœtus—whether alive or dead—appears to be possible without serious injury to the mother; and because of the greater width of the pelvis of the Mare, it is more likely to be successful in that animal than in the Cow.

The *direction*, *intensity*, and *nature or means of developing the force to be employed*, have first to be considered, after which it will be desirable to compare *manual* with *mechanical* force, and point out their respective advantages and disadvantages from an obstetrical point of view.

SECTION I.—DIRECTION OF TRACTION.

Since the forceps was introduced into human obstetric practice, the direction which the fœtus should be made to follow in the pelvic cavity of woman has been continually discussed, and has been acknowledged to be a very difficult, as well as a very important problem to solve. This difficulty is mainly due to the fact that the pelvic canal in the human female is not uniform in its dimensions, and that the head of the fœtus must pass through it by always offering its greatest diameter to that of the cavity. Consequently, it must execute during its passage a *rotation* movement in one or other direction, according to the presentation—a movement necessitated by the different planes of the cavity. In addition, the canal is curvilinear, its axis not being represented by a straight, but by a curved line, the form and direction of which are, besides, modified by those deformities of the pelvis that are so frequent and varied in woman, and which constitute one of the principal indications for the use of the forceps. So that the difficulty in the question is to determine, in a rigorous manner, the direction in which to exercise traction with

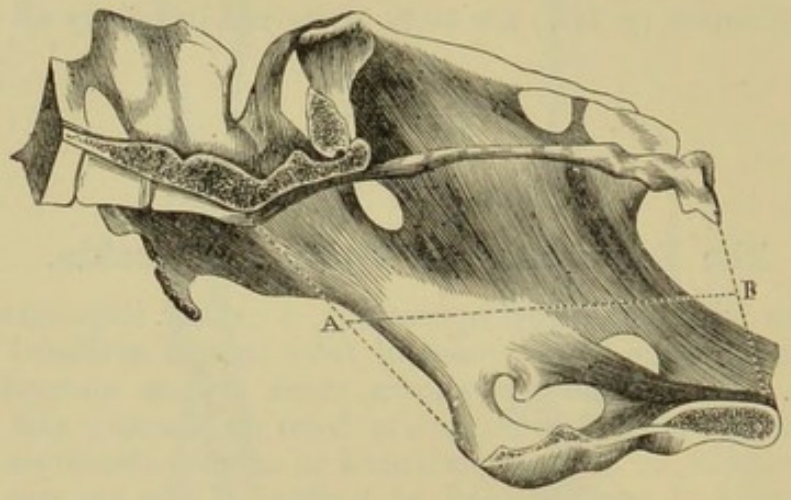

Fig. 195.

Diagram of the Pelvic Axis.

this instrument; though it is generally agreed that it should be made according to the pelvic axis.

With animals, the problem is, of course, much less complicated, as their pelvis is somewhat cylindrical; and its axis—almost rectilinear—can readily be determined by a line passing from the centre of the anterior circumference to the centre of the vulva, or somewhat towards the middle of the line uniting the two superior ischiatic tuberosities. Traction should therefore be made in the direction of this axis (Fig. 195, A B); and this line of traction, happily for the veterinary obstetrist, and thanks also to the flexibility of the cords which, in his practice, take the place of the forceps, offers no serious difficulty. At p. 261 it was shown that this direction can vary, and may be modified according to the presentation—and more particularly the position—of the fœtus, and also according to the period of labour.

SECTION II.—DEGREE OF TRACTION.

When passing through the pelvic cavity, the fœtus undergoes a certain amount of compression, proportionate to the uterine contractions or the

external traction which determines its progression outwards; at the same time, this compression produces a kind of reaction in the body of the fœtus, and gives rise to an eccentric pressure against the walls of the passage, related to that which itself experiences. The question is, therefore, limited to the amount of force necessary to overcome the resistance that prevents the onward progress of the fœtus, without injuring either the latter or the parent. In veterinary obstetrics we have no fixed data to rely upon; but the experiments of Joulin, Delore, and Poullet, alluded to by Saint-Cyr, may afford some idea of the resistance offered by the pelvic girdle to the eccentric pressure. These authorities found that if a rounded body—a ball, for instance, to represent the head of a fœtus—is attempted to be pulled through the pelvis of a woman, it requires a force represented by 375 to 441, and even as much as 635 pounds (estimated by the dynamometer), to produce such serious lesions as fracture in the bones or disunion of the symphyses. But it must not be concluded, from this result, that such powerful traction can be practised with impunity in woman. In the first place, the child could not be extracted alive, for its existence appears to be compromised if the degree of traction by the forceps exceeds from 132 to 154 pounds; and in order that the pelvis of woman could resist such pressure, certain conditions are required which we never meet with in ordinary practice; for instance, the pressure should be equally applied to every part of the bony girdle in contact with the head of the fœtus. But this does not take place with the ordinary forceps, which, even in the hands of the most expert accoucheur, not only acts as a traction agent, but at a given moment is unfortunately transformed into a lever of the first or second kind, whose power is incalculable, and which, resting on two opposite points of the pelvic circumference, may burst it, without the dynamometer showing anything more than a relatively feeble degree of traction.

Otherwise, it is not only the bones which have to be considered, but also the soft parts, which, pressed between the fœtal head and the hard pelvic circumference, may be bruised, crushed, or lacerated to a variable degree, if the compression exceeds a certain limit. This pressure, however, is always considerable; for, according to Chassagny, when a tractile force of fifty kilogrammes is exercised on the head of a fœtus seized by the ordinary forceps, we may calculate that each square centimetre of surface of the pelvic walls sustains a pressure of 1,800 grammes, even in the most favourable conditions; though it may be as much as six kilogrammes or more, according to circumstances.

These observations, though doubtless valuable and significant for the accoucheur of woman, are only very indirectly applicable to veterinary obstetricy. Without taking into account the strength of the pelvic osseous girdle, so much greater in the Mare and Cow than in woman, several other circumstances enable us to understand why this bony circle may, in these animals, resist an amount of strain which would appear to be altogether unreasonable, if judged according to the principles which should guide the practice of the human obstetrist. But the veterinarian is in possession of means of traction which give him a great advantage in this respect—an advantage which the accoucheur has not yet been able to avail himself of; we allude to the cords the former so frequently employs as traction agents, and which can never be transformed into levers, like the forceps.

In woman, as with animals, the fœtus, in passing through the pelvic

cavity is pressed upon by its walls, and in turn it presses upon them, in the manner of a wedge which tends to tear them asunder. But there is a great difference in woman and animals. On the one hand, it is a hard, bony, and little reducible region—the head—which presses against the pelvic walls, to which it transmits, almost undiminished, the pressure itself receives; on the other hand, it is a bony cage—the chest—formed of numerous very movable parts, and which can submit without injury to much distortion, in addition to its being covered by soft and readily compressible tissues; consequently, we can easily comprehend how much in the latter case—that of animals—the eccentric pressure produced by the passage of the fœtus should be attenuated. In addition, the head of the infant is spherical, and therefore comes in contact with the interior of the mother's pelvis by a circle or narrow zone; the surface of the pelvis in contact with the fœtal head has been estimated at sixty square centimetres, and it is to this limited space that the head transmits the pressure it sustains. Chassagny, from a series of experiments, estimates that, for a traction of sixty kilogrammes—exerted under the most favourable circumstances by his forceps on the head of the human fœtus—each square centimetre of the surface of the pelvis in contact with it should support a pressure of about 500 grammes; in less favourable conditions it may even be much more.

From some measurements made by Saint-Cyr, the pelvis of the Mare and Cow, which is nearly cylindrical, may be reckoned at 1,600 square centimetres (248 inches) of internal surface; and it is on this expanse that is distributed, in a nearly uniform manner, the eccentric pressure which the chest of the fœtus transmits to the walls of the genital canal, to which it is very closely applied during its passage outwards. If, then, it be admitted that the total of this eccentric pressure amount to about one-half the tractile force expended on the fœtus, it will be easy to find, by a simple calculation, the pressure on each square inch. Supposing the traction to be equal to 1,540 pounds—the estimated strength of seven or eight men pulling with all their force at the cords—the pressure on each square inch would be about $7\frac{3}{4}$ ounces; or one-half that exerted on the same extent of surface with a tractile force of 132 pounds, in woman!

Saint-Cyr does not pretend that these calculations give a rigorously exact measure of what really takes place during parturition; but he believes they may assist, up to a certain point, in explaining certain facts in comparative obstetrics which otherwise would remain obscure—how, for instance, natural birth, which is always so painful in woman, is comparatively painless in the larger animals; and why traction, the very idea of which alarms the accoucheur of woman, is in the majority of instances so well sustained by the veterinary surgeon's patients.

It must be confessed, however, that we have as yet no certain data by which we can estimate the exact amount of force necessary, or which may be employed without danger; and on this point the opinions of the best authorities are widely divergent. Some declare for moderate traction—two, three, or four men at the most, pulling simultaneously at the cords with all their force, are, in their opinion, quite sufficient in all cases, if well managed; and they assert that it is rash and dangerous to employ more. Others do not hesitate to have recourse to more energetic traction, and are not afraid of employing the combined strength of six, eight, or ten strong men; being convinced that the parent suffers

more from protracted labour than from powerful traction—and not infrequently their success justifies their boldness.

Donnarieix admits that three assistants are usually sufficient with the Cow—one at the head, another at the tail, and the third to aid the operator; while ten are needed for the Mare—one at the head, another holding the rope which confines the limbs of the animal and prevents its doing damage, a third to hold the tail, a fourth to assist the operator, and the other five or six to pull at the fœtus when necessary. Zundel, however, is of opinion that these numbers are somewhat exaggerated; very often more than three assistants are required for the Cow, and if more than six are needed for the Mare it is better to have recourse to mechanical means; as too many assistants hamper the operator, and are often in each other's way, while their united strength cannot be usefully applied.

The assistants should be strong, and have had some experience in handling animals; some of them maintain the creature in a favourable position, while the others aid the attempts at extraction, under the orders of the operator. Precautions should be adopted to prevent accidents—especially to the assistants—from the struggles or defensive movements of the animal; and if the traction is severe, the latter should be supported against it by assistants pressing on the buttocks, by holding a rope or band against these—or even by placing the hind-quarters against the half-door of the stable. The tractile efforts should be made simultaneously without jerking, in a continued and energetic manner, and always in the direction of the axis of the pelvis—in a straight line behind the animal. The direction of the traction may, however, be a little downward in the anterior presentation, lumbo-sacral position, until the withers have passed through the inlet; as by this means the top of the withers is depressed, and this part enters the pelvis before the sternum. The operator stands behind the mother, his hands on the sides of the vulva, which he depresses with the cubital border of one hand, while with the back of it he separates the lips, and prevents their being abraded by the cords. It is better to engage only one shoulder of the fœtus at a time, if possible; and when the sternum and one shoulder have been carried into the passage, then the other shoulder is brought forward by directing the assistants to pull a trifle towards the opposite side. By acting in this way with care, and by slow though continued efforts while the parent is straining, delivery will be effected, if this be possible by traction. The operator must not act hurriedly or brusquely, and his hand should carefully attend the advance of the fœtus: facilitating its passage, and aiding the progress of the haunches by passing his open hand between them and the maternal pelvis.

In the posterior presentation, when at least one assistant must be told off to each cord, the traction should be moderate, or even gentle at first, until the operator's hand has adjusted the fœtus as much as possible. In addition, the latter, besides directing his assistants, must frequently himself guide the traction by the disengaged hand, and personally exert himself in the extraction of the young creature—separating the lips of the vulva, and pressing them towards the pelvis when they are pushed outwards by the advancing fœtus; lubricating the latter and the genital canal when necessary, etc.

With the smaller animals the operator himself applies the needed force, though an assistant is usually necessary to hold the creature.

Generally, very little traction can be made because of the danger of tearing the fœtus in pieces, and what is employed should be gentle and sustained; indeed, the fœtus should be held steady, traction only made during the expulsive efforts of the mother, and then lightly and steadily.

SECTION III.—MEANS FOR DEVELOPING THE NECESSARY FORCE.

Hitherto the employment of human or manual force in the extraction of the fœtus has only been considered, and this, of course, is that which is generally resorted to at first. But it is not the only force that may be employed, and especially if it is desirable to exercise very powerful traction. It is true that empirics and amateurs have often adopted the barbarous expedient of attaching the cords fixed on the fœtus to a Horse or Ox, and by making the latter exert its strength, to tear the young creature through the maternal passage. Rainard mentions that in the Camargue, those who have the charge of droves of Mares, not having the services of a veterinary surgeon, yoke another Mare to the cords they fasten on the fœtus, and deliver the parturient animal in

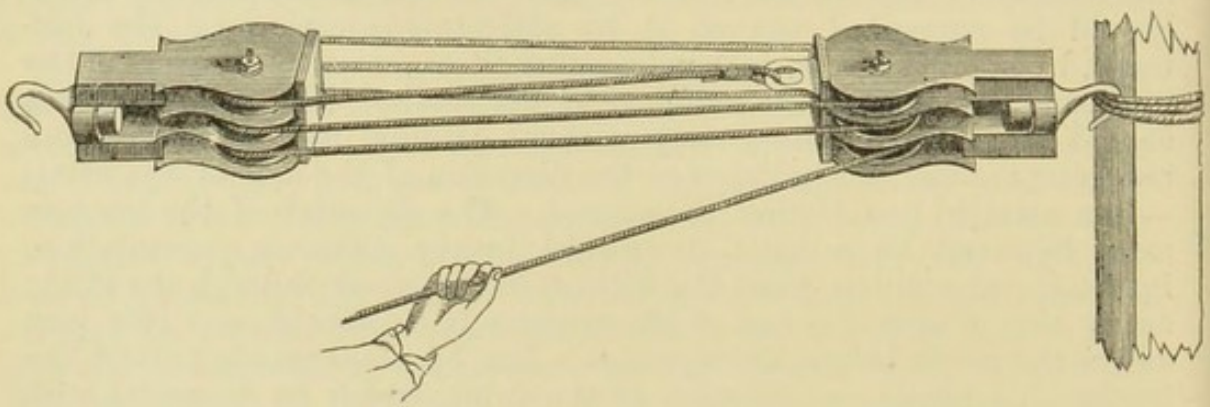

Fig. 196.

Obstetric Pulleys.

this cruel fashion. Being destitute of anatomical knowledge, they act blindly; and not understanding how to adjust a malposition, the Foal is nearly always extracted dead, and only too frequently the mother perishes.

With the object of extracting the fœtus by force when manual traction is not sufficient, the *windlass, capstan, wheel, cart, and pulleys*, have frequently been used, and with great benefit. Many veterinarians consider the employment of machines as barbarous as Ox or Horse traction, but this opinion is scarcely just. They say such machines are blind instruments which cannot be directed at will, and they prefer increasing the number of men indefinitely rather than resort to them.

But many of the most intelligent and experienced veterinary obstetrists speak of the great utility of these machines; and some of them state that whenever the combined strength of six men is not sufficient to extract the fœtus from the larger animals, they do not hesitate to employ one of these articles. Not only can a greater tractile force be developed by them, but this force may be diminished or increased at will, and as gradually as circumstances may require. In this direction, though the windlass, capstan, or wheel may be utilised,

yet for convenience in application, portability, and steady graduated traction, nothing can approach the light obstetric pulley, the manner of using which is shown in the annexed drawing (Fig. 196).

When very powerful traction is required, whether manual or machine, there is the risk—particularly if the animal is standing—of dragging it backwards until it falls, or doing it some injury unless the precaution is adopted of fixing it in some way. It is obvious that there is great danger—indeed cruelty—in attaching it merely by the head or neck, and allowing this to bear all the strain. It is necessary to render the creature immovable by passing cords, bands, or a sack behind the thighs and above the hocks, bringing the ends towards the animal's shoulders, and maintaining them there either by assistants, or by attaching them to the manger or any other part sufficiently strong. A wooden bar placed behind the thighs and secured to the stall-posts, is also serviceable; as is likewise an ordinary harness breeching, the front parts being secured to rings in the wall or manger. In some cases, vigorous assistants, by placing their back against the haunches of the animal, will offer sufficient resistance to its displacement. Many practitioners prefer throwing the animal down, if it is standing, in order to avoid the dangers of being dragged; Schaack even asserts that the body when lying on the ground increases the expulsive efforts, and keeps the fœtus in the plane of the pelvis. Donnarieix is not afraid of seeing the animal dragged a little, and recommends that the traction should not cease in consequence. Nevertheless, during decubitus the operator is more quickly fatigued, besides being restrained in his movements; the necessary manœuvres are more difficult to perform, and the weight of the fœtus is often an additional obstacle. And even when the creature is lying, if the traction is very strong, it is often necessary to prevent the body being drawn backwards.

All these inconveniences being recognised by Baron, in 1858 he introduced an obstetrical machine in the form of an apparatus for producing sustained traction (*appareil à traction soutenue*) in the extraction of the fœtus. This apparatus presses against the hind-quarters of the parturient animal, and owing to its construction it can not only develop a very energetic extractive force in the gentlest and most inoffensive way possible, but itself produces the counter-extension in an exactly proportionate degree.

The principal parts of the machine are: a kind of horse-collar (Fig. 197, A) with three stalks (B, C, D) intermediate between this collar and a broad, fixed, female screw (E), which receives a movable screw rod (H) that bears a revolving hook and chain (K) at one end; the other end of the chain has also a hook to which the cord or cords fixed on the fœtus are attached. The collar is made of several pieces of light wood superposed, and bound together by an iron band applied to its posterior surface. This band is perforated by three screwed holes placed in a triangular position, and which receive the iron stalks. The anterior face of the collar is so fashioned as to fit closely on the hind parts of the animal, the space for the passage of the fœtus being about twenty inches in diameter. The intermediate stalks (B, C, D) serve to transmit to the collar the pressure exercised by the female screw; they are about forty inches long, and each is composed of two pieces, one of these being hollow (4, 5, 6), the other solid (1, 2, 3): consequently, one fits into the other, and the end opposite the collar enters one of the openings in the flange of the female screw (E); a

small thumb-screw (7, 8, 9) secures the two portions of the stalk. The female screw is of iron or copper, the flange being of wood, and its circumference provided with two handles to hold it firmly when the machine is in use. The male screw (H) is of iron, and screwed to the right; one extremity articulates with the turning-hook (I); it is screwed in the contrary direction to the principal portion, so as not to become unscrewed during the operation; the other end has a four-branched windlass which can be removed at will.

To use the machine, the animal is made to lie; the cords are attached to the fœtus in the usual manner; the windlass handle is put on its place; the screwed stalk (H) is introduced into the female screw to about as far as J; the collar is applied to the animal's croup, and the three long stalks are fixed—one end in the collar, the other in the

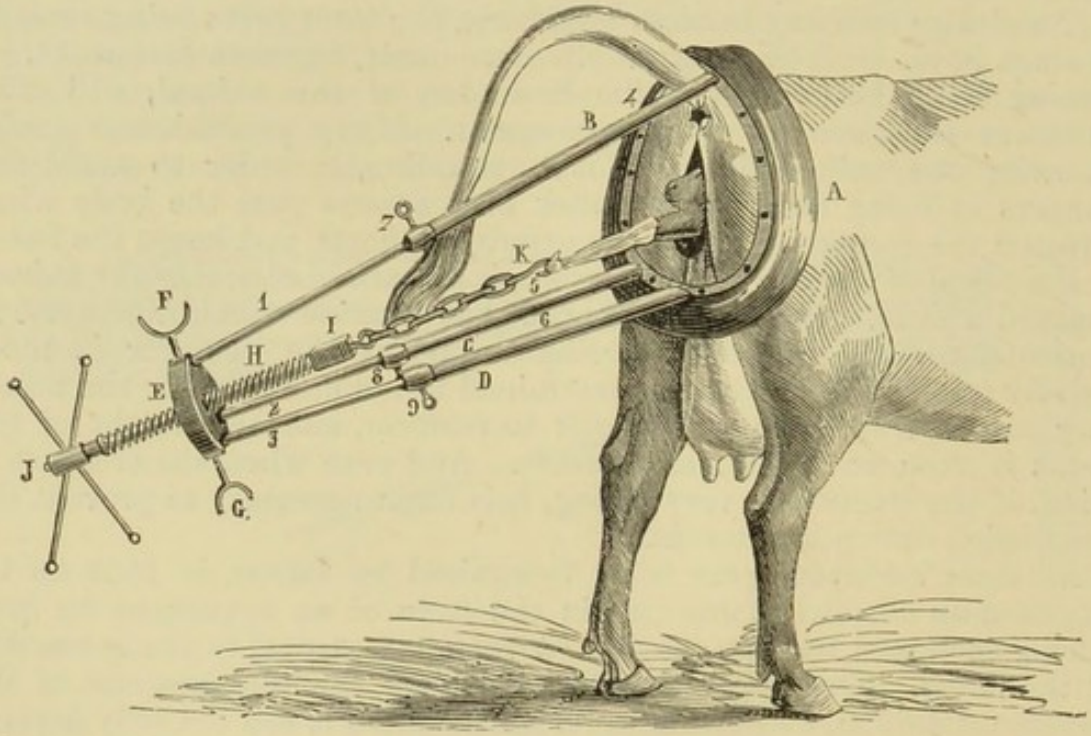

Fig. 197.

Baron's Obstetric Machine.

flange. An assistant keeps the machine in equilibrium by placing one of his hands on one of the forked handles of the flange, while the other handle rests firmly on the ground. Another assistant, the cord attached to the fœtus being fixed in the hook at the end of the chain (K), slowly turns the windlass in such a direction as will bring the extremity of the stalk (I) towards the flange, while the operator superintends the extraction. It will thus be seen that a strong traction is exerted on the fœtus, while a proportionate pressure is transmitted to the croup of the parent through the three long rods—the machine producing extension and counter-extension at the same time, while it also allows a sustained traction to be obtained—without jerks or checks, and as powerful as may be desired.

This machine has been well tested in France, and received the highest praise.

SECTION IV.—COMPARISON BETWEEN MANUAL AND MECHANICAL FORCE.

The employment of machines which multiply force for the artificial extraction of the fœtus, can be traced to a somewhat distant period; and the use of the windlass, the wheel, and the cart by rude empirics is of ancient date.

Resorted to by ignorant people destitute of that knowledge which alone can ensure safety and success, these appliances must have been productive of great injury and loss. It was probably from witnessing these results that the early French veterinarians were almost unanimous in their condemnation of their use, and designated them as "cruel" and "murderous." "It is cruel," says Fromage de Feugré, "to tie a cord to a Calf, and to pull at it by the windlass or capstan, or by horses attached to it. It is much better, the Cow being tied by its horns, to make men pull at the cord, so that force may be employed with more precaution and management." And Hurtrel d'Arboval remarks: "There are people who would go so far as to pull at the cord which is attached to the Foal or the Calf by the windlass, the capstan, or pulleys; this procedure is not only cruel, but its violence usually kills the fœtus, and often causes lacerations, serious injury, and displacement of the uterus." Other writers have written in equally strong terms against the use of traction machines, and in favour of manual force—which, they argue, is an intelligent force that may be graduated at will, and its direction modified according to circumstances, so as always to act in the most favourable way—*i.e.*, in the axis of the pelvis.

Nevertheless, since 1838, when Lecoq spoke in favour of mechanical appliances, many of the most experienced practitioners have expressed themselves in their favour. "I propose the pulley," says Lecoq, "because it affords much more gentle and steady traction than that obtained by strength of arm. . . . This opinion is shared by the majority of the veterinary surgeons in our part of the world." "The employment of the pulley," writes Darreau in 1852, "gives a more regular and sustained traction than that of assistants, no matter how vigorous and intelligent these may be; in turning it slowly, we obtain a gradual and continuous traction; the shoulders and the body of the fœtus are elongated, the sides are flattened by the pressure, and delivery is effected in the majority of cases without an accident. . . . By this procedure, we succeed in eight cases out of ten." Ayrault writes:[1] "I have decided to employ a means which I have often very severely qualified when in the hands of empirics, and which can be only barbarous and brutal by reason of the ignorance of those who apply it: I speak of the windlass, and wheel and axle. . . . It is now amply demonstrated to me that this obstetrical means, so little enticing at first sight, is the first among all the means for producing traction which the veterinary surgeon has at his disposal—provided always that he watches its operation with much attention . . . so that no part of the fœtus wedges against the sides of the pelvis; for the windlass does not know of any obstacle which it cannot overcome." And Garreau,[2] commenting on Baron's obstetric machine just described, reports, "From what has been said, it results from an examination of every part of this apparatus that it is simple, and works well and easily; that its power is at least

[1] *Recueil de Médecine Vétérinaire*, 1857.
[2] *Report à la Société Centrale de Médecine Vétérinaire*, 1858.

equal to that of the pulleys, windlass, or capstan; that its action is based on mechanical laws; that the traction it produces is so gentle, slow, and regular, that it is without danger for the mother; that its employment altogether leaves behind all the other means used for the production of the necessary counter-extension in fœtal extraction; that the collar transmits, in a regular manner, and to the whole of the inferior and posterior parts of the maternal pelvis, the pressure it receives from the female screw; that this pressure, disseminated over the entire hind-quarters of the female, is proportionately less severe and painful during traction of a given intensity."

Many more references could be given to other very competent authorities in favour of mechanical over manual traction; but the evidence may be summed up by stating that mechanical traction is preferable to that produced by manual power, inasmuch as it is slower, more regular, its action is more sustained, and it is more powerful and efficacious, without imposing increased strain on the parent or fœtus. Manual traction is unsteady and jerking, especially when several men are pulling; all the men do not pull alike, or at the same time; therefore even during traction, however steady it may aim to be, the strain varies, as men soon become fatigued; whereas the machine can maintain the traction for any length of time without increasing or diminishing it.

One of the objections urged against machine traction is that its direction cannot be so easily varied upwards, downwards, or to one side or the other, as manual traction. But this is a very trifling objection, and it may be nearly, if not altogether, overcome by making assistants press against the cord or cords, so as to give these the necessary direction.

When powerful traction is required, whether it be manual or mechanical, great attention is necessary in guiding the fœtus through the genital canal, so as to prevent injury to the parent. The traction should cease in the intervals between the labour-pains, and the efforts ought not to be continuous; the animal should be allowed intervals of rest, and time be given for the genital canal to dilate and adapt itself to the passage of the fœtus. Severe and injudicious traction may be productive of the most serious results. Even when the operation is nearly terminated, care will be requisite in order to prevent inversion of the uterus. This accident may be obviated by careful manipulation, and abundant injection of emollient fluids.

CHAPTER V.

Embryotomy.

Embryotomy, or *embryulcia*, is the name given to every operation which has for its object the reduction in volume of the fœtus at parturition, by mutilating or dividing it; so as to allow it to be extracted by portions when it cannot be delivered whole. It is a generic term for a number of operations very different in their character, and performed on the fœtus either while it is wholly retained in the uterus, or more or less engaged in the genital passage.

The operations may be practised on various parts of the young creature—head, limbs, or body—and they facilitate the removal of one

or more parts, so that the remainder can be removed from the uterine cavity. Of course, the life of the fœtus, if it be alive, is sacrificed in every case; and this sacrifice is only made to prevent a greater loss—the death of the parent. But in resorting to embryotomy, the veterinary obstetrist is not hampered by those grave considerations which, from a legal, moral, and religious point of view, have so long embarrassed the action of the accoucheur of woman.

The question with the veterinary surgeon, should the fœtus be living, is as to the respective value of parent and offspring, and which of these should be preserved in the interest of the owner.

In nearly every instance the response is entirely in favour of the parent, this being of most commercial value; and this fact, together with the absence of legal and moral objections, will account for embryotomy being much more frequently practised in veterinary than in human obstetrics. Nevertheless, the destruction of the living fœtus in the case of the domesticated animals should not be lightly entertained; it is the duty of the veterinarian, in the interest of his client, to preserve the life of the young creature, as well as that of the parent, by every means in his power; and it is not until these means have been fairly tried, or are deemed insufficient after due deliberation and without trial, that the necessary mutilation should be undertaken. And it must not be forgotten that embryotomy is not always without danger for the parent; on the contrary, it is nearly always serious, and its consequences have often to be dreaded, while to the operator it is in the great majority of cases a heavy and fatiguing task.

When the fœtus is alive, then, it is only the most urgent necessity that should impel the obstetrist to resort to embryotomy; though when the creature is dead there is no need for hesitation, and the operation may be undertaken at once, if the operator is satisfied that extraction cannot be effected otherwise.

The conditions which generally require recourse to embryotomy have been indicated. They are: *deformities of the maternal pelvis*—either congenital or acquired, constitutional or accidental—which prevent extraction of the intact fœtus, this condition being, however, very rare in animals; *hysterocele; disproportion between the size of the fœtus and the genital canal;* certain kinds of *monstrosity;* particular *malpresentations* and *malpositions* of limbs or body, as well as *irreducible distortions* of the fœtus; *death of the fœtus*, when its retention in the uterus has given rise to intense emphysema which hinders delivery; certain *diseases of the fœtus*, as hydrocephalus, ascitis, œdema, etc. Indeed, embryotomy is indicated in every case when parturition cannot be accomplished by the other measures already mentioned, without seriously compromising the life or future usefulness of the parent.

It has been stated that division of the fœtus is very often a heavy and fatiguing task; and it may now be remarked that, however easy it may be to lay down rules and give directions as to how the operation should be conducted, only those who have had experience of it can testify that it is much easier to write and to speak than to act, and that some of the manœuvres so complacently recommended by those who have but little knowledge of the practical part of veterinary obstetrics, cannot be carried out.

The fact that only one hand can be employed in the uterus, that this organ is applied close to the fœtus when the "waters" have escaped for some time, that the membranes are adhesive and cling to the

fingers, and that the flaccid tissues of the young creatures glide away from the cutting instrument—as they can only be rendered tense in certain circumstances by the cords or crotchets—all this testifies that, combined with the straining of the mother, the removal of the fœtus by instalments in the larger animals imposes a severe strain on the veterinary surgeon's physical and mental powers.

It must be stated that embryotomy cannot be restricted to definite rules which shall be applicable to every case; the operation must vary according to circumstances, and these are often of the most diverse kind. In very many instances, before the veterinarian is called in rude and misguided hands have greatly complicated the case, and caused so much injury and swelling to the maternal organs that the difficulties are increased manifold.

But, as in everything else, there is a right way and a wrong way of operating—apart from the collateral difficulties of the operation; and though no fixed rules can be laid down for every case which requires embryotomy, yet there are directions, based on the results of practical experience, which afford a general and trustworthy summary of the most important points to be observed—by the young practitioner more particularly. These directions will now be alluded to, in treating of the incision, excision, or ablation of those parts of the fœtus which are selected for operation—these being the head, limbs, and body. But the instruments in actual use, or which are recommended for performing embryotomy, must first be noticed.

Embryotomy Instruments.

The performance of embryotomy necessitates the use of surgical appliances for the division, puncture, or removal of certain parts; and as these operations have to be effected either in the genital canal or in the cavity of the uterus, the manipulation of cutting instruments in such a confined space by one hand, under all the disadvantages of distance from the operator, the struggles and paralysing straining of the mother, and without the aid of vision to guide and direct, renders the task peculiarly difficult and dangerous. These difficulties and dangers have stimulated the inventive faculties of veterinarians for a long time, in devising instruments by which they might operate quickly and safely, and so obviate fatigue and danger to themselves, and exhaustion and risk to the parturient animal.

It is needless to remark that many of these instruments have never come into general use, either because they did not fulfil the requirements claimed for them, or because they were too complicated or expensive. Sometimes, also, prejudice rather conflicts with the introduction of any novelty in this direction; while long experience often enables the practitioner to achieve the desired end with instruments which would be useless, if not dangerous, in the hand of a less expert obstetrist.

So it is that, for nearly all cutting operations, an ordinary pocket-knife or bistoury is sometimes the only instrument employed; the operator being satisfied if the spring is sufficiently strong to prevent the blade shutting up in the handle when it is used in the uterus. Rainard preferred an ordinary knife with a blunt point and a convex cutting edge; others use a bistoury caché. Even small pocket-knives of various sizes are utilised for this purpose, and one of Mr. Cartwright's embryotomy knives is not unlike a gardener's large pruning-knife. In

the use and preference for knives, much must depend upon custom and the expertness of the operator.

Nevertheless, convenience, safety, and the absence of long experience, demand that proper instruments be devised for this operation. One of the earliest to introduce a convenient and efficient embryotom was Günther, who, in his work, published in 1830, figures an instrument which is fixed on the finger by a ring; the cutting edge of the blade—which is about two inches long—being somewhat concave. This embryotom has been slightly modified in various ways by different practitioners—sometimes having two narrow rings, so as to grasp more of the finger; at other times having, in addition, a small button on the back of the blade for the finger to press upon; while the blade itself has been made more curved, straighter, longer, or like the blade of a fleam. This instrument is the prototype of the ring scalpel invented by Dr. Simpson, of St. Andrews, for opening the head of the human fœtus. Two of these embryotoms which have been used in this country, are shown in the annexed figures (198, 199). An improvement in this instrument is having a hole at the opposite end of the blade (Fig. 199), through which a piece of cord or tape can be passed and tied round the wrist, to prevent the knife slipping from the finger and falling into the cavity of the uterus. Indeed, this is a wise precaution with all

Fig. 198.

STRAIGHT EMBRYOTOM.

Fig. 199.

CURVED EMBRYOTOM.

the short instruments introduced into the genital organs, as the contractions of the uterus, struggles of the animal, and the position of the hand, as well as the slipperiness caused by the presence of mucus, etc., only too often render the hold of the instrument very insecure. The middle finger of the operating hand is passed through the ring and the other fingers enclose the blade, which is in this way safely conveyed to the part of the fœtus which is to be incised. The finger-knife is the most useful instrument in embryotomy.

Günther also at that time introduced another form of embryotom, which has likewise continued in use, and has been more or less altered or improved in shape. This consists of a blade that can be made to slide out and in a handle, by the thumb of the hand holding it. It can therefore be introduced into or withdrawn from the genital passage without risk of injury to the maternal organs. The annexed figure (200) exhibits an improved model of Günther's second embryotom; the original pattern had double cutting edges. It may be remarked that Zundel and Saint-Cyr give Thibeaudeau the credit of inventing this sliding bistoury; but the instrument was only described by the latter in 1831; [1]whereas an exactly similar knife is figured in Günther's work,[2] published at Hanover in 1830.

[1] *Recueil de Médecine Vétérinaire*, 1831, p. 152.

[2] *Lehrbuch der Praktischen Veterinär-Geburtshülfe*, Hanover, 1830.

Another kind of embryotom is one not unlike an ordinary large scalpel, on one side of which glides a blade-guard that can also be moved backwards or forwards by the thumb of the hand that holds it. This is a very convenient knife (Fig. 201); there is also a similar embryotom, projected from the handle by pressure of the finger on a button when the incision is to be made, and which is perhaps preferable to any

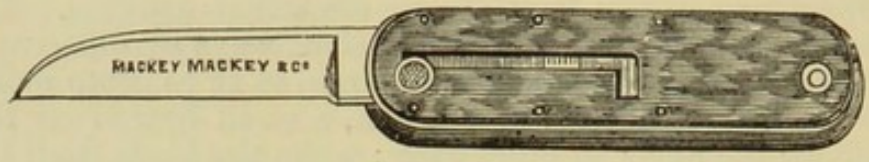

Fig. 200.

GUNTHER'S EMBRYOTOM: IMPROVED PATTERN.

others. Unsworth's embryotom (Fig. 202) is somewhat similar, the blade being projected from the side of the handle by means of a spring pressed upon by the finger.

Embryotoms have also been proposed by Brogniez, Hubert, Contamin, Obermayer, and others, but they all are more or less imitations of the foregoing models.

Fig. 201.

COLIN'S SCALPEL EMBRYOTOM.

Günther figures an embryotom fixed on a handle, and which may be of any convenient length—about thirty inches is recommended (Fig. 203); the blade is semicircular, the concave border and point being very sharp. This instrument is extolled for it usefulness in cutting through the muscles subcutaneously, and especially in separating the limbs from the trunk. The same authority gives the figure of a "Scheerenmesser,"

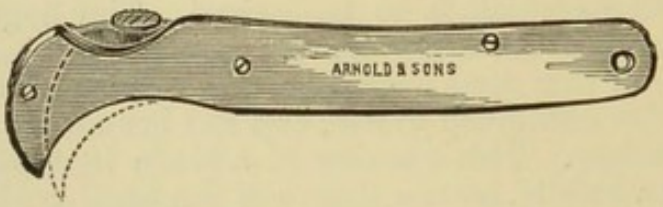

Fig. 202.

UNSWORTH'S SPRING EMBRYOTOM.

or "secator," as it has been termed. This is an instrument about thirty-six inches in length, composed of two branches, held together by two short sheaths, through which the one glides on the other. Each of the branches has a blade placed at a right angle to the stalk; these blades are opposite each other, the opposing edges being sharp, and they are brought in contact by a rachet arrangement and screw moved

by a handle at the other extremity. This instrument is very powerful, and can divide bones as well as soft tissues.

Subcutaneous embryotomy is at times very necessary, but after the skin has been incised great difficulty is often experienced in separating it from the textures beneath, by tearing through the connective tissue. This is found to be the case more particularly in amputating the shoulder, when the fingers become fatigued in trying to pass them beneath the skin. To facilitate this part of the operation, different-

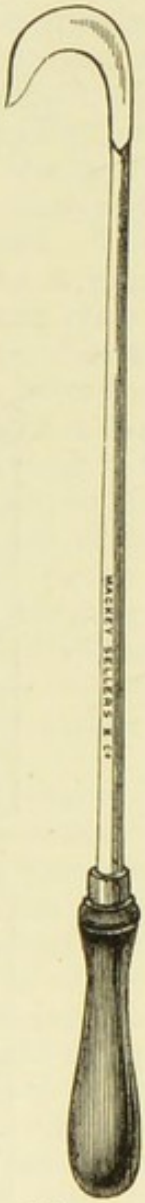

Fig. 203.

GUNTHER'S LONG-HANDLED EMBRYOTOM.

Fig. 204.

CARTWRIGHT'S SUBCUTANEOUS SPATULA.

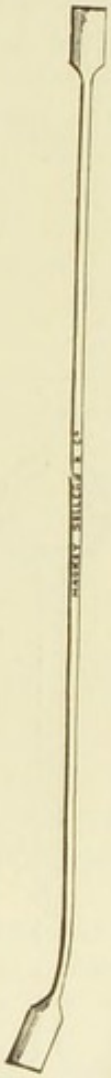

Fig. 205.

CARSTEN HARM'S SPATULA.

shaped spatulas have been devised, which do the work of the fingers in liberating the skin from the parts it covers. One of these spatulas has been used by Cartwright; it is merely a thin but rigid blade of iron, about seven inches long and one or one and a quarter inch wide, the edges being smooth and rounded, and one end fixed in a wooden handle (Fig. 204).

Carsten Harms employs a double spatula about three feet in length; the blade at each end is about an inch wide and two inches long, the

intermediate portion being simply a round rod about half an inch thick; one end is a little bent to one side (Fig. 205). This instrument can be used with both hands, and is more firmly held than a one-hand spatula.

Ungefrohrn proposes another, but somewhat differently-shaped

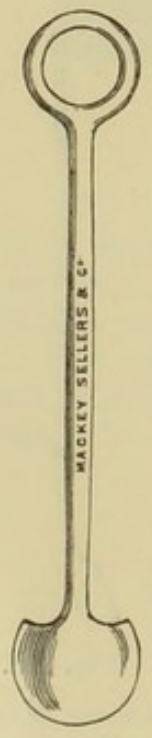

Fig. 206.
UNGEFROHRN'S SPATULA.

Fig. 207.
CARTWRIGHT'S BONE-CHISEL.

Fig. 208.
CARTWRIGHT'S BONE-SAW.

Fig. 209.
SWEDISH CHAIN-SAW.

spatula. This measures about twenty-five inches, the stalk being about three-eighths of an inch thick, and the blade two inches long and somewhat crescent-shaped; the convex border is most useful in raising the skin, particularly in parts where the connective tissue is close and resisting. The blade must be pretty strong and slightly convex on one

side, concave on the other. The other end has a wide eyelet as a handle (Fig. 206).

The section of bones, though not often necessary, is nevertheless sometimes required to be made, and it is found to be no easy matter—with the larger bones especially. For this purpose chisels, saws, and forceps have been proposed and employed. Cartwright has a model of an instrument for slitting up the skin of a limb, which may, on occasions, be made useful as a bone-chisel. Including the handle, it is about thirty-two inches in length; the chisel portion is a little more than two inches long, and one or one and a half inch broad; only the middle portion at the end is sharp, the two corners, which project a little, being blunt and rounded, as are also the sides (Fig. 207).

Margraff's "Stemmeisen," or chisel, is not unlike a joiner's chisel in shape; the instrument itself is seven or eight inches long, and at its cutting edge (end), which is very sharp, it is one to one and a quarter inch broad. The sides are well rounded, and the instrument gradually tapers as it reaches the handle, into which it is fixed. This handle is a round piece of hard wood about three feet long and about two inches in diameter, with a ferrule at the end into which the chisel is fixed, as in the ordinary carpenter's chisel. The cutting end of the instrument is carried by the right or left hand to the part of the fœtus to be incised, while the handle is held by the other hand. The two hands can in this way be employed: that in the uterus guiding the movements of the chisel, while that holding the handle applies the necessary force. This simple instrument has been found most serviceable in dividing the vertebræ when the head of the fœtus had to be bisected, dividing the head, or, in double-headed monstrosities, the two heads; as well as slitting up the skin. It has been suggested that if the cutting edge were made slightly concave the chisel would be more useful.

For the same purpose a saw has been proposed. Such an article has been successfully employed when the occasion demanded it, though some authorities consider it to be of little value. Cartwright's saw is figured here (Fig. 208). The stalk (of iron) is sixteen inches in length, the saw four inches long, and the handle six inches. The saw-blade should be of the same thickness throughout, the end and back being well-rounded and smooth.

Sjöstedt[1] draws attention to the value of the ordinary surgical chain-saw, which a veterinary surgeon at Strömsholm (Petersen) had successfully employed. That which he recommends is about a foot in length, and an inch wide. Each end has a ring to which a cord is attached, and to the cord may be fixed a short, transverse wooden handle (Fig. 209). The chain-saw has the advantage of being perfectly flexible, and can therefore be passed around bones, joints, etc., and the necessary movements performed in cutting through these—by pulling alternately at each cord—without endangering the organs of the mother. One hand of the operator must, of necessity, guide the saw and ascertain its progress.

Bone-forceps might be used advantageously, but we are not aware that they have been employed in veterinary obstetrics. They should be made with the jaws bent, so that the cutting edge would be concave, and they could be made sufficiently strong in jaws and handles to cut through the largest bones. A screw at the end of the handles would

[1] *Handbok i Förlossnings Konsten för och uppfödare af Husdjur.*

bring these together with sufficient force to divide the strongest pieces of bone.

In the foregoing, allusion has only been made to the instruments which are generally approved of; many more might have been described, but no particular advantage could have been derived by doing so. A multitude of instruments can only be embarrassing to the veterinary obstetrist. Besides, it must be confessed that too little attention has been devoted to the perfecting of those already in use, or to devising others more simple and efficient to supplant them. There is here a wide field still open for those who desire to cultivate a most important department of veterinary surgery.

Instruments necessary for particular operations will be referred to as these are described.

Preliminary Arrangements for Embryotomy.

There is not much to arrange before commencing embryotomy. The operator is supposed to have made an exploration of the genital passage, and to have ascertained the state of affairs; he may even have attempted everything possible in the way of extraction and failed. Being satisfied that nothing remains to be done to preserve the life of the parent but removing the fœtus piecemeal, he has to decide, from the nature of the case, how this is to be effected. The necessary instruments he may have with him, or they may be devised on the spot; if the case is more difficult than usual, they may have to be sent for. But, as a rule, the operator must utilise to the best of his ability whatever is to hand; as he usually finds his patient greatly exhausted, either from protracted labour or the mischievous meddling of untutored hands.

The animal must be detached from the manger or rack, and kept, if possible, in a standing attitude: this position being the one best suited for such an operation, or it may be tied by the head to a stake, by a rather long head-rope. A rope, or better still, a rug or blanket, should be passed round the hind-quarters, a little above the hocks, the ends being held by assistants standing towards the shoulders of the animal. This precaution is required to steady the creature, to keep it in a standing position, and to assist it in resisting the traction generally employed in removing the fœtus. It may be necessary, if the animal is much exhausted or suffering much pain, to administer a stimulant, meal or flour gruel, or an anodyne draught.

Craniotomy or Cephalotomy.

Every operation which has for its object the diminution in size of the cranium, when that part offers an obstacle to the passage of the fœtus, is designated by these names. Hydrocephalus is the condition which most frequently calls for the operation in the larger animals; though certain malformations and monstrosities, and even an exaggerated volume of the head of the fœtus in the Bitch or Cat, may also require it.

Craniotomy comprises several distinct operations, which may be performed independently or simultaneously. These are *simple puncture*, *incision*, or *crushing* of the cranial parietes (*Cephalotripsy*).

Puncture of the Cranium.

In order to allow the escape of fluid from the cranium—as in hydrocephalus—and thus permit the birth of the fœtus, a simple puncture is often all that is necessary. The fluid having escaped, the thin fragile bones of the cranium readily collapse from the pressure they undergo in the pelvic cavity; so that the head and body can be removed by traction.

Supposing the presentation to be anterior, it is first necessary to fix the head, unless it is firmly wedged in the passage; this fixation may be effected by using a head-stall, Schaack's head-stall forceps, or even a cord on the lower jaw: exercising sufficient traction on the cord to prevent the head from slipping from under the hand of the obstetrist during the operation.

The head may be punctured by a scalpel, straight bistoury, finger-knife, or even the finger in certain cases. If a long-bladed instrument is used, there is sometimes a good deal of risk, so far as the maternal organs are concerned; it is advisable to wrap twine, tow, or tape, around a good portion of the blade towards the handle.

The best instrument, if it is at hand, is a long, medium-sized trocar and cannula, the end of the latter fitting closely on the stalk of the trocar, which should be very sharp. It is introduced safely into the genital canal by drawing the point sufficiently far back into the cannula to be entirely concealed. This end is then seized between the fingers and thumb in such a way that the index-finger extends a little beyond the extremity of the cannula; the other three fingers holding it in the palm of the hand, while the right hand sustains and guides the instrument. Should the trocar not fit the cannula tightly, the play between the two renders their introduction somewhat difficult, and the point may glide through and wound the operator. The trocar may, in such a case, be pushed quite through the cannula, and the point fixed in a cork, which can readily be knocked off by one of the fingers when the instrument has reached the head of the fœtus. Having arrived at this part, the proper spot for puncture is selected, and then the instrument is applied to it—perpendicular to its surface if possible, to prevent slipping. The trocar is made to penetrate slowly by a slight rotatory motion from side to side, and when all resistance ceases the cranium is perforated. This perforation should not be made at the sutures, if they can be avoided, as they overlap and close the opening. The cannula is now held firmly in its place by the left hand, the trocar is withdrawn by the right, and the fluid escapes. The instrument should be sufficiently long for the end to be near, or even outside the vulva, when the point is on the cranium of the fœtus.

There is no difficulty in performing this operation when the head presents first, even though it should not have entered the inlet, so long as it is easily accessible to the hand. With the posterior presentation, however, the operation is troublesome; as owing to the body of the fœtus occupying the passage, it is extremely difficult to pass the hand armed with the trocar so far as the head. Nevertheless, it may be accomplished in many cases by patience and tact. There is no reason why the trocar and cannula should not be passed through the mouth of the fœtus in some cases, and made to penetrate the cranium at the base of the skull, when the frontal region cannot be attained. If the head cannot be reached in this presentation, then the body of the young creature must be divided, and the parts removed until the head can be manipulated.

Craniotomy.

Craniotomy is resorted to when puncture has not sufficiently reduced the size of the head. It is an operation of great antiquity in human obstetrics, and various instruments have been introduced to facilitate its performance; but very few of them have been utilised in veterinary obstetrics, and indeed for the larger domesticated animals they are of no use. A simple straight or curved bistoury, Günther's sliding embryotom (Fig. 200), finger-scalpel (Figs. 198, 199), the long-handled embryotom (Fig. 203), scalpel embryotom (Fig. 201), bone-chisel (Fig. 207), or saw (Fig. 208), may one or all be employed, according to circumstances. It cannot be denied, however, that the operation is very difficult to execute, and is not without serious danger for the parent. Even in woman, with all those advantages and appliances of which the veterinary obstetrist cannot avail himself, craniotomy is always a formidable undertaking. The *cephalotribe* and *cranioclast*, so useful in human obstetricy, cannot be employed with our animals, it would appear; but there is no reason why modifications of these instruments might not be devised to answer the same end.

Hurtrel d'Arboval recommends that craniotomy be performed with a convex probe-pointed bistoury (sharp on the convex border), the middle of the cranium being incised; then the fingers compress the bones, and so effect delivery.

Rainard advises two incisions on each side of the head, in the parietal region. Günther mentions that if, after puncture, the operator cannot crush the bones of the cranium with the hand, they should be cut by his secator, and removed piecemeal. Carsten Harms states that when the head is an obstacle, it should always be crushed, if possible, the bones being broken beneath the skin. Sometimes it is sufficient to remove the lower jaw; and in order to effect this, the jaw is first fixed by a cord, the skin is then cut through on each side—from the commissure of the mouth to the temporo-maxillary articulation, the masseter muscles and the ligaments being divided; a transverse section of the skin is now made between each joint, the finger separating it, and then two or three assistants pulling at the cord, the jaw is removed. If it is the transverse diameter of the head which forms the obstacle, the division must be longitudinal, and great service may be derived from the use of the bone-chisel—either Cartwright's or Margraff's pattern. As much of the skin should be left as possible, in order to cover the jagged ends of the bones.

With the smaller animals, puncture and craniotomy are not at all difficult operations, the bones being fragile and easily perforated or crushed.

Decapitation and Decollation.

Decapitation, an operation which consists in separating the head completely from the body, so as to allow these parts to be removed one after the other, is not very often required; and fortunately so, as it is not without great danger to the parent. More frequently the head is partially removed, the fore-limbs amputated, or evisceration of the chest or abdomen—or both—practised, rather than resort to decapitation.

Decollation is necessary when the neck is distorted and cannot be straightened, and has to be divided at the point of curvature, the head and portion of neck attached to it being then extracted.

Decapitation is indicated when a double-headed monstrosity—monosomian or sysomian—is presented, and in certain irreducible malpositions of the head or limbs—especially in Heifers, when the head of the Calf is in the genital canal, and can neither be advanced nor pushed into the uterus.

The operation is more or less difficult, according to the situation of the head—if entirely in the uterus or fixed in the passage, or if it is at, or can be brought near or beyond the vulva. In the latter case, it is easily accomplished; although, except in the case of double monstrosities, it is rarely very useful, as when the head is in this situation it is not an obstacle to birth, and its removal deprives the operator of a most powerful means of exercising traction on the parts which are firmly retained in the maternal organs. When wedged in the canal, however, the head may prove a troublesome obstacle to the performance of those manœuvres necessary for the reduction of other parts; as it may not be possible either to advance or repel it, nor yet to pass the hand between it and the pelvic walls to search for a deviated limb, for example, or to bring that limb into a proper position.

The passage must therefore be freed from the obstacle, and this can be accomplished in various ways, the most common of which is as follows: The fore-limbs, if present, are corded and pushed as far towards the uterus as possible; then the head is secured by cording the lower jaw, a pointed hook fixed in each orbit, or a head-collar over the head if it can be placed. Four or five assistants now pull at the head by these appliances, so as to bring it as near the vulva as circumstances will permit; while another assistant keeps the labia apart, in order to expose as much of the head as he can, and prevent injury to the organs of the parent. The operator, with a convenient knife (the curved finger-scalpel is very useful), incises the skin around the neck—first one side, then the other—close to the occiput, passes his fingers between it and the muscles beneath, and pushes it well back on the neck—the assistants pulling at the head at the same time, facilitate this separation. A few cuts now divide the soft tissues down to the vertebræ, and nothing more remains to be done than to produce disarticulation by vigorous traction and a twisting movement of the head at the same time; the ligaments gradually yield and tear, the head extends and at last comes away, and the body of the fœtus recedes more or less suddenly into the abdominal cavity. If the limbs have been previously secured, they are brought into the passage by the cords attached to them; or if they are not so accessible, they must be sought for in the way already indicated, and delivery completed; care being taken to cover the exposed bones of the neck by the surplus skin, while the fœtus is being brought through the passage.

Another method is to make an incision through the skin across the forehead, in front of the ears, and to separate it by means of the fingers or spatula, as far as the occipital articulation. The knife divides this joint, as well as the soft tissues around it, and particularly the ligaments; traction will bring away the head. The upper part of the neck is covered by the loose skin—which may be fixed there by ligature—and directed into the middle of the passage. Crotchets should now be placed on the bodies of the vertebræ, or even on the ribs if they can be reached; as the limbs do not offer sufficient resistance when they alone are pulled at, neither do they bring the body fairly into the passage.

Traction should be made on the sternum, not the withers, as the latter ought first to enter the inlet.

A third method consists in removing the lower jaw, and excising the head from below. Or this incision may be practised from the mouth, the chisel being used to divide the vertebræ, after the cheeks, masseter muscles, and soft tissues behind the lower jaw have been cut through.

Decapitation, under the most favourable circumstances, is often a long and fatiguing operation, as the greatest care has to be observed in order to avoid injuring the parent. But this fatigue and anxiety are vastly increased when the head is deeply buried in the passage or the uterus. Then the hand—moist with the fluids of the genital organs, embarrassed by shreds of the fœtal envelopes, hampered by the presence of the limbs, compressed and paralysed by the uterine contractions—can scarcely hold and guide the cutting instrument, or distinguish what belongs to the fœtus and what to the mother, and has scarcely strength to divide the tissues, which are all the more difficult to cut by reason of their softness. It will readily be understood how such an operation must be difficult for the operator and dangerous for the mother. It might also be deemed impossible, if veterinarians had not attempted it and succeeded; though the majority of them have said but little as to their mode of procedure.

It is always preferable, if possible, to remove one of the fore-limbs, as this is easier, quicker, and less dangerous.

But decapitation must sometimes be performed, and then the above instructions will be found useful.

In the case of double-headed monstrosities, the saw and bone-chisel, or a pair of strong bone-forceps, will be valuable. When the head of the fœtus is retained in the uterus, and bent back towards the shoulder or flank, then it may be decided to amputate the head and a portion of the neck. Disarticulation may be commenced at the most convenient part of the convexity made by the bend of the neck, cutting through the soft tissues down to the vertebræ on that side, then on the other; then sawing or chiselling through the bones, and afterwards using the crotchets carefully.

Amputation of the Limbs.

When the limbs are so deviated that they cannot be straightened, or when by their presence in the genital passage they prevent the necessary manœuvres for the adjustment of other parts of the fœtus, then it may be necessary to amputate or disarticulate one or more of the extremities. Some of the indications for the operation have been referred to on various occasions; they include all those fœtal monstrosities which have supernumerary limbs that require removal before delivery can be effected; those cases in which the fœtus is exaggerated in volume, either normally, or through having become emphysematous after death *in utero;* those complicated malpresentations—such as the abdominal, hock, thigh, etc., and certain deviations of the head and neck in the anterior presentation. In the latter it is well to hesitate before deciding to remove the limbs; for if it is true that their ablation allows more space for manœuvres, and more facility for adjusting the head, it is not less true that, should these manœuvres fail, by the loss of the limbs we are deprived of a powerful means of traction when we are compelled, as a last resource, to adopt forced extraction. Besides,

it must not be forgotten that embryotomy is itself an extreme measure, which should only be adopted when every other fails or seems to be really hopeless.

One or both of the fore or hind limbs may be required to be amputated, according to circumstance. In the earlier days of veterinary science, the obstetrist was content to pull at the limb of the fœtus which he wished to remove, either by mechanical or manual power, until it was torn off by brute-force. Fromage de Feugré mentions that Texier had in this manner torn away the limbs of many Foals which he could not extract—the separation of the limb always taking place between the chest and scapula, by rupture of the muscles uniting these two parts; and he asserts that by this procedure he was able to save many Mares—though he says nothing as to the suffering of these before the limbs could be torn from the body.

Subsequently, it was discovered that the skin offered most resistance to this kind of avulsion—the muscles and ligaments being much more easily torn. Then the knife was employed to incise the skin, and thus get rid of the chief difficulty. On the Continent, in amputating a fore-limb, for instance, the skin and muscles were divided as near the shoulder as possible, and the bones, united by their ligaments and covered by the skin, separated by traction. Skellet,[1] in his crude and imperfect work published in 1807, writes: "Take a sharp knife, and cut from the point of each shoulder of the Calf to the muscular or thick part of the fore-leg; then cut round it, so as to enable the operator to skin the upper part of the shoulder. A knife is then to be conveyed between the shoulder and brisket, so as to cut the muscles which unite them. When so done, the leg and shoulder may be easily pulled off from its body. The other fore-leg, etc., is to be taken off in the same way." But the subcutaneous method of excision was greatly facilitated by the directions published in Günther's work in 1830, and also by the publication of the procedure of Huvellier[2] in the same year; while the parent was protected from some of the dangers and pain which attended the old plan. Since the introduction of this method, it has been adopted by every obstetrist of note, who has either kept to the original procedure, or modified it to suit his own fancy or convenience.

Amputation of the Fore-limbs.

In order to amputate a fore-limb, it must be more or less advanced in the vagina, or partially beyond the vulva. So that, if it is still in the uterus, it must first be removed therefrom and brought into the canal. If both limbs are to be removed, they must be secured by cords around the pastern in the ordinary manner, the cord of the one which is to be first excised being pulled at by two, three, or four assistants, so as to draw it as near, or as much beyond, the vulva as possible. Another assistant then keeps the labia wide apart, in order to allow the operator more room. A circular incision is made above the fetlock—or, better still, the knee, taking care not to go deeper than the skin. From this incision, gliding his hand into the vagina, along the limb, the operator gradually makes a longitudinal one, extending higher up as the leg becomes elongated by the traction.

Some practitioners make this incision on the inner aspect of the limb,

[1] *A Practical Treatise on the Parturition of the Cow.* London, 1807.
[2] *Recueil de Médecine Vétérinaire*, 1830, p. 449.

others on the outer side. On the latter there is perhaps less danger of wounding the maternal organs, and it may be more convenient for the operator. But this is a matter of minor importance; it is more necessary to be careful in incising the skin beyond the articulations, so as not to divide the ligaments of these, as this might lead to the limb being torn away at the wrong place; no such precaution is necessary with the muscles.

This longitudinal incision having been made, the skin is separated from the structures beneath, either by means of the fingers or the spatula—pushing it up towards the shoulder as it is detached, until at length, as the leg becomes stretched, the incision and the detached skin are as high as the shoulder. The dissection being then deemed sufficient, and the limb being only retained by the muscles which attach it to the thorax, the operator, either by his hand or the crutch, makes pressure on the fœtus, while the assistants are ordered to pull energetically at the cord on the pastern, and in a kind of jerking manner. Soon slight cracking sounds are heard, the muscles are rupturing and giving way, and in a very short time the entire limb—scapula and all—is removed.

The removal of one limb usually leaves a considerable space in the genital canal, and this allows delivery to be completed. Sometimes, however, and particularly when the head is deviated towards the flank, it is necessary to remove the other limb; and this, when effected, permits the head to be sought for and rectified, version accomplished, etc., according to the requirements of the case.

Some practitioners operate in a somewhat different manner to the foregoing. Lecoq, for instance, commences his incision at the upper part of the shoulder, brings it down over the head of the humerus, on the side of the forearm, and as far as the middle of the cannon, where he makes his circular incision; the skin is separated from this part upwards. In some cases this procedure may be preferable to the other, and it certainly is less dangerous for the parent; but it sometimes happens that the shoulder cannot be reached.

Günther pushed back the fœtus as far as possible by means of the crutch, with the finger-scalpel divided the skin before and behind the scapula, then across—below and above; then cutting through the pectoral muscles, and extracting the limb. Cartwright operates in a similar manner to Lecoq. He first has a leg drawn out, and divides the skin as far as possible; or he introduces his hand, containing a knife, as high as he can on the side of the scapula, and makes an incision thence down the whole length of the limb to the pastern bones; the skin is separated by the fingers or spatula as far as possible from the entire leg, and the transverse pectoral muscles cut through. The limb is then disjointed, either at the pastern or fetlock; the foot being left attached to the skin, as it is afterwards found to be useful in the extraction of the body. Cords are fastened around the limb above the fetlock-joint and knee, and the Cow being firmly tied by the head, the necessary force is applied, and the whole limb drawn away. He writes: "I have known, in some of these cases, the limbs to separate at the shoulder joints, and yet the fœtus has been extracted—both from the Mare and Cow—with the shoulders attached, the points of the latter having, fortunately, not caught the edge of the pelvis. The great danger in these cases is, that the shoulder-joints may catch against the pelvis and thus prevent extraction."

Meyer recommends that the circular incision on the cannon be not made until the skin is detached above, as this facilitates avulsion.

It is well to divide as many of the muscles uniting the limb to the chest as possible, and also to apply counter-extension by means of the arm or crutch placed against the chest or opposite shoulder of the fœtus; this also spares the mother much of the pain and exhaustion attending extraction.

Amputation of the entire fore-limb, including the scapula, is a very useful operation in the most serious cases of dystokia; but there sometimes occur instances in which the whole leg need not be excised—as when the legs are an obstacle rather from their length than their volume. This happens, as has been described, in the abdominal presentation of the fœtus, when the limbs so often render version difficult—all of them being perhaps in the genital canal, from which they cannot be advanced or pushed back. In these circumstances, disarticulation of the limbs at the knee or elbow joints is often practised—the latter being generally preferred; though it must be remembered that excision at this part can be but of limited value, and, in fact, is only useful in the presentation just alluded to, because it does not give so much room as removal of the scapula and humerus.

In the abdominal presentation with four legs in the vagina, Donnarieix lays down the following procedure: Three pieces of supple twine are got ready, as well as a strong cord. With the twine the pasterns of three of the limbs are firmly bound, while the cord is fixed on the limb which is to be detached, and confided to five assistants, who pull at the cord while the other limbs are pushed towards the uterus. The knee, then the forearm appear, and the lips of the vulva being kept widely separated, the operator makes a circular incision through the skin at this part; traction is again applied, the muscles tear, and gradually the joint is reached. The tendons and ligaments are cut, and the leg being twisted as it is pulled out, another cut of the knife finally removes it.

With the Sheep or Goat, amputation of the fore-limbs of the fœtus is very rarely indeed required, though, if necessary, it can be effected. The same remark applies to the Bitch and Cat.

Amputation of the Hind-Limbs.

When the fœtus makes a posterior presentation, and a hind-limb appears at the vulva, it may be necessary to amputate this limb; or with the hind-limbs flexed at the hocks, and so firmly wedged in the canal that they cannot be extended backwards, nor yet sufficiently bent to permit delivery—which is far from being rare in the Mare—these joints are disarticulated.

In the latter case, it is accomplished by passing a running noose round each leg, above the hock, and tying it firmly there. Powerful traction made on one of the cords by four or five assistants, will bring the point of one of the hocks to the vulva, the lips of which are separated, while the operator divides the gastrocnemii tendons and the lateral ligaments of the joint, so as to produce complete disarticulation. The tibia is then pushed into the vagina, the other limb is amputated in the same way, and birth is accomplished by pulling at both cords, which remain attached to the lower end of the leg-bone.

When the limbs are completely retained in the uterus at this presentation, the procedure recommended at pp. 471 and 517 must be adopted. The following procedure has also been recommended: A long incision is

made through the skin and muscles behind the hip-joint; the hand removes all the muscles around the upper part of the femur, round which a cord is then fixed and pulled by two assistants, while the operator cuts through the attaching muscles and ligaments—especially the capsular ligament. In this way the joint is disarticulated, and a circular incision through the skin completes the task, as traction will remove the limb.

It may be remarked that Carsten Harms recommends symphsiotomy to be practised on the fœtus when the buttocks present at the inlet—the symphysis pubis being cut through. By this means, the two borders of the symphysis can be made to overlap, and the transverse diameter of the pelvis is thereby diminished. The finger-scalpel and spatula are the instruments he prefers. The saw might be advantageously used.

In certain kinds of monstrosity in which the posterior parts of the fœtus are double, or when the hind-limbs are in the vagina, and in consequence of the narrowness of the maternal pelvis, or width of the croup or haunches of the young creature, birth cannot take place, then amputation of the legs at the trunk may be necessary. Such an operation can be rarely required, however. It is performed in a similar manner to that for removal of the fore-limbs—subcutaneously. A cord is fastened to each pastern, and, one after another, the limbs are drawn towards the vulva; a circular incision is made through the skin above the hock; then a longitudinal incision is carried as high as possible on the thigh, and the skin separated in the ordinary way by means of the spatula—always ascending towards the croup; the gluteal and other muscles attaching the thigh to the pelvis are cut across, and the limb is at last torn away by strong and sustained traction.

Amputation of the hind-limb is a much more onerous and fatiguing operation than the removal of the fore-extremity. The skin adheres very closely to the subjacent textures, and more labour is needed to separate it from them; the muscles attaching the limb to the trunk are more numerous and powerful, and when they are cut through there remains the resistance of the pubio- and coxo-femoral ligaments (in the Foal—the pubio-femoral ligament is not present in the Calf). Harms estimates that if three assistants can pull away a fore-limb, four men will not in every instance remove a hind one. However, the difficulties are not always insuperable, and many cases are on record in which the operation has been successfully performed.

After avulsion of the limbs, crotchets should be fixed in the cotyloid cavities or oval foramina, and delivery completed according to the directions already laid down.

Detruncation or Division of the Body of the Fœtus.

When one half of the body of the fœtus has more or less passed through the pelvic canal, and the other half is retained, so that it is impossible to extract or return it, it is recommended to cut the trunk in two—*division* or *detruncation*. It has been shown that this retention may be due to malposition or malpresentation, excessive development or deformity of the hind-quarters of the fœtus, as well as ascites, anasarca, or emphysema (*physometra*).

If the hind-parts are retained, and the head and fore-limbs are not much beyond the vulva—if so far—cords should be placed on each pastern and a head-stall on the head, and slow, gradual, but strong traction exerted on them, so as to expose as much of the body of the

young creature as possible. This done, the operator, with a sharp bistoury, incises the body in a circular manner as close to the vulva as is convenient (the labia being kept well away by an assistant)—the incision commencing below, which allows the elongation of the spine; then the skin and muscles on the sides are divided. When the vertebræ are reached, the bistoury is passed between them, and as close to the loins as possible; slight pulling and twisting will then complete the bisection.

It is a good plan to incise the skin at some distance in front of the place where it is intended to divide the spine, and to separate and push it back over the portion of trunk in the genital canal. When the division of the body is effected, this superfluous skin is pulled over the remaining part of the trunk and sewn together, so as to enclose the latter completely, thus preventing injury to the parent during the subsequent manœuvres.

Should the hind-limbs be doubled under the croup in the passage, or should they still be in the uterus, they ought to be sought for and corded at the pasterns, the cords being given to assistants. Then vigorous pressure is applied to the divided end of the spine in the remaining part of the trunk, while the assistants pull until version is effected; extraction is afterwards easy. In some cases it is not necessary, nor is it always possible, to secure the hind-limbs before the trunk is pushed into the uterus, version taking place merely by the retropulsion; and sometimes when one limb has been found, there is much difficulty in discovering the other. In such a case, and when version cannot be effected, the limb which has been secured should be drawn towards the vulva and disarticulated; this will enable the operator to find the other leg.

When the fœtus is altogether in the uterus, division of the body is a formidable business, even when the hand can reach it and move about it easily; it is still more formidable, if not impossible, in large-sized animals when the fœtus can scarcely be touched.

When the fœtus is in the horizontal dorso-lumbar presentation, Saint-Cyr suggests that the maternal straining, if too violent, should be subdued. The hand, armed with a bistoury, is passed between the uterus and the fœtus, and the latter is cut down through the back to the vertebræ; then the knife is passed into the body between the last rib and ilium, and the flank cut through, another incision upwards reaching the under side of the vertebræ—a hook fixed in the abdominal walls makes this region more tense and easier cut, while it brings it nearer the hand. A cord is now passed around the exposed vertebræ to bring these closer to the operator, who divides them with a knife or saw. The body of the fœtus is then in two portions, the most convenient of which is first to be extracted, while the other is pushed out of the way. In extraction the crotchet and cords are employed; the first portion being removed, the second has to be found, secured, and got away likewise, care being taken to guard the maternal organs from injury by the exposed vertebræ.

If necessary, the body may be divided into more than two portions at the spine, and the ribs and sternum may also be removed.

In other presentations the details of the operation may have to be modified, but the principles are the same.

Evisceration.

When it is desired to reduce the volume of the thorax or abdomen, or both, the organs they contain are removed. This procedure is

generally adopted when, after removal of one or more of the limbs, the body of the fœtus still remains fixed in the genital canal—as in sterno-abdominal and sterno-lumbar presentations; by it we obtain a considerable diminution in the dimensions of the body, more room for manipulation and version, and perhaps, next to the removal of the limbs, it is the most useful operation in embryotomy.

As we have said, evisceration of either of the cavities may be practised, according to circumstances. We shall, therefore, describe the mode of reducing the volume of both—thorax and abdomen.

Thoracic Evisceration.

This operation is sometimes practised in the anterior presentation when the thorax of the fœtus is too large, and may be performed independently of abdominal evisceration. The chest is emptied of its contents first, when the anterior part of the fœtus is in the passage. The head and limbs should be corded—if one of the latter is removed all the better; if not, the cords should be pulled well upwards, in order to make more room between them. Should the head be an obstacle to the performance of the operation, it may be amputated; but if it is back in the uterus, then it may be left there. A strong scalpel with a long handle, the finger-scalpel, or either of the two embryotoms shown in Figs. 200, 201, is the best instrument. It is passed carefully into the vagina until the hand reaches the breast of the fœtus, when the blade is thrust deeply into the chest, between the two first ribs, and as close to the spine as possible, cutting down towards the sternum and upwards to the vertebræ.

The knife is now dispensed with, and the hand being re-introduced, the fingers are pushed into the chest and the two first ribs removed, thereby allowing sufficient room for the whole hand to enter the cavity. The lungs and heart are torn away from beneath the spine, and, with the thymus gland, removed from the uterus. The chest collapses a good deal, but if the fœtus cannot yet be extracted, the hand may be pushed through the diaphragm, and the contents of the abdomen carried away through the chest.

Some operators, instead of opening the thorax in front, incise from two to five of the ribs close to the sternum, and pass the hand into the chest by the aperture so made. Others divide the ribs on both sides, and remove the sternum as well as the viscera. It will often be found that the contents of the chest and abdomen can be removed without cutting the ribs.

Abdominal Evisceration.

Evisceration of the abdomen may be effected, as just stated, through the thorax, by tearing away the diaphragm.

But in the posterior or adominal presentations, and indeed in any presentation or position in which this region is accessible to the hand, eventration can be performed. Nevertheless, it is not always easy; on the contrary, it is sometimes most difficult and dangerous.

Either of the embryotoms used for evisceration of the chest may be employed for the abdomen.

The edge of the instrument is applied to the wall of the cavity, which is incised by drawing the hand towards the operator. Then the whole of the viscera are torn away, and, if need be, that of the chest also, through the diaphragm

CHAPTER VI.

Vaginal Hysterotomy.

At p. 361 reference was made to induration of the cervix uteri as a cause of dystokia, and the indications for overcoming the obstacle were described more or less fully; allusion was also made to the manner in which these indications should be carried out. As we are now treating of obstetric operations for the extraction of the fœtus, it is necessary that we describe more fully the operation and its consequences, as these are of much importance.

Vaginal hysterotomy consists in incising the indurated and inextensible neck of the uterus in such a manner and to such an extent, that it will allow the fœtus to pass through its canal.

For this purpose, the only instrument necessary is a strong probe-pointed bistoury, a bistoury caché, or one of the finger-scalpels or other embryotoms. When the straining of the animal has propelled the cervix uteri towards the vulva, with partial prolapsus of the vagina, the operation is simple, as the eye can then aid the hand. All that has to be done is to glide the instrument into the os, and make the necessary number of incisions through the tissues composing the cervix—the situation and depth of the incisions depending upon the extent of the induration and the atresia.

In other cases there is no prolapsus of the vagina, which is quite soft and elastic. Then the left hand may be passed into it, and the index-finger being introduced into the os, draws the cervix towards the vulva; the labia of the latter are separated by an assistant, and the operator passes the blade of the instrument—guiding it by the index-finger of the other hand—into the os, where he gradually and steadily incises the tissues.

When, however, the walls of the vagina are involved in the induration, this retraction of the cervix cannot be effected, and the part must be operated upon in its ordinary situation: the knife being carried carefully into the vagina, passed to the necessary depth in the os, and the incision made. Perhaps the bistoury caché is the best instrument for such cases.

It is rare indeed that one incision is sufficient; generally from two to four are required, and it is better to have a larger number than make them too deep: they certainly must not pass through the entire thickness of the cervix.

The situation of the incisions is a matter of some moment. The lower portion of the cervix should be avoided, in consequence of its proximity to the floor of the vagina, which is in immediate contact with the bladder and urethra; should these be wounded, the results might be serious, if not fatal; and if the peritoneum is cut or torn during the passage of the fœtus, fluids and discharges will escape into the abdominal cavity, and give rise to peritonitis. There is less danger in incising the upper part of the cervix, as the rectum is not so near; nevertheless, in induration there may be adhesions between them, and an accident is therefore possible—though it must be rare.

So that, if only two incisions are required, it is advisable to make one on each side of the cervix; and if four are necessary, to have them at each corner.

Horsburg[1] recommends, if atresia is complete, to pass the finger or a blunt instrument into the os, then introduce a stout, sharp-pointed, curved bistoury about four inches long—dividing the stricture laterally by two incisions—always drawing the bistoury towards the operator; after which he is to introduce both hands, with the palms towards each other, and press them apart. "He will find the part immediately dilate to the proper size, and labour may go on naturally; or he may then proceed to extract the Calf if labour has been protracted."

The object in making the incisions only to a comparatively slight depth, and not through the entire thickness of the os, is to prevent extensive lacerations of the organ during the passage of the fœtus. It will generally be found that these partial incisions will, with a little patience, admit the hand; this being passed into the uterus, seizes the presenting part of the young creature, places it in a favourable position if necessary, and then begins to draw it gently into the os.

Sometimes with primiparæ in good health and strong, delivery is afterwards effected spontaneously, and this is the most favourable result; but in the majority of cases labour has been going on for a long time—perhaps two days or more, the parent is exhausted, and the uterine contractions are either suspended, or so feeble, as to preclude all hope of their expelling the fœtus. The head and fore-feet must then be corded, and delivery accomplished in the ordinary way.

It is well to remember, however, that the traction resorted to must be judiciously employed. It should be moderate, gradual, and sustained, in order to allow the tissues of the cervix time to accommodate themselves to the eccentric pressure imposed on them by the advancing fœtus. To act otherwise is to incur the grave risk of lacerating the uterus beyond the possibility of repair, and is quite as reprehensible as making deep incisions.

With regard to the consequences of vaginal hysterotomy, it must be admitted that it is not without danger, and that death not infrequently results. There are no reliable statistics to serve as a guide in estimating the amount of success or non-success following its performance, as not all—or perhaps not many—of the cases are published. Saint-Cyr has collected forty cases—all published in France and Belgium since the commencement of the century, and an analysis of these gives the following results:

Mother and progeny saved in - - - - -	14	instances.
Mother saved—fate of the progeny not mentioned—in	9	,,
Mother alone saved in - - - - - -	5	,,
Progeny saved, mother died, in - - - - -	6	,,
Mother succumbed—fate of progeny not mentioned—in	5	,,
Mother and progeny perished in - - - -	1	,,

So that of 40 Cows operated upon, 28 survived, and twelve—or 30 per cent.—succumbed; while, with regard to the progeny, 14 Calves were delivered alive and continued to live, and 6 were dead; nothing is said as to the other 14.

In other words, of 80 lives more or less compromised, 18 at least—or 22½ per cent.—were not saved by the operation. But Saint-Cyr is inclined to think that if all the successful cases have been published, there is reason to believe that all the unsuccessful ones have not; and

[1] *Veterinarian*, vol. xviii., p. 215.

he is apparently confirmed in this view by Bugniet,[1] who writes: "Distinguished veterinarians have published very interesting observations on this important question in obstetrics; but I am bound to say that these experienced practitioners have been more fortunate than myself, for I have had nothing but misfortune, and in the interest of science I do not hesitate to say so." Bugniet, after describing three cases in which he operated, and in which death of the mother followed, as evidence that his procedure was not at fault, remarks: "Nevertheless, I acted with extreme prudence; when the incisions were made, I proceeded to complete delivery with great care and deliberation. Incision, dilatation, birth, removal of the placenta—all conducted with knowledge and circumspection; and yet this did not prevent a fatal issue." But in opposition to this experience, there is that of other practitioners who have had a fair—indeed, a large—share of success. Donnarieix,[2] for instance, commenting on Bugniet's report, blames the latter for adopting *expectant* instead of *active* treatment, and asserts that he has taken the exception for the rule. From his own experience, extending over thirty years, during which he had performed vaginal hysterotomy in sixty cases with only one death (the cause of which was not apparent), he concludes (1) that incision of the cervix uteri is generally curable, and (2) that palliative measures are more injurious than beneficial, when their uselessness is demonstrated.

There is no doubt that, in the majority of instances and in the hands of careful obstetrists, vaginal hysterotomy will be successful, and prove a useful operation.

As a rule, for a period of eight or ten days after the operation, there is a muco-purulent discharge from the vulva; but the Cow eats, ruminates, gives the usual quantity of milk, and does not appear to be any more inconvenienced than after normal parturition.

The unfavourable results, however, must not be overlooked. Serious injury to the neighbouring organs by the knife, or by the extension of the laceration, is within the range of possibility. When the cervix is completely divided, either by incision or by subsequent laceration during the passage of the fœtus, there may be intense peritonitis arising from escape of the liquor amnii or other fluids into the abdomen, and speedy death. Or excessive hæmorrhage may lead to serious consequences.

In every case, of course, there must be more or less bleeding from the incisions; but, as a rule, this is of no importance, and it ceases after a time. In less frequent cases, however, it persists, and either brings on great debility, or, if excessive, leads to a rapidly fatal termination. This result is most to be apprehended when the cervix is greatly degenerated, and its tissues extremely vascular—as in carcinoma and sarcoma. It may also occur from rupture of bloodvessels, in laceration of the cervix or body of the uterus, during the passage of the Calf through the incised os.

When serious hæmorrhage occurs, cloths or sponges steeped in cold water, astringent lotions and styptics—as the perchloride of iron—must be applied as close to the part as possible; while cold water irrigation should be maintained on the loins.

Another result is metritis, or metro-vaginitis, which is rapidly fatal, and in which we find the usual local lesions on making an autopsy.

[1] *Recueil de Médecine Vétérinaire*, 1873.
[2] *Op. cit.*, 1874, p. 511.

Septicæmia is also to be apprehended; and to prevent it, it is well to remove every source of putridity, or anything likely to become putrid, and to use plentifully a weak solution of carbolic acid (1 to 100) or the permanganate of potass in the interior of the uterus, and particularly about the incisions in the cervix—even for some days after the operation.

CHAPTER VII.

Gastro-Hysterotomy, or Cæsarian Section.[1]

GASTRO-HYSTEROTOMY, *Cæsarian section*, or *abdominal hysterotomy*, is an operation which has for its object the removal of the fœtus or fœtuses from the uterus of the parent—when they cannot be delivered *per vias naturales*—by making an opening in that organ through the abdominal walls, and thereby extracting them.

This is a formidable and a serious operation, whether it is practised on the human female or on animals. In the obstetricy of woman, it has been resorted to from a very early period; the Greeks knew it as ὑστεροτομοτοκιη or ἐμβριοελκη, though it is supposed that they only performed it after the mother was dead, and to save the child. Persons thus born were sacred to Apollo, and Æsculapius was designated the son of that god, because it was believed he had been delivered by gastro-hysterotomy. Some strange notion appears to have been attached to this method of delivery, as among these old-world people the person who had been born by means of the operation was esteemed remarkable and fortunate. Hence Claudius Cæsar, Scipio Africanus, Cæso Fabius, Julius Cæsar, and other more or less illustrious personages of old Rome, received the surname of "Cæsones" from being extracted by abdominal incision from their mother's womb: "Quia cæso matris uteru in lucem prodiscunt." At a later period these persons were designated "Cæsares," —a noble title; though, as has been demonstrated, it is a mistake to assert that it owes its origin to Julius Cæsar—this being merely his patronym.

Since these early times, abdominal hysterotomy has been often practised on woman; but when it was first attempted on animals is not quite certain. Haller was led to believe that the Greek veterinarians—Apsyrtus and Hierocles—knew and performed the operation on the domesticated animals; but this has been shown to be a mistake. Until we arrive at the time of Bourgelat—the illustrious founder of veterinary schools, in the latter half of the last century, we appear to have no evidence that such an operation was ever proposed for animals. And even Bourgelat[2] only suggests it in cases in which the dam is attacked by a dangerous disease when the period of gestation has nearly or quite expired, and its life may be beneficially sacrificed in favour of its progeny, which is to be quickly removed from the uterus. In 1781, Brugnone[3] intimates that this operation may be performed on Mares and other animals which could not bring forth; but, like Bourgelat, he does not state whether he ever practised it.

It was not apparently until 1813, that Morange, and in 1816 Goheir[4]

[1] It has been suggested that the term "laparotomy," or "laparo-hysterotomy," would be a better term for this operation.

[2] *Traité de la Conformation Exterieure du Cheval*, 1768.

[3] *Trattato della Razzi di Cavalli*, p. 406.

[4] *Mémoires sur la Chirurgie et la Médecine Vétérinaire*, vol. ii., p. 40.

attempted it on the living animal, though unsuccessfully. Morange operated on a Cow, and it was to all appearance in a fair way to recovery, when it succumbed to an attack of indigestion caused by improper feeding. About the same period, Rohlwes[1] operated on a Mare.

Since that time gastro-hysterotomy has been practised comparatively often, both in this country and on the Continent; and there can scarcely be a doubt that it was mainly indebted to its general introduction, as an obstetric operation, to the fact that the abdomen of animals could be opened with impunity in such operations as ovariotomy (spaying) in Swine and other creatures; as well as from the experience that, in abdominal hernia in the pregnant animal, the fœtus had been often extracted in this way and the mother did not succumb.

Gastro-hysterotomy has been practised both on the large and small domesticated animals, but perhaps with most success on the latter. In 48 cases of this operation, Franck finds that 25—or 52 per cent.—had a fatal termination. Saint-Cyr, from a smaller number makes the mortality 71 per cent. Franck can only note three instances in the Mare, and they were all fatal, though the Foals were saved. For the Cow he has 17 instances; 6 of these recovered (one of them, however, was Morange's, which died from overfeeding fifteen days after the operation, and another was Sacchero's, which was sent to the butcher in six days). This gives 35 per cent. saved, and 65 per cent. lost. In three Sheep there were no recoveries, and in two Goats only one. With the Pig the operation appears to have been wonderfully successful. In 8 instances all recovered—a result Franck is inclined to attribute to the different arrangement—or rather attachment—of the placenta, which renders this animal less liable to septic infection through injury to the uterus. With the Bitch, the mortality is about the same as in the Bovine species; in 15 cases 6—40 per cent.—lived. Franck thinks this percentage might be much increased if the operation were performed on the right side and antiseptic treatment adopted, or, if necessary, even extirpation of the uterus; as putrid infection readily occurs in the Dog.

With regard to saving the young, the operation is not very favourable. In nearly all the instances in which the parent recovered, the progeny has been dead, or died; and in only 4 of Franck's cases were the parents, and one or more of the young creatures, saved. Three of these cases were Bitches, and the other was a Sow.

With the Cow, the Calf is often saved, while the parent dies. Of 7 instances, the Calves were extracted alive in 6.

With the Mare, the operation must be resorted to early in order to save the Foal, as, for the reasons already given, it perishes quickly.

It is only on a knowledge of the length of time the fœtus may live during parturition, or after the death of the parent, that the operation can be undertaken with any prospect of success—so far as obtaining it alive is concerned; and this is an important consideration with regard to the Bovine species. Kehrers, in his observations on the Bitch, found that three minutes after death the fœtus began to show symptoms of asphyxia, and in thirty-six minutes it was dead. In pregnant Cows and Sheep which were slaughtered, the fœtus moved about in a very lively manner for eight to ten minutes, but death ensued soon after.

Sauer observed an unusual instance of fœtal vitality in a Bitch which

[1] *Das Ganze der Thierheilkunde*, 1822, p. 143.

could not be delivered, and was poisoned by cyanide of potassium. Eight minutes after death the fœtuses were observed to move in the abdomen, and this and the uterus being opened, they were extracted alive.

After fifteen minutes, Franck has found in slaughtered Sheep that the fœtus was usually asphyxiated; and he concludes that during the first eight minutes after the death of the parent, the fœtus can be extracted alive; even towards fifteen minutes there is a chance of preserving it, but by that time it is usually dead. When extracted late, and in the first stage of asphyxia, though it may rally for a short time, yet it usually succumbs to inflammation of the lungs—through the amniotic fluid having penetrated into the air-passages during the convulsive gasps the young creature makes.

There can be no doubt that much of the great mortality which follows the operation is due to the circumstances under which it is undertaken. It is, as a rule, never resorted to until every other means of delivering the animal has failed, and the creature, worn out by suffering, is already almost dead. In addition to this, the fœtus itself—subjected to long-continued and severe manipulation—is either dying or dead; indeed, it may have perished days before, and, becoming putrid, has already infected the parent.

Death is usually due, when not immediate, to putrid infection—to peritonitis or metro-peritonitis. This is more particularly the case with the Bitch, in which, when the operation is performed early and the young are extracted alive, recovery generally takes place; though Franck remarks that wherever the green colouring matter of the placenta imparts a similar tint to the textures it comes in contact with, very often septic inflammation begins there. The same authority points out that there is no great reason otherwise why death should be a frequent result of the operation, when we consider the hundreds of similar operations performed in the study of embryology, by Bischoff and others, on Bitches, Guinea-pigs, and Rabbits, the majority of which did not have a fatal termination. He also alludes to the success of Nature's Cæsarian section, when we have mummification and maceration of the fœtus, consequent on occlusion of the os uteri, and the remains of the creature find their way out by another channel without much disturbance to the mother.

Certainly, the brilliant results obtained from antiseptic surgery in other directions give reason to expect more successes from this operation —at least in the case of the smaller animals.

The most dangerous cases for operation are those in which the fœtus is dead, and more or less decomposed.

Indications.

The operation should only be resorted to in those cases in which delivery by the natural passages—the fœtus being alive—is altogether impossible, or so difficult and dangerous that the mother incurs nearly as much risk as from gastro-hysterotomy itself, while the young creature must be sacrificed; or when the owner prefers having the latter alive, instead of incurring the risk of losing both—the progeny being the most valuable. The operation is therefore likely to be demanded in those deformities of the pelvis produced by fractures, exostoses, etc., which considerably diminish its canal, intra-pelvic tumours, hernia of the uterus, extra-uterine fœtation, certain cases of uterine torsion irredu-

cible by the methods we have described. Atresia of the os should be more advantageously overcome by vaginal hysterotomy, unless the owner is desirous of saving the fœtus and sacrificing the mother.

The operation is also indicated when an animal, near the termination of pregnancy, is so seriously ill or injured that it cannot live until birth takes place. It may then be most judicious, if the progeny is valuable, to kill the parent and extract the fœtus at once. If the parent has just died, or is dying, the operation may also be practised.

In considering the adoption of the operation, the species of animal will, of course, weigh a good deal. Those which can be utilized as food there need be no hesitation in operating upon and sacrificing immediately afterwards; the value of the carcase and the living Calf or Lamb, diminishing very considerably the loss which would otherwise be sustained. With the Mare, as we have said, the Foal may be much more valuable than the parent.

With the Bitch and Sow, there is much more prospect of a favourable result from the operation; and as difficult parturition in them is often so serious, it is advisable to operate in good time. Indeed, in all cases when the operation is once decided upon, no delay should occur in practising it, if it is desired to preserve the progeny and give the parent a chance.

We have seen that the Foal soon perishes when it cannot be born, and though the fœtus of other animals retains its vitality longer, yet there is also a limit here. Besides, it must be remembered that the strength of the parent is an important factor in the case, and the longer the delay so the less chance is there of a successful result. It is, therefore, most important that the obstetrist lose no time in making his diagnosis, and coming to a conclusion as to the course he must pursue. Embryotomy will, of course, present itself to his mind before gastro-hysterotomy, which is, after all, only to be an ultimate means of saving either mother or progeny, or both, in very exceptional cases. It need scarcely be pointed out that in irreducible uterine hernia, there need be no delay in deciding, and that this condition gives good hope of success—especially in the smaller animals.

Operation.

Looking at this operation from a purely surgical point of view, there can be no doubt that, so far as the larger domesticated animals are concerned, it is one of the longest, most fatiguing, and most difficult in veterinary surgery.

There is also the great extent of the wound, as well as the opening of the peritoneum, the hæmorrhage, and the escape of blood or liquor amnii into the peritoneal cavity, to be considered. Besides, the animal is, as a rule, in a state of extreme prostration, and the results of mischievous interference may be already apparent before the operation is commenced, or even before the veterinary surgeon is called in.

The after-treatment of the mother, too, often requires much attention, and is expensive; and recovery requires a considerable period, as convalescence is only too often protracted.

What, however, makes the operation so formidable, if the mother is to be saved, is the quadrupedal position of animals; for, after section of the abdominal parietes, the mass of intestines presses heavily on the part which has been incised; so that it needs much careful management and supervision to effect cicatrisation, and to procure such a

solid adhesion of the margins of the wound that hernia may not result.

If the mother is alive, the operation is a painful one, and of long duration in some cases, while the pain inflicted causes the animal to struggle; this inconveniences the operator more or less, and—not to speak of the humane feelings which should ever be predominant on such occasions—induces him to avail himself of the advantages of anæsthesia, if they can be obtained. Perhaps no agent is so useful in this respect as chloral hydrate, though chloroform or ether may be administered in the usual way—by inhalation—and produce their effect. The objection to the two latter substances, however, is very great, so far as cattle are concerned; as they taint the flesh, should it be necessary to kill the animals, and utilise their flesh as food; whereas the chloral hydrate has not this objectionable action. The latter is perhaps best administered in enema; for Horses and Cattle, the dose may be from fourteen to twenty-two drachms; about two or three drachms for Dogs (depending on the size), and three to six drachms for Pigs. It is best given in mucilage or bland syrup of any kind. In a quarter of an hour or so the animal is in a state of narcosis, and the operation may be commenced. Unfortunately, the drug only too frequently causes the death of the fœtus—a matter of some importance when this is of more value than the parent, but not to be considered when the life of the latter is to be preserved.

When the parent is doomed to be killed—as in the case of a worthless Mare, or one suffering from an incurable disease or accident—and the young animal is to be rescued, the best course to follow is to pierce the medulla oblongata, and operate at once, as Vollmar has done with success. By this means insensibility has been produced, and the young creature extracted alive. Günther recommends dividing the posterior aorta after removal of the fœtus, as it is close to hand in the abdominal cavity, and death quickly ensues.

For the operation but few instruments are needed. They consist chiefly of a scalpel, probe-pointed bistoury, scissors, forceps, muscle-hooks, and some common suture needles, pins, and sutures—silk or catgut. For the larger animals a strong suture needle, suture wire, and waxed carbolised thread, catgut, wire or twine, teased oakum, tow, small pieces of wood or whalebone for the sutures, and large pieces of linen are required in addition, as well as a body-bandage made by folding a linen or cotton sheet. If the parent is not to be preserved, or is already dead or dying, of course no such preparations need be made; as a scalpel and probe-pointed bistoury, or even an ordinary pocket-knife on an emergency, and used with care, will suffice.

The operation should, if possible, be performed with all antiseptic precautions.

The incision in the abdomen may be made in either of two regions—at the *linea alba* or the *right flank*. If it is desired to preserve the parent, the flank operation is certainly to be preferred with the larger animals and the Sow, as no sutures can resist the weight of the intestines when the incision is at the inferior part of the abdomen. Even with the Bitch the flank operation should be adopted for the same reason, and also because wounding the mammæ is avoided—an important consideration in more respects than one. It is true that Bourgelat, describing how gastro-hysterotomy ought to be performed in the Mare in order to obtain the living fœtus, says that the animal

should be carefully thrown, placed on its back, and there secured. "Then a *crucial* incision is to be made at the middle of the lower part of the abdomen, and it should be about a foot-and-a-half in length—terminating at the pubis. If the large intestine, forced outwards by the struggles of the animal, appears, it should be carried to one side, when the uterus will soon be seen; then an opening, corresponding to the other, must be made with the greatest circumspection, so as not to wound the foal; the membranes are to be opened, the 'waters' they contain escape, and the young creature is to be immediately removed. The success of the enterprise depends upon the attention paid in order to prevent the death of the Mare; the more time lost, so the more is the fœtus weakened; the less time is there to spare if the Mare is dead, for then it is certain that the Foal will not live longer than a few moments." The umbilical cord was to be ligatured at four or five inches from the body of the Foal; "after which it is only a question of providing means for rearing the young animal, until it can attend to itself."

But Rainard points out that nothing is said as to closing and bandaging the incision, or the after-treatment of the Mare—thus indicating that preserving the Foal only was in view.

With the Mare or Cow the operation is sometimes attempted in the standing attitude; but it is obvious that there must be great inconvenience and danger in this. It is much better, therefore, to place the Mare, Cow, Sheep, or Goat, on the left side—right side uppermost; either side suffices for the Bitch or Sow.

If the animal is narcotised and insensible, then it is not necessary to secure the limbs; but if it is only partially or not at all unconscious, then means of contention must be adopted, for the safety of the animal as well as the operator. The right hind-leg should be firmly fixed backwards, so as fully to expose the region to be operated upon, the other three limbs being secured together in the ordinary manner. A small animal can be held by one or two assistants.

The incision, as has been said, is made in the right flank, rather below and in front of the anterior spinous process of the ilium, so as to avoid wounding the circumflex artery—an accident which might embarrass the operator; if this or any other artery is wounded, it must be tied immediately. If there is no great hurry, and the hair is long, this had better be clipped off. The incision should pass downwards and forwards, in the direction of the fibres of the small oblique muscle of the abdomen (no muscle should be cut across); it ought to extend through the skin to the muscles, and even if it passes into these there is no danger to be apprehended.

The length of the wound will, of course, depend upon the size of the animal—for the Mare or Cow, it may be from twelve to fourteen inches. The layers of muscles are to be gently cut through until the peritoneum is reached, and into it a small opening is to be made; but in doing this the greatest care is to be exercised, so as not to wound the viscera. The two first fingers of the left hand are passed through this opening, the back of the hand downwards; the blade of the probe-pointed bistoury is placed between these fingers, and carried along—cutting through the peritoneum and muscles until the opening is of the same length as that in the skin. An intelligent assistant should be at hand to prevent the escape of the intestines through this large aperture.

The arm of the operator is now pushed into the abdominal cavity in search of the uterus, which, when found, is brought opposite the inci-

sion, should it not be there at first. Two assistants compress the sides of the wound, so as to maintain them closely against the uterus; this the operator cuts through slowly, layer after layer, using all diligence so as to escape wounding the fœtal membranes.

Two fingers are insinuated between the walls of the organ and these membranes, and the bistoury is again employed to dilate the opening, as in the peritoneal incision, so as to give it nearly the same direction and extent of that in the abdominal wall. Should the membranes be still intact, they are to be torn, and the "waters" allowed to flow—but only *outside* the abdomen, if possible. The operator now, plunging his arm at once in the cavity of the uterus, seizes the first parts of the fœtus that come to hand—fore-legs, head, or hind-quarters, if possible—and removes it quickly; the umbilical cord is torn or tied, and the young creature given to those who will dry and rub it, wrap it in a warm blanket, and otherwise attend to it.

The obstetrist immediately, if the parent is to be preserved, removes the fœtal membranes—an easy task comparatively in the Mare, much more tedious and difficult in the Cow, as all the adhering cotyledons must be separated one by one. Then, by means of a sponge, all the fluid remaining in the organ is to be cleared out, as well as any that may have escaped into the abdomen. It might be well to damp the interior of the uterus with a very weak solution of carbolic acid, or potassium iodide (1 to 500 or 700). This accomplished, the great wound is to be closed.

Nothing is done to the uterus, as a rule; the organ soon diminishes very considerably in volume, and it would appear that the wound in it is not long in cicatrising. The borders of the wound in the abdomen, however, must be speedily and solidly united. The best means of union is undoubtedly the quilled suture, which is to be applied according to the ordinary rules of surgery; care must be taken to make the sutures enter at a good distance from the border of the wound, and to include the muscles as well as the skin. If the cord fixing the outstretched hind-limb is slackened a little, it will facilitate closing the wound. A small corner should be left open at the lower end of the incision, to allow the products of inflammation and suppuration to escape. External to the wound, either a layer of fine tow or lint, slightly carbonised, or oakum, may be placed. Over this, long narrow strips of canvas covered with melted glue may be fixed, to support the sutures and retain the dressing; then on these another thin layer of carbolised tow or oakum, and, lastly, the wide body-bandage around the abdomen and loins of the creature. Though it is somewhat difficult to apply, yet it is essential that this bandage or compress be put on before the animal is allowed to rise. Afterwards the bandage may be adjusted and tightened if necessary.

When the incision is made at the *linea alba* the procedure is somewhat similar; but, as we do not recommend it for the reason above stated, we need not allude to it further.

The after-treatment of the wound is that followed for all such serious traumatisms. If possible it should be kept perfectly dry, and dressed with antiseptic powders—such as boric acid.

The diet should be light and sloppy for a short time, unless the animal is very feeble, when nourishing food must be given.

With the smaller animals the operation is similar, but with the multiparæ the cornu containing the young is drawn partially outside

the wound, opened, and each fœtus and its membranes removed separately. The after-treatment will be the same. For enlarging the abdominal and peritoneal incisions, small sharp scissors will be found very useful and safe, the blade with the blunt point being introduced.

The bad results to be apprehended from the operation are septic metritis, or peritonitis, or both; abscess at the seat of the incision, or adhesion of the abdominal organs to this part.

CHAPTER VIII.

Symphysiotomy.

Symphysiotomy, as the name implies, consists in dividing the ischio-pubic symphysis throughout; so that, by allowing the bones to separate somewhat in the pubic region, the pelvic cavity may be enlarged, and the passage of the fœtus through it rendered possible. But even in woman, with every advantage and appliance, and after a most serious mutilation, the separation procured between the bones is infinitesimal, and therefore can have but little influence on the progress of the fœtus. And when we remember that in woman the mortality is more than 32 per cent., while among those which survive many are permanently disabled, and those which recover often require months before convalescence is established, it will be understood that the operation can never, with our present knowledge, be reckoned among those which the veterinary obstetrist can successfully practise. It may also be sufficient to notice the fact that in animals the symphysis pubis, as a rule, soon becomes ossified. The operation does not appear to have been resorted to in veterinary obstetricy, and it would require a bold operator to attempt it.

CHAPTER IX.

Artificial Premature Birth.

At p. 294 it was explained that, in order to obviate some of the difficulties occurring in pregnancy and parturition in animals, artificial labour might be induced—*i.e.*, birth effected when the fœtus has attained such a stage of development as to be viable, but before the period of normal parturition has been reached. Such a procedure may be necessary when there is deformity of the maternal pelvis, or tumours thereon or therein; excessive size of the fœtus—absolute or relative; protracted gestation; serious paraplegia; eclampsia; cerebral congestion; ante-parturient exhaustion from the presence of too many fœtuses; prolapsus of the vagina and uterus; transverse presentations, etc.

This measure is often resorted to in the human female, and with great advantage, for by it both parent and offspring may be saved; whereas if not adopted, one or both might perish when pregnancy came to an end.

It has even been suggested that in animals it might be made available in those cases in which they have become pregnant when too young, when the male has been disproportionately large, or—as is often the case with Dogs—belonged to a large-headed breed.

When the fœtus is expelled from the uterus before it is viable—before

it can maintain an independent existence apart from the parent, this constitutes *abortion*. In the Mare this would be the case if the accident occurred before the 300th day of pregnancy; in the Cow before the 200th day; in the Sheep before the 130th day; in the Sow before the 109th day; and in the Bitch before the 50th day. So it is estimated that the fœtus would be viable, and yet notably less in size and weight than when born at full term, if removed from the Mare 20 to 40 days before that period; from the Cow 15 to 30 days; and from the Bitch 10 to 15 days.

Operation.—The operator has merely to induce labour, Nature carrying on and finishing parturition in the usual manner; so that he has only to dilate the os uteri somewhat to effect this; then the "water-bag" is extruded, the uterus commences to contract, the animal also begins to strain, dilatation of the os is completed, and the fœtus is expelled.

The different ways in which the os may be dilated have been already described in treating of sterility, and rigidity of spasm of the cervix; but it may be remarked that, in the case of the larger animals, and especially if near the end of pregnancy, the hand alone may be used to open the os, slightly detach the chorion from the uterus around that canal, and even perforate that membrane a little to hasten the formation of the "water-bag."[1]

In the smaller animals the sponge tent, a long probe, or uterine douches, will suffice.

CHAPTER X.

Supplementary Observations regarding Mother and Progeny.

The condition of the mother after obstetrical manipulations and operations generally demands attention—all the more if these have been severe and protracted. In trifling cases, it is true, no care beyond that usually given after normal parturition is required; for as soon as delivery is completed, she will seek her offspring—if it be alive—and manifest her interest in it, though she may have suffered considerably before it was born. But in the great majority of difficult cases, such as have been described in the preceding chapters, the animal is much prostrated from prolonged suffering and straining—so much so, indeed, as to lie extended in a comatose condition, or apparently dead, from nervous exhaustion. Though the Mare can endure very much suffering during parturition, yet this state of collapse is not infrequently observed. So stout-hearted is this animal, that when she has rallied from the effects of parturition and evinced maternal solicitude for the Foal, she begins to eat and drink; when she does not do so, it may be regarded as a very grave sign.

To render the mother comfortable and restore her strength should be

[1] André (*Annales de Médecine Vétérinaire*, 1877, p. 156) was called to see a Mare, eleven months pregnant and very heavy, which could not be got up, and had been lying so long that her sides were contused. He had her placed on an inclined plane, with the front of the body higher than the hind-quarters. Then by means of a finger, and afterwards by the whole hand, he succeeded in dilating the os, and soon a large living Foal was born. The Mare was kept quiet and nursed for two hours afterwards, when she got up without difficulty and suckled the Foal, which was well and lively.

the first consideration. The body ought to be rubbed and dried, and covered with warm clothing; stimulants must be given, as well as warm gruel and tepid water to drink. If resting, she ought not to be disturbed; though, in the case of the larger animals, some authorities assert that if recumbent they ought to be got up if possible, as the internal generative organs then assume their natural position more readily. But unless there is apprehension of inversion of the uterus, it is generally the best course to allow repose.

For Cows much exhausted in calving, it has been recommended to give a subcutaneous injection of veratrine (4 to 5 grammes in alcoholic solution, 1 to 25), which soon rallies them. When, after delivery has been effected, animals remain lying or are restless, and apparently suffering pain, they should receive soothing medicine, especially opium or its tincture, either in gruel or enema—or morphia subcutaneously.

If the young animal is alive and able to suck, it should be put to the teat; if it is dead or unable to suck, then the mother must have the milk taken from the mammary gland.

Any contusions or injuries to the maternal generative organs should be attended to next; the treatment to be adopted will depend on the nature and seat of the lesions, but it ought to be antiseptic whenever possible. This must also be the rule when the fœtus has been extracted in a decomposed state; the uterine cavity must be well syringed out with warm water, and subsequently irrigated with some antiseptic fluid—I have used permanganate of potass with good results in these cases.

With regard to the young animal when it is extracted alive, the damage it has received should be ascertained; this can be done when the cords are removed. The slighter injuries are usually simple wounds and soon heal; but fractures of bones are more serious, and generally necessitate slaughter of the animal. If looking healthy, yet it cannot get up or stand when lifted up, this is in all probability owing to strain of the limbs, and passes off in the course of a few days.

When apparently dead, besides the measures already mentioned for this condition, veratrine has also been given with great advantage subcutaneously, one or two centigrammes being the dose. In other cases in which the Calf could not respire—though the heart was contracting rapidly and violently—it has been placed near the open door, with the head pendent, in order to send blood to the brain, while the limbs were vigorously rubbed and the chest compressed and relaxed alternately; these measures not succeeding, a small quantity of brandy carefully administered has produced the desired effect, and respiration was soon established.

Sometimes it happens that the Calf has been retained in the genital canal for some hours, with its head partially out of the vulva, and owing to the pressure on the neck there is much swelling of the head, especially of the tongue, which is turgid and projects from the mouth. When extracted, the creature can scarcely breathe because of the tumefied tongue, and asphyxia is imminent. Scarifications of the organ, or leeches applied to it, with turpentine or mustard rubbed on the limbs, soon bring relief.

BOOK IV.

ACCIDENTS AFTER PARTURITION.

THE *accidents* occurring subsequently to parturition are rather diverse, and not infrequently complicate the difficulties already alluded to as hindering natural birth. They may occur either during parturition, immediately after delivery, or within a few days subsequent to that event.

In addition to the accidents, there are *diseases* which appear during the puerperal period; though the distinction between them and the former is not always easy to establish.

Some of the complications just alluded to may succeed a perfectly normal delivery, or an accidental abortion, as well as a difficult birth.

The accidents consecutive to or accompanying parturition, may be enumerated as follows: (1) *Retention of the fœtal envelopes in the uterus, and its consequences;* (2) *Post partum hæmorrhage from the genital organs;* (3) *Displacement or hernia of one or more of the internal genital organs through the vulva;* (4) *Traumatic lesions of the genital or neighbouring organs.*

Some of these accidents are either very serious in themselves or in their consequences, and require the greatest skill to remedy; or they are comparatively trifling, and easily repaired.

CHAPTER I.

Retention of the Fœtal Envelopes.

THE retention of the fœtal envelopes, placenta, "secundines," or "after-birth," beyond a certain time after the expulsion of the fœtus from the uterus, must be looked upon as an accidental or pathological condition which requires attention. It has been already shown that the placenta is usually shed or expelled soon after the young creature is born, and particularly with such animals as the Mare, Sow, and Bitch, the placenta of which is diffused or zonular; indeed, with multiparous animals—as the two latter—the placenta of each fœtus is extruded soon after its birth, by the succeeding fœtus; so that if retention occurs at all, it is only the last, or the two last placentæ which remain in the cornua of the uterus.

With Ruminant animals, however, retention is far from rare; though even in them there is a difference in this respect, according to species—the accident being much more frequent in the Cow than in the Sheep or Goat. This frequency in Ruminant animals is doubtless due to the peculiar formation of their placentæ—the cotyledonal arrangement being evidently opposed to ready separation.

But if the Cow is the animal of all others in which this accident occurs, it is also the one which appears to be the least inconvenienced by it; for it is not uncommon to see Cows which four, six, eight, and even ten or twelve days after parturition, have not got rid of the placenta, and yet are lively, the appetite is unimpaired, and they con-

tinue to ruminate and give milk as if there were nothing amiss ; though in some instances the animal may stamp with its hind-feet, raise the tail, and act as if about to defecate or micturate, while a small quantity of fœtid sanious fluid escapes from the vulva.

Symptoms and Terminations.

The symptoms are generally so marked that the state of affairs is readily discovered. Nearly always there is a more or less considerable mass of the fœtal envelopes—sometimes only the umbilical cord—hanging from the vulvar orifice, the labia of which are often swollen and injected. Occasionally the mass is so large as to reach below the hocks, with little bags of liquor amnii at the lower end ; it has, if recently expelled, a fresh tint, not unlike that of the intestines ; but if exposed for some time, and especially in summer, it is greyish-coloured, somewhat adhesive. and generally soiled by fæces or litter.

In other cases nothing is noticeable, except when the animal is lying on its abdomen ; then the pressure on the uterus pushes the cervix into the vagina, and if any portion of the membranes is through the os, of course it is visible. In others, again, nothing whatever is to be seen whether the creature is lying or standing, the whole mass being retained in the uterus. After the third day of delivery, the os is usually closed ; and unless a portion of the membranes chanced to be in the vagina before this period, the entire placenta is imprisoned in the uterus, and a manual exploration will not always discover it. Sometimes only a fragment of the membranes is so retained.

It has been mentioned that in many cases the animal does not evince any uneasiness at first ; sometimes when the portion of placenta hanging outside the vulva is large and heavy and the creature is standing, the meatus urinarius is pressed upon, and micturition is rendered difficult. There may also be symptoms of abdominal pain—whisking the tail, stamping with the feet, and making efforts as if to defecate or micturate, with slight and brief uterine contractions, which may eventually lead to the expulsion of the placenta.

It often happens that when the os is not completely closed, owing to a portion of the membranes lying in it, spontaneous expulsion takes place after a variable period.

Deneubourg asserts that it occurs at fixed intervals, which are almost regular " tertiary periods " ; that is, if expulsion does not ensue in the first twenty-four hours, it should take place on the third day ; and if not then, it will be either on the sixth, ninth, twelfth, fifteenth, or other tertiary interval—but most frequently on the ninth day. How far this assertion may be correct, experience can alone decide ; what is more to the point is the fact, that when once this spontaneous expulsion has been effected there is little to be apprehended.

It is not so if retention be accompanied by decomposition of the membranes. This occurs when the air has access to them ; and all the more rapidly does putrefaction progress if the temperature is high, and they are impregnated with discharges.

The odour is most repulsive, and a sanious brown-tinted discharge, composed of *débris* of the membranes and secretions from the irritated mucous lining of the genital canal, flow from the vulva—soiling it, the tail, thighs, and hocks, and often excoriating them. This discharge is most abundant when the animal extends itself to micturate, and it is

then horribly fœtid. The hand, on being passed into the vagina, is covered with the fluid, and it may encounter shreds of the placenta.

In such cases the health of the animal often suffers; there is dulness, prostration, diminution in the secretion of milk, decreased appetite, respiration perhaps quickened, temperature increased, and other indications of illness.

The complications from placental retention are somewhat numerous. Contact with the decomposing membranes may so irritate the interior of the uterus as to occasion metritis, or even metro-peritonitis—a condition which is always serious, and often fatal. There is also risk of septicæmia; and even under the most favourable circumstances there sometimes remains a local irritation—a chronic vaginitis or metritis that leads to leucorrhœa.

Some authorities have observed trismus, tetanus, metastatic arthritis, and chest affections, as *sequelæ* of placental retention.

There is no danger when the retention has only lasted for two or three days, particularly if a large portion of the membranes protrudes beyond the vulva, and it has a fresh tint. Attention is necessary, however, when the placenta begins to putrefy, and a fetid discharge commences from the vulva; though even so late as fifteen days after parturition the membranes may be expelled spontaneously, without any injury occurring from the prolonged retention. But the case is serious when the animal begins to show symptoms of general illness, and particularly if no portion of the placenta can be seen or the os be occluded. Plastic adhesion of the placenta to the uterus is also a grave complication, though happily rare.

In these instances, the animal gradually becomes listless, weak, and emaciated, loses its appetite and ceases to yield milk, until at length it falls into a state of marasmus, and perishes from septicæmia. Or in more rapid cases, with these general symptoms the lining membrane of the vagina is of a deep-red colour and intensely hot, a fetid sanguineo-purulent discharge escapes from the vulva; there are tremblings over the whole body, hurried respiration, intense fever, and all the other signs of metritis.

Though retention is not, in the majority of cases in the Cow, a very serious affair, yet it should be attended to even in this animal. With other creatures it is much more to be dreaded, as they incur greater risks from prolonged retention.

Saint-Cyr mentions the case of a fine Mare which died in less than eight days from metritis, due to the fœtal membranes being retained; though the cause was not ascertained in time.

Causes.

Retention occurs most frequently in cases of abortion, or when birth takes place some days before the proper time. It has been remarked that a Cow which retained its placenta unusually long after the birth of its first Calf, will do so at every succeeding parturition. A protracted and laborious birth is also said by some authorities to favour retention, while others declare that the converse is true. The accident is stated to be more frequent with old Cows, and especially when these are employed in draught—as in France and other countries. Abnormal adhesion between the maternal and fœtal placentæ would, of course, be a sure cause of prolonged retention, and we have given instances of

such adhesion; indeed, every obstetrist knows that at times there is much difficulty in disuniting the cotyledons in the uterus.

When the cervix uteri contracts rapidly after delivery, and the os is consequently firmly closed, the placenta, though non-adherent, will be retained.

Rueff mentions that the accident is especially frequent in certain years when the herbage and forage is not good, and particularly when the latter is mouldy; it has long been known that these conditions favour abortion. He also alludes to a popular belief in Germany, which attributes this *Zurückbleiben der Nachegeburt*, as it is termed, to allowing the Calf to take the teat before the placenta has been expelled; the irritation of the udder so produced reacts sympathetically on the uterus, which contracts at the cervix, and so retains the membranes.

According to Baumeister, milking too soon, or giving cold water to drink, is supposed to act in the same way.

Numerous other causes have been mentioned as influencing this retention; but they need not be noticed, as there is really no proof that they do operate in this way. The accident occurs under all systems of management, and all kinds of conditions; it is, therefore, probable that several causes may produce it, and that some of them are still obscure.

Treatment.

The treatment of placental retention appears always to have been a subject on which diverse views and opinions have been held; many obstetrists maintaining that—with the Cow more particularly—this retention is never dangerous in itself, and that, unless there arise complications, the removal of the fœtal membranes should in every case be left to the efforts of Nature; while others assert that there is great risk in this retention, and that when it has exceeded two or three days after the birth of the fœtus there is need for active intervention. The experience of the majority of obstetrists will negative both of these opinions; for it is a matter of almost daily observation, that in many instances the placenta remains without inconvenience in the uterus for several days—six or eight—before it is spontaneously expelled; while in other cases retention for the same period is marked by more or less serious symptoms. This difference undoubtedly depends upon circumstances, the precise nature of which cannot always be fully ascertained. Nor can positive rules be laid down as to when it is time to interfere, or when abstention is the prudent course:—this can only be learned by individual experience and the tact of the practitioner.

It may be remarked, however, that when parturition has been normal, when the Cow does not appear to suffer pain or inconvenience, when the "straining" is unfrequent and slight, the appetite good and lactation established, and particularly when, during a low or moderate temperature a portion of the membranes protrude beyond the vulva, then there is no great reason for interference until a week, or even more, has elapsed.

But if, on the contrary, the external temperature is high, if the labour has been difficult, the genital organs irritated or abraded, and if fever, restlessness, and suffering are noted, with strong and frequent straining, especially if there are foul-smelling discharges from the vagina, then intervention is called for, no matter whether the time which has elapsed since parturition is long or short.

When the envelopes form a somewhat large mass hanging from the vulva, it may be anticipated that early and spontaneous removal will take place; though it sometimes happens, as has been pointed out, that the weight of the pendulous portion causes inconvenience in micturition; while it fatigues and pains the animal by dragging on the uterus, and induces expulsive, but futile efforts. Schaack has shown that in nearly all these cases it will be found that a loop of the membranes has become twisted around the pedicle of some large uterine cotyledon; and as this is the obstacle to separation, it is necessary to release the loop as soon as possible, in order to prevent accidents.

It has also been remarked that, even when birth has been easy and favourable, primiparæ are often irritable and impatient, the presence of the secundines in the vagina and vulva increasing the restlessness, and occasioning frequent and energetic uterine contractions. In such cases it will generally be found judicious to remove the membranes as soon as possible—on the same day, or the day succeeding delivery, if necessary.

If after the birth of the fœtus nothing is seen at the vulva except a thin cord, formed solely by the umbilical vessels, it is almost certain that there is strong adhesion between the maternal and fœtal placentæ, and that the separation of the latter will be protracted—in all likelihood require to be removed artificially. But even in such a case there is no occasion for immediate interference; on the contrary, it is more judicious to wait, and allow time for the placentæ to soften and the adhesions between them to diminish, though the opportunity for complete detachment must not be overlooked.

When nothing whatever is discernible externally, there is reason to surmise that the placenta is completely retained. But even in this case there is no need to resort at once to its removal; though it may be necessary, in order to prevent imprisonment for some time, through the closure of the os uteri, to introduce the hand into the uterus, and if it is already partially detached, to extract it. If it remains firmly adherent, however, it is better to gather as much as can be seized into a single mass, carry it through the os into the vagina, and tying it there by a long piece of cord, to leave the latter hanging outside the vulva. This prevents the os from closing, while the cord will assist in effecting artificial removal at a later period, should such be required.

Certain medicaments, more or less of the nature of emmenagogues—such as rue, savin, laurel, stramonium, carbonate of potass, etc.—have been for a long time credited with the power of hastening the expulsion of the placenta; and their administration has been recommended before resorting to manual force. Some of the recipes for these potions are very antiquated, and others are quite modern, and lauded by the highest authorities.

Zundel, for instance, extols laurel berries, and gives the following recipe:

Laurel berries - - - - -	120 grammes.
Aniseed - - - - - -	60 „
Bicarbonate of soda - - -	120 „

These are infused in 4 litres of water, and given in two doses. It may be repeated the following day; but, as a rule, the membranes are expelled within twenty-four hours after the last dose has been given. Zundel asserts that this infusion has rendered excellent service, suc-

ceeding in 60 per cent. of his cases of retention. Hering and Stockfleth also speak highly in its favour, and assert that it is always successful, provided there is no mechanical obstacle to expulsion. Baumeister and Rueff recommend potass carbonate in the dose of 45 grammes daily, at three times, in an infusion of chamomile or savin. Hummer prescribes 90 gramme doses for three consecutive days, and Hertwig, Lund, and others also prescribe it with the same object. Hering gives the following formula :

Carbonate of potass - - - -	15 grammes.
Savin leaves - - - - -	30 ,,

These are infused in 500 grammes of water, filtered, and administered tepid. The dose to be repeated every six hours.

Garreau lauds Caramija's uterine tincture, which he states always succeeds in producing expulsion of the membranes, even when they have been retained for two months after parturition.

The formula for this tincture is given by Tabourin as follows :

Powdered savin - - - - -	250 grammes.
Treacle - - - - - -	190 ,,
Powdered cumin - - - -	125 ,,
Essence of rue ,, ,, savin } āā - - -	80 ,,
Alcohol - - - - - -	2 kilogrammes.

Garreau prescribes this tincture in doses of 100 grammes, given in 2 litres of savin infusion.

Cruzel has his favourite potion, composed of 30 to 40 grammes of green rue, or 10 grammes of ergot of rye and 20 grammes of powdered savin, made into a decoction in a litre and a half of water. Delwart, Rainard, and Schrader recommend ergot of rye, and Ungefrohrn stramonium seeds (30 grammes in two litres of water), which he believes to be specific in their action ; he advises that linseed decoction be given in the intervals, as it acts as a diuretic, and Rychner asserts that this simple medication is particularly useful when the fœtal membranes are so decomposed that they cannot be removed by the hand.

The subcutaneous injection of ergotine, or ergot of rye, has also been advised. Extract of ergot of rye, 1 to 3 grammes, dissolved in glycerine and spirits of wine (15 grammes of each), has been used for injection.

Though medication has been so highly vaunted by some authorities, yet some others have not much faith in it. Deneubourg thinks its chief advantage lies in inducing the owner of the animal to exercise patience until spontaneous expulsion is effected, the least active measures being the best. Other obstetrists entertain the same opinion of these emmenagogues.

For a very long time, an empirical mode of removing the placenta when a part of it protruded beyond the vulva, was to exercise slight and continuous traction on it by attaching a weight to the pendulous portion : in France the farmers attach a sabot filled with gravel. Favre of Geneva, who notices this rude method, admits that a weight not exceeding two pounds may be suspended from the membranes, which are collected into a mass and tied with a piece of hemp. This method is, however, objectionable from several points of view.

Manual traction is often employed when a portion of the membranes

is visible. This is seized either by the hands, or by means of a towel, or wisp of hay or straw, and gently pulled at—particularly when the animal strains—twisting it at the same time, until the whole mass is removed from the uterine cavity.

This traction is not likely to be productive of much injury to the Mare, Sow, or Bitch, as the adhesion of the placenta is not great, and is usually limited to a few points ; it is, therefore, as a rule, generally and quickly successful in these animals.

With the Cow, however, it is not so, owing to the numerous and often strong attachments of the placenta, and its fragile texture, which renders it easily torn if too much force be employed; if it does not give way, and the traction is immoderate, then there is risk of irritating the uterus, tearing away the cotyledons, or producing partial or complete inversion of the cornua, or even of the entire organ. Should the placenta give way, this may lead to greater difficulty in removing what is left of it in the uterus.

For these reasons, some practitioners discountenance this mode of abstracting the placenta ; but there can be no doubt that if the traction is moderate and judicious, the membranes not very adherent to the interior of the uterus, and a good part of them beyond the os, the operation is quite justifiable and will be successful. When, however, the resistance is marked, or the membranes begin to tear, it is better to desist.

Deneubourg recommends the following method, as better than employing the hands: The protruding umbilical cord is seized between two pieces of wood, the length and size of an ordinary walking-stick, and rolled round them until they are close to the vulva; there, by a slight and gentle circular movement, the portion engaged in the vagina produces a kind of titillation which induces the animal to stretch as in micturition—an act it nearly always accomplishes, and during this period the membranes are rolled round the pieces of wood as they are detached, which usually occurs in about six days, when the whole is removed. When resistance is experienced, and anything is found to tear or rend, it is evident that adhesions still exist, and the rolling must cease; but then, by a kind of jerking movement from side to side, there is communicated to the uterus a series of shakes more or less energetic, according to the state of the organ. Deneubourg says that there need be no hesitation in employing a certain amount of force in practising these movements: "We may act strongly, but gently." Great success is said to have attended this method.

But, after all, it is doubtful whether the more scientific and surgical, if old plan—that of direct extraction by enucleation of the cotyledons —is not preferable. This method consists in passing the hand into the uterus, and detaching or enucleating the cotyledons, one by one, so as to destroy the adhesions between the maternal organ and the fœtal envelopes, when the latter can be taken away.

When this extraction should take place will depend upon circumstances. It will generally be found that it will not be successful before the third day, as the cotyledons are too closely and firmly united to allow their disunion without injurious force, which may bring about inversion of the uterus, or laceration of the maternal cotyledons, and consequent hæmorrhage. About the third day is generally a favourable period, as the cervix is still sufficiently relaxed to pass the hand through the os into the uterus; while disintegration between the fœtal and

maternal placentæ has advanced sufficiently to permit the hand to complete the disunion without need for violence. It sometimes happens, however, that extraction can be effected so late as the fifth or eighth day after delivery; but then the membranes are extremely friable, and will scarcely withstand any degree of traction. Besides, the operator himself incurs great risk of infection, either local or general, from the absorption of the putrid matters in the uterus by the skin of the hand and arm.

An assistant holds the tail of the animal to one side, and the hand and arm, well oiled, are passed into the vagina; if a portion of the membranes is in this canal, then the operation is not so difficult, as the os will probably be more or less relaxed, and this portion lying towards the palm of the hand—the back of which is upwards—serves as a guide; while the left hand pulls at it gently, as occasion requires. When, however, nothing of the envelopes is to be found outside the os, and that opening is firmly closed—as happens four or six days after birth—then it may be very difficult to reach the interior of the uterus. One finger must be at first introduced, then two, three, and so on, until the hand in the form of a cone, and by a semi-rotatory motion, can be passed through. This operation is often long, troublesome, and fatiguing, and requires to be carefully managed, so as not to bruise, irritate, or wound the organ.

When the hand reaches the interior of the uterus, it is pressed forward between the mucous membrane of the latter and the chorion—the palm towards the latter—separating them as it advances until it meets with the cotyledons. Some of these—the maternal—may be detached from the membranes, while others are still imbedded in them, as it were, through their fœtal cotyledons. These last have to be enucleated; and to effect this, the cotyledon is gently pressed at its base between the thumb and index finger, and, if necessary, the fingers are moved over each other as if removing a button from its buttonhole. Other practitioners make pressure on the summit of the cotyledon by the three first fingers, and thus destroy the adhesion. In this manner the hand passes from one cotyledon to another, effecting disunion as rapidly, yet carefully, as possible. At times a cotyledon will be met with which adheres so very firmly that it cannot be detached in the way just mentioned. Then the nail of the thumb or other finger must be gently insinuated at the border, so as to gradually raise it, and pass the finger over its entire surface.

The tediousness of the operation will be inferred when it is known that the number of adherent cotyledons may sometimes amount to more than a hundred; and the fatigue is often so great that the right and left hand have to be employed alternately—a circumstance which has advantages otherwise.

When a certain number of cotyledons are detached, the portion of envelopes so released is carried into the vagina and beyond the vulva, where the other hand, or an assistant, seizes and pulls gently on it. As the bulk of this increases by the detachment of more cotyledons, the pulling must cease, and the mass will require to be supported so as to prevent tearing the membranes, or painful dragging on the fundus of the uterus.

As the hand reaches the cornua the cotyledons increase, and it becomes difficult to reach them—particularly the cornu in which the hind-limbs of the Calf were lodged, because of the insufficient length

of the arm. Moderate traction, however, on the part just detached will bring the others nearer, and facilitate the task; but the traction must be judiciously managed, so as to avoid tearing the membranes or the adherent cotyledons, invagination of the cornu, or even inversion of the uterus. So likely is this accident to happen, that some practitioners, instead of pulling at the membranes in this way in order to disunite the most distant cotyledons, are content to await their natural separation, merely tying near the vulva the portion of the membranes separated, and cutting away the parts beyond—the separation generally occurring in from two to five days. To facilitate traction, Gunther recommends that the abdomen of the animal should be well raised by a plank placed under it, and held by assistants.

It has sometimes been found, as already mentioned, that the greater part of the membranes has been expelled, when all at once expulsion ceased, notwithstanding the volume and weight of the pendulous mass, which caused so much disturbance to the animal that it has refused to eat, persisted in lying, and when compelled to get up has kept stamping its hind-feet until it could lie down again. On introducing the hand into the uterus, it is discovered that this unusual interruption to the expulsion has been occasioned by one or two large maternal cotyledons becoming entangled in the loop of a fold of the membranes. Sometimes the drag on these cotyledons has been so great that they have been brought as far as, or even beyond, the os. Relief has been given by cutting the membranes off by scissors, close to the vulva, and then releasing the cotyledons.

When extraction of the membranes has been properly conducted, there is no hæmorrhage; if bleeding ensues, then one or more of the maternal cotyledons have been injured, or perhaps torn off altogether —an accident not without danger sometimes, and all the more serious if a number of the cotyledons is involved. This injury may lead, in addition to hæmorrhage, to uterine irritation, metritis, or uterine phlebitis.

Still, such an untoward accident is not always the result of injury to the cotyledons, as instances are recorded in which great numbers, or even the whole of the maternal placentæ, have been torn away by ignorant empirics, and yet the animals have survived; at the commencement of this work it has been shown that fecundation and gestation may even take place after ablation of the cotyledons. Nevertheless, these cases must be looked upon as entirely exceptional, and should not be relied upon as evidence that these bodies can be injured with impunity.

The disaggregation of the placentæ has been, in some instances, greatly facilitated by injecting into the vagina, os, and uterus a small quantity (1 to 2 drachms) of tincture of veratrin (1 to 25), which produces continuous expulsive efforts, and in a few hours slight traction will remove the membranes. With the same object, some practitioners have successfully injected a quantity of warm water into the uterine cavity.

In order to be assured that the whole of the fœtal envelopes has been removed from the uterus, it is well to make an examination of them. Knowing their formation and extent, there should be no difficulty in ascertaining whether they are all present.

After the removal of the membranes, there remains in the uterus a quantity of thick, grumous, diversely-coloured, and more or less un-

pleasant-smelling liquid, which is derived from the fœtal fluids, the blood that has escaped from the umbilical cord, and the partly-decomposed envelopes. As its retention is likely to do harm, particularly if there is any wound or abrasion of the mucous membrane, as much as possible of it should be removed by the half-closed hand. It is often advisable to wash out the interior of the organ with tepid water, and to inject a weak solution of cresyl, carbolic-acid, chloral, or permanganate of potass.

When extraction of the envelopes has been effected in good time and with the necessary precautions, the Cow bears the operation very well and does not appear to be much inconvenienced, so that little after-treatment is needed. Gentle walking, if the weather is fine, in order to calm its restlessness and to allay the straining, if it is still present; keeping it in a well-lighted and properly ventilated stable, with a blanket over the body if the temperature is low; a few enemas, if constipation threatens; and a light laxative diet, with bran, oatmeal, or linseed gruel, are usually all that is necessary.

When the envelopes have putrefied in the uterus, through delay in removing them, and an abundant and fetid discharge flows from the vulva, the animal itself being unwell and feverish, then the case is serious, and requires instant attention. The uterus must be cleared without delay from its putrescent contents, and in order to accomplish this the hand must be passed into the organ, and everything removed which it can possibly seize. Before doing so, however, the hand and arm should be well and frequently smeared with carbolised lard, butter, or oil, to prevent septic infection; if there are wounds or abrasions upon them, the greatest care should be taken in this respect—indeed, it is questionable whether they should be introduced at all if the skin is not intact.

When everything has been taken away which the hand can remove, then the interior of the organ should be thoroughly cleansed by the continuous injection of tepid water from a large syringe and tube, until the fluid comes away perfectly clear.

Very weak solutions of the before-mentioned antiputrescents should also be injected, but they need not be allowed to remain. Should the discharge continue, this treatment may be repeated daily until it ceases; and tonics, stimulants, and antiputrescents (as sodium sulphite or small doses of carbolic acid) be administered internally. Good food and cleanliness are also essentials in treatment.

It must be remembered that cleansing and detergent injections are absolutely required when the mucous membrane of the vagina or uterus is inflamed, abraded, or wounded, and has been in contact with putrid membranes or fluids. More particularly are they necessary when this occurs in the Mare—an animal peculiarly liable to septic infection. Indeed, so much is this the case, that it may be laid down as a rule that manual extraction of the membranes is always indicated in the Mare, when they are not expelled immediately after birth. The injection of warm water will materially facilitate the operation.

With this animal, however, retention of the placenta does not invariably lead to serious results, as several cases are on record in which it has continued for two days, and even longer. Binz mentions an instance in which the membranes were not thrown off until the ninth day, owing to adhesion of the uterus to a hernial sac.

The hands and arms of the operator should be thoroughly washed

as soon as possible after the uterus has been emptied; for this purpose nothing is better than carbolised soap. On the slightest sensation of uneasiness in the arm, advice should be taken with regard to it, as an attack of *Ecthyma parturitionis* is often a serious affair, and has necessitated the amputation of fingers, and even the greater portion of the arm.

So dangerous and unpleasant, indeed, is the removal of a putrid placenta (the odour being often most sickening), that disinfection by intra-uterine injections of solution of cresyl, carbolic acid (2 per cent.), boric acid, corrosive sublimate (1 to 2,000), etc., is regularly practised by some veterinary surgeons. The interior of the uterus is first washed out with warm water by means of a powerful syringe, or a long india-rubber tube to which a funnel is attached, and into which the water is poured. The injection is continued until the water that comes away from the vagina is colourless and odourless; then the disinfectant can be thrown into the uterus, and the arm introduced to remove the placenta. But the latter measure is rarely necessary, as the injections generally suffice to detach it.

As the practitioner is also exposed to septic infection by inhalation, and as this has occurred most frequently while fasting, it is advisable to fortify the body against this risk by taking some food before proceeding with the uterine evacuation and cleansing.

CHAPTER II.

Post Partum Hæmorrhage.

HÆMORRHAGE from the uterus or "flooding," after abortion or the birth of the fœtus at the ordinary term—an accident so frequent and alarming in woman—would appear to be far from common in the domesticated animals. This difference between the female of the human species and that of animals, is evidently due to the dissimilarity in organisation of the uterine mucous membrane in them, particularly at the insertions of the *placenta fœtalis;* as well as to the absence of those immense vascular lacunæ which exist in the uterus of woman, the walls of which are so thin and fragile as to be easily torn when the placenta is detached, and which renders insufficient contraction of the uterus after delivery such a grave matter. Another reason for the infrequency of metrorrhagia in the veterinary obstetrist's patients, is the great rarity of *placenta prævia* in them,[1] and which is a somewhat common cause of hæmorrhage either during or after delivery in woman.

Nevertheless, whether owing to some anatomical or pathological peculiarity, to atony of the uterine walls, rupture of vessels during removal of the fœtal placenta, or even during its spontaneous expulsion, almost every practitioner of any experience has met with cases of metrorrhagia of a more or less alarming character. So serious, indeed, is this hæmorrhage, that the mortality has been estimated as high as 73 per cent. of the cases reported.

At p. 197, metrorrhagia was alluded to as occurring during pregnancy.

[1] Franck (*Handbuch de Thierärztlichen Geburtshülfle*, and *Zeitschrift für Thiermedicin*) has clearly demonstrated the occurrence of placenta prævia in animals. At pp. 87, 88, reference has been made to it, and cases of it are frequently mentioned in veterinary literature.

In what Cox has designated "pre-placental presentation,"[1] we may have hæmorrhage ensuing. According to this authority, such presentations are rare, and if they occur at the termination of gestation may be looked upon as unfavourable; though they are most frequent in cases of abortion, and are then seldom followed by serious results. Metrorrhagia ensues when the usual period of parturition has been exceeded, and the "water-bag" has been presented and ruptured, the entire *placenta fœtalis* coming away before the fœtus itself. "In some cases, a considerable portion of the membranes envelop the foreparts of the fœtus, and occasionally to such an extent as to retard delivery; this may be shredded off and removed without risk, but it will be found that the posterior portion remains attached. The fatality attendant upon these cases is due to neglect of examination and proper aid, and this negligence, again, is owing to the absence of 'pains.' After the removal of the fœtus, it is found that hæmorrhage has taken place from the open vessels, and the quantity of blood indicates that it commenced immediately after separation of the placenta. I have seen these cases only in cattle."

In certain instances there can be no doubt that, as in woman, insufficient contraction of the uterus is a cause of *post partum* hæmorrhage; and, according to Schrœder, this atony of the organ is especially observed after a rapid emptying of its cavity, whether artificially or naturally produced, also after a previous and very considerable distention. It therefore occurs in her after very rapid delivery, too early turning and extraction, in hydramnios, and at the birth of twins. The hæmorrhage is sometimes also due to general debility, and feeble development of the uterine muscles—either congenital or depending upon previous very difficult labours. Partial adhesions of the placenta to the uterine wall, which, however, are rarely caused by real connective-tissue bands, may also give rise to profuse hæmorrhage, as the separated places in the vicinity of the adhesions can only imperfectly contract.

Symptoms.

The symptoms of *post partum* hæmorrhage are not well marked unless the bleeding is visible, though they are those of profuse hæmorrhage in general. There is the quick, weak, running-down pulse, which becomes imperceptible as death approaches, and the throbbing, irregular contractions of the heart; the decoloration of the mucous membranes, rapidly increasing prostration of the animal, with the unsteady staggering gait on movement, and the difficulty of maintaining the standing position towards the end; the haggard *facies;* with chilliness of the surface, cold clammy perspiration breaking out over the body; and, finally, the recumbent position, convulsions, and death.

Sometimes there are indications of abdominal pain—indicated by pawing and looking anxiously at the flanks; but these indications are only likely to be present when the hæmorrhage is due to traumatic influences. When the hæmorrhage *per vulvam* is discernible—coming away in a fluid condition or in masses of clots—then, of course, there can be no difficulty in diagnosing the accident; but when it is entirely internal, the manifestation of the symptoms above indicated should give rise at once to a suspicion of the state of affairs, and lead to a manual exploration of the uterus.

[1] *Veterinary Journal*, March, 1877, p. 178.

Treatment.

The essential indication in the treatment, is to suppress the hæmorrhage as speedily as possible; the next, to sustain the vital powers of the animal.

If the fœtal membranes have not been expelled, they must be removed without delay—yet as gently as possible; for until their removal is effected the uterus will probably not contract. The contraction of the organ is very important, and when the membranes are present it often happens that the manipulation required to remove them brings about this result. If the membranes are not present, then the hand and arm must be pushed into the uterus and gently moved about, in order to excite contraction, if the organ is flaccid and uncontracted. At the same time its interior should be freed from the blood and clots it may contain; cold-water douches must be applied to the loins and vulva, as well as injections of the same into the uterus. If deemed necessary, a towel, or sheet steeped in cold water, or a large sponge impregnated with vinegar-and-water, perchloride of iron, or any other styptic, may be passed into the vagina, or even into the uterine cavity.

Should the hæmorrhage persist, revulsives in the form of mustard cataplasms or stimulating liniments may be applied to distant parts of the body—as the chest, neck, or limbs. Internally, tannic acid, salts of lead and morphia, perchloride of iron, tincture of ergot of rye, or any other agent likely to act as a hæmostatic, may be administered.

Hypodermic injections of morphia have been recommended, and large doses of oil of turpentine—for the Cow from three to five ounces, mixed with the contents of half a dozen eggs—have been successfully employed by Macgillivray.

CHAPTER III.

Inversion of the Uterus.

Inversion, *procidence*, *prolapse of the uterus*, or *vagino-uteral inversion*, signifies a displacement or kind of hernia of the organ, which is partially or completely turned inside out—the inverted fundus escaping through the os uteri (*partial inversion*), vagina, and vulva, and perhaps descending as low as the hocks (*complete inversion*), where it forms a more or less voluminous tumour.

When the inversion is very partial, nothing whatever is seen externally, and an exploration alone reveals the existence of the accident; if more developed, the uterus appears as a round tumour between the labia of the vulva when the animal is lying, and especially if the floor of the stall slopes backwards, which causes the gastro-intestinal mass to press upon the organ. Sometimes the procidence is so very slight that there is merely a bulging inwards of the fundus of the uterus, or of one of the cornua.

In complete inversion there is frequently prolapsus of a portion of the vagina, which appears in two forms or degrees, according as there is inversion of the body of the uterus, or inversion of the cornua as well; sometimes it is only one cornu, which is then deviated to the right or left of the vertical direction of the body of the organ, just as it happens to be one or other of these parts. If both cornua are completely inverted, they terminate inferiorly in the form of a cone; but if they are

only incompletely so, then they remain cylindrical at their lower end, at the centre of the cylinder being a depression or cæcal cavity.

Inversion of the uterus is, of course, only possible when the os uteri is dilated; consequently, it occurs either immediately before or after birth.

Again, inversion is *simple* or *complicated*. It is *simple* when the viscus is intact, uninjured, and not accompanied by the extrusion or displacement of any other organ. When it is wounded or torn, or when there is accompanying hernia or protrusion of other viscera, then it is *complicated*.

As we have said, Ruminants are most liable to this accident: the Cow coming first, then the Sheep and Goat; the Mare is less frequently affected, and the Sow and Bitch perhaps not so often as the Mare. Inversion of the uterus has been observed in the Cat and Rabbit.

With the Bitch and Sow, incomplete inversion of the uterus is far from uncommon, as is also simple inversion of the vagina, for which it might be mistaken. In uniparous animals the whole of the organ is usually inverted; while in multiparous creatures, generally little more than the portion which contained the fœtuses is involved.

The accident has been observed in animals kept in houses and stables, as well as in those roaming about at liberty; and it has been known from time immemorial. The Roman veterinarian, Vegetius, alludes to it, and recommends the employment of an inflated pig's bladder as a good pessary.

Symptoms.

The symptoms of uterine inversion vary with its extent. With uniparous animals, inversion always commences at the fundus of the organ, most frequently towards the largest cornu where the greater portion of the fœtus was lodged. Under the influence of an irregular, and kind of spasmodic contraction, this part is drawn or pushed inwards, just as the foot of a stocking is inverted; and this action continuing, the fundus or cornu is more or less rapidly carried towards the os, through which it passes into the vagina (*incomplete inversion*), dragging after it the body of the organ, which also becomes inverted as it proceeds.

It is rare indeed that inversion does not go beyond this; for the considerable alteration in position and relations which has already taken place gives rise to sensations of discomfort and pain, and these react on the nervous system, inducing contraction of the uterine and abdominal muscles. Powerful and hurried expulsive efforts ensue, and soon the organ is pushed beyond the vulva, where its own weight carries it downwards, and renders the prolapsus *complete*—the lining or mucous membrane having become external.

When inversion is complete, the uterus has the form of an enormous pear or calabash-shaped tumour hanging between the posterior limbs—the wider and rounded portion being inferior, and sometimes extending as low as the hocks, the narrow extremity or pedicle being at the vulva, in the interior of which, and between the labia and the tumour, is a more or less deep and circular *cul-de-sac*, according as the prolapsus has involved a certain extent of the vagina.

That the surface of the tumour is composed of the uterine mucous membrane, is easily apparent from its softness and colour—which is

sometimes a bright red, at other times somewhat violet or brown, according as it is much injected with venous blood, irritated by the external air, or by the litter, fæces, etc., with which it has come in contact, and which may be adhering to it. With the Mare and Sow, the uterine placental villi, and the innumerable depressions for the reception of those of the fœtal placenta, can be recognised; in the Cow, Sheep, and Goat, there are the deep-red, isolated, fungiform eminences or cotyledons, and in the Bitch and Cat the wide dark-brown zone. Sometimes with the Cow—more rarely with the Mare—there are portions of chorion still attached to the placental surface of the uterus; and nearly always there are seen excoriations, more or less extensive ecchymoses, and even gangrenous patches, on the membrane—indications of the injury the organ has sustained, either during or after parturition. This mucous surface is not so sensitive as might be imagined; it is more or less hot, and bleeds at the slightest touch, though the hæmorrhage may not be profuse; at one side or the other may be noticed a kind of depression—the opening to the cornu which is not yet inverted.

The longer the period which has elapsed since inversion occurred, so the larger is the tumour. This increase is due to the violent expulsive efforts of the animal, as well as to the increase in weight of the organ, in consequence of the congestion and infiltration which have taken place in its textures; constricted—even strangulated—at its upper part, the circulation is maintained with great difficulty, and the capillaries become gorged with blood. The walls lose their elasticity, become thickened, dense, and darker tinted, until, from its increased volume and altered aspect, the organ can scarcely be recognised; while its reposition is rendered extremely difficult, if not impossible.

In consequence of the excessive hyperæmia, ulceration and gangrene usually supervene; these are serious lesions, and may induce a fatal termination.

Such a grave accident as this is, in which there is extensive displacement, with severe straining at the suspensory ligaments of the uterus, and sometimes their rupture; the irritation and perhaps abrasions or wounds of the mucous membrane; the tension on the vagina, and the compression of various parts or organs—all this might be expected to produce general disturbance. And such is the case. From the very commencement, and even before anything is apparent at the vulva, the animal is uneasy and anxious-looking; it paws with the fore or stamps with the hind feet; switches the tail as if driving off insects; lies down and gets up frequently, finding no ease in either attitude; and strains more or less energetically at closer or wider intervals, thus adding to the extruded mass. Not infrequently the Mare kicks at the prolapsed uterus, or endeavours to attack it with its teeth.

At first there is no perceptible fever, and the animal, in the intervals of straining, attentive to what is going on around, is solicitous about its progeny, and may even eat. This state is not of long duration, however; for soon after inversion is complete, indications of fever become manifest—quickened pulse and respiration, elevated temperature, and an expression of anxiety and pain. The straining is more frequent and energetic, and soon exhausts the animal; and the prostration, together with the great weight of the pendent uterus, compels it to assume and maintain the recumbent posture, in spite of attempts

to make it get up. The organ assumes a gangrenous or intensely inflamed appearance, and the animal soon succumbs, either from the nervous prostration resulting from its sufferings, or from the condition of the uterus.

In woman, sudden inversion of the uterus always leads immediately to great general disturbance—the heart's action is deranged, and syncope, convulsions, vomiting, etc., may sometimes be caused by the sudden change in the position of the uterus. More frequently those symptoms depend upon acute cerebral anæmia, to which the sudden emptying of the contents of the uterus already predisposes, but which must be still greater when not only these contents but the whole organ itself passes out of the abdominal cavity. The blood then rushes into the vessels of this cavity, which are suddenly under a greatly diminished pressure, and the cerebral anæmia that ensues is due to the scanty supply which the upper half of the trunk now receives.

A similar condition is sometimes — though rarely — observed in animals, and particularly in the Mare.

Complications.

One of the ordinary complications of this accident, is the adherence of the fœtal placenta to the uterine surface; though this is much more frequent with animals which have a multiple placenta—Cow, Sheep, and Goat, than with the Mare, Ass, Sow, Carnivorous animals, or the Rabbit.

The inversion of the uterus—when complete—also brings about displacement of the vagina; the deeper portion of this part is found folded on the neighbouring surface of the cervix; the bladder and inferior wall of the rectum are also drawn into the middle of the pelvic canal, and occupy the place the uterus has quitted; the *meatus urinarius* is doubled on itself, and so compressed that no urine can pass through it; while the ureters continuing to carry that fluid to the bladder, this reservoir soon becomes greatly distended, without relief being possible. Hence results another source of suffering, and another cause of exhausting efforts added to those occasioned by the prolapsed uterus. In certain cases there may also exist prolapsus of the rectum, and displacement, or even inversion, of the bladder.

The uterus may also be wounded or torn, either from bad management during parturition, or from injudicious attempts at reposition; or the injury may be due to Rats, Cats, Dogs, or Pigs gnawing at the bleeding mass; sometimes it is the creature itself, or a neighbouring animal which inflicts the damage.

Contact with the air, and particularly with foreign bodies, induces inflammation, which frequently runs to on gangrene, and this to dissolution. Gangrene readily occurs in the Sheep. Sometimes perforation of the vagina or uterus, arising at times from sloughing of a gangrenous patch, has caused fatal peritonitis; in other cases pelvic abscesses have formed.

After reduction has been effected, metritis and metro-peritonitis may appear; this is not at all unlikely in the Mare. Lafosse mentions paraplegia also as a complication; this may be a consequence of gangrene and septic infection.

An exceptional complication is hernia of the intestines, through a rupture in the uterus. It may be noted that in prolapsus uteri in the Mare, it has happened that the colon has followed the fundus of the

organ, and become invaginated in the inverted sac. Funk also mentions the case of a Bitch in which one of the cornua became inverted, and prevented the expulsion of the remaining fœtuses from the other cornu; this necessitated the performance of the Cæsarian section.

Ayrault has, on three occasions, encountered an unusual complication after reduction of the prolapsed organ, in the form of severe lameness, with knuckling over of the two hind-fetlock joints, but without any articular swelling. This complication disappeared as the animals recovered from the effects of inversion.

Prognosis.

There can scarcely be any doubt that, if no assistance is rendered to an animal suffering from prolapsus uteri, death must ensue, and more or less speedily; as gangrene is inevitable, while spontaneous reduction is impossible.

In some instances death occurs in less than twenty-four hours, but most frequently the animal may live from three to five days—very rarely longer. Sabini,[1] an Italian veterinarian, cites a case in which treatment was not adopted until the seventh day; but this is an altogether exceptional instance.

Inversion of the uterus is generally fatal when owners of animals have neglected to procure assistance until too late, or who employ ignorant people to attempt reduction. If attended to sufficiently early by those who are competent, the number of recoveries is considerable, and perhaps in no other pathological condition is the utility and power of art, when invoked at the proper time, better demonstrated.

The prognosis is not equally favourable, however, in all the domesticated animals; and between the Mare and Cow, for instance, the difference is considerable.

With regard to the latter animal, Deneubourg, who has often had to treat this accident, never lost one of his patients. In 100 cases, Donnarieix has only had 3 deaths. Moens, in 27 cases, has not had a fatal termination. Guillaume, cited by Gellé, lost 3 cases out of 42; Loyer of Nemours, 9 out of 27; and Mazure, Holland, 1 in 4.

With regard to the Mare, Donnarieix had 8 cases, and all perished; Cruzel had 3, and they also succumbed; Schaack only saved 1 of 2.

In 268 cases of prolapsus uteri in the Cow, collected by Saint-Cyr, there were 35 deaths—or a mortality of 12 per cent. For the Mare he only found 25 cases, and of these 17 were fatal—a mortality of 68 per cent.

A number of authorities quoted by Zundel[2] give the percentage of recoveries in the Cow as 97, and in the Mare as 50.

It would, therefore, appear, and it is no doubt true, that this accident is much more fatal in the Mare than in the Cow.

Inversion in the Sow is nearly always fatal, and often within twenty-four hours, unless amputation of the uterus is resorted to; but the Bitch will live, in very rare cases, for two, three, or four days with the uterus prolapsed.

It has often been stated that inversion of the uterus leads to infecundity; but though it may do so in some instances, yet this cannot be

[1] *Journal des Vétérinaires du Midi*, 1869, p. 175.
[2] *Dictionnaire de Méd., de Chirurg. et d'Hygiène Vétérinaires*, vol. iii., Art. "Uterus.

accepted as a rule. Numerous cases are on record, and particularly for the Cow and Bitch, in which fecundation has taken place after this accident.

Though inversion is likely to recur after another birth, or even during a succeeding pregnancy, it is not invariably so; though to avert it care may be necessary.

Causes.

Inversion of the uterus generally occurs immediately after parturition, and is most frequent in the Cow, whose uterine ligaments are so extensive and extensible. It usually occurs within two or three days, rarely later.

With multiparous animals, in which each uterine cornu forms a kind of independent uterus, one of these may alone be inverted, the fœtus contained in the other cornu being retained there for some time—though not without danger to its existence, should the period be much prolonged.

With uniparous animals, however, this does not take place, as the uterus cannot become inverted without the fœtus being expelled. Nevertheless, Aubry[1] has published a very curious observation regarding a Cow, affected with prolapse of the vagina during pregnancy, and which had complete inversion of the left cornu at the end of that period; but the Calf, lodged in the right cornu, and which was alive and well developed, was retained there for two entire days. It was then necessary to interfere and effect delivery, which was followed by total inversion of the organ. This incident, which appears to be unique, does not, however, preclude acceptance of the general rule, that inversion of the uterus is absolutely incompatible with the prolongation of gestation.

In order that this inversion can take place, it is essential that the os uteri be more or less dilated; consequently, the accident is only observed in breeding animals, and either during or soon after parturition or abortion.

In order that it can occur, a certain degree of relaxation of the sublumbar uterine ligaments must be present; there must also be some cause of irritation in operation after the expulsion of the fœtus, sufficient to excite the contraction of the muscles of the uterus and lead to inversion—though it is often difficult to ascertain what this cause may be.

In very many instances pregnancy has gone on to its full term, the animal is strong and healthy, birth natural and easy, and there is nothing to indicate the advent of such an accident—when, suddenly, after a few expulsive efforts, the uterus is ejected in an inverted state.

It has been attempted to explain the occurrence of the accident in such cases, by alluding to the lymphatic temperament of the animals, and their consequent laxity of tissue; and it is often the case that Cows which are "soft," and kept on food that is better suited for the production of milk than flesh, are the most frequent subjects of inversion—this sometimes occurring after each birth, though parturition was perfectly normal.

Inversion of the vagina during pregnancy has also been mentioned as the cause of inversion of the uterus; and it may be so in some instances, but it certainly is not so in all. Indeed, excellent authori-

[1] *Recueil de Médecine Vétérinaire*, 1859, p. 731.

ties maintain that there is no proof that this accident is more frequent in animals suffering from inversion of the vagina than those which are not. And it is to be remembered, as already stated, that the os must be more or less dilated and dilatable for inversion of the uterus to occur—a condition which does not always, nor yet frequently, co-exist with vaginal inversion. The latter, indeed, is far from rare in non-pregnant animals, and in those which have never been pregnant; and it is not at all uncommon in those which are advanced in pregnancy, and yet do not suffer afterwards from this uterine displacement,

Difficult and laborious parturition, when much manipulation and energetic traction on the fœtus have taken place, has likewise been acknowledged as a cause of uterine inversion; and it is certain that the efforts to remove a fœtus which, whether from malposition, deviation of parts, excess of volume, etc., cannot be expelled in a natural manner, are somewhat frequently followed by this accident. But on the other hand, how often does it happen that the most vigorous—even painful and violent—traction, and long and complicated manœuvres, are not succeeded by inversion; while, on the contrary, the easiest and most rapid birth sometimes is.

The retention of the fœtal placenta beyond the ordinary period, must also be taken into account as one of the exciting causes; as it then acts as a foreign body, irritates the interior of the uterus, and so by a reflex influence induces contraction of its muscular layer—this giving rise to invagination of the extremity of one of the cornua, which is supposed to be the commencement of inversion.

It is also extremely probable that injudicious traction on the fœtal membranes may, for mechanical and physiological reasons, bring about this result in a flaccid and dilated uterus, when the cervix is also relaxed. More especially is this likely to happen if the placenta is adherent towards the fundus of the organ, or in one of the cornua.

Much mystery appears to have attached to this inversion of the uterus, and though various causes have been assigned as operating in its production, yet as these are not present in every case, it has been admitted that a particular predisposition must have existed.

It is evident that several causes may be invoked to account for the accident. A flaccid, non-contracted uterus after birth, with a weak cervix and dilated os, and relaxed broad ligaments, may be looked upon as a predisposing condition; and this is most likely to be present in lymphatic animals, or those suffering from atony brought about by debility from disease, bad or insufficient food, exposure to weather, etc. When such a condition is present, it is easy to understand why inversion may occur from abdominal pressure on the cornua or fundus of the organ, or from external mechanical force; and we can also comprehend why an antiperistaltic movement of one of the cornua, or a portion of it—just as happens in intussusception of the intestines—may take place sometimes immediately after birth, and before the cervix has had time to contract. Any trifling irritation may lead to this wrong movement, and once commenced it is far more likely to continue than to cease—as in the case of the intestines, when one portion becomes invaginated within another.

We believe this will be found to be the correct opinion.

Treatment.

Whatever may be the cause of inversion of the uterus, the obstetrist must lose no time in remedying the accident; as when interference is not prompt, a fatal termination, or, at the very least, serious consequences, will rapidly follow.

In treating it, several important indications are to be observed, but they may be classed as: (1) the *immediate* or *preliminary measures* which the local symptoms demand, (2) the *reduction* or *reposition of the uterus*, (3) the *retention of the organ*, (4) the *after treatment;* should reposition be impossible or contra-indicated, then recourse must be had to (5) *amputation of the uterus*.

Preliminary Measures.—The preliminary measures consist in combating the local and general symptoms.

The animal is sometimes standing, sometimes lying down. If the latter, it must be got up; as the standing attitude is by far the best for reducing the inversion, there being more space in the abdomen when its walls are not compressed by the ground, and the obstetrist can operate more easily and quickly, while the downward inclination of the lower surface of the pelvis and abdomen is favourable for reduction and retention. If the animal is not very feverish, but only debilitated, and there is otherwise no great urgency in the case, a strong diffusible stimulant may be administered, with the view to enabling it to get up. It may also be induced to rise by bringing a dog before it; or it may be aided by a sack or sheet passed under the chest.

If it cannot be made to get up, or is unable to stand when raised, reposition must be effected while it is lying—fatiguing, and often troublesome as the operation then is. This fatigue and difficulty may be somewhat diminished in raising the hind-quarters of the animal as much as possible, by means of bundles of straw placed under them,—all the litter being removed from beneath the abdomen, so as to relieve its contained viscera from pressure as much as possible. Cosse, Tyvaert, Haubner, Anderson, and others advise placing the animal on its back, with the croup so raised; while Viborg, Fässler, Bettinger, Obermayer, Hering, Merkt, Adam, and several other obstetrists recommend raising or suspending it by the hind-limbs, over a beam—a procedure which, they assert, is most advantageous when reposition is possible or advisable. But, as has just been said, the recumbent position with the larger animals is always to be avoided when possible, and every means should be tried to make them stand. With the smaller animals—as the Sheep, Goat, Sow, Bitch, or Cat—it is convenient to place them on a bench or table, and lying either on the side or back, with the hind-quarters well raised.

If the accident is recent—an hour or two, or even a little longer—the uterus may be returned at once; but should a longer interval have elapsed, it is well to ascertain the condition of the rectum and bladder, and to empty them if necessary; though it must be confessed that it is often a most difficult task to accomplish evacuation of the bladder. It may be done, however, by causing assistants to raise the uterus, then seeking for the meatus urinarius on its lower surface, near the vulva, and introducing one or two fingers into that canal, or a catheter through it into the bladder.

Should the fœtal membranes still be adherent to the uterine surface

—wholly or partially—they must be carefully removed without injuring the cotyledons, enucleation being effected in the manner already described. If properly performed, this removal should not cause any hæmorrhage; and if any pulpy gangrenous cotyledons are found, it is better to remove them at once with scissors than leave them to be eliminated in the ordinary way; though if they show any vitality at all they need not be interfered with. Torn or gangrenous portions of mucous membrane are also to be excised in the same manner.

This done, the uterus should be cleansed from matters adhering to its surface—such as litter, mud, dirt, filth or blood; this may be effected by means of a fine soft sponge or cloth, the fluid employed being either cold or tepid water, milk and water, some astringent or soothing lotion, if there is much tumefaction or irritation, or a stimulating fluid—as the dilute tincture of opium—if the organ is much bruised and congested. Some practitioners immerse the entire uterus in a bucket containing either of these fluids; and some particularly prefer cold water, allowing the organ to remain in it for as long as five or ten minutes. By this means it is freed from extraneous matters and cleansed; while the congestion is allayed and the mass considerably reduced in size.[1] Meyer, Pfirter, and others state that this immersion in cold water has an astonishing effect, and greatly facilitates reposition. Schnee even recommends the application of ice, which, he asserts, not only diminishes the volume of the protruded organ, but allays its irritability and contractions. When attempting to reduce the cornu or uterus, he holds a piece of ice in the hand he applies to the part.

If from long inversion and consequent congestion, infiltration or inflammation, the volume of the uterus is so increased that it appears impossible to return it, scarifications may be made on its surface; these often lead to a notable decrease in its size, and reduction may then be effected. If it is determined to scarify the organ, the greatest circumspection should be observed in making the incisions; they must be quite superficial, and only a few at a time. Should the hæmorrhage prove excessive—which it sometimes does when the scarifications are deep and numerous—then styptics must be applied.

When the organ is so increased in size that it cannot be returned, it is well to ascertain whether this is not due chiefly to the intestines having entered the pelvic cavity and filled the space in the inverted uterus. If this be the case, they must be removed from it before reduction is attempted.

Coculet's[2] method of reducing the size of the congested uterus has been successfully employed on many occasions. A dry and clean piece of linen, about a yard in length, and twenty-eight to thirty inches wide, is passed beneath the inverted uterus, and close up to the vulva; its lower border is then lifted over the organ, one of the ends folded over it, and the other end over this, so as to envelop the entire uterus—the four corners of the wrapper being uppermost. Tepid water is now kept incessantly applied to this cloth, which is gradually

[1] A little care on the part of owners of animals would often prove of great advantage in averting serious consequences in such an accident as inversion of the uterus, before the arrival of the veterinary surgeon. This care should be mainly directed to keeping the animal in a standing attitude, and preventing the uterus from being soiled, bruised or torn, as well as swollen. The organ may readily and easily be preserved from injury by receiving it on a sheet or large cloth, or, better still, a basket or tray, and keeping it well raised until professional assistance arrives.

[2] *Journal des Vétérinaires du Midi*, 1862.

tightened every minute, by placing the open hand beneath the mass, and with the other hand pulling at the upper end of the wrapper. This equable, gentle, and sustained pressure over the entire organ in fifteen to twenty minutes brings about a marked diminution in its size, and renders its reduction easier.

Esmarch's india-rubber bandage has been suggested to overcome the uterine congestion in these irreducible cases, but there is no record of its having been tried.

If the uterus is torn, it may be necessary to close the wound by the continuous suture—but this must not be drawn too tight, mere apposition of the edges being all that is necessary. If the wound is not extensive, it need not be closed; indeed, there are many cases on record in which wounds of the uterus have not been sutured—the organ having been merely returned to the abdominal cavity, and yet recovery has taken place.

Careful washing with a weak solution of boric acid is perhaps the best course to adopt before reposition is attempted in any case.

If hernia of the intestine or any other viscus is present, then, of course, this must be reduced before the uterus.

Reduction or Reposition.—When inversion of the uterus is incomplete—a very rare occurrence—and the organ has not passed beyond the vagina, reduction is comparatively easy. It is sufficient, with the larger animals, to introduce the closed fist into the vagina, and to push the uterus as far into the abdomen as may be deemed necessary. When the animal strains, the operator must not push, but maintaining what he has accomplished as well as he can, recommence as soon as the expulsive effort has ceased. Whether inversion is complete or incomplete, and if the animal is standing or lying, it is always well to have the hind-parts higher than the fore.

When it is complete, then four assistants are generally necessary. One of these stands at the animal's head, and holds it firmly—if a Cow he may seize it by a horn with one hand and nasal septum by the other; if it is a Mare, a twitch on the nose or ear may be required, and it may even be necessary to have a side-line on one of the hind-limbs Another assistant holds the tail over the croup with one hand, and with the other he presses or pinches the loins in order to diminish the straining; while a man stands at each side of the croup to aid in raising and returning the uterus. It is well to attract the animal's attention as much as possible, as it then offers less opposition to the manipulations, and does not strain so violently. Pinching the nose and loins will be found very effective in this respect, and if a Cow, a Dog may be introduced in front of it. Should the animal be much exhausted or unsteady, two additional assistants may be required to stand at each side.

The uterus must be placed on a cloth or sheet in two or three folds and well moistened, the ends being held by the two assistants at the croup, so that the organ may be lifted as high as the vulva. By doing so, there is neither traction nor compression on the mass, and as the circulation in it is thereby much facilitated, the tumefaction subsides to a corresponding degree. It also allows the operator more freedom, as he could not sustain the weight of the prolapsed organ—which is sometimes as much as 100 to 140 pounds—and at the same time attempt its reposition. Indeed, some practitioners recommend that the two corners

of each end of the cloth on which the uterus is placed, should be tied round the neck of the assistants, so that their hands may also be free to aid the operator in his manœuvres: though the device must, one would imagine, have more disadvantages than conveniences.

When the animal strains very severely and continuously—as sometimes happens during reposition—it is useful to constrain the chest as much as possible by a girth, so as to prevent its expansion. It may even be necessary to give a strong anodyne draught of chloral or opium, or a dosé of alcohol sufficient to produce semi-narcosis. Indeed, with the Mare, in serious cases it is most advantageous to administer chloroform or ether, in order to produce general anæsthesia before attempting to handle the uterus.

For effecting reposition, two methods are recommended, and these we will now notice—merely observing that, whichever be adopted, the operator always places himself directly behind the animal, with the inverted organ immediately before him.

First Method.—If the inverted tumour formed by the uterus is not very voluminous, and if by the application of cold water to it—should it be tumefied—it is reduced in size, then reposition may be effected by pressure on the fundus of the organ. This pressure is to be made by the closed fist against the central part of the tumour; and in some instances, if it is well directed, and the inversion not serious, the organ may be returned to the pelvic cavity by one push, while another will carry it into the abdomen.

Rainard and other practitioners approve of this method, and describe it somewhat in detail. The operator is to seek for the largest cornu—that which contained the fœtus—seize it by the fundus, and reduce this by pushing it inwards, as we would the finger of a glove which has been turned outside in—continuing the reduction by successive portions until the pedicle of the tumour is reached, when more serious resistance is encountered from the os uteri. This being overcome, the body of the uterus is next replaced, either by the fist pressing against the widest part, or by using a pessary. The pressure is to be directed straight forward, through the vulva and pelvic canal, upwards and inwards.

Great care is necessary in exerting the pressure, which should not be applied while the animal is straining. During expulsive efforts the operator must be content to wait, merely keeping the parts where he has carried them, until the straining has ceased. The pressure must be steady and well directed, so as not to bruise or lacerate the uterus. When a portion is got within the vulva, it is held there by one hand, while the other manipulates the next part to be returned. Reduction must be effected progressively, so that the organ may be completely replaced; if it is not, then re-inversion is certain to occur.

Some practitioners employ the pad or cup-shaped pessary, to aid them in this operation; the round end is applied to the fundus of the uterus, and pressure is made at the other end of the instrument by the chest or abdomen of the operator, whose hands are thus at liberty to direct the viscus into the vulva and vagina.

Second Method.—If the uterine tumour is voluminous, and hangs heavily as low as the hocks, then the first method is dangerous, if not impracticable, and must not be attempted. The best method now undoubtedly is to return, first, *the parts of the organ nearest the vulva*, and not act directly on the fundus of the uterus until the greater portion has been replaced in the pelvis.

In order to accomplish this, the assistants on each side of the croup raise the uterus in the manner already described, so as to bring it near the vulva, and opposite the axis of the pelvis. Then the operator gently presses with open hands at each side on the parts close to the vulvar opening, in order to force them gradually into it. By acting in this way with care and patience, and preventing, as well as he can, the expulsion of those portions he has already reduced, the tumour by degrees becomes diminished, and may even be entirely returned. But it is not necessary to continue the method after two-thirds or three-fourths of the total mass has been carried into the pelvic cavity; for it is then more expeditious, and quite as safe, to apply the closed fist to the extremity of the tumour, and push it directly into the vagina and abdomen. In some instances it will be found that, towards the termination of reduction, the organ itself returns to its normal position, and often quite suddenly, as if it had been thrown forward by a spring.

Sometimes a combination of the first and second methods is most useful—an assistant pressing on the extremity of the tumour, while the operator manipulates near the vulva.

When the uterus has been returned to the abdominal cavity, the operator has then to ascertain if it is properly disposed. It sometimes happens that the extremity of one or other of the cornua remains invaginated in itself to a certain extent, and thus renders reduction incomplete; this will undoubtedly induce renewed straining, and in all probability bring about re-inversion. It is, therefore, essential that the hand of the operator should carefully examine every part of the interior of the uterus and the genital canal, and particularly around the cervix.

This is more especially necessary when, after reposition has been effected, straining continues—a sure indication that the parts are not in their normal position. The hand must be again introduced, and if any abnormal folds of the mucous membrane—any commencing invagination—is encountered, they must be gently smoothed down or adjusted—not forgetting, should the cornua be involved, the very dissimilar disposition of these in the Mare and Cow.

When reposition has been finally accomplished, the straining ceases, and the animal soon appears to be quite easy: that is, if reduction is made early—on the same day, for instance—and provided there is no injury to the organ. It is generally advisable to keep the hand in the uterus for a short time until the latter begins to contract freely; if this is not done, the flaccid organ may again become inverted.

With the smaller animals, reposition is rendered difficult because of the pelvis not admitting the hand; and with some of them, and particularly the Sow, reduction of the prolapsed cornu or cornua is often a serious matter. The cornua must be reduced in the manner already indicated, the finger, or even a tallow candle, being employed to adjust them, then the body of the organ should follow; a small pessary with a handle, or retroverter, may be used to complete the operation. Frick,[1] a Swiss veterinarian, has adopted a plan which has succeeded in his hands, and also with other obstetrists who have tried it. The inverted organ being reduced, the animal is raised by the hind-limbs, and a quantity of mucilaginous fluid is injected into the vagina and uterus, until they are filled. This fluid acts in a mechanical manner, forcing the uterus to distend and assume its ordinary form. It has been

[1] *Schweizer Archiv.*, vol. xii., p. 249.

suggested that this distention plan should also be adopted for the larger animals.

It should be observed that reduction has been effected in large and small animals by elevating the hind-quarters until they are almost vertical, the weight of the uterus, with careful manipulation on the part of the operator, carrying it down to its normal situation.

Retention of the Uterus.—Reduction of the inverted uterus having been accomplished, and everything done to remove the slightest traces of invagination, the animal—unless serious injury has been inflicted on the organ—immediately begins to look easier and happier, and the inexperienced would suppose that there was no further occasion for interference. The experienced obstetrist, however, is well aware that certain precautions must be adopted against a possible recurrence of the accident. True, this recurrence is to a certain extent provided for by raising the croup of the animal as high as may be convenient, either by means of litter or boards, and keeping the forehand low. But this is not always a preventive, and veterinary obstetrists have therefore devised other means for retaining the uterus in its place until all risk of another inversion has passed away. These devices consist of *pessaries*, *sutures*, and *bandages*.

Fig. 210.
Pad Pessary.

Pessaries.—These are instruments of various forms, which are introduced into the genital organs, and kept there for a certain time in order to prevent displacement of the uterus after its reduction. There are several described and used by veterinary obstetrists.

The *pad pessary* (Fig. 210) is a round piece of wood, from twenty to twenty-five inches in length, with a hole at one end, through which passes a loop of strong cord six to eight inches long; at the other end is a round pad, three or four inches in diameter, composed of tow or rags, covered by a piece of soft cloth or oiled silk, and firmly tied to the stalk by a piece of twine fixed in a small circular groove therein.

In using this pessary, the pad is steeped in oil or melted lard; it is then carefully introduced into the vagina, placed against the cervix uteri, and cords from each side of the loop at the other end, attached to a surcingle round the chest, keep it firmly in its place. The pad portion of the pessary may be of wood, though the elastic material is to be preferred. A transverse piece of wood, with an eyelet at each end, and made to move up and down the handle by means of a screw, is sometimes substituted for the loop of cord.

This pessary may be most usefully employed as a repositor, in effecting reduction of the inverted uterus.

The *ring pessary* (Fig. 211) is equally simple, and is preferred by some practitioners to the pad one. It is composed of a wooden, or better, an iron ring, about two and a half inches in diameter, pierced by an elongated or mortised hole at opposite sides, and of a strong wooden

stem about twenty inches long, cleft in two as far as the middle, where it is tied by a piece of twine or wire. The ends of the two branches (A A) are firmly tenoned in the mortises of the ring; and the other end of the stalk (B) is flat, and passes through the central opening of a transverse piece (T T), which is about eight inches long, and has at each end an aperture (O O), in which are fastened the cords or straps destined to fix the apparatus.

When required for use, the ring is wrapped in a narrow piece of fine linen, which is rolled round it in a uniform manner, so that it may not irritate the neck of the uterus, with which it has to come in contact.

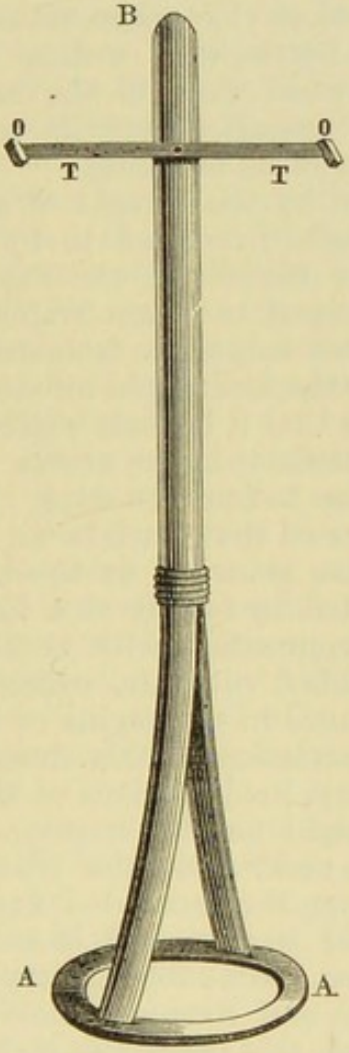

Fig. 211.

Ring Pessary.

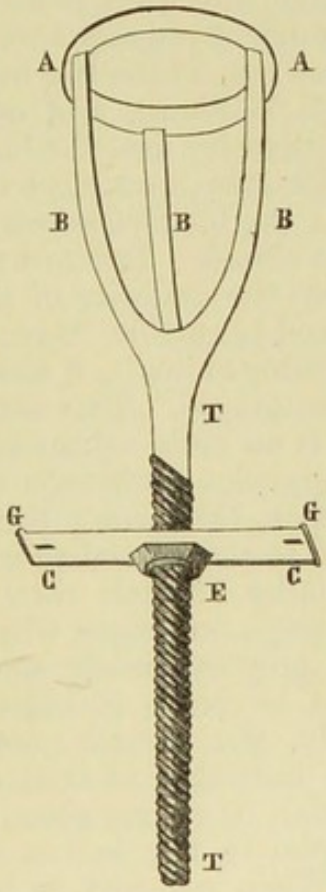

Fig. 212.

Cup-and-Ball Pessary.

This part is well oiled, and being passed through the vagina, is so placed against the uterus that the cervix will be in the middle of the ring, which should make pressure on the *cul de sac* of the vagina. It is secured by means of cords or straps at the end of the transverse portion, in a similar manner to the other pessary.

The *Cup-and-ball pessary* (Fig. 212), invented or first described by Chabert, is not unlike the last. It is composed of a round iron or steel ring (A A), about the same in diameter as the other; from this arise three stalks (B B B); these unite about six or seven inches from the ring into a single stalk (T T), which is screwed from a little beyond this

union to the end. On this screwed portion moves a transverse piece (C C), by its middle opening or female screw (E); this piece has openings (G G) at its extremities which receive straps or cords.

To use it, the ring and the three branches are dipped in melted wax, then cooled, and again and again dipped and cooled, until the instrument has acquired a sufficient volume, and the middle of the ring is reduced to about one and a half inches. This prevents its injuring the genital organs, when it is applied exactly in the same manner as the preceding pessary—the cervix uteri being in the centre of the ring.

A *rondelle pessary* has been devised by Leblanc, and Rainard has invented a pessary (similar to Fig. 210) for small animals.

A *bottle pessary* has frequently done good service, when nothing more suitable was at hand. An ordinary glass bottle, with a deep concave and smooth bottom, has a long piece of wood fixed in the neck, and can thus be made to act like the other pessaries; but its weight is objectionable, and there is also the danger of its breaking.

A very ancient pessary—employed even by the Greeks of an early period—and one which has been most usefully resorted to by Tolney, Laubender, Willburg, and others, is the *bladder of the Pig* or *Ox*. When required for use, the bladder is steeped in warm water, then a long wooden tube, or a piece of india-rubber tubing, is fastened to the neck of it; the bladder is introduced into the uterus and inflated, when the tube is closed. Rainard recommends that it be only placed in the vagina; but the majority of obstetrists prefer it in the uterus. It has been allowed to remain there as long as ten to fourteen days.

For valuable animals, it has been suggested that Gariel's air pessary might be employed. This acts on the same principle as the bladder; in fact, it is an india-rubber bladder inflated by means of a long tube with a stop-cock. This tube may be in connection with another bag and stop-cock, the former being already filled with air, which can be transferred to the other bag when it is placed in the vagina or uterus.

The smaller animals rarely require pessaries of this description; though there is no reason why, if necessary, modifications of the three first, on a proportionately small scale, might not be employed. The ring might be made of india-rubber, or cork. For the Bitch more particularly, the *cuvette pessary* has been recommended and used. This is an imitation of that employed for woman, and is merely an oval, circular, or oblong piece, made of gum, india-rubber, gutta-percha, or ivory, one to two inches in diameter, and having a hole in the middle. When required to be introduced, this pessary is well oiled; the narrow end is passed edgeways into the vulva, and the piece is pushed beyond the bulb of the vagina. Then, by means of the index-finger, it is placed vertically, the hole in the middle allowing the finger to fix it in the centre of the vulva, its two ends being retained by the branches of the ilium, or at least in front of the ischium and the bulb.

A spring or elastic pessary, such as is now frequently employed for woman, and which can be more easily introduced into the vagina, might be useful with the smaller domesticated animals.

Salt, of Birmingham, has introduced into human gynæcology a new flexible annular pessary, which might be advantageously employed by the veterinarian for small animals. It consists of a watch-spring coiled spirally, with the extremities left free, and encased in caoutchouc; it collapses for introduction, and when *in situ* it expands to the circular

form, or such other shape as may best accommodate its contact with surrounding parts.

The value of pessaries in inversion of the uterus in animals has been a good deal discussed. We are not aware that they have been much, if at all, employed in this country; and in Germany they do not appear to have obtained much favour; while in France, though they have often been resorted to, yet their use has been only limited, as their practical utility has been questioned by many excellent obstetrists.

It has been pointed out that if they can be supported without inconvenience by some phlegmatic unimpressionable animals, more frequently they irritate the organs in the pelvis, cause straining and uneasiness, and produce those relapses which their application was intended to avert. Therefore it is that, nowadays, they are not made available to anything like the extent they were a few years ago.

Saint-Cyr admits that if, in some exceptional case, it is necessary to employ a pessary, the *Pig's bladder* deserves the preference for the larger animals. It is found nearly everywhere, requires no other preparation than merely softening its texture by pouring some tepid water into it, whilst its outer surface can be well oiled. It is easily placed where desired, even in the uterus; its soft, flexible walls cannot bruise or excoriate; and, by inflation, it can be distended to the size necessary for each particular case.

Sutures.—The suture is generally preferred to the pessary, as being simpler, more easily applied, and having fewer inconveniences than the latter. Being inserted outside the genital organs, they do not irritate those which are most concerned in inversion, neither do they provoke expulsive efforts on the part of the animal.

The sutures may be of hemp, silk, or metal; and they may be passed directly through the lips of the vulva, or include the skin towards the point of the hip, on each side. The first may be named the *labial suture*, the second, the *hip suture.*

The *labial suture* may be "interrupted," or "quilled," and is made according to the principles of surgery. A saddler's large needle, or a sacking-needle with a handle at one end and an eye near the point, is the most useful. Through the eye is passed a piece of whipcord, two or three strands of well-waxed thread, or a piece of cotton or silk tape, or moderately thick carbolised catgut. The needle is passed through one lip of the vulva—say the right—from the outside, and near the *upper* commissure; it is then passed through the left lip, from within to without, towards the inferior commissure. It is then cut from the suture, sufficient of the latter being left for both ends to tie in the middle of the vulva. A second suture is placed in the contrary direction—upper part of left to lower part of right lip—so that the two sutures cross each other obliquely, in an X fashion. The ends are now tied towards the centre of the vagina; and, if thought necessary, a third suture, directly transverse, may be placed between these.

It is more convenient and painless to pass the needle first through the tissues, then the suture through the eye of the needle, withdrawing the latter, which carries the suture with it.

This *labial* suture is painful, as it is placed in textures already swollen and sore, and it does not always retain a sufficiently solid hold to prevent the uterus tearing it out when the straining is very severe and violent. The *hip suture* has therefore often been resorted to in these

cases, and with advantage. The needle—either the above or a small seton needle—is passed through a fold of skin lifted up at the point of the hip or ischium, on a level with the upper commissure of the vulva, and carried across to the other hip. The next suture is a trifle lower, and the others below this: there being, in all, about four to six sutures, the ends of each being tied in the middle, or fastened to bits of round wood at each side. In this way the vulva lies behind a number of strong cords—their strength and durability being in proportion to the width of skin they are made to enclose. The sutures may be drawn more or less tightly, and they may either be transversely parallel or cross each other obliquely.

When the animal is not pregnant, the vulva is not nearly on a level with the ischial tuberosities. After parturition, however, it is swollen and prominent, and projects beyond these parts. It will therefore press against the hip sutures, and may even become excoriated or cut by them; so that, to avoid injury and diffuse the pressure, it is well to place a thick pledget of tow or other soft material on each side of the vulva, on which the sutures may chiefly rest.

Though good service has been obtained from these sutures in a number of instances, yet many practitioners prefer the *metallic* suture. This may be of lead, or iron wire softened. The needle is like that used for the other sutures; a pair of wire-pliers is necessary, and two sizes of wire are recommended. The thickest size is cut into pieces of a convenient length, and an eyelet turned at one end, while the other is made into a hook. The left lip of the vulva is seized by the left hand, and the needle pushed through it from the outside, a little obliquely upwards, so as to bring it out above the superior commissure; the wire is passed into the eye at the point, and the needle being smartly withdrawn, the wire is pulled through. The needle is introduced into the right lip in the same manner, but downwards, and the wire pulled through it. The hooked end is now passed into the one with the eyelet, drawn sufficiently through, cut off, and the end bent also into an eyelet, the suture constituting an ellipse at this part, which is opposite the vulvar opening. Beneath this suture one or two more are placed, and all are joined together by the thinner wire, which, doubled, is longer than the space occupied by the sutures; each piece is passed into each eyelet of the upper suture, and firmly crossed and twisted as far as the two points of the suture; the same is done with the second and the third suture—the whole being joined into a solid piece, which, according to report, does not interfere with the physiological functions of the animal.

The same objection applies to wire sutures through the vulva as to vegetable sutures; but there can be no doubt that they are less painful and more effective when passed through the skin at the point of the hip. Two wires across are generally sufficient; the ends are bent round by pliers after they are inserted, and through these eyelets on each side a vertical wire is passed (Fig. 213). This keeps the horizontal wires together and in place.

Metallic sutures in the form of pins, screwed at one end to fix into plates after being passed through the labia of the vulva, and other contrivances of this description, have been described; but in principle they are all the same, and there is no manifest advantage in their employment.

In fact, it may be said of all the labial or other sutures, that they in

no respect prevent the inversion of the organ internally, but merely hinder its escaping beyond the vulva ; and as their utility depends not only upon the material of which they are composed, but also upon the

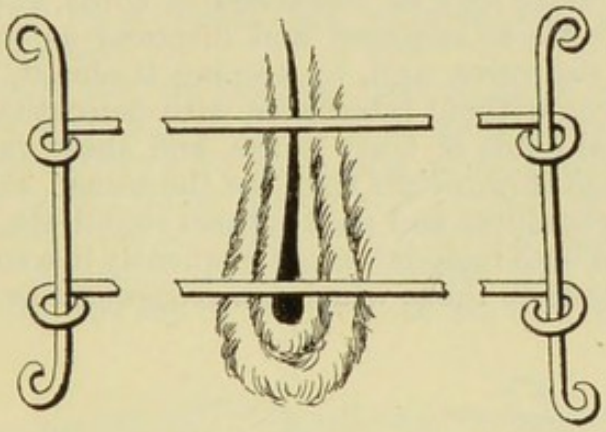

Fig. 213.

ZUNDEL'S LABIAL SUTURES.

integrity or power of resistance of the textures through which they pass, it often happens that they either give way, or they "tear out" prematurely, leaving sometimes troublesome wounds or cicatrices.

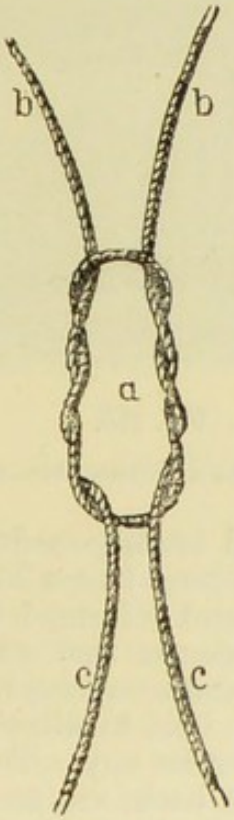

Fig. 214.

THE LOOP OF DELWART'S TRUSS.

It must not be forgotten, too, that even under the most favourable circumstances, these sutures, both during their insertion and their maintenance, are a source of uneasiness and pain to the animal.

Bandages or Trusses.—To dispense with the inconveniences of the pessary and suture, the *bandage* or *truss* has been proposed and extensively employed; and in the great majority of cases of uterine inversion, it should be adopted in preference to the other methods of retention.

The truss or bandage may be composed of cords, surcingles, leather, canvas, etc., which are so arranged and disposed as to make pressure upon the sides of the vulva, and, by keeping it closed, prevent the extrusion of the uterus without interfering with defecation or micturition.

There are several kinds of truss in use, and these vary somewhat in their details, though in principle they are the same. Some of them are fixed around the shoulders and neck, others round the chest only, and others, again, round both regions—most frequently to a collar or surcingle. Allusion will be made to those which are recognised as most valuable.

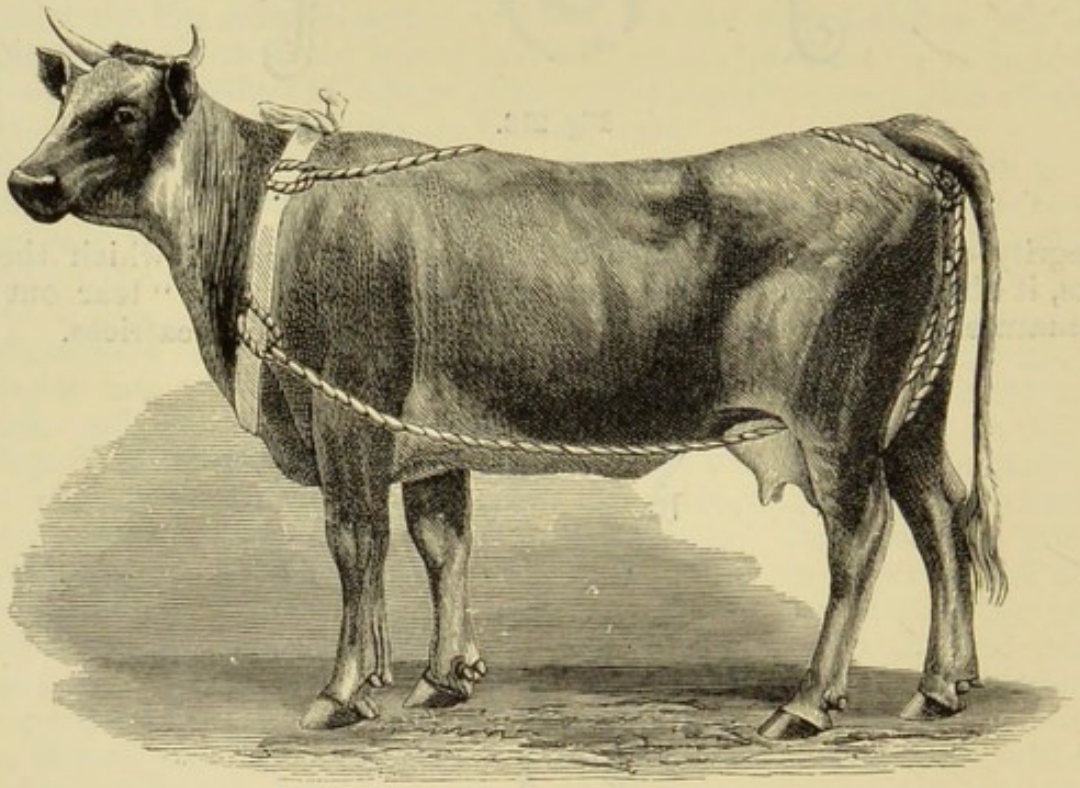

Fig. 215.

DELWART'S TRUSS APPLIED.

Two of the most useful and readily-made trusses are composed of light rope or thick cord—something like a clothes-line. One of these is termed "Delwart's Truss," and is formed by cords united by a loop in their middle, in such a manner that an oval space (*a*, Fig. 214) sufficient to admit the vulva, and compress it laterally, is formed—the inferior commissure being left free, to allow the escape of urine, and uterine discharges, should there be any. The two portions of one of the cords (*b b*) passing over the back, are secured to a collar or band round the neck or chest; while those of the other cord (*c c*) pass between the thighs, and are tied to the lower part of the collar or surcingle, in the manner depicted in Fig. 215. The loop may be wrapped in tow or cloth, to prevent chafing to the parts under the tail.

Another rope truss, described by Renault,[1] is perhaps more simple, yet quite as, if not more, effective than the preceding. This is com-

[1] *Maison Rustique du XIX. Siècle*, vol. ii., p. 286.

posed of a leather strap which buckles round the neck, and a rope from twenty-four to thirty feet long—the thickness of the little finger, or a trifle less, according to the size of the animal. The neck-strap is not indispensable, though it is useful in giving more firmness to the truss; it may be replaced by a thicker rope, or in the case of the Mare by an ordinary draught collar.

In order to apply the bandage, the neck-strap or collar is first to be put on; the cord is then to be doubled in equal parts and put across the back, behind the withers, so that each portion may fall behind the shoulders, to be passed under the chest. In front of the chest, the two portions are crossed, the left passing to the right and the right to the left. Each side is carried through the collar, and back over the front of the shoulder, at the top of which both are tied in a simple knot, so

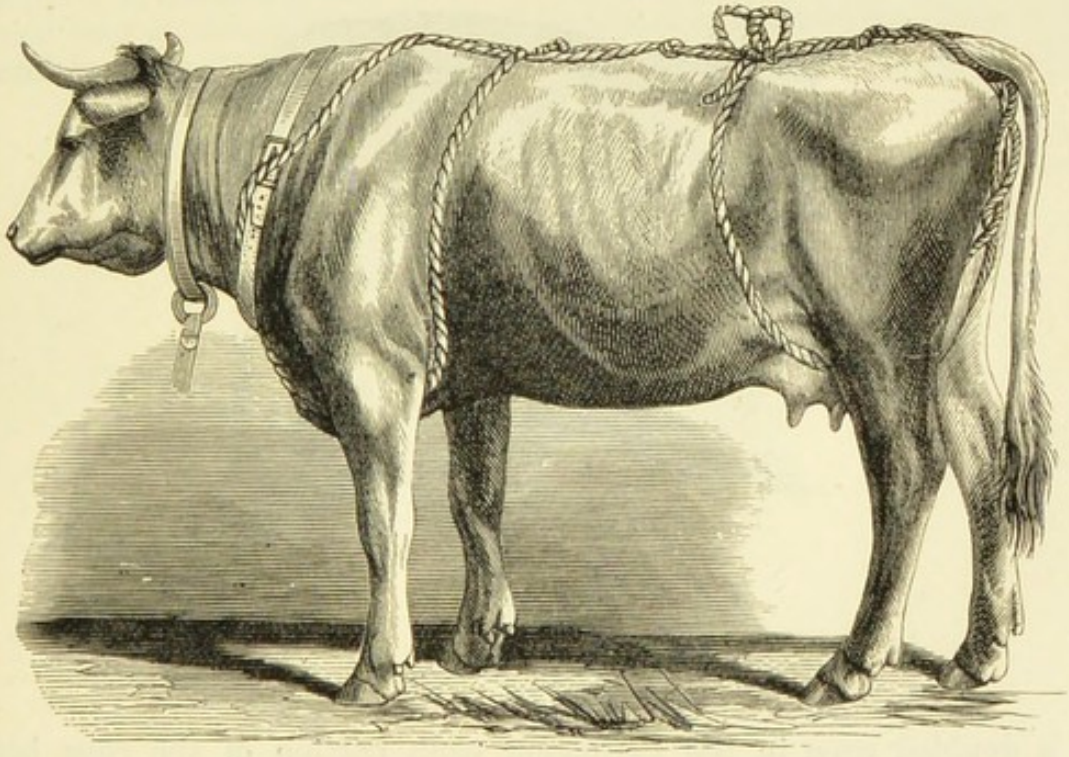

Fig. 216.

RENAULT'S TRUSS.

as to be easily untied when required. At ten or twelve inches from this, a firmer knot is tied, then several others beyond it towards the loins—according to the length of the animal—and at nearly equal distances as far as the root of the tail, where a simple knot is tied. The branches of the cord then separate on each side of the vulva, and unite again by a simple knot below the inferior commissure; again separating, each cord is carried between the hind-legs, brought up by the flank towards the loins on each side, and tied over the back to one of the loops there, as shown in Fig. 216. This truss can be made as easy or tight as may be necessary; its simplicity is its great recommendation.[1]

[1] Horsburgh (*Veterinarian*, vol. xiv., p. 490) describes a similar truss, which he applied to a Mare that had inverted the uterus three days after foaling. Giving the animal some extract of hyoscyamus and gum opii, dissolved in a pint of warm water, to allay the straining, as soon as this dose began to operate he reduced the organ. This was done by securing the animal, sponging over the uterus with a little vinegar and water, and "taking hold of a clean towel in the left hand, doubled, and the corners of the towel

A very efficient and suitable truss is that made of a piece of stout leather, with a round opening in it above, corresponding to the anus, and an oblong opening beneath this, through which the vulva passes. The leather is so shaped as to embrace and lie close to the root of the tail and between the buttocks, extending for some distance below the vulva, as in Fig. 217. It is maintained in position by four strong leather straps—two above and two below—which pass on each side to a surcingle around the chest, which may again be attached to a collar or breast-strap, should the straining be violent.

Another kind of truss is formed by an ordinary crupper attached to a surcingle, and, if need be, this to a breast-strap or collar. From the part of the crupper under the tail proceed, two, three, or four narrow leather straps, which, passing over the vulva, are attached to the loop

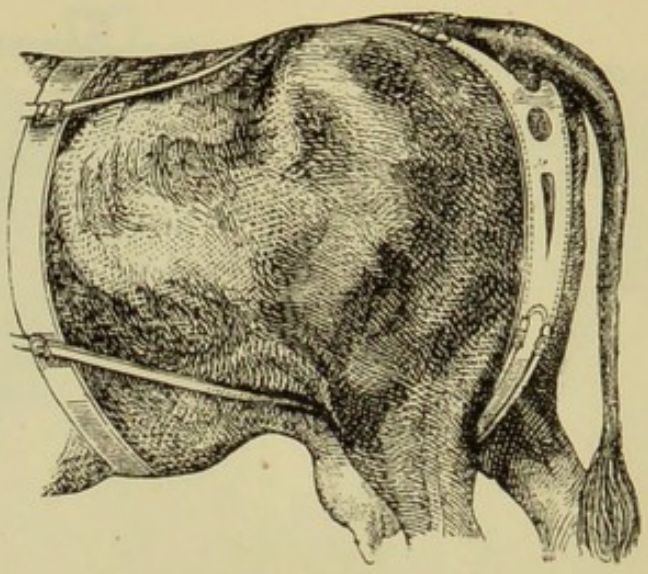

Fig. 217.

Leather Truss.

of a doubled rope in the perinæum, each portion of the rope being passed between the hind-legs and tied to the lower part of the surcingle. Or a cord may be attached to the crupper at each side of

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falling back on the arm—made bare for the purpose. I then applied the doubled fist to the fundus of the uterus, with the assistance of the right hand in bearing it up by a moderate degree of force, and returned it to its place, slowly withdrawing the hand, and leaving the towel for a few minutes. I next proceeded to remove the towel, by introducing the hand, greased for the purpose, into the vagina, taking it by the corners, turning it several times round, and at the same time bringing it out slowly. After which I introduced the arm to the full length, in order to ascertain whether it was in its proper position, using a little force on the further end, in order to stretch it. I then withdrew the arm, and proceeded to apply the necessary bandages. First, a strong girth or surcingle was buckled tightly round the abdomen, to prevent the muscles acting with such force as again to expel the uterus. This is essentially necessary. I then took a small rope, or narrow web (the one used on this occasion was a cavesson for breaking horses in the *ménage*), forming an eye (loop) in the middle, to be passed over the neck, as if for casting. I then passed the ends between the fore-legs and along the belly—one on each side of the udder, up between the hind-legs—tying a single knot exactly at the inferior part of the vulva. Another was placed superior to the anus, carrying the ends up on each side the tail, fixing them securely and tightly to the loop round the neck, and on each side of the withers." This truss was a perfect success, and could be dispensed with in three days. Horsburgh condemns sutures passed through the labia pudendi.

the vulva, and carried forward between the hind-legs and underneath the belly in the same manner, two or three transverse narrow straps passing between the two, immediately over the vulvar opening.

When there is much swelling, a soft cloth doubled several times, or a sponge steeped in cold water, may be placed over the vulva beneath the straps, though in such a way as not to interfere with micturition or defecation.

Various other trusses for the Mare or Cow have been proposed by veterinary obstetrists, but in principle they are all the same. We need only notice one of these, which has been proposed by Lund, a Danish veterinary surgeon, and which has been greatly lauded by Dieterichs and others for its cheapness, simplicity, and efficiency. The chief part of it is a narrow piece of iron, nine millimetres thick (about one third to three-eighths of an inch), welded at its extremities, and turned into a triangular shape that enables it to include the vulva, while the loops at its three corners allow it to receive cords (Fig. 218). The

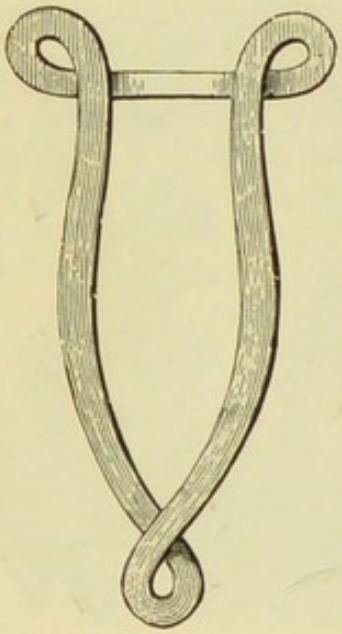

Fig. 218.

LUND'S TRUSS IRON.

base of the triangle, which fits under the tail, is about two to two and a half inches wide, and the sides from five to seven inches long. The loopholes at the angles may be replaced by small hooks to receive the cords.

This metal plate—which may be of round iron and convex on one side, concave on the other—fits over the vulva and the base of the tail, the apex being below the lower commissure, while the convex side is towards the animal. Cords pass through the loops or around the hooks, one above, another below—as in Fig. 219—and are fastened to a surcingle or collar, or both, like the preceding trusses. Any blacksmith can make the plate in a few minutes; and from what has been said in praise of this cheap and simple method of retaining the uterus, there can be no doubt that it will be found most useful.

All these trusses are intended for the larger animals, and cannot well be applied to the smaller creatures, with the exception perhaps of

Lund's plate, which, much diminished in size and made of a piece of strong iron wire, might be serviceable for the Ewe, Sow, Goat, or large Bitch. For small animals Rainard recommends a bandage made by folding a piece of strong cloth in a triangular manner. The base of this triangle lies over the loins, is carried down the flanks to beneath the abdomen, where the corners are tied; the apex of the triangle is passed over the croup and vulva—a hole being made for the tail to pass through and another for the anus—brought between the hind-legs, and either by means of tapes attached to it, or, if sufficiently long, by splitting up the end to a short distance so as to make two strips of it, fastening the piece to the ends already tied beneath the belly.

It must be acknowledged that these trusses, no matter how skilfully they may be contrived or however well they may be adjusted, will not

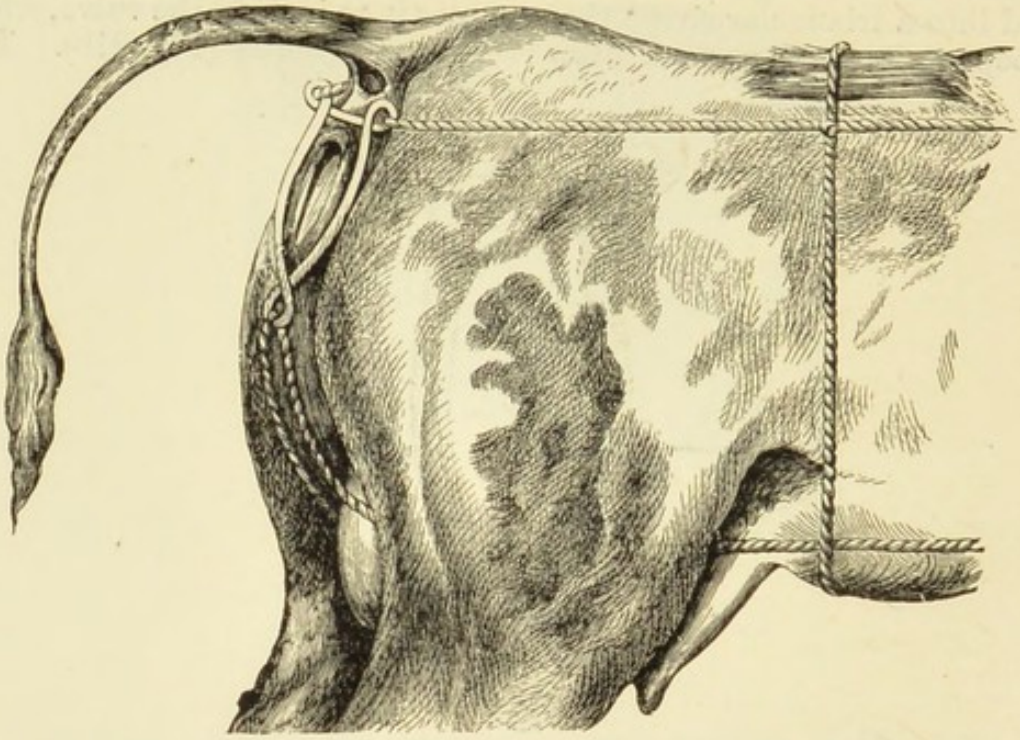

Fig. 219.

LUND'S TRUSS APPLIED.

hinder vaginal inversion of the uterus; all they can do is to prevent the organ from being suddenly protruded beyond the vulva again, and so exposed to the air and the irritating effects of extraneous matters before it can be returned once more. This alone, however, is an important object achieved, and is a great step towards permanent retention. Besides, by maintaining the labia of the vulva in close apposition, the truss, if well applied, prevents the admission of air into the genital canal, and thus does away with one source of irritation. And as the apparatus does not cause any pain or inconvenience to the animal, it is to be preferred to any other means for retaining the uterus.

With regard to the best kind of bandage, this is of secondary importance to its proper application. Simplicity and efficiency are the *desiderata*, and these will be found, we believe, in the trusses we have described, and particularly in those of Renault and Lund.

If reposition of the uterus is properly effected and the truss well

applied, there is little reason to apprehend a recurrence of the accident.

After Treatment. — When the uterus has been returned to its natural situation, an antiseptic injection or "swabbing" of the interior should be carried out, and precautions against a recurrence of the inversion adopted; then little more remains to be done except to observe some simple directions, which are to be followed for a few days after reposition.

If the weather is favourable, and little or no fever present, the animal —covered with a rug—should be walked about for a few minutes; as this takes away its attention from the accident, regulates the general circulation, and allays the expulsive efforts.

The animal should stand with the hind parts well raised, and it ought not to be allowed to lie down for a day or so.

Great attention should be paid to the diet, particularly with Ruminants, from their tendency to tympanitis and constipation. Indeed, tympanitis may be sometimes considered a cause of inversion in the Cow and Ewe; and the rumen is at times so distended with gases, and so proves such an obstacle to reduction, that it has to be punctured in the usual way before reposition can be effected. For the same reason, this inflation of the digestive organs has to be guarded against in the after treatment. For the first day, only oatmeal gruel with barley-water—both tepid—should be allowed in small but frequent quantities. For some days, easily-digested sloppy food may be given, and if the appetite is fickle it should be tempted by choice portions of diet; though the quantity must not be large at any time until all danger is past.

If there is apprehension of inflammatory complications, such as metritis or peritonitis, emollient poultices or a strong rubefacient may be applied to the abdomen. It is advisable in all cases in which the mucous membrane has been injured or exposed to the air for some time, to inject some antiseptic fluid—such as boric acid solution—into the uterine cavity for two or three days.

Should there be a tendency to constipation, soap-and-water enemas may be administered.

Micturition is rarely deranged; but if no urine is passed within twenty-four hours after reposition, an examination should be made, and the bladder emptied in the usual manner. The different disposition of the urethral valve in the Mare and Cow will, of course, be borne in mind in passing the catheter.

Nearly always these simple measures suffice to restore the animal to its usual condition in three or four days, in uncomplicated cases. In exceptional instances, however, metritis, metro-peritonitis, or leucorrhœa will follow the accident. The animal may go off its milk and fall into low condition, without exhibiting any acute symptoms; or indications of puerperal fever may supervene. Sometimes the animal remains sterile for a variable period. With the Ewe, chronic inversion of the uterus often leads to loss of the wool.

In complicated cases there may be wounds, lacerations, rupture of the uterus, cornua, or vagina, lesions of neighbouring organs or textures, etc.; these will be referred to hereafter.

A curious complication of uterine inversion has been mentioned by Ayrault,[1] who witnessed it in three cases. This was great lameness

[1] *Recueil de Médecine Vétérinaire*, 1857, p. 723.

in the limbs, without swelling of the joints, but with marked knuckling over of the hind-pasterns. It disappeared spontaneously as the patients recovered from the other effects of the inversion.

Amputation of the Uterus—Metrotomy.—Though it should be recognised as a rule that, provided there is no serious complication and the obstetrist is called in good time, with patience and skill reposition of the inverted uterus is possible, yet cases will occur in which the operator is baffled in his attempts at reduction, or when, at the first glance or after an examination, he has to recognise this as impossible or useless. "Since I have been in practice," says Schaack, "I have been often called upon to remedy this kind of displacement, and from what I have seen I am led to believe that the impossibility of reduction is not so much due to the difficulties in the cases themselves, as to the hurtful manœuvres which have been performed. Nevertheless, it must be acknowledged that the development of the hernia and the rigidity of the tissues are sometimes so great that it requires a certain amount of confidence in one's self not to be disconcerted nor afraid. . . . To be successful it is necessary to insist—to insist in spite of everything—on applying one's self to seize each alternative point of relaxation; to engage, bit by bit, the displaced organ in the vulva, in commencing with that which is nearest this opening, then successively all the remainder."

This advice is judicious and sound; but, as has been said, in certain cases the extruded organ is so injured, either by the unskilful attempts of ignorant men to return it, or from other causes, that it would be certain death to the animal to replace it in the abdomen. We refer now to extensive lacerations and bruises, or when the organ has become softened and gangrenous; and lacerations and ruptures are always more serious, it must be remembered, in the lower than the upper wall of the uterus.

In other cases, when reduction has not been complete, and one horn remains more or less invaginated, or the body of the organ is not well adjusted, inversion will again and again occur in spite of all attempts at retention; and this only too frequently leads to such grave injury that there is no hope of the organ regaining its normal condition, even should reposition be at last successful. Indeed, its walls are so softened and friable that they cannot withstand the least pressure, but tear whenever an attempt is made to carry the uterus into the vulva.

With certain animals, too — as Swine — reposition is extremely difficult, particularly when one or both cornua are inverted; as the smallness of the organ, as well as the narrowness of the pelvis, is a great obstacle to manipulation.

In such exceptional circumstances complete extirpation of the uterus (*Metrotomy*) has been recommended and practised.

It is now many years since the operation was introduced into veterinary surgery, as Binz states that it was performed by Jenne, a German veterinarian in Forchheim, in 1802.

Though the operation is apparently a most formidable and painful one, and only to be ventured upon as a last resource, yet, on the whole, it is tolerably successful. Of thirty cases collected by Saint-Cyr, no fewer than twenty-three recovered from the operation. Franck refers to thirty cases, eighteen of which recovered, and four (two Cows and two Goats) were killed, though not, it would appear, on account of

the operation. Of these thirty cases only one was a Mare; 17 were Cows; 3 Goats; 4 Sows; 1 Ewe; 2 Bitches; and 2 Cats. He remarks that, of the unfortunate cases, there were probably some which died from other causes than the amputation; while others evidently perished from septic infection. Recoveries have taken place after the Cæsarian section and excision of the uterus practised on the same animal, at the same time.

The operation might be more successful did it not happen that it is late before it is resorted to, and very often the animal is already greatly exhausted.

It is curious to note that it has been recorded by several observers, that some Cows which recovered have shown signs of œstrum—doubtless because the ovaries were left intact; while other Cows have yielded milk after the operation. Lecoq knew of a Cow from which the uterus had been removed, and which gave an abundance of milk for two years afterwards.

Operation.—Various modes of operating have been practised and recommended. With the larger animals, the hind-limbs should be secured—especially with the Mare—or they may be thrown down, or fixed in a travis if there is one convenient.

Chloroform, chloral, or morphia should be administered to the animals about to be operated upon. It is also a good plan to tie the uterus up in a large cloth, so that it may be easier moved about by the operator or his assistants, and render the operation cleaner and less repulsive-looking.

The oldest, and perhaps most popular, method is the *ligature in mass.* A piece of strong whipcord, well waxed and made into a running loop, is passed over the tumour as near to the vulva as possible, but without including the meatus urinarius. When evenly placed around the pedicle, it is gradually but firmly tightened by pulling at each end, so as to completely intercept the circulation in the organ. This done, the cord is tied in a knot.

Though this method has been much employed, and with a fair amount of success, yet it has been condemned by some good authorities, on the plea that it is dangerous to tie such a voluminous mass; as all the parts cannot be sufficiently and equally compressed to become mortified at the same time. Those parts which have not been firmly constricted still retain a certain amount of circulation, become inflamed, and occasion violent pain.

Rainard therefore recommends the *double ligature.* A long sacking or saddler's large needle, is armed with a somewhat long double piece of whipcord. This is passed through the middle of the pedicle of the tumour, from below to above, and the needle cut away from the cord. The pedicle is thus perforated by two pieces of cord; one of these is very firmly tied round the right half of the pedicle, the other round the left, so as to include the whole in two separate ligatures.

Claverie[1] reports a serious hæmorrhage from the employment of this double ligature after removal of the uterus, which necessitated the application of a ligature in mass above the others, as well as the application of the actual cautery to the cut surface. It is possible that the needle wounded some large vessel, which, of course, would not be included in either of the ligatures.

[1] *Journal des Vétérinaires du Midi*, 1860, p. 535.

The uterus of the Cow has been successfully deprived of its circulation by means of *clams* about an inch thick and ten inches long. They were applied close to the vulva, and the two ends fastened together by twine.

Saint-Cyr alludes to a successful case of amputation of the uterus in a woman, by means of *caustic clams*, or rather a clamp; the operator being M. Valette of Lyons; and he believes that the same procedure might be advantageously adopted by veterinary surgeons. He recommends the long curved clams used for hernia, and suggests that the groove be filled either with chloride of zinc, or with tallow powdered over with corrosive sublimate.

By whatever procedure the pedicle of the tumour is rigidly compressed, the uterus has afterwards to be excised. Some veterinarians are of opinion that it is better to wait until it is completely mortified, or even until it sloughs away spontaneously; and they allege, in justification of this opinion, the danger of hæmorrhage when dealing with such a large and vascular organ as the uterus is at parturition. Others, dreading the dangers resulting from the retention of such an enormous mass suspended behind the animal, counsel its immediate amputation. The incessant traction it exercises on the vagina, the obnoxious odour it gives off, the contact with the absorbing surface of the septic products resulting from its mortification, expose the animal, they declare, to serious accidents, which can only be averted by at once cutting away the uterus.

These dangers are certainly most serious; and as the risk of hæmorrhage may be obviated by sufficiently constricting the base or pedicle of the mass, it is advisable to amputate it at once, and at a short distance —from an inch to three inches—behind the constriction.

Trasbot[1] brings under notice the use of the *écraseur* in amputating the uterus. The case to which he refers was not successful; but it is probable that this result was due to the imperfect or improper manner in which the instrument was used.

With the *écraseur*, the tissues should be slowly and gently cut through. The entire pedicle may be included, or the chain may be passed through the middle of it by means of a needle, like the double ligature. But there is grave risk in this mode of amputation, as the abdominal cavity is opened when the pedicle is divided by the chain, and through the opening the intestines may escape, or blood and the products of inflammation and putrefaction may enter the peritoneal cavity, and give rise to a grave condition.

The *elastic ligature* (Dittel's) has been suggested as worth a trial, and if properly applied the result might be favourable. Indeed, it has been successfully employed in amputating the uterus of a Cow, a Sheep, and a Bitch. The operation is simply applying a long piece of india-rubber tubing around the pedicle, and tying it firmly there. The tissues are cut through by the continuous pressure, which causes obliteration of the vessels and cessation of nutrition.

It has also been suggested that Esmarch's method of amputation by *elastic compression* of the part to be excised, might be most successfully employed in ablation of the uterus in animals. Considering the volume of the uterine tumour and its great vascularity, there must be an immense

[1] *Bulletin de la Société Centrale de Médecine Vétérinaire*, 1870.

advantage in sending back into the circulation of the animal the larger part, or even the whole of the blood contained in the organ, before separating this from the body, and, in addition, performing a bloodless operation. Coculet's method of reducing the volume of the inverted uterus by compression, has been already alluded to, and is the same in principle. Esmarch's method essentially consists in winding around the part to be amputated—commencing at the distal extremity—an elastic band, so as to press the blood from this part into the body; and above the band to tie firmly a piece of india-rubber tubing, so as to prevent a reflux of blood by the arteries. The elastic band is then removed and the part—pale and bloodless—is excised.

When the uterus has been cut away, the portion of vagina or cervix remaining should be returned as far as possible into the genital canal, and if there is any hæmorrhage injections of cold water will probably check it. Cicatrisation generally occurs within fourteen days. If ablation of the uterus is not effected immediately after constriction of the pedicle, but allowed to take place spontaneously, mortification and sloughing are completed in from six to ten days.

In some cases the animals do not appear to be much disturbed after the operation, in others they are very uneasy. Ledru[1] describes an instance in which the Cow operated upon was for an hour as if mad. It lay down, got up, rolled about, kicked and stamped, and climbed into the manger. The eyes appeared to be starting from their orbits; it flexed its hind-limbs like a horse attacked with paraplegia, and it was impossible to get near it. These symptoms appear to have been caused by the intense pain; though they gradually subsided and the animal ultimately recovered.

In many instances no unusual symptoms have been observed, and the mother has anxiously occupied itself with its progeny. This has been noticed with the Sow.

After the operation the cows appear to have fatted well; and when killed, in those which were examined large masses of fat have been found in the place of the uterus, and filling the pelvis.

It may be remarked that in one case recorded—in the Cow—a portion of intestine had become prolapsed with the uterus, the interior of the sack of which it occupied; another similar occurrence was noticed in a Bitch. Franck insists on this complication being always looked for in the Mare, and he recommends that this animal be either narcotised by morphia or chloroform, so as to get rid of the violent straining to which it yields itself.

An exploratory incision may then be made in the body of the uterus, and if any intestine is found in its interior, this must be returned to the abdomen before amputation is ventured upon.

CHAPTER IV.

Inversion of the Vagina—Inversio Vaginæ.

Inversion, procidence, prolapsus, or *fall of the vagina*, is a hernia of this part through the vulvar opening, analogous to that of the uterus, and with which it may be complicated when inversion of the latter is

[1] *Recueil de Médecine Vétérinaire*, 1866, p. 115.

extreme; though in such a case it does not add to the symptomatology or gravity of the accident.

It may occur in other than pregnant or parturient animals, though rarely; the cases recorded of Mares had no assignable cause for the accident, though those occurring in the Bitch were observed immediately after copulation, and ascribed to anatomical and physiological peculiarities. It may also take place during pregnancy, particularly towards its termination, when the gravid uterus pushes it outwards. Most frequently, however, it is witnessed after parturition, particularly when delivery has been difficult and protracted, owing to a disproportion between the size of the fœtus and the passage through which it passes, and especially when force has been necessary to extract it, and the expulsive efforts have been severe.

It often occurs when the "waters" have escaped for some time, and the young creature, lodged in the genital canal, is extracted without the precaution of lubrication. The progress of the fœtus through the dry, tenacious passage causes the mucous membrane of the vagina to gather in ridges and folds; the connective tissue beneath is torn, and this leads to inversion, which may occur immediately, along with the exit of the fœtus, or when the animal afterwards strains—sometimes so long as four, six, or eight days subsequent to parturition.

Fatigue, such as that induced by travelling, or severe exertion immediately or soon after calving, or keeping the animal in a stall the floor of which slopes too much backwards, are also likely to produce, or at least predispose to, the accident. It may also take place after abortion and retention of the placenta.

When inversion of the vagina occurs without that of the uterus, the latter is propelled backwards by the contractions of the abdominal muscles, pushing before it the walls of that canal until it has extruded them beyond the vulva, and itself occupies the cavity of the pelvis. During this extrusion, the connective tissue which attaches the vaginal mucous membrane to the adjacent organs and the pelvis is more or less lacerated; and it is this laceration which constitutes the serious character of the accident, and differentiates it from simple prolapse due to relaxation of the connective tissue, which is of no great moment. The latter condition is not very rare towards the end of pregnancy, and under certain circumstances may lead to complete inversion. Rainard mentions having seen a Goat which had inversion of the vagina fifteen days before parturition, and to such an extent that the mouth and nostrils of the fœtus protruded through the half-open os uteri, so that it could breathe and lick the hand.

This simple inversion of the vagina during pregnancy, however, disappears spontaneously after parturition, as it is simply due to the backward pressure of the gravid uterus; but that occurring after birth has no tendency to spontaneous reduction any more than complete inversion of the uterus. Very exceptional cases have been reported, in which the simple form was succeeded by the more serious one; but Saint-Cyr insists upon these being so rare that they only serve, when compared with the latter, to prove the rule.

As has been said, this serious inversion of the vagina occurs far more frequently after abortion and parturition, though not so often as inversion of the uterus.

Symptoms.

Of course, the chief symptom of this accident is the presence of a tumour protruding from between the labia of the vulva, and which may hang for some distance below that opening. In this respect it resembles inversion of the uterus, though the difference is otherwise very marked. In the majority of cases the tumour is most voluminous when the animal is lying, and can then be best examined. It is circular in outline, varies in size from that of an apple to the dimensions of a large melon, and is not unlike a sausage in shape; the surface is *smooth*, more or less of a deep red colour streaked with darker patches, and covered by a thick white mucus or a fibrinous exudate; in other cases it is inflamed, excoriated by the tail or litter, and covered with foreign matters. *There are no traces of cotyledons or placental follicles.* On the under surface of the tumour is observed a longitudinal depression or furrow, which leads to the urethra. At its end is a round opening, into which the finger can be passed as far as the os uteri, which will be found either completely closed or partially open. At the vulva the tumour is narrow, and exhibits longitudinal folds or ridges, due to the constriction caused by the vulva. Passing the finger between the tumour and the vulva, there is found a depression, or *cul-de-sac*, formed by its direct continuity with the vulvar mucous membrane. In certain cases the cervix uteri can be seen in the middle of the tumour. Not infrequently the tumour is invisible when the animal is standing; though it may show itself when it lies down, micturates, defecates, or strains. When, however, the inversion is extensive, or the case is chronic, the tumour often remains external to the vulva.

There is generally more or less difficulty in micturating, arising from the pressure on the urethra; and instances are recorded in which extreme distention of the bladder from retention of urine had occasioned serious symptoms, and led to paralysis, and even rupture, of that viscus. There may also be more or less straining—indeed, this symptom is nearly always present; febrile symptoms may likewise be noted in some cases.

When the mucous membrane has been long exposed to the air, it becomes thickened and indurated, from the constant irritation giving rise to effusion and exudation; it assumes a grayish tint, and is covered with a hardened epithelium, which gives it a leathery appearance.

The local symptoms we have indicated should sufficiently distinguish between this accident and the presence of tumours in the genital canal. In the Bitch, inversion of the vagina has been sometimes mistaken for a condylomatous tumour; and cases are recorded in which tumours of this kind, protruding beyond the vulva, through insufficient examination have been mistaken for inversion. Inversion of the bladder has also been confounded with that of the vagina. The pyriform cysts that sometimes form in that canal, and contain a clear citron-coloured fluid, have likewise been occasionally considered as inversion of the vagina.

To avoid errors which might have a serious result, a careful examination must be made, and nothing should be attempted in the way of operation until the state of affairs is exactly determined.

Prognosis.

Inversion of the vagina is not nearly so serious an accident as inversion of the uterus; and Cows, Mares, and Bitches may often suffer from

this condition for months without showing much apparent inconvenience. This is the kind of inversion that is liable to recur; reposition may be readily effected, but no sooner is it accomplished than inversion again takes place through the animal straining.

In other instances, however, the accident is much more serious. The mucous membrane of the vagina, exposed to contact with the urine, fæces, and litter, in addition to friction from the tail and other objects, as well as the attacks of flies, etc., becomes irritated, excoriated, abraded, and indurated, while it is greatly thickened from exudation; a more or less fœtid muco-purulent secretion covers its surface; cicatrisation of the torn submucous connective tissue ensues; new adhesions are formed which fix the part in its abnormal situation, and offer what is sometimes an insurmountable obstacle, if not to reduction, at least to retention, after that has been effected. If assistance is not afforded, the animal gradually loses condition and becomes emaciated; hectic fever sets in, and it falls into a state of marasmus. At other times the extruded part becomes acutely inflamed, intense fever supervenes, and the creature succumbs to the effects of vaginitis—either simple or complicated with metritis—and almost as rapidly as from inversion of the uterus.

Treatment.

The more speedily treatment is resorted to after inversion has occurred, the more easily is reduction effected and likely to prove permanent, while the risks from injury are greatly diminished.

The treatment is somewhat similar to that recommended for inversion of the uterus, the preliminary steps being the same in both accidents, and reduction is accomplished according to the same rules. The part of the vaginal membrane nearest the vulva is to be carefully and gradually returned, should the tumour be large; if comparatively small, then it may be reduced *en masse*, by applying the closed fist to the centre of the most dependent part, and pushing it into the canal. When reduction has been effected, it is particularly necessary to observe that every part has assumed its normal shape and position; as it often happens that the mucous membrane, particularly towards the bottom of the canal, forms a thick fold, which must be effaced if it is desired to obviate renewed straining and a recurrence of the inversion. All the folds and inequalities from one end of the canal to the other, as far as the cervix, should be smoothed carefully down by the hand or a soft damp cloth. If, after reduction, the straining continues, it may be inferred that the mucous membrane is irritated by the existence of wrinkles or folds on its surface. The hand must then be introduced again into the vagina, and the ridges effaced either by passing the hand over them, so as to carry the membrane onwards, or by gentle pressure entirely obliterating them.

If the membrane is irritated and inflamed, astringents—such as acetate of lead—and anodynes—such as opium—may be applied to it; and as a matter of precaution, a truss may be used for a few hours.

When the fœtal membranes are still in the uterus, some obstetrists recommend that they should be removed before reduction of the inversion is attempted; but others are of opinion that reduction should be accomplished first, and removal of the membranes afterwards, unless the latter are so lightly attached that they can be pulled away without introducing the hand into the uterus. In any case the membranes

must be removed, as their presence is certain to cause expulsive efforts which will inevitably lead to protrusion of the vagina again.

For retention of the reduced part, sutures are often preferred; they are passed through the labia of the vulva. Harms and Schleg[1] employ *ringelns* with this object. Schleg's ring is a thin flat band of steel, pointed at one end, and with a round hole and slot a little above the point; at the other end is a kind of button raised on the surface. The point is passed through the labia, and the band bent round so as to meet and button at the ends. This ring has been worn, according to Schleg, from a few days to more than five months. Other sutures have been described; but they are all on the same principle as Zundel's already mentioned (Fig. 213).

In some cases one of the trusses alluded to for inversion of the uterus may be found useful, especially if the accident is recent. Pessaries should not be employed.

When the submucous connective tissue of the vagina has been much lacerated, and abnormal adhesions have taken place, then a recurrence of the inversion is to be apprehended. This recurrence is, of course, most likely to take place in chronic inversion, and all the skill and patience of the veterinary surgeon will be required in dealing with such a case. At times the accident has proved so troublesome, and retention has so baffled every attempt after reduction was effected, that amputation of the protruded portion has been practised, and with success.

Rainard appears to have been the first to venture on this bold measure, and he practised the operation several times on Bitches. He ligatured the entire inverted mass close to the vulva, in one case; but as this gave rise to intense fever, and, when cured, the animal suffered from incontinence of urine, he adopted another procedure. Instead of including the whole of the tumour in one ligature, he divided the pedicle into three portions, which he tied separately, so that each ligature only enclosed one-third of the mass. After tightening the ligatures, the Bitch was allowed to run at large, the only attention it received being the injection of emollient fluids into the vagina, and a smaller allowance of food. The pain was much less in intensity and duration than in the first case, and the tumour came away in five or six days, when recovery took place. Rainard, however, advises immediate excision of the portion of the mass beyond the ligatures, when these have been drawn tight.

Daprey operated on a two-year-old Filly in a somewhat different manner. Inversion of the vagina had been present for fifteen days, and the tumour was as large as a man's head; it was cold, of a dark-brown colour, and the animal was greatly agitated and feverish. As gangrene was apprehended, it was decided to remove the whole mass. This was done by practising a kind of saddler's stitch around it, by means of two needles armed with a waxed thread; and when sewn round, the two ends of the ligature were drawn so tight as to raise the enclosed sides of the tumour into plaits like the mouth of a tied sack; they were then firmly joined. The Filly was kept standing with the hinder part of the body raised, and the tumour was dressed with chlorinated water and vinegar. Between the seventh and eighth days the mass came away; the discharge diminished in quantity and fœtidness, and on the tenth day the animal was nearly well.

Bernard, of the Toulouse Veterinary School, operated upon a female

[1] *Magazin für Thierheilkunde und Viehzucht*, 1869, p. 13.

Ass, which had the vagina inverted for more than a month, and every means of retention had failed. Amputation was practised, by a circular incision around the base of the tumour. At the first cut of the bistoury, it was observed that the mucous membrane was very much thickened, and easily detached from the other parts ; so that, instead of making a total amputation, it was considered better to make it only partial, by dissecting away all that tissue to the extent of four or five inches. This was done, and the hæmorrhage was inconsiderable ; but it persisted so long afterwards that the animal was seized with symptoms of syncope. However, these symptoms passed away, and the creature began to eat. A rope truss was applied, and for eight days there was a discharge of pus. At the end of that time, when the truss was removed, recovery was found to be complete. On exploring the vagina some time afterwards, a thick but dilatable ring, about the middle of the vagina, was found, through which first one finger, then two and three, could be passed. Beyond this ring the canal was normal in width.

There can be no doubt, then, that the inverted vagina may be amputated without much risk, when reduction is impossible or incomplete ; but whether an animal which has undergone this operation can be utilised for breeding purposes afterwards, we have no evidence to prove. It is possible that the cicatricial tissue uniting the wound may be sufficiently yielding to allow of gradual dilatation by manual or mechanical means, and thus not offer much impediment to impregnation or parturition.

CHAPTER V.

Inversion of the Bladder—Prolapsus Vesicæ.

At p. 351, allusion was made to inversion of the bladder as occurring before parturition, and the symptoms and treatment of this accident were described. The remarks there made are applicable to the accident when it follows delivery. It is of somewhat rare occurrence, and is perhaps more frequently met with in the Mare than in the Cow.

We have particularly insisted upon the necessity for a careful examination of all vulvar tumours before adopting any surgical measures ; and this precaution is above all things necessary in this accident, as incision of the bladder is certain to lead to a fatal termination.

Reduction should be attempted according to the directions given at p. 352, and care must be taken not to lacerate the organ, as this also will prove fatal. Elmue[1] relates an occurrence of this description. Reduction has been accomplished successfully in the Mare two months after parturition, when the accident happened.[2]

In desperate cases, when reduction cannot be effected, or when the organ is so much injured that reposition is almost certain to be followed by death, amputation may be ventured upon with some prospect of success.

With regard to the operation, Cartwright remarks : "It is be observed that the ureters enter the substance of the neck of the bladder obliquely towards its sides, but their orifices are to be seen when the bladder is inverted, the Cow or Mare standing, at the upper surface of the viscus, about half an inch apart. To detect them, we must draw the bladder

[1] Canstatt's *Jahresbericht*, 1859.
[2] *Archives Vétérinaire*, 1877, p. 801.

sufficiently down, so that we may be able to inspect the parts. Where they enter, the inner membrane (now the ureter) will have a soft and jelly-like protuberant appearance, in the middle of which will be detected two very small openings of a nipple-like shape. To be certain that we have hit upon them, we may introduce a probe, and pass it down towards the suspended fundus. Having discovered the orifice of the ureters, and passed a ligature around the neck of the bladder below them, we have nothing more to do than occasionally tighten it, so as to effect complete strangulation and sloughing of the body of the bladder; though, as soon as we find it dead, we may, to save time, cut it away with a scalpel. We should also, after having applied the ligature, puncture the distended fundus; since its great weight may cause dragging and inflammation about its cervix, or may force the ligature over the mouth of the uterus, which would occasion the death of the animal. After the separation has taken place, the remaining portion will contract within the vagina, and the cavity will be closed by the vulva. The urine will generally ever after run down the thighs, excoriating them; though in other cases the fluid will accumulate within the vulva, and be from time to time ejected in large quantities."

When excision is not resorted to, spontaneous amputation may take place.

When the inversion or prolapsus is complicated by rupture of the floor of the vagina, then the accident is of the most serious character, though not invariably fatal in its results.

CHAPTER VI.

Traumatic Lesions of the Genital and Neighbouring Organs.

Either during or after parturition, the genital and neighbouring organs are exposed to injuries of a more or less serious character, according to their situation and extent. These we will now consider in the following order: 1. *Laceration and rupture of the uterus;* 2. *Laceration and rupture of the vagina;* 3. *Thrombus of the vulva and vagina;* 4. *Relaxation of the pelvic symphysis;* 5. *Rupture of the bladder;* 6. *Rupture of the intestines;* 7. *Rupture of the diaphragm;* 8. *Rupture of the abdominal muscles;* 9. *Rupture of the sacro-sciatic ligament;* 10. *Rupture of the heart.*

I.—Laceration and Rupture of the Uterus.

Laceration and rupture of the soft parturient passages are very far from being unusual during parturition in the domestic animals, particularly in the Mare and Cow, and of these the uterus and vagina are most frequently involved.

Solutions of continuity of the uterus are often met with by the veterinary obstetrist, and they are either *incomplete*—when the organ is only partially torn or lacerated, or *complete*—when it is torn through and the uterus opens into the abdominal cavity. These tears may occur either during pregnancy, during parturition, or at a variable period after the fœtus has been removed from the uterus—when it is generally a complication of inversion of this organ. *Ante partum*

rupture has been already fully alluded to at p. 194, and we have now to study its occurrence during and after birth.

Rupture during Birth.—Rupture of the uterus may occur spontaneously in a complete or incomplete form during parturition; and though the accident is perhaps not so frequent in animals as in woman, yet there are many cases on record in which it has undoubtedly occurred in them, and it has been affirmed by highly competent authorities that it has been observed in Cows which had not received any assistance during parturition.

It can easily be understood why, if there is any material obstacle to the passage of the fœtus—such as induration or torsion of the cervix, or malposition or deformity of the young creature—the violent contractions of the powerful muscular layer of the organ should overcome the resistance of some portion of its own fibres, and thus lead to a more or less extensive laceration, which may involve the other tunics and produce complete perforation. Non-perforating or incomplete lacerations occur, in the majority of instances, towards the cervix, and are usually longitudinal. Complete rupture may take place at any part of the organ.

This accident is more likely to occur spontaneously when there happens to be an alteration in the texture, wholly or partially, of the uterine wall; though this predisposing cause does not appear to be so often present in animals as in the human female, in which sudden perforating ruptures never take place when the organ is healthy. Nevertheless, there can be no reason to doubt that in animals alterations in the tissue of this organ may and do occur; and, as in woman, this may assume the form of anomalous development; interruption of the normal tissue by interstitial fibroids or cicatrices; separation of the muscular fibres by submucous fibroids, or by projecting thin parts of the fœtus; inflammatory softening of some portions of the parenchyma during pregnancy; or thinning of the wall at some part by pressure. This pressure may arise from contact with the brim of the pelvis, or exostoses in or upon the bony canal.

The exciting cause, however, proceeds from considerable impediment to the progress of labour, and the accident is due to the energetic contractions of the uterine walls and abdominal muscles, as well as to the pressure, direct or indirect, of the diaphragm by the fully dilated chest.

In such cases the rent may be so great that the fœtus passes entirely through it into the abdominal cavity, enveloped or not in its membranes; or only a portion of it escapes through the tear, and it may be extracted therefrom with more or less difficulty *per vias naturales;* in some recorded cases birth has taken place by natural efforts, the existence of rupture only becoming evident when the uterus was accidentally extruded after birth.

More frequently, however, the accident arises from artificial mechanical causes, brought into operation in the course of manœuvres for effecting the extraction of the fœtus. The various instruments employed may either tear or incise the uterus; or the organ may be lacerated during traction on the fœtus when the "waters" have escaped, and its walls closely envelop the young creature; or during retropulsion or version. The thinness of the uterine wall at this period renders such an accident as laceration one of easy occurrence; and, however large the tear may be during life, after death it usually appears much smaller, because of the contraction of the muscular tissue.

In all these cases, when the organ remains *in situ*, the *diagnosis* is difficult, and generally it is only on *post mortem* examination that the lesion is discovered. The moment of its occurrence may be inferred when a crotchet suddenly loses its hold, or the feet of the fœtus penetrate the uterine walls.

Certain clinical symptoms are often observed during life, which, if they were constant, might lead to a suspicion of the existence of rupture. Thus, the expulsive efforts are very energetic and regular up to a certain period, when all at once they cease; the animal begins to manifest symptoms of abdominal pain—lying down and getting up, stamping and pawing, looking towards its flanks, moving about uneasily, moaning, bellowing, neighing, or even screaming, when the rupture occurs. It has been stated that the Cow opens its mouth and protrudes the tongue, extends the head, and utters a moan or grunt at each expiration, but does not strain—these symptoms being indicative of uterine rupture.

Non-perforating lacerations do not, as a rule, give rise to very marked symptoms immediately; though subsequently they may produce metritis or metro-peritonitis, or induce septic infection. Their presence is not easily diagnosed during life.

In some few instances, the existence of complete rupture has been ascertained by manual exploration of the uterus; in others it has been discovered *de visu* in inversion of the organ. The pulse soon becomes feeble if there is much hæmorrhage, and exhaustion quickly supervenes. If death does not occur promptly, acute fever ensues, with symptoms of peritonitis or septic infection.

The complications attending this accident are always serious, and render the prognosis unfavourable in nearly every case. When, however, the laceration occurs at the upper part or sides of the uterus, the accident is not so grave as when the floor of the organ is involved; if the os remains closed, so as to prevent the admission of air, the prognosis is still more favourable, though this can rarely be the case.

The chief *complications* are *hæmorrhage*, *hernia of the intestines*, and *peritonitis*.

Death from direct *hæmorrhage* is less frequent than might be anticipated, knowing the great vascularity of the uterus at parturition. This infrequency is explained by the fact that bleeding from such a laceration is less profuse than from an incised wound of the same dimensions. Nearly always, too, the fœtus is partially or entirely expelled from the uterus into the abdominal cavity, or is born immediately after the accident, and the organ then may firmly contract.

Nevertheless, in some instances, the hæmorrhage is so great that a fatal termination soon takes place, with all the symptoms already described at p. 575.

Hernia of the intestines occurs when the rent is somewhat large, and the uterus, flaccid and uncontracted, allows them to enter its cavity—they being pushed therein by the action of the abdominal muscles. In some instances the intestinal mass received into the uterus has been so large that they have passed through the vagina and vulva, reached the ground, and the animal has trodden upon them—thus hastening death; while in others, the hernia has been reduced and the creature survived.

Peritonitis may be primary or secondary. When *primary*, it is due to the escape of blood, the fœtal fluids or envelopes, or the fœtus itself.

When *secondary* or *consecutive*, it may result either from the extension of the inflammation to the peritoneum, or the discharge of the lochia, pus, etc., from the uterus. The escape of fluids is, of course, more likely to take place when the rupture is inferior than when lateral or superior. Death is nearly always the result of peritonitis or metro-peritonitis.

Treatment.

The treatment of rupture of the uterus during parturition is generally very unsatisfactory. Very little can be done to check the hæmorrhage, if it is great, and consecutive peritonitis is always a most serious complication.

If the fœtus remains within the peritoneal sac, a favourable termination can scarcely be hoped for; though in some rare instances, if air does not obtain access to the cavity of the uterus or abdomen, it is possible that the case may terminate in one of the various ways of extra-uterine pregnancy. If the fœtus is extracted, the rent may heal up; though this is very unlikely if the edges are much contused, and the animal will, in all probability, perish from consecutive purulent peritonitis.

If the fœtus is still wholly or partially in the uterus, it and its envelopes must be extracted without delay, and as gently as possible; as hæmorrhage will probably only cease with the contraction of the organ. If the uterus does not contract, but remains flaccid after removal of the placenta, then it may be stimulated to do so by introducing the hand into the interior for some time, after removing the coagula. If this fails, and the rupture is not in the floor of the uterus, small pieces of ice, cold water, or astringents may be introduced, and ergot of rye administered; a jet of cold water should be allowed to play upon the loins, wherever the rupture may be. If there is hernia of the intestines, these, of course, must be promptly returned into the abdominal cavity before anything is done to the uterus.

Some authorities advise that the uterus should be gently inverted, brought outside the vulva, in order that the rent may be closed by suture, and then returned. But this course is not to be recommended, as it is very dangerous, and the wound will unite without sutures if the organ contracts and no complications follow.

The cavity of the uterus should be swabbed with a weak solution of carbolic acid (1 to 100—250) or cresyl, and to prevent septic infection by admission of air, a pledget of carbolised lint or tow should be placed in the os or vagina, and changed now and again.

Straining must be subdued by doses of opium or chloral, or the subcutaneous injection of morphia, and the diet should be carefully attended to. If there is constipation, mild laxatives and enemas may be administered. Consecutive fever and peritonitis must be treated by cold affusions, and large doses of anodynes—such as opium, as well as counter-irritants. Metritis must be treated in the same manner, by the gentle injection of cold water; or the introduction of small pieces of ice into the genital canal will be beneficial. Should symptoms of septic infection appear, stimulants, with small doses of carbolic acid and sulphite of soda, must be given.

When the fœtus has passed through the rent into the abdominal cavity, delivery *per vias naturales* is then impossible, and the Cæsarian section must be resorted to; unless it be decided to allow the animal

to take its chance, and get rid of the fœtus as in extra-uterine fœtation, should it survive the accident.

Rupture of the Uterus after Parturition.

Rupture of the uterus after parturition generally complicates inversion of the organ, and is due to mechanical injury either on the part of amateurs, or even of the veterinary surgeon, when endeavouring to replace it; sometimes it is produced by the animal itself, or by other animals when the prolapsed organ gets in their way. In some instances it has been caused by the jagged bones of the fœtus in embryotomy, and in others by pessaries introduced into the genital canal to retain the inverted organ.

In such instances the diagnosis is easy; for if the uterus is still inverted the rent is visible, and its dimensions, situation, and gravity can be taken into account.

It is somewhat remarkable that laceration or rupture of the extruded organ is much less serious than the same amount of injury to the uterus *in situ*, and it would appear that in inversion there is the greatest tolerance of the most serious lesions. Why this should be has not been explained; but the fact is nevertheless patent, that in very many instances, when reposition of the uterus has been effected, the rupture has readily cicatrised, and union has been so complete and substantial that the animals have afterwards been successfully bred from.

Some authorities have closed the rent by suture; but very many have not, and the termination has been as favourable in the one series of cases as the other. Unless the rupture is in the lower wall of the uterus, sutures are at least superfluous.

Beyond the measures for reduction of the inversion, and the necessary antiseptic after-treatment, little more has to be observed. When the rupture is serious in inversion, and grave results are to be apprehended should the uterus be returned, then it may be advisable to amputate the organ. This may be accomplished in the manner already indicated.

II.—Laceration and Rupture of the Vagina.

Lacerations and rupture of the vagina are not at all infrequent in the larger domesticated animals, and they are generally as serious as those of the uterus. They may occur during copulation, as well as in parturition; but they are more common in the latter. Trifling laceration of the vagina and vulva is often observed in primiparæ, or those animals in which the soft parturient passages are narrow or rigid.

The injury may be either *spontaneous* or *accidental*. The accidental injuries are those produced artificially during assisted labour, and are due either to the instruments employed—hooks, forceps, knives, etc., the hand or the nails of the fingers of the obstetrist, the sharp exposed bones of the fœtus when embryotomy has been practised, or from some salient part of the young creature during the uterine contractions. In the latter case, the feet generally cause the laceration or rupture. Deformity of the pelvis, or roughened nodules of bone in the vicinity of the genital canal, may also lead to serious lesions of the vagina.

When the lesion occurs in what we may call a "spontaneous manner," it happens either that the vagina is lacerated along with the uterus,

during natural labour and from continuity of texture; or when the os is amply dilated, but the vagina is overstretched by the fœtus.

In some instances such an accident as rupture of the vagina may be *secondary*—as when the textures which form its walls are much bruised and contused during the passage of the fœtus. Then gangrene may supervene, and the mortified tissue be thrown off in a gradual manner, until complete perforation has taken place.

The lesions arising from these different causes are extremely varied —from removal of the epithelium or simple abrasion, to laceration of the mucous membrane, or even complete perforation of the vagina; they may be situated either towards the vulva or cervix uteri, on the sides, floor, or roof of the canal; or they may only concern the vagina, or involve at the same time the neighbouring organs and textures. Consequently, the gravity and the symptoms of such lesions vary considerably, according to their simplicity or complexity. Nevertheless, as will be noted hereafter, a trifling abrasion may bring about very serious consequences; while an apparently formidable injury may be followed by no unfavourable indications.

With regard to rupture of the vagina, and particularly that which may be designated "spontaneous," it may be remarked that when the lesion occurs towards the cervix uteri, it is nearly always transversal, and, as has been before stated, the vagina may be completely separated from the uterus. In other instances, the form and direction of the rupture will differ considerably. Longitudinal rents often extend into the cervix uteri and body of the uterus.

Of all the domestic animals, the Mare appears to suffer most frequently from lesions of the vagina produced during parturition. The reasons for this liability have already been alluded to; they may be chiefly referred to the length of the limbs of the fœtus, and the energetic and rapid contractions of the uterus, as well as the greater susceptibility of this animal to morbid influences—such as septicæmia. Nevertheless, in all animals these injuries are notoriously serious, and if the laceration occurs when the tissues of this part are bruised, chafed, and irritated by manipulations during a laborious delivery, they are all the more grave. Rainard justly remarks that Bitches and Cats in which such a condition of the tissues exists, all succumb if there is the most trifling rupture of the vagina, even if there be no hernia.

If the laceration is extensive towards the bottom of the vagina, the abdominal cavity will be opened, and the fœtus, if it has not been expelled, may have partly passed through the rupture; in consequence of the walls of the passage being much less contractile than those of the uterus, the accidental opening is more pervious in the vagina than the uterus, and thus all the more readily allows the intestines or bladder to pass through.

Laceration or rupture of the vagina is more easily diagnosed than when this accident occurs in the uterus, as it is much more accessible to the eye and hand; though in some cases it is difficult to arrive at an exact knowledge of the situation or extent of the injury.

With regard to *prognosis*, this will much depend upon circumstances and the complications met with. Sometimes a mere abrasion of the mucous membrane which produces a raw surface, or a laceration extending to the submucous connective tissue, may lead to *septic infection*. This is particularly to be apprehended should the fœtus or membranes have undergone decomposition, or any putrid matter—as the lochia—

been allowed to remain in the genital canal, especially during hot weather. Wounds or lacerations of the floor of the vagina are generally more serious than those on the roof or sides, for the reasons mentioned with regard to rupture of the uterus. And even wounds, or rupture of the sides or roof of the canal, are much more serious than the incisions made through its walls in ovariotomy, owing to the presence during parturition and the puerperal state of fluids which may quickly become, or are already, putrescent.

Hæmorrhage is generally not so much to be dreaded as in lacerations of the uterus; though occasionally it may be so serious as to endanger the life of the animal.

Hernia of the intestine occurs when perforation of the vaginal wall near the cervix is complete, and the peritoneal cavity is opened. This is a serious complication, as is also *hernia of the bladder*, which may happen when the rent is adjacent to that viscus; though sometimes it is deemed a fortunate circumstance that cystocele is present, as the bladder effectually closes the rupture in the vagina, and thus prevents the escape of the lochial and other fluids into the abdominal cavity.

Vaginal fistula, due to perforation, has been described. The single opening is on the floor or at the side of the vagina; an exploration by the finger proves that the canal runs in an oblique direction, and does not communicate with the bladder or rectum. It contains a quantity of thick yellow pus which flows intermittently from the vulva, and might lead to the supposition that the case was one of vaginal catarrh. Cagny, who gives this description, says it is readily cured by tearing the superficial wall of the fistula with the finger, so as to convert it into a simple wound which needs no further attention. It might be well, however, to apply an antiseptic dressing until cicatrization was well advanced.

Peritonitis and *pelvic cellulitis* are also very serious complications of laceration, and are a consequence either of the extension of vaginal inflammation to the neighbouring tissues, or the escape of septic matters or inflammatory products into the pelvic connective tissue or the peritoneal cavity.

It will be observed that, if extensive laceration of the vagina does not produce rapid death, there are other grave dangers to be apprehended from either present or subsequent complications. The inflammation of the vagina and submucous tissues, with suppuration and partial gangrene, may lead to the formation of fistulæ, or even of wide-spread destruction of the soft parts in the pelvic cavity, which sooner or later induces a fatal termination. Should this not occur, and some of the neighbouring organs have been injured at the same time as the vagina, then there may be such important damage inflicted as to render the animal nearly valueless. Some of these injuries will be alluded to presently.

The *symptoms* of injury to the vagina and neighbouring organs will, of course, vary with their nature and extent.

Much constitutional disturbance is generally only manifested when the lesions are serious, or when septic infection has taken place. Small rents may not give rise to any perceptible derangement, except perhaps a little fever and tumefaction; but if they extend deeply into the connective tissue, then acute fever, infiltration, and other grave symptoms may supervene.

With regard to *treatment*, this also must depend upon circumstances. When rupture of the vagina is recognised during parturition, delivery should be effected as speedily as possible, and with every care, in order to prevent the laceration extending and the fœtus passing into it. If, unfortunately, some part of the latter has lodged in the rent, it must be removed therefrom with the utmost precaution, so as not to injure other viscera. The fœtal membranes should also be extracted as soon as possible. If there is hæmorrhage from the vagina, this may be suppressed by ice or injections of cold water if the rent is superior or lateral; if it is inferior, then a sponge or a cloth soaked in cold water, in which is a small proportion of iron perchloride, should be placed in the canal. Should there be hernia of the bladder or intestines, these must be replaced at once.

In all cases of wounds, abrasions, or rupture of the vagina, every precaution should be observed with a view to the prevention of septic infection. With this object the greatest cleanliness must be observed, all decomposing matters, or those likely to decompose, should, if possible, be scrupulously removed, and injections or "swabbings" of weak solutions of carbolic acid or other antiseptics, practised. If there is much danger of hæmorrhage, a suitable tampon of lint or fine tow, saturated in one of these fluids, may be allowed to remain in the vagina for some time.

Complications of Ruptured Vagina.

We have mentioned some serious complications of ruptured vagina, in which adjacent organs and tissues were involved. These are chiefly the rectum, bladder, and perinæum, one or more of which may be perforated and torn, along with the vagina. These ruptures vary in extent and gravity, and while some are necessarily fatal, others are not so; but they may lead to serious deformity and inconvenience, such as accompany chronic fistulæ in important regions. They are *recto-vaginal fistula*, *rupture of the perinæum*, *vesico-vaginal fistula*, and *occlusion of the vagina*.

Recto-Vaginal Fistula.—Injuries to the rectum are generally produced through the wall of the vagina, during the passage of the fœtus. When the salient parts of the latter, and more especially the feet, are misdirected and pressed up towards the sacrum of the mother, and if the rectum chances to be distended with fæces, not only will the vagina, but this viscus also may be perforated, and some portion of the fœtus soon appears at the anus. If this accident is discovered in time, it may be possible to push back the parts thus misplaced into their natural channel, and complete delivery by the vagina; but notwithstanding this happy termination, the communication between the vagina and rectum very often remains permanent, and a recto-vaginal fistula is established.

The treatment of these cases is not always satisfactory, so far as a perfect cure is concerned. Sutures have sometimes been employed to close the wound in the rectum, when accessible. But this surgical operation can rarely be resorted to, and all that may be done is to keep the lacerated parts clean, by frequent injections *per vaginam* and *rectum*, prevent constipation, and treat the injury on ordinary principles—not forgetting the free employment of antiseptics.

If sutures are employed to close the fistula, they may be supported by a pessary or tampon placed in the vagina, beneath the fistula.

When the limbs or other parts of the fœtus protrude through the anus, it is nearly always advisable to amputate them, in order to move the body more easily in the vagina, and with less risk of further injury to the parent. Once in the genital canal, then the fœtus can be extracted in the ordinary manner. Opiates should be largely administered.

Rupture of the Perinæum.—Laceration of the vagina is not at all infrequently complicated with more or less extensive rupture of the perinæum, and occasionally rupture of the vagina, rectum, and perinæum may be met with in the same animal. Sometimes it is only the *fourchette* and superior commissure of the vulva which are involved; in others the entire extent of the perinæum is lacerated, and the lesion only ends at the anal sphincter; while in others, again, the sphincter and part of the rectum are included.

If, in malpositions of the fœtus, assistance is not timeously afforded—particularly in the Mare—the young creature is pushed onwards by the violent uterine contractions, and should it enter the rectum the anus is dilated; while, if the expulsive efforts are continued, the sphincter and all the tissues between it and the vulva are greatly stretched and strained until they tear. Then the fœtus is finally expelled—sometimes dead, at other times alive—and there remain immense lacerations which convert the rectum and vagina into one vast opening, in which the termination of the digestive and genito-urinary organs open in common.

In rare cases the injury is not so extensive, owing to the anal sphincter being sufficiently elastic to yield to the pressure without being much torn, in this way exempting the perinæum; so that there is only a wide recto-vaginal fistula to deal with.

These ruptures, occurring immediately after birth, appear two or three times larger than they are some days afterwards, when the distended textures have contracted somewhat; the borders of the laceration are sometimes even, in other cases uneven, ragged and shreddy.

The consequences are variable, according to the extent of the injury. Moderate laceration does not usually prove very prejudicial; but if severe, serious inflammation of the perinæum, extending sometimes to neighbouring tissues and organs, sets in. If the tear involves the anus and its sphincter, there will be involuntary escape of fæcal matters and flatus; and in the most formidable cases—those in which the vagina and rectum form one wide gaping cavity—the mucous membrane is irritated by the free admission of air and excreta, inflammation and suppuration ensue, fistulæ are formed, and the poor animal only too often presents a painful and repulsive spectacle.

In other instances, partial recovery takes place, and the animals do not appear to be much affected or inconvenienced. They maintain good health, rear their progeny, if born alive, and may even bring forth young again, though the wound has not cicatrised. Indeed, in severe cases, union of the edges of the wound is exceptional, and in the large majority only the margin of the tear cicatrises, and a gaping, unsightly cavity remains.

The treatment will vary, according to circumstances. If there is much hæmorrhage, styptics must be employed; if the bleeding is slight, cold may check it; but if severe, iron perchloride must be used.

The lacerated margins, if much torn, must be freed from shreds which are likely to lose, or have already lost, their vitality. They must then be brought together by sutures—either of metal, carbolised silk, or

catgut. Cold-water dressings may then be applied; or styptic colloid, iodoform, boric acid, collodion, or carbolised glycerine may be employed. The parts must be kept as clean as possible, and the animal not disturbed or allowed to lie down until union has been effected. With this object a narrow stall is to be preferred. The sutured septum should be supported from the vagina, by a tampon placed therein. This will tend to prevent the pressure of fæces tearing away the sutures in the floor of the rectum, and this result will also be greatly obviated by administering enemas frequently, and covering the mucous membrane with lard. Sloppy food should be given as diet. Fever and other unfavourable complications must be treated according to their indications. Opiates will prove of great service; if there is much local disturbance or straining, suppositories of opium are to be recommended.

Vesico-Vaginal Fistulæ.—When the floor of the vagina is ruptured, it may happen that the neck or walls of the bladder are involved in the lesion, just as that viscus may, as we have seen, become prolapsed or hernied through the vaginal rent. When rupture of the bladder occurs in this manner, the case is indeed serious. The urine is no longer confined to its receptacle, but escapes through the laceration and becomes infiltrated in the pelvic connective tissue. Hence arise most serious complications—pelvic cellulitis and urine-abscess, which rapidly lead to a fatal termination. In less formidable cases the urine may escape by the vagina, but involuntarily; so that incontinence of urine not only proves a troublesome infirmity, but the constant passage of this fluid over the membrane lining the vagina gives rise to intense inflammation of that canal, and leads to the formation of a vesico-vaginal fistula. This fistula may also be produced by pressure or bruising. When the fœtus is very large it occasions over-stretching of the vagina, and if it remains for any length of time in the passage the distention weakens the vitality of the soft tissues; so that the compression to which they are submitted between the fœtus and the floor of the pelvis will produce mortification, which may extend to the neck of the bladder. The resulting sloughing, should the creature survive, will establish a direct communication between the vagina and bladder.

An animal may live with a fistula of this description, provided urine-abscess, uræmia, or other serious complications, do not occur.

The *symptoms* need not be specified. The chief is incontinence of urine. When this fluid is observed to be constantly dribbling from the vulva after parturition, the existence of the accident may be suspected, and an examination *per vaginam* will confirm the suspicion.

Treatment must be mainly palliative.

Occlusion of the Vagina.—This has occurred after parturition, as a result of injury to the mucous membrane of the canal during delivery —union taking place between the sides of the vagina. Occlusion may be more or less complete, and its seat at any part of the canal, but always beyond the meatus urinarius. Such cases have been observed in the Mare and Cow. A careful manual examination will detect the state of affairs, and if cicatrisation is recent the new tissue may be broken down by the finger, finger-nail, or finger-knife (figures on pp. 535, 536); but should it have become firm and unyielding, then careful dissection will be necessary to separate the sides. If the adhesion is situated some distance from the vulva, the operation will be facilitated by employing a vaginal dilator.

III.—Thrombus of the Vagina and Vulva.

Thrombus or *hæmatoma* of the vagina and vulva, is sometimes observed in the Mare and Cow after parturition, and is due to an infiltration of blood into the connective tissue of these parts, from the almost inevitable injury they sustain during laborious parturition.

In such cases, when the fœtus is very large or in a wrong position, considerable manipulation and traction are often necessary to adjust and remove it; and this leads to bruising of the soft parts against the pelvis, and laceration and rupture of the bloodvessels and connective tissue. The bloodvessels are larger, and probably more numerous, during pregnancy than at other times; consequently, there results extravasation of blood, and considerable tumefaction of the genital canal, particularly in the vagina and vulva. Sometimes this tumefaction appears during parturition, when it may form an obstacle to birth.

The mucous membrane is raised into irregular masses, perceptible to the eye, and still more markedly to the touch. The membrane itself has a blue, violet, or black tint; the labia of the vulva are considerably swollen, and the engorgement may extend to the thighs and croup.

If there is not much extravasation, the effused blood may be absorbed in a few days; but if the thrombus is extensive, the blood becomes decomposed, gives rise to inflammation, which may run on to gangrene, and septic infection consequently ensue.

As to treatment, scarifications are, above all things, to be recommended.

Samson,[1] who has had much experience of these cases, says that the labia of the vulva should be well separated, and a bistoury plunged into the right and left walls of the vagina, as if to open an abscess; the incisions should be large, and proportioned to the quantity and situation of the clots; pressure must then be made, so as to remove the latter.

The operation appears to be quite innocuous; though a case is recorded by Cartwright,[2] in which a stream of blood issued from one of the punctures, in consequence of a large vein being wounded.

When all the extravasated blood has been removed from beneath the mucous membrane or skin, cold water injections and sponging, and weak solutions of carbolic acid, permanganate of potash, or other detersive and antiseptic fluids, should be resorted to. The same treatment is to be adopted when suppuration has set in, only more attention must be paid to the antiseptic treatment.

Should hæmorrhage from the incisions prove troublesome, styptics —such as dilute iron perchloride—and tampooning the vagina, may be had recourse to.

IV.—Relaxation of the Pelvic Symphysis.

This accident, which is far from common in woman, is still more rare in animals; and there appear to be only two cases recorded, both being Cows.

With regard to the cause, there is probably a natural tendency to the

[1] *Recueil de Médecine Vétérinaire*, 1863, p. 106.
[2] *Veterinarian*, vol. xix., p. 386.

accident, which is increased by pregnancy, and the volume and malpresentation of the fœtus no doubt lead to its occurrence when parturition takes place. The sacro-iliac articulations may also participate in this relaxation, the symptoms of which are deformity of the pelvis, and altered movement of the hind-limbs.

The animal lies almost continually, and rises with great difficulty. When up, it can scarcely move, and the hind-quarters sway from side to side—the ilium of either side rising or falling as the corresponding limb sustains or is relieved from weight. The hand, passed into the rectum, will cause pain if pressure is made on the sacro-iliac articulation. The internal angle of the iliums projects much beyond the spines of the sacrum, and when the animal walks movement can be detected between the pubic bones.

The condition is considered incurable.

V.—Rupture of the Bladder.

Rupture of the bladder alone, during parturition, would appear to be an unusual accident, from the infrequent mention of its occurrence. That it may happen, however, is beyond dispute, and the cause of it is obvious. In the Mare the act of parturition is hurried and energetic, and if it occurs while the bladder is distended with urine, the pressure of the fœtus during expulsion may rupture this viscus, and particularly if the rectum above is also full of fæces, the fœtus large, and perhaps in a wrong position.

The extravasated urine gives rise to peritonitis, and the animal will present the symptoms of that most painful inflammation. Death is inevitable.

VI.—Rupture of the Intestines.

There are some instances recorded in which rupture of the intestines —small and large—has occurred during parturition, without the uterus or other organs being involved. The accident may have been due to over-repletion of the stomach and intestines with ingesta, and the energetic action of the abdominal muscles upon these organs during the labour pains; or from the animal throwing itself down violently, under the same circumstances.

Schaack mentions a case in which rupture was due to a loop of intestine being compressed between the fœtus and the brim of the pelvis, when the former was passing through the genital canal.

Such an accident is beyond remedy.

Invagination of the intestines—rectum and floating colon—in the Mare, has also occurred during parturition, due probably to severe expulsive efforts.

VII.—Rupture of the Diaphragm.

Rupture of the diaphragm is a rare occurrence during parturition, and I can only find three cases recorded. They were probably due to the same causes as those which produce rupture of the intestines. Death resulted.

VIII.—Rupture of the Abdominal Muscles.

At page 293, when treating of "Hernia of the Uterus" during pregnancy, it was explained under what conditions, and the manner in which rupture of the abdominal muscles occurs. The accident can scarcely be designated as one consecutive to parturition; but its treatment may nevertheless engage the attention of the veterinary surgeon, after the uterus has been emptied of its contents. In the same section allusion was made to the appropriate measures.

IX.—Rupture of the Sacro-sciatic Ligament.

We can only find one case of this accident on record; so that it must be extremely rare. It is given by Naylor,[1] and the subject was a three-year-old cart Mare, which had a malpresentation. The animal was down, and the fore-feet of the fœtus protruded beyond the vulva, but the head was not visible, it being bent back to the side of the chest; the young creature was dead. Embryotomy was resorted to, and one limb was about to be removed, when the uterus suddenly contracted with great violence, and half expelled the foal; traction then removed it. "All attempts to get the filly up were ineffectual, and an examination showed that a rupture of the sacro-sciatic ligament on the right side, with other lesions, had taken place." Stimulants and laxatives were administered, and a mustard plaster applied to the loins. "In two days she was on her legs, and tottering about the yard. Suffice it to say that she ultimately recovered, and though for two years the off-quarter was less in size than the other, she ultimately got quite well, and had two or three Foals."

X.—Rupture of the Heart.

This is also an extremely rare occurrence, and I can only find one case—that of a young Cow which had been straining violently for some hours, and suddenly fell down and, gasping, died. At the necropsy a transverse rupture, two centimetres long, was discovered in the right ventricle of the heart.[2]

[1] *Veterinarian*, vol. xxxiii., p. 321.
[2] *Mémoires de la Société Centrale de Médecine Vétérinaire*, vol. v.

BOOK V.

PATHOLOGY OF PARTURITION.

Under the head of Pathology of Parturition, it is intended to include those diseases which accompany or follow this act, and are more or less related to it. Some of these maladies are of great pathological interest and practical importance, and deserve the closest study. The parturient or, if the term might be employed, puerperal period, is a very remarkable and critical one in the life of the female animal, and it becomes all the more so as the creature is submitted to the influences of domestication, and rendered more and more artificial by skilful breeding and management.

During pregnancy, a large amount of nutritive material has been abstracted from the parent to nourish and develop the fœtus, and when birth takes place this is retained until the lacteal secretion has been fully established. Consequent upon this reflux, there is established a kind of plethora which, together with the nervous excitement and succeeding prostration induced by the straining and pain of labour, renders the animal more susceptible to the influence of morbific causes of various kinds. Hence we have maladies peculiar to the parturient state, or if witnessed at other times, at least much aggravated when they appear at this period. Though the parturient diseases of animals are not so numerous as those of the human female, yet they are neither unimportant nor few; and it is possible that, with the advance of veterinary science, their number will be increased—so far as exact definition and differentiation are concerned.

In this respect, the prominent part infection by septic material—produced by the action of micro-organisms—plays in the development of parturient diseases is to be remarked. It is but recently that this agency has been recognised as one well worthy of consideration in veterinary pathology; and the closer its effects are studied, so the more inclined are we to attribute many diseases—and particularly those of the parturient state—to one common source, septic infection.

Of course, there are other maladies or disturbances, chiefly of a local character, the etiology of which cannot at present be traced to septosis, and which merit notice in this part of our work.

The diseases which we have to consider are: 1. *Vaginitis;* 2. *Leucorrhœa;* 3. *Metritis*, *Metro-peritonitis*, and *Parturient Fever;* 4. *Parturient Apoplexy;* 5. *Post partum Paraplegia;* 6. *Parturient Eclampsia;* 7. *Epilepsia Uterina* or *Mania Puerperalis;* 8. *Parturient Laminitis;* 9. *Mammitis;* 10. *Agalactia;* 11. *Injuries to the Teats; Diverse Injuries.*

CHAPTER I.

Vaginitis.

Inflammation of the vagina may exist independently, but it is generally an accompaniment of inflammation of the uterus, or "metritis," which, being the more serious evil, masks this malady. When occurring after parturition it is generally due to protracted and laborious delivery,

which necessitates manipulatory efforts, the use of instruments, etc., the passage of a very voluminous fœtus, the pressure of a pessary, or any other cause that may lead to irritation, bruising, or wounding of the mucous membrane. In very exceptional instances, the inflammation may be indirectly due to the action of cold on the skin, or the ingestion of very cold water—though this is more likely to induce metritis or metro-vaginitis.

The inflammation may lead to, or be complicated with, ulceration, gangrene, or mortification to a greater or less extent.

The labia of the vulva and the lining membrane of the vagina are more or less swollen, the latter being of a deep or bright red, brown, or livid hue; there may be also patches of congestion and ecchymoses, with wounds or abrasions, and in rare cases phlyctænæ may be observed on the surface of the membrane. The temperature of the canal is also greatly increased, while its walls are dry and often adhesive. Micturition is generally painful and difficult, constipation is often present, and there is sometimes much itching in the region of the vulva, which is indicated by the continued attempts the animal makes to rub the part. If the inflammation is severe and extensive, fever will be present.

When the inflammation has existed for one or two days, the mucus secreted by the membrane is greatly increased in quantity; it is at first a serous limpid fluid, sometimes streaked with blood; then it gradually becomes thicker and sero- or muco-purulent, soiling the tail and the thighs and hocks, and sometimes becoming so acrid as to cause removal of the hair and excoriation of the skin.

Simple vaginitis, of itself, is not a serious affection, and the inflammation often subsides spontaneously in the course of a few days, or rapidly yields to treatment. In some instances, however, it assumes a troublesome, if not a grave character. When gangrene ensues, there may be also infective inflammation in the surrounding parts, and large portions of the membrane, or even the skin of the labia, may slough, while the discharge is sanious and fœtid. Baumeister describes a diphtheritic form of vaginitis which he observed in a Cow that had calved a few days before, and which died on the third day. At the autopsy, the vagina, as well as the uterus, was found full of pseudo-membranous productions. Another Cow which stood beside this one, and which had calved four weeks earlier, contracted the disease a few days after the Cow that died, and also perished—leading to the supposition that this form of vaginitis is contagious.

The *treatment* of simple vaginitis does not merit much consideration. Cleanliness, attention to diet, and injections of cold or tepid water, or mild astringents, into the vagina, generally succeed in subduing the inflammation; but if the injections induce straining they should only be administered in small quantity, and in combination with anodynes. When, however, there is any tendency to acute inflammation and gangrene, or there exists ulceration, sloughing, or even abrasions, antiseptic treatment is advisable—a solution of carbolic acid (2 to 10 per cent.), permanganate of potass, boric acid, or chlorinated or tar water, being perhaps the best local applications. General constitutional treatment may also be necessary, and especially if the fever runs high and there are indications of septic infection.

CHAPTER II.

Leucorrhœa.

When inflammation of the vagina, and perhaps also of the lining membrane of the uterus, becomes chronic, the more acute symptoms disappear; but the vaginal discharge continues, and may even increase in quantity. Usually the fluid is of a white, glutinous, and odourless character; or it may be purulent, muco-purulent, or even chocolate-coloured and sour-smelling, or sanious at times. The secretion is mainly composed of mucus. Histologically, we find mucus corpuscles, an abundance of epithelial cells, probably some pus corpuscles, and at times micrococci and infusoria, particularly the *Trichomonas vaginalis*, which is also found in healthy mucus from the vagina. Sometimes the secretion is only manifest in an intermittent manner—as when the animal is lying down or in movement, or during micturition. It is more frequently observed in the Cow—particularly if lymphatic—than the Mare, and especially if there is bad hygiene; it is somewhat rare in the smaller animals. The appetite is in many cases unimpaired, and the creature does not appear to be inconvenienced in any way; in other instances, with the increase in the discharge and the duration of the disease, there is loss of condition and appetite, the yield of milk is less, and it may be viscid; signs of œstrum are more frequently present, but fecundation does not take place so readily as in health if the os and uterus are affected; if it does occur, the chances are that the full period of pregnancy will not be reached.

When the discharge is chiefly from the cervix uteri, it is more transparent and watery-looking than when it comes from the vagina or interior of the uterus, and the os is usually more or less dilated when these parts are involved, while the uterus itself is not so firmly contracted as when in a sound condition.

The mucous membrane of the genital canal is pale, relaxed, and insensible; in other cases it may be roughened by granulations; and sometimes it is tumefied and red. Vaginal catarrh in the Bitch is often associated with, or dependent on, the presence of papillomata or epitheliomata.

In rare instances the tissues forming the canal become indurated and lardaceous, while its calibre is diminished. Lafosse has even observed adhesions between the sides of the vagina in an old Mare.

With regard to *treatment*, if the disease is not of very long duration it may yield to cleanliness and astringent injections—such as solutions of sulphate of zinc, alum, permanganate of potass, tannic acid, etc. When it has been in existence for a long time, however (it may continue for months, and even years), it is generally very obstinate, chiefly from the relaxed condition of the membrane. The uterus or vagina, or both if affected, should be thoroughly washed out twice or thrice daily with warm water, which ought to be injected until it flows out quite clear. A solution of carbolic acid or cresyl in warm water should then be injected. A solution of the sulphate of iron has likewise been successfully used. Nitrate of silver has also been efficaciously employed in solution (1 to 10), as has tannic acid (1 to 70).

Tonics should be freely administered, and good food allowed.

If the discharge continues after two or three weeks' treatment, it may be found useful to apply a blister to the loins, croup, or thighs.

CHAPTER III.

Metritis, Metro-Peritonitis, and Parturient Fever.

Inflammation of the uterus (*Metritis*) may be limited to one or more of the internal layers of the organ (*Endo-metritis*), or it may extend to its outer covering—the peritoneum (*Metro-peritonitis*), and produce certain signs; while the introduction of septic matters into the blood, which is very often a result of this inflammation, will give rise to symptoms of septicæmia. The latter complication, from the febrile indications which accompany it, is appropriately distinguished by the name of "Parturient Fever"—a designation applied wrongly to another and very different malady of this period—*Parturient apoplexy* or *Puerperal collapse*—and which will be studied hereafter.

It is true that we may have metritis and metro-peritonitis without septicæmia—at least to any very marked degree; but the symptoms of fever which accompany the former are generally more or less apparent, and it is often difficult to discover when septic infection has taken place—the high temperature and greatly accelerated circulation being the first notable symptoms observed, and they often appear at an early stage of metritis. And septic infection may take place without metritis, when putrid matter obtains admission to the circulating fluids through a lesion in the uterus or vagina.

Inflammation of the uterus and *Septicæmia puerperalis* occur in all the domesticated animals. The latter would appear to be very frequent in the Bitch; but the Mare, Cow, Sheep, Goat, and Sow are liable to septic infection, either as a result of metritis, or the introduction of putrefying matter into the blood through an abrasion or wound.

The inflammation, as well as the infection, varies in intensity from acute and sub-acute, to chronic.

Symptoms.

Inflammation of the uterus and parturient septicæmia may ensue very soon after delivery—rarely before the second day with the Cow, and seldom beyond the eighth day. With the Mare and Bitch, according to Franck, the development of these conditions may be later. Immediately after parturition the animal may appear to have quite recovered from the effects of that act—yields milk, takes care of its progeny, and there is nothing to indicate the existence of disturbance. The temperature in the rectum is normal, except in those cases—far from rare—in which birth has been difficult, and the genital canal has been roughly treated and injured; then the rectal temperature may be higher. In simple metritis there is tumefaction of the vulva, with heat and redness of the vagina, fever, straining, difficulty in micturition, diminution or suppression of the milk secretion, inappetence and dulness. With, and often without, treatment this condition passes off in a few days. In traumatic metritis the same symptoms are observable, but soon there are well-marked rigors and horripilation; if a Cow, rumination is suspended; in the Cow and Mare the pulse becomes small, hard and quick; the secretion of milk is stopped, and the udder diminishes in size and is flaccid; the temperature rises rapidly, and the respiration is hurried and shallow; the mouth is hot and pasty, and the visible mucous membranes injected; while the horns and ears are very warm.

The animal grinds its teeth, and betrays the existence of colicky pains

by lying down and getting up, stamping, striking at the belly and turning the head towards the flanks, whisking the tail, and making more or less energetic expulsive efforts. Signs of pain or lameness in the hind-limbs become apparent. When the uterus is more inflamed, the animal does not lie down, because of the increase of pain produced by pressure on the abdomen. The smaller animals, however, maintain the recumbent position.

A very marked symptom is tumefaction of the vulva—the labia of which are separated—and the discharge therefrom of a fluid at first serous, and either transparent or having a yellow, chocolate, or reddish tinge; then it becomes gradually thicker and more abundant, and is modified according to the termination of the disease. Manual exploration of the vagina discovers it to be very hot and sensitive, particularly towards the cervix uteri; when its lining membrane is exposed, it is observed to be swollen and reddened, and sometimes there are found diphtheritic ulcers and croupous deposits on the inflamed surface. In some cases, when the uterus is very much swollen—and particularly in lean, flat-sided animals—the inflamed organ can be felt on the right side, and pressure on the abdomen often, but not invariably, causes pain. Rectal exploration generally discovers the uterus larger than natural, and more or less distended by gas.

Defæcation is painful, and the fæces are hard.

The Mare attacked by metritis or metro-peritonitis generally maintains the standing posture, with the back arched and rigid, and marked indisposition to move—only lying down on the approach of death, or towards convalescence; whereas the Cow persists in lying, and this is supposed to be due to paralysis of the hind-quarters, but it is more probably owing to debility or prostration induced by the pain.

In Ruminants there is generally distension of the rumen with gas; there are also acid eructations, and even regurgitations. When the temperature rises very high—and it may reach 107° to 108° Fahr.—death is certain.

In metro-peritonitis there always occurs—and sometimes very rapidly—an effusion of serum into the abdominal cavity. When this is in great quantity, the abdomen becomes enlarged and rounded, as if the animal had been feeding freely. There is then dulness on percussion in the lower part of the abdomen, contrasting markedly with the tympanitic resonance of the upper regions; while sudden pressure by means of the open hand on one part while the other hand is placed at another point, will cause a perceptible movement of the fluid.

Terminations.

The course of metritis, metro-peritonitis, and parturient septicæmia, is generally very rapid, and may not occupy more than a few days—usually three or four, rarely five or six days. In some cases a chronic form may be met with—and particularly in simple metritis, due to retention of the fœtal membranes, and sometimes to abortion. But these exceptions are few, and the disease or diseases just named may be designated as serious, when we learn that death carries off more than one-half of the number of animals attacked.

Though so serious, however, in those animals which are about to recover convalescence ensues very rapidly, especially with the Cow. A few hours often suffice to bring about such a change for the better, that one could scarcely believe it unless he saw it, and it might excite a doubt

as to whether metritis had really been present. In the evening the animal is left in an almost hopeless condition, and next morning it is standing, the eye limpid, the physiognomy bright and cheerful, and it caresses the offspring which previously was unheeded or repelled. The animal has not recovered, however, but it is out of danger, and with a few days' care it may be on the way to convalescence. The decrease in rectal temperature is always a favourable sign.

But, as has been said, death is the most frequent termination; and this may occur in two, four, or six days from the commencement of the malady—rarely later. Then all the symptoms become aggravated. The tumefaction of the genital organs increases, and extends to the mammæ and hind-limbs; the vulva is covered with ecchymosed patches and is cold; the vaginal discharge is ichorous and brown in colour, and emits a most fœtid odour; the temperature suddenly falls; the surface of the body is covered by a cold glutinous perspiration—especially in the Mare—and the animal expires either in a state of profound coma, or in convulsions.

In such cases death may be due to the violence of the inflammation and its extension to the peritoneum, gangrene of the uterus, or to septic infection by absorption of the putrid matters in its cavity, and general poisoning therefrom.[1]

More frequently than rapid recovery, the malady passes into a chronic state. Then the more acute symptoms gradually diminish, the appetite returns, and the animal does not exhibit much suffering. But convalescence is not established—the mammæ remain flaccid, and the secretion of milk is either very scanty or altogether suppressed; the swelling disappears from the vulva, but the discharge therefrom persists or is increased in quantity. This discharge is either of a white glairy character—leucorrhœa; grayish and grumous, resembling clotted milk; or red, brown, or sanguinolent. It is always more or less malodorous, and sometimes extremely fœtid; more particularly is this the case when, as often happens with the Cow, the discharge is mixed with, or derived from the retention in the uterus of the fœtal envelopes, or even the fœtus itself. In some instances, the croupous exudates which have been formed on the mucous membrane become broken up, and are cast off with the discharges. Franck states that, in one case, a large croupous or false membrane, which had covered the greater part of the interior of the uterus, was shed in this way.

In other instances the cervix uteri contracts, though the mucous membrane is still inflamed; consequently, the muco-purulent secretions are retained for some time, and the discharge from the vulva ceases. But when the organ becomes distended, it contracts, or it is pressed upon when the animal lies down, or during micturition or defecation;

[1] Franck mentions that in three instances the disease manifested itself on the day after an easy parturition, and it had become so severe that on the second day it was necessary to slaughter the animals. On the inner surface of the vulvar labia—which was of a dark-red hue—were one to three parturient ulcers, and in a few hours there had occurred an enormous tumefaction of the labia, which extended to the pelvic connective tissue and as low as the hocks, while the dependent parts of the body were also involved. Deep scarifications—which caused no pain—were useless, and were not followed by bleeding. On examination of the bodies after death, thrombi were discovered in the uterine and ovarian veins. In these cases the infection seemed to have been derived from an adjoining Cow, which retained the placenta.

Meyer refers to a case of this kind, in which death ensued during the evening of the day on which the disease manifested itself. He found a large blood-clot in the uterus, and ecchymoses on the intestines.

then the os is forced partially open, and the accumulated fluid escapes in great abundance. Gohier, Chouard, and other veterinary writers, give instances of this singular form of chronic metritis; they have seen Mares which every forty days, every month, or at shorter intervals, expelled fourteen, sixteen, and even as much as twenty pints of pus, after exhibiting symptoms of colic, followed by more or less marked expulsive efforts.

The animal soon loses condition; the appetite is irregular, the skin is unhealthy-looking and clings to the bones; and though debility is present, œstrum may occur far more frequently than in health, yet fecundation is not possible. Marasmus sets in, with febrile attacks at intervals—pyæmic fever; and though recovery is still possible, by skilful treatment and long-continued nursing, yet death is only too often the sequel.

Even when recovery appears to be progressing favourably, relapses may occur, sometimes through the breaking up and diffusion of venous thrombi, which give rise to a pyæmic process, as in the case recorded by Contamine. On the morning after an easy parturition, the after-birth having also been expelled, the Cow began to tremble very much; the udder was small and flaccid, the back arched, the appetite gone; there was anxiety, with colicky pains, constipation, and pressure in the right flank caused pain; the labia of the vulva were apart, swollen, and of a dark-red colour. In three days the animal was much better; but after three weeks there was a relapse. Petechiæ formed on the conjunctivæ, the hind-limbs became swollen, bleeding ensued from the skin and nostrils, and there was cough. The Cow finally recovered.

Occasionally during the subacute or chronic stages of metritis, metastatic formations occur in the lungs, liver, joints, and other parts; not infrequently there are caseous deposits in the uterus, which may attain such a thickness in its walls as to simulate pregnancy.

Pathological Anatomy.

In those cases in which death has taken place and an examination of the body been made, the local and essential lesions are found in the genital organs and peritoneum, and when puerperal septicæmia has been present there are indications of general infection of the body. Decomposition sets in early, the tissues are dark-green and fœtid, and meteorism is most marked.

In simple endo-metritis such pronounced and general lesions are not found, nor is the peritoneum involved. In the more acute cases, and particularly those in which there has been septic infection, puerperal ulcers of a dirty greenish hue are generally met with in the vagina, often in the vicinity of the meatus urinarius, and about the labia of the vulva. The mucous membrane is of a dull dark-red hue, and swollen in patches by diphtheritic infiltration, or covered in parts by croupous exudates. The bladder may also be implicated, though not to such a serious extent, and especially if the catheter has been employed. In the cavity of the uterus is constantly found a quantity of chocolate-coloured or grayish fluid, composed of effused blood, remains of fœtal envelopes, and the secretions of the mucous membranes—all in a more or less advanced state of decomposition, and emitting the most repulsive odour. This fluid contains quantities of epithelial and round cells, fat globules, and septic bacteria. The quantity of fluid

varies considerably, according to circumstances—amounting sometimes to many gallons.

The uterus itself is never contracted as in the normal condition, and it is often two or three times larger than it ought to be.

The walls of the organ are thickened, friable, softened, intensely red, and infiltrated with sanguinolent serosity, inflammatory products, and pus globules. The mucous membrane is thickened, of a dirty-brown or dark-green tint, livid, softened, ecchymosed in places, and covered here and there with diphtheritic or fibrinous exudates and blood-clots, the latter being chiefly found—in the Cow—at the base of the cotyledons, which are, with the exudates and clots, in process of putrefaction, and are gray, pulpy, and almost detached. Sometimes portions of decomposed fœtal membranes yet remain attached to the cotyledons; and there are here and there gangrenous eschars, in the form of green or grayish spongy masses of a diphtheritic nature, which are in process of softening and dissolution. In all these alterations—which are usually very notable in the cornu that contained the fœtus—there are the characteristic features of *Endometritis septica*.

It is seldom indeed that the puerperal or septic inflammation is limited to the mucous membrane. Nearly always it extends to the submucous connective tissue (*Metritis phlegmonosa*), which is infiltrated with an œdematous transudation; or it becomes the seat of acute inflammatory œdema, in which the tissue swells, becomes tumid, and its interstices filled with fluid, small cells, and a gelatinous, semi-solid material. The muscular tissue is swollen and softened, and a dark fluid flows from it.

The subperitoneal connective tissue of the uterus may suffer in like manner, and undergo necrotic softening and putrefaction; while the serous membrane itself becomes inflamed (*Metro-peritonitis*).

When this takes place, the abdominal cavity contains a quantity of reddish, turbid, sanious serosity, in which are flakes of lymph. The lining membrane of this cavity, and especially that covering the uterus, is highly inflamed, and its surface is covered with pseudo-membranous layers of fibrin; while adhesion may have taken place between the different organs it covers. In some cases the inflammation of the peritoneum is not so diffuse, and is more or less limited to the uterus and organs immediately adjacent.

In other cases, again, the phlegmonous inflammation extends to the pelvic connective tissue (*Parametritis*), and then there is diffuse acute œdema, infiltration with pus, or even abscesses.

Indeed, in the uterine connective tissue there may be, in different parts, active cell proliferation and abscesses, and if the animal chances to live beyond a certain period, these terminate in caseous inspissation, or even perforation into the abdominal cavity.

A very important pathological lesion, and one which is not infrequently noted in parametritis, is thrombosis of the veins and lymphatics, Thrombosis of the uterine veins has been observed in animals—solid, white, or yellowish thrombi adhering to the internal surface of the vessels, and extending towards the larger venous trunks—even as far as the posterior vena cava. Sometimes the breaking-up of these thrombi causes relapse, and embolic pyæmia of the lungs or neighbouring organs. When septic infection does not occur, bruising of the soft parts during difficult parturition may give rise to thrombosis of the veins, with secondary pyæmia. This may explain the occurrence of

abscesses appearing at the joints, and inflammation of the feet supervening on parturition. Thrombosis of the lymphatics has rarely been observed in animals; it is noticed within the inflamed spot. "The coagulated lymph either uniformly fills the vessel, or gives the appearance of a string of beads. Sometimes, also, single larger dilatations of lymphatic vessels are seen. The thrombosis may be due to the direct influence of the infecting matter, but more frequently it is caused by the inflammation of the connective tissue around the vessel. The products also of the inflammation of this tissue have a tendency to coagulate, and the contents of the vessels participate in the process." Sometimes the lymphatics are filled with pus (*Purulent lymphangitis*), and the neighbouring glands are swollen and softened. This thrombosis of the lymphatics has been considered a favourable circumstance, since the occluded vessels are prevented from conveying the infecting materials: the inflammatory process being at least delayed at the nearest group of lymphatic glands. The lymphangitis is therefore considered an accidental change, which usually remains limited to the diseased part, and may disappear; and it has been remarked that it rarely extends further towards the thoracic duct, unless there are other very considerable changes.

Sometimes the thrombi in the vessels of the uterus soften; so that, in cutting into the walls of the organ, they appear like small abscesses, varying in size from a pea to that of a nut. They can only be distinguished from abscesses by their smooth walls, since the afferent and efferent vessels cannot always be found.

In intense parametritis, with extensive infiltration of the subserous connective tissue, other organs may be involved, and especially those which are directly connected by means of this tissue—such as the ovaries. The peritonitis may extend through the diaphragm to the pleuræ, or the inflammation in both membranes may be due to ichorrhæmia.

In those cases in which thrombi in the bloodvessels have become detached and broken up, the fragments may be carried in the circulation, and give rise to embolism and hæmorraghic infarcts, or to metastatic abscesses in such parenchymatous organs as the lungs, liver, spleen, kidneys, etc.

In the most rapidly fatal cases, in which death is due to septic parametritis, there is no time for fibrinous exudation, and there are appearances not unlike those observed in splenic fever. The blood is dark-coloured and non-coagulable, ecchymoses are found in various organs and tissues, and there is a marked tendency to rapid putrefaction. The elementary structures of organs show the commencement of an acute inflammatory process — the fine granular infiltration or "cloudy swelling," fatty degeneration, or even disintegration of cells.

It has been already stated that there is nothing exceptional in parturient fever, and so far as its pathological anatomy is concerned, the same alterations are observed in non-parturient subjects. Parturition only predisposes the animal to its occurrence, from the fact that there are wounds and bruises inflicted on the soft tissues of the genital canal; that there is present a quantity of matters—fluid and solid—either decomposed or decomposing; and that the bloodvessels and lymphatics of the uterus at this time are in a favourable condition for the reception and action of this septic material. In animals which have succumbed

after the operation of ovariotomy, similar pathological alterations are found.

With regard to chronic metritis, various changes have been observed. In some cases the uterus has contained a considerable quantity of fetid pus, or muco-purulent matter of a white or gray hue; while the mucous membrane has been gray or dark-coloured, thickened and softened, and the cotyledons infiltrated, softened, or even indurated; the vaginal mucous membrane is also infiltrated and indurated in some cases.

Causes.

The *predisposing* cause of metritis, metro-peritonitis, and parturient fever, is the parturient or puerperal state. It is true that septic infection, with its train of symptoms, may occur at other periods and from various causes; but metritis and its complications are, as a rule, observed only after abortion or parturition.

The *occasional* causes of metritis, and therefore of metro-peritonitis and fever, are injuries to the genital canal or interior of the uterus, during or after birth. The manipulations necessary for the artificial removal of the fœtus or its envelopes, and by which the mucous membrane is abraded or wounded, are a frequent cause; inversion of the organ, and especially when it has been exposed for some time to the air and the action of irritating substances, or bruised or lacerated in returning it, is another cause. Retention of the fœtus or fœtal envelopes has also been given as a cause of metritis.

But other cases have been noted in which birth was easy and natural, and at the usual time; and yet towards the second, fourth, or sixth day after parturition, the animal began to lose its appetite, the vulva became swollen, fever set in, and all the symptoms of metro-peritonitis became rapidly developed. In these cases, the occurrence of disease has been attributed to some imprudence in management, which brings about derangement in the functions of the skin or digestive organs—such as exposing the animal to wet and cold out of doors or draughts of cold air in stables, giving it cold water to drink, or unsuitable food.

Sometimes the disease occurs among such a large number of animals almost simultaneously, that it has been looked upon as epizoötic, and due to a miasma. More particularly has this been the case with parturient fever, but which must now be considered as due solely to the absorption of septic matter.

The production of parturient fever in animals, as in the human female, requires two conditions: (1) a fresh wound by which the septic poison can enter. The wound need not be large, but it appears to be almost essential that it is recent—for suppurating or granulating sores do not absorb, so long as the infecting agent does not destroy the surface. If the mucous membrane is intact and protected by its epithelium, absorption is also prevented; (2) an active septic substance, either produced in the animal which is to be the subject of parturient fever—auto-infection, or introduced from without—external infection.

Birth rarely takes place in animals without more or less laceration or abrasion of the cervix uteri, vagina, or labia of the vulva; and those injuries which are on the floor of the genital canal are more likely to be followed by septic fever than those on the sides or roof, simply because they are brought more directly in contact with the decomposing

material. Infection less frequently takes place from the interior of the uterus under normal conditions, as injury is not so likely to occur there from the passage of the fœtus. Exceptionally, it may take place in the uterus through the cotyledons, when some of these are torn during the separation of the fœtal membranes.

As has been mentioned, the parturient period is eminently favourable for the absorption of septic matters; as the mucous membrane of the genital canal is exceptionally vascular, and the bloodvessels and lymphatics are greatly developed.

Auto-infection occurs generally when there is a fresh wound, and when the fœtus is dead, and, still retained in the uterus, has become decomposed through the access of air; or from retention and putrefaction of the envelopes. The ichorous putrefaction of wounds, or new growths in the uterus or vagina, may also lead to septic infection.[1]

Embryotomy, when the fœtus is decomposing, is a dangerous operation if a wound chances to be inflicted during its performance. It is the same with the removal of the fœtal envelopes.[2]

With the Mare, removal of the fœtal membranes does not appear to be dangerous, and their retention is not usually followed by infection, for it is not until the second or third day after parturition that their decomposition usually commences; so that if small injuries have been produced during birth, it is most likely that they will be suppurating or granulating by that time, and thus be proof against the passage of putrid matter. If, however, a fresh wound is made, or the granulations are injured by mechanical means, then removal of the putrid envelopes is full of risk. Foelen mentions that a Cow had a wound on the vulva, and this was infected by putrid membranes; on the fourth day after, the animal died with all the symptoms of parturient septicæmia.

External infection does not appear to be so frequent as auto-infection among animals. It takes place when septic materials are brought to

[1] Franck gives the following illustrations, which could be easily and largely supplemented:

1. The fœtus of a Heifer was dead in the uterus, and much distended with gas. Embryotomy had to be resorted to in order to extract it; and this was accomplished, apparently, without causing any noticeable injury to the vagina. On the third day septicæmia became manifest, and the animal had to be killed.

2. A Cow gave birth to a Calf in a normal manner; but the hoof of the young creature on its passage through the vagina made a small wound. Twenty-four hours afterwards a second Calf in a state of putrefaction was removed by manual force, but without injuring the Cow. In two days the latter was attacked with puerperal fever, and was killed.

3. Mombrini removed a dead Calf from the uterus by embryotomy. Septic inflammation of the uterus and peritoneum set in, and the Cow died on the seventh day.

4. It is well known that Bitches which retain the fœtus in the genital canal for any length of time (eighteen hours or thereabouts), frequently perish from *Septikæmia puerperalis*. This appears to be due to the fact that the puppy so retained quickly dies: owing to the shortness of the umbilical cord, the early separation of the placenta, and birth taking place in the amnion. The young creature also speedily putrefies, and the large raw surface formed by the maternal placenta is a ready inlet for the direct introduction of the septic material into the blood. Speedy death of the Bitch is the consequence.

[2] A Cow retained the fœtal envelopes for five days after parturition, when they were removed. The operator had evidently wounded a cotyledon or the uterine mucous membrane in doing so, as his hand was stained with blood. In three days the animal was affected with parturient fever and died. No injury to the uterus could be detected on *post-mortem* examination.

the recent wounds or lacerations of the genital organs by any means—as directly by the hand, instruments, sponges, straw, etc., or indirectly through the atmosphere, when the septic micro-organisms are suspended therein—the so-called miasmatic infection. There is a close relationship between abortion and parturient fever—a Cow suffering from the latter being undoubtedly dangerous in a stable or pasture where there are a number of pregnant cattle; while a case of abortion or placental retention occurring in a stable, might be considered nearly as serious among parturient Cows.

A retained and decomposed placenta is undoubtedly a fertile source of parturient fever. Franck refers to three instances, in which the Cows calved in a normal manner and the fœtal membranes came away in four hours after; but a trifling wound existed in the mucous membrane, at the entrance to the vagina. In two or three days afterwards these animals showed very acute symptoms of parturient fever. They stood near another Cow whose uterus contained a decomposing placenta. The emanations from the vulva or discharges of this animal had, there can scarcely be a doubt, infected the three; or the soiled straw may have been the means of conveying the septic matter to the vulvar wounds; the tail of the Cow may even have been an active agent in throwing the vaginal discharges about, as it is generally much soiled by them.

External infection may also be conveyed by means of cords, crotchets, and other obstetrical appliances, if they are soiled with septic matters—which they may be, if previously used in the removal of a decomposing fœtus; and the operator himself may be the means of infecting. An instance of this kind is related as occurring in Switzerland, during 1861-63; in a large cowshed containing about 200 head of cattle, suddenly a number died of parturient fever, though they had no difficulty in calving. For a long time afterwards no other births took place, so no more accidents of this kind were observed; but it was strongly suspected that the herdsman who attended the first sick animal, cleaned it, etc., in assisting the others during parturition, had conveyed the infection to them. And it is quite possible that many serious and wide-spread outbreaks of parturient fever in cattle are due to an obstetrist who has been engaged in removing a dead fœtus or a retained placenta. The same cause may be in operation among Ewes during the lambing season, when, as is well known, parturition occurs in the flocks within a limited period, and under circumstances favourable to the spread of infection; and not infrequently large numbers of Ewes perish from parturient septicæmia ("heaving pains").

We have mentioned that exposure to cold is supposed to be one of the causes of parturient fever. Franck, however, is of opinion that real parturient fever cannot be so produced, and in this he is correct; the malady is of septic origin, micro-organisms (the *Micrococcus septicus puerperalis* of Arloing?) being the active agents in engendering the disease.

General infection takes place when there are parturient sores or ulcers in the vulva, vagina, or uterus, and this infection is manifested externally by the high temperature and other serious symptoms. In other cases, when only a small quantity of septic matter has been absorbed, the symptoms have more of a local character; they are less severe, and though the fever may be of a continuous character, yet it is not so acute, and indications of peritonitis are generally absent.

Indeed, we may have simple metritis without much constitutional disturbance.

Prognosis.

The prognosis of parturient fever must be, in the majority of cases, unfavourable, as the veterinary surgeon is only too frequently not called in until too late. When infection is but slight, or when the local inflammation is not very severe, then careful treatment may restore the patient to health. It must not be forgotten, however, that what appears at first a mild form of metritis, may become a very grave attack of this fever.

Prophylaxis.

From what we have said with regard to the causes of parturient fever and metro-peritonitis, it will be seen that in obstetrical operations great care should be exercised, so as to avoid wounding the genital canal, and especially the interior of the uterus. Should injury be unfortunately inflicted, cleanliness and careful dressing with some such antiseptic as carbolic acid, should be enforced. This is especially necessary when extraction of a dead fœtus or retained placenta takes place.

No person who has been handling a creature suffering from parturient fever or any decomposing animal matters, should be allowed to assist animals in parturition; and the same rule ought to be observed with regard to instruments and other obstetrical appliances, unless they have been thoroughly cleansed.

If a case of parturient fever should occur where there are other pregnant animals, or animals which have quite recently brought forth, these should be immediately removed. An animal which retains a decomposing fœtus or fœtal membranes, is also dangerous among them. The same remark applies to animals—such as Ewes and Cows—at pasture. The soiled ground should be most carefully disinfected with lime, when possible, and pregnant or parturient animals kept away from it.

Treatment.

Metritis, metro-peritonitis, and parturient fever being grave disorders and rapid in their progress, demand prompt and energetic treatment. Indeed, it is well in all cases in which the genital canal has been injured, or the placenta or dead fœtus has been retained until putrefaction has begun, to prevent evil effects by cleaning out and injecting antiseptic fluids into this canal and the uterine cavity—such as solution of corrosive sublimate, 1 to 2,000—3,000. The first thing to be attended to in treatment is the condition of the uterus, and the removal of any infective matters it or the vagina may contain; as well as the disinfection of any wounds or abrasions in these parts.

The genital canal should be thoroughly cleansed by injections of warm water, and the wounds dressed with cresol,[1] or carbolic acid and olive oil (1 to 10), applied by means of a brush or feather; or salicylic acid 1 part, spirits of wine 20 parts, warm water 24 parts.

After the interior of the uterus has been cleansed by injections of

[1] Cresol, cresyl, or cresylic acid, which enters largely into the composition of Jeye's Fluid, has been extolled as an excellent antiseptic, and is preferred by many Continental veterinarians to corrosive sublimate and carbolic acid. It is not poisonous, like these, and mixes readily with water, a 1 per cent. solution being a most powerful antiseptic. It is also recommended for internal medication instead of carbolic acid, and for the same reasons.

warm water, an injection of carbolic acid solution (1 to 20—50) boro-glycerine (1 to 20—40 of water), or the above solution of corrosive sublimate, should be made every day, and the wounds, if accessible, dressed at the same time. Permanganate of potash (1 to 50 of water) may be employed to inject into the genital canal, when the disease is less acute.

All fluids injected should be warm—80° to 100° Fahr.; and solution of opium or extract of belladonna may be advantageously employed in the uterine injections, to allay pain and straining.

The external treatment must be hot fomentations, cataplasma, or counter-irritation to the surface of the abdomen—or all three combined. The smaller animals may have linseed-meal poultices applied, or be immersed in hot water.

With regard to the constitutional treatment of puerperal septicæmia, this must be directed towards neutralizing the effects of the septic matter by the exhibition of antiseptic remedies, and reducing the high temperature; as a long continuation of this leads to rapid waste of the tissues, and is fraught with danger to the system.

There is no specific remedy with which to neutralize the action of the septic matters in the blood and tissues. The sulphites of soda and potash have been recommended, as well as sulphurous acid. These appear to have acted favourably in some cases. Carbonate of soda and permanganate of potash have also been well spoken of, as well as large doses of quinine. Carbolic and salicylic acids are now most in repute, and are given in small and frequent doses.

If there is a tendency to constipation, a purgative may be administered; indeed, unless special circumstances forbid it, a purgative may prove most serviceable in assisting in the removal of the septic matter through the intestinal canal. Dogs which have been poisoned by this matter, often recover after profuse and fœtid diarrhœa; and a purgative generally reduces the temperature.

In acute cases, in order to obtain the more prompt action of antiseptics, it has been proposed to introduce them directly into the circulation by intravenous injection. Solutions of cresol, carbolic acid, and iodine have been employed successfully; and in woman a desperate case has recovered after the intravenous injection of liquor ammoniæ (1 to 3).

As a last resource, and to substitute healthy for poisoned blood, transfusion has been also practised in woman, and with good results. The experiment is worth trying in the parturient fever of animals.

With regard to the diminution of temperature, quinine has been highly lauded. Bleeding is certainly not to be recommended. If the temperature continuously remains very high, then the application of cold water to the surface of the body is indicated. The cold water may be applied to the larger animals by means of cold wet sheets wrapped round the body, and kept cold for an hour or two at a time by pouring on water, at intervals, by means of a small vessel. Smaller animals may be put into a gradually-cooled bath.

The skin must be well dried after the application of the cold water, and with the larger animals a dry blanket should be thrown over the body. Food should be sloppy and laxative. The stable must be kept scrupulously clean and well ventilated.

Tonics and good food must be allowed when recovery is taking place, and the *sequelæ* of the disease treated according to their indications.

Peritonitis may be combated by the exhibition of large and frequent doses of calomel. Van den Eide and Clement were successful in treating serious cases of metro-peritonitis by administering calomel, and applying mercurial ointment to the abdomen.

When the pain is very severe, mustard may be applied to the surface of the abdomen, and, in the case of small animals, linseed-meal poultices on which laudanum has been sprinkled; while subcutaneous injections of morphia may be freely resorted to. When great exhaustion or collapse is present, large and frequent draughts, containing diffusible stimulants, must be administered, with nutritious gruel. To the smaller animals milk or beef-tea may be given.

In the chronic form of metritis, the same treatment may be adopted, so far as the genital canal is concerned; and if there is vaginal discharge, the treatment recommended for leucorrhœa will be suitable. If the uterus is not contracted, this may be promoted by the exhibition of preparations of ergot of rye.

In handling animals suffering from parturient fever, or in examining the carcases of those which have died, the veterinary surgeon should be on his guard against inoculation. More particularly is this necessary when exploring the genital canal of the living animal, or removing a putrescent fœtus or fœtal envelopes. The arm and hand should then be well smeared with oil or lard, and thoroughly cleaned with carbolic acid soap when the operation is completed.

CHAPTER IV.

Parturient or Puerperal Apoplexy or Collapse.

Perhaps no disease affecting animals has received a greater amount of attention, or given rise to more widely divergent opinions as to its nature, than the malady to which, chiefly for convenience, we have given the designation of parturient apoplexy or puerperal collapse. Veterinary literature, since the commencement of the century, teems with descriptions and discussions relative to the disease, and the most eminent veterinary pathologists still appear to be far from unanimous as to its nature. The great number of names given to it—some of which either indicate the opinions prevalent with regard to its pathology or causes, or point to prominent symptoms—are evidence of the uncertainty which has prevailed, and now prevails, with regard to it. For instance, it has been designated *puerperal fever*, *nervous* or *paralytic form of puerperal fever*, *milk-fever*, *puerperal apoplexy*, *paraplegia*, *puerperal collapse*, *vitulary fever*, *vitulary apoplexy*, *vitulary paralysis*, *processus puerperal*, *puerperal typhus*, *calf fever*, *dropping after calving*, *eclampsia puerperalis*, etc.

In France it is usually designated "Vitulary Fever," while in Germany it is commonly known as "Calving Fever." In England it is usually designated "Parturient Apoplexy," "Puerperal Fever," "Milk Fever," etc.

The malady appears to have been known from an early period, but the first exact description of the symptoms we can find is that given by Skellett,[1] who names it "Milk Fever, or Dropping after Calving"; in the

[1] *Practical Treatise on the Parturition of the Cow.* London, 1807.

following year it is alluded to by Jörg,[1] who evidently knew Skellett's work, as the latter's plates are copied. Some years after this period the disease began to attract much attention, as with improvement in the breeding of Cattle it gradually became more prevalent, until now the literature of the subject is very extensive.

Without entering at this moment into a discussion as to the nature of the disease, it may be sufficient to say that it is a very serious and acute affection, almost special to Cows in the parturient state—and particularly those of the improved Milch breeds, in which it is frequent; that its invasion is sudden and its course rapid; and that it is characterized by loss of consciousness and paralysis, seldom by convulsions. It is extremely fatal, death ensuing in a very short time; or if recovery takes place, this is sometimes nearly as rapid as the attack was sudden. It has been confounded with parturient fever, or considered to be only a nervous or paralytic form of that malady; while Franck, who appears to have studied it very carefully, is of opinion that it is identical with the eclampsia of the human female, and considers that "puerperal eclampsia" (*Eklampsie in Folge der Geburt*) is the best designation for it. He asserts that to look upon it as a "fever" is a mistake, as a high temperature—the sure sign of such a condition—is not present; while to name it "calving fever" is not quite exact, as it has been known to affect oxen and other domesticated animals—though seldom.

We shall, however, revert to this question presently.

Symptoms.

The disease sets in suddenly after calving, and without any premonitory symptoms. It may attack the Cow so early as twelve or twenty hours after parturition, but it is most frequent on the second or third day, and generally follows a rapid and an easy birth. It has, though very rarely, manifested itself before parturition, and also during that act. It is seldom that it appears after the third day; though Harms says it may occur so late as the tenth day; Hess records an instance on the fourteenth day, and a case has been witnessed in the fourth week; while Gierer states that he saw a Cow which offered all the symptoms of the disease seven weeks after calving.

In some instances, before the symptoms commence, the lacteal secretion is either diminished or suspended. Generally, however, the first indications are the Cow hanging back in the stall, or the head drooping; there is uneasiness, whisking of the tail, striking at the belly with the hind-feet; the appetite is suddenly lost and rumination ceases; the fæces are hurriedly expelled, and the animal becomes indifferent to its Calf. There is often a shivering fit, but this is not followed by an increase of temperature. In a few cases, congestion of the brain appears to be present at the commencement; the Cow presses its head to the wall or leans against the stall-post, bellows, looks stupid, its mouth is hot, the eyes are reddened and the eyelids wink, and it half unconsciously treads with the hind-feet. The respiration becomes hurried and plaintive, though the pulse may be normal; and if the animal is conscious, its physiognomy expresses anxiety and suffering. Unsteadiness and staggering are manifested; the animal can no longer stand, and it either lies down, or falls on the floor of the stall. There it may remain tranquil, merely moaning or bellowing, or striking with its feet at the belly as if affected with colic, and making convulsive

[1] *Anleitung zur Einer Rationellen Geburtshülfe*, etc., *für Thierärzte.*

movements. Other signs of congestion of the brain may be more or less marked; the ears and horns may be warmer than natural, and in addition to the redness of the eyes, tears may flow down the cheeks.

All these changes generally become developed in a very few hours; so that an animal which was left in apparent good health only a short time before, is found lying, cannot get up, and is in a soporific condition. This is the stage of the malady at which the veterinary surgeon is usually sent for.

Then he finds it lying tranquilly on its side, fully extended or, which is far more frequent, resting on the sternum, and the head turned round towards the shoulder or flank (Fig. 220). This position of the head is supposed to be due to contraction or tonic spasm of the cervical muscles of one side of the neck. It is sometimes observed at the commencement of the attack, even while the animal is standing. The neck is so rigidly bent that force cannot extend it, and the temperature is distinctly increased on the concave side—that on which the muscles are contracted.

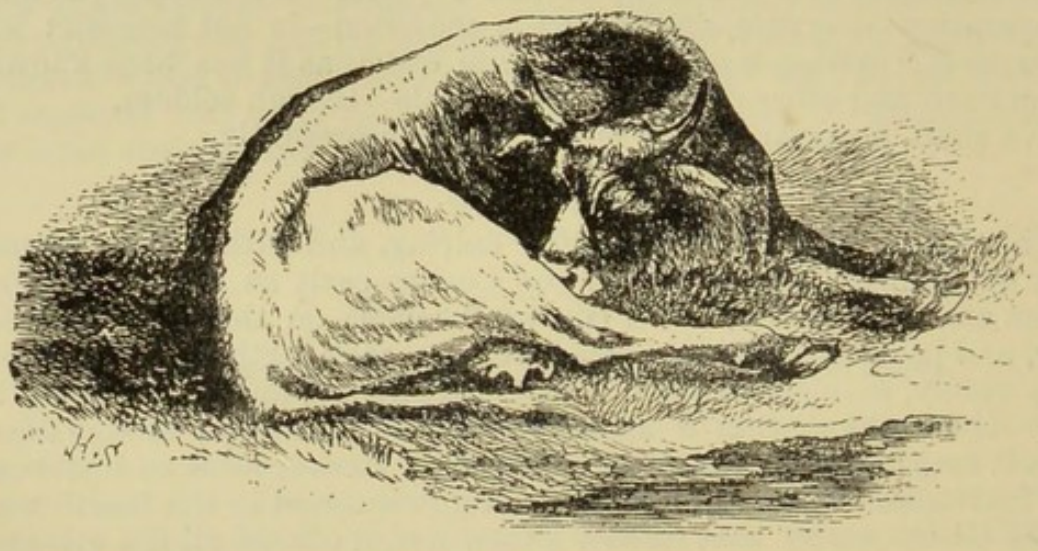

Fig. 220.

PARTURIENT APOPLEXY: COW.

From time to time it may attempt to rise, but it cannot, as a rule, do so; the knees may be flexed, but the hind parts of the body seem to be fixed to the ground. If assistance is afforded, it cannot avail itself of it; or if it chances to be raised, it falls again as soon as let alone. It appears to be insensible to blows or pain of any kind; and if the head is lifted and let go, it drops an inert mass, or is again pressed round against the shoulder. The teeth are ground at intervals, and the stupor or coma becomes more marked. The animal pays no heed to surrounding objects; the eyes are half closed, and they either move convulsively in their orbits, or are fixed, dull, and lustreless; the hair is erect and dry, and flies settle on the surface of the body.

The pulse does not vary much in the earlier stage; it is generally more frequent, and may number fifty, sixty, or seventy beats per minute; or it may be fewer than in health, but it is very full and soft. When coma is well advanced, however, and paralysis appears to be complete, it becomes small and quick, numbering 100 to 120, and at last is irregular and almost imperceptible.

The respirations may be increased to eighty or ninety per minute, and this occurs more particularly when there is pneumonia, due to the passage of foreign matters into the bronchi—an accident frequently noted in this disease. When the coma and paralysis are very marked, the respirations are often slow and deep—from eight to five in the minute, sighing or stertorous—indicating paralysis of the soft palate; at other times it is calm and regular. All these variations may be observed in the same animal—the hurried, stertorous breathing succeeding the quiet and deep respirations in a very abrupt manner. As the pulse increases in frequency the breathing sometimes becomes slower.

The temperature of the body is not increased, as a rule; on the contrary, it is very often below the normal standard when coma sets in—Harms and Adams have found it as low as 35° Cent. (95° Fahr.). According to Thomassen,[1] it may be 102·2° to 103° Fahr. at the commencement, and in a few hours fall to 100°, or even 96°, to rise again when there is improvement. Cases have been reported in which it was as low as 89·6° and 90°, and in the latter it ascended in three hours to 100°, the animal recovering. It is possible that, in the cases in which these very low temperatures were noted, the anal sphincter has been relaxed, so that the air passing into the rectum would make it cooler. The extremities are generally icy cold, and the surface heat of the trunk is irregularly distributed.

The mucous membrane of the mouth is pale, and saliva accumulates about or flows continually from it (hence the disease is sometimes designated *Abtröpfeln aus dem Maule* by the Germans). Food and water are refused, and, indeed, at an early period there appears to be paralysis of the pharynx and œsophagus, and if care is not taken the solids or fluids attempted to be administered may find their way into the air-passages, and if they do not quickly produce asphyxia, they will probably give rise to pneumonia. When fluids are administered, they pass down the œsophagus with a gurgling sound. The functions of the rumen and digestive system are more or less suspended, and the peristaltic movement of the intestines decreased. Hence we have tympany, eructations, and constipation. The eructations may carry fluid and food from the rumen into the pharynx, and even into the nostrils, and they may pass thence into the trachea. So that we may have pneumonia from this cause alone, and without attempts having been made to administer food or medicine. Constipation is also a marked feature of this paralysed condition, and if tympany appears at an early period, it is considered an unfavourable sign by some practitioners.

All these changes in the functions of the digestive apparatus, together with those of the respiratory and circulatory organs, show that the pneumogastric nerves are seriously involved.

Micturition is also, as a rule, suspended from the commencement; consequently, urine accumulates in the bladder, and it usually contains sugar and a certain quantity of albumin.

The secretion of milk may be diminished or suspended, and sometimes very suddenly, even before the voluntary muscles are paralysed; in other instances it may be uninterrupted.

When the animal is about to recover, these symptoms may persist for some hours, or even for two, three, or four days. Then it appears to rouse up suddenly from the stupor into which it was plunged; the

[1] *Recueil de Médecine Vétérinaire*, 1889, p. 491.

tongue is moved about; the head is raised; attempts are made to get up; it elevates the fore-part of the body, and after some struggles finally gets on its hind-legs and stands. The first favourable indications are elevation of temperature and resumption of the intestinal peristalsis. The latter is assured when the rectum is found to be filled with fæces, after it has been emptied.

The animal's physiognomy changes, and becomes natural—though it may still look half stupefied; it drinks and seeks food, and is not long in commencing to ruminate; its calf is caressed; urine and fæces are passed; and recovery sets in so promptly, and goes on so quickly, that in many cases it is scarcely possible to believe that the animal, which twenty-four hours previously appeared to be dying, is now not only recovering, but apparently completely recovered without being convalescent.

When death is about to take place, the more serious symptoms are still more marked. The *collapsus*—the coma—becomes more and more complete. The nose rests on the ground as if the animal could no longer support the head, and at times sways from side to side. The decubitus, instead of being sternal, becomes lateral, and the body is stretched out at full length. The eye is glassy, and there is no movement of the eyelids when the cornea is touched; the body and mouth are colder; the tympanitis increases; the pulse becomes small, irregular, intermittent, and very quick, until at last it is imperceptible; the breathing is puffing, slower, and more stertorous, and the animal dies without a struggle, or in the midst of slight convulsions.

In some cases there are epileptiform movements, or there may be symptoms of delirium: the animal throws its head about violently from side to side, or bends it rigidly backwards, struggles, bellows, groans, extends the limbs convulsively as if undergoing an electric shock, and appears to be unconscious; the breathing is deep and spasmodic, and apoplexy—parturient apoplexy—seems to be the cause of death.

Duration, Terminations, and Complications.

The duration of the disease is very brief. There are instances on record in which it has been less than twenty-four hours; but two or three days is the ordinary term; it has rarely extended to five or six days.

If there are no complications, the terminations are death or recovery. The chief complications are broncho-pneumonia, milk-metastasis, amaurosis, temporary or permanent paralysis (sometimes in the form of monoplegias), gangrene of certain parts, and swellings in the region of the thigh and hocks.

Pneumonia is due to the passage of foreign matters—either food or medicine—into the air-passages during the period when the animal cannot swallow, or when it is comatose, and meteorismus and eructations are present. This is often a cause of death when the Cow has recovered from the parturient malady. Indeed, the animal may perish from suffocation alone when the quantity of matter that passes through the larynx is considerable. And not infrequently, when the creature has lingered for a few days and is then killed, the existence of pneumonia from this cause will be discovered on making an examination

of the body. Adam[1] believes that ten per cent. of the Cows which recover from parturient collapse eventually die of pneumonia, due to extraneous matters introduced during the paralysed condition of the pharynx. Sometimes the animal appears to be almost recovered from the attack of parturient apoplexy, when symptoms of lung congestion or inflammation are suddenly developed, and death soon occurs. Paralysis of the œsophagus, which may persist for some days after recovery, has in some cases been the cause of death from choking.

Another complication of parturient apoplexy, is the so-called *milk-metastasis* which does not appear to have been noted in this country, but which is alluded to by Violet in France, Bentele, Born, and Franck in Germany, and Allemani in Italy. Occasionally there is observed after an attack of the disease, a white, milky-looking emulsion similar to chyle, expelled as urine, or as a discharge from the nostrils; and at one time it was imagined that this was the milk which, instead of being got rid of by the mammæ, was absorbed or retained in the blood, acted upon the nervous centres, and was then expelled in this vicarious manner.

Though no analyses appear to have been made of this fluid, Franck is of opinion that the fluid is only the normal secretions mixed with lymph. The milk-metastasis theory is untenable, as it is quite opposed to what we know of the lacteal secretion, especially during this disease.[2]

With regard to *paralysis*, this is not evident until the animal recovers consciousness, and begins to look bright and anxious for food, when it is found that it cannot be made to rise. The paralysis may affect various parts, but it is usually limited to one limb, to the two hind-limbs (*paraplegia*), or to one side of the body (*hemiplegia*). Saake says he has sometimes seen instances in which the fore-limbs were paralysed, while the posterior ones could be moved freely. In certain cases the paralysis of limbs is accompanied by muscular atrophy.

Amaurosis is readily discovered from the animal being blind. It is generally persistent. Breulet, Gabler, Dommelen and Festal have recorded instances.

Gangrene of certain parts—feet and teats—is often met with in some parts of Holland. The Cow will have recovered from an attack of parturient collapse from ten to fifteen days, when a fœtid fluid is found exuding from between the claws and around the coronets of the hind-feet; soon a line of demarcation forms about the middle of the shanks, and this is quickly followed by complete sphacelus of the extremities.

[1] *Wochenschrift für Thierheilkunde*, 1870-71.

[2] Bentele (*Wochenschrift für Thierheilkunde*, 1857, p. 145) states that a Cow attacked by calving-fever, lay for sixty hours in a state of lethargy. The urine, which was passed six hours afterwards, was milk (?) with clots—as if boiled—in it. The animal recovered from the attack, but some weeks later it had to be killed in consequence of diseased lungs —probably pneumonia from extraneous matters.

Born (Anacker's *Thierarzt*, 1871, p. 279) relates a case in which milk flowed from the nostrils of a Cow that was affected with calving-fever.

Allemani (*Il Medico Veterinaria*, 1870, p. 289) tells us of a Cow-proprietor who believed one of his Cows passed milk instead of urine. The supposed milk—which was of a yellowish-white colour—contained epithelium from the bladder, a large quantity of epithelium from the kidney, lymph-corpuscles, and albumin. After some days this condition disappeared. The fluid did not coagulate spontaneously.

Violet (Saint-Cyr's *Traité d'Obstetrique Vétérinaire*, p. 1072) found a similar condition of the urine. This came away through the catheter with much force, and it was so white that the attendants thought it was milk. It was also foamy and effervescent, like champagne or bottled beer. The animal recovered, but the urine was slightly effervescent for some days.

The animals are slaughtered. From time to time in the same country, dry gangrene of the teats is reported as a sequel of collapse.

Swellings in the region of the thigh and hock, and laceration of certain muscles—chiefly of the hind-limbs—have been observed in many cases. Sometimes both limbs, and at other times only one limb is involved, the injury being generally so serious that the animals have to be killed. In all probability the damage is due to the struggling and slipping that takes place before the animal becomes unconscious and immovable; and the damage is not discovered until consciousness returns and it is observed that it cannot get up.

Prognosis.

The prognosis of parturient apoplexy is generally unfavourable, as a fatal termination occurs in a very large proportion of cases. Of 721 cases treated by various methods, Franck states that 294 either died or were slaughtered—40·8 per cent. Of course, no definite conclusion can be drawn from these figures; as it is possible that some, if not many, of the cases may have been parturient fever, while of those killed probably a few recoveries might have been noted if treated. Saint-Cyr, in 466 cases gives 45 per cent. deaths; Stockfleth gives 50 per cent.; and Violet 25 per cent. Some practitioners have a large percentage of recoveries, while others are unfortunate in obtaining only a small number.

Often cases which appear very trifling at first, have a rapidly fatal termination; while others which commenced with alarming symptoms, quickly recover. Therefore it is, that perhaps in no other disease of animals is a reliable prognosis more difficult to be arrived at, not only in the earlier stages, but during the whole of its course. "There is no absolute *criterium*," says Lanzillotti-Buonsanti, "by which we can positively say whether we can cure the case, or whether death will ensue; and it often happens that the result contradicts the prognosis." And Allemani states that he has seen cases which looked so favourable as to lead him to believe they would recover, suddenly become aggravated without any apparent cause, and succumb; while others which exhibited the gravest symptoms in all their intensity, and gave no hope of recovery, have been restored to health.

This is probably the experience of everyone who has had to contend with the disease; it is in consequence of this uncertainty, and the fatality attending the malady, that the butcher is so frequently called in, and the animal is killed and its flesh sold as food. As to the propriety of utilising the flesh in this manner, there have been different opinions; but provided the animal has not been drugged to any considerable extent before death, and it is killed early, there is no evidence that the flesh possesses pernicious properties when utilised as food. But with regard to using the flesh of animals which have been affected with *parturient fever*—a disease with which parturient apoplexy is so often, and has been for so long, confounded—that is quite another matter, as in this we have a blood poison—sepsin.

Though the prognosis is generally so uncertain, yet there are several manifestations which may assist us—at any rate to some extent—in forming an opinion as to the probability of recovery or death. Thus the earlier the attack occurs after parturition, the more serious the case may be considered; while the longer its invasion takes place after that act, so is it less likely to be fatal. When it appears within twenty-four

hours after calving, then it nearly always terminates in death. It is the same when the attack is very sudden and severe ; when there is marked coma, rapid and general loss of heat, great distension of the rumen (which may speedily cause asphyxia), violent convulsions, deep mucous *râles* in the trachea and bronchi, lustreless eyes—insensible to light or touch ; paralysis of the digestive organs—indicated by meteorismus, torpidity of the bowels, so that the rectum remains empty when it has been evacuated ; as well as paralysis of the pharynx and œsophagus—shown by inability to swallow ; suspended lacteal secretion, relaxed sphincters, puffing breathing by the mouth, pendulous lower jaw, and total suppression of milk.

The favourable indications are maintenance of the normal temperature in body and limbs, or the slightest elevation when this is low ; natural tint of the mucous membranes ; expulsion of the urine either spontaneously or when the finger is introduced into the urethra ; and, according to Schaack, "a mode of respiration in which the animal retains its breath for an instant, then allows the air to escape by a long and slightly plaintive expiration."

It is likewise a very favourable sign when the fæces are passed. A return to consciousness is also, of course, a happy omen, and particularly if the animal attempts to rise, desires food or drink, and the lacteal secretion begins to reappear.

In some cases, however, there appears to be slight recovery, and yet fatal relapse takes place. The pulse will also aid in forming an opinion as to the probable termination of the malady.

The longer the disease continues, so the more hope there is of recovery ; though there is all the more danger of pneumonia from extraneous matters in the bronchi, if the coma or the paralysis of the muscles of deglutition lasts for some days. Weigand says that when an animal continues lying for six to eight days, unless it can eat and drink, it should be killed.

Causes.

The unanimous opinion with regard to this disease is that it is peculiar to the puerperal condition, and that it has a close relation to the state of the Cow previous to parturition, and to a more or less marked *breed* or *individual* predisposition. So far as breed is concerned, it is a fact that the Cows most liable to be attacked are those in which the secretion of milk is abundant—"deep milkers"—and which are in a more or less plethoric condition. With the perfecting of Cows for the production of milk, this disease has become vastly more prevalent. Numerous observers testify to this fact. "Since in Algau," writes Bentele, "the Cow has been so largely utilised for the production of cheese—converted into a milk machine, in fact—the previously unknown calving-fever has appeared."

So it is, that in countries or districts where Bovines are reared more for their flesh than their milk, parturient apoplexy is not a very common malady, and the losses from it are comparatively small. It is, therefore, a disease almost peculiar to the best breeds of milch Cows, and the malady has extended with the extension of these breeds. For instance, in North Holland it appears to have been completely unknown forty years ago ; but when attempts were made to improve the milking qualities of the Cows by importing numbers from South Holland—where they are "deep milkers," and where the disease is very frequent—then it showed

itself, much to the surprise of the veterinary surgeons and cattle-owners, who were previously unacquainted with it. And it is supposed that the greatly-increased prevalence of puerperal apoplexy in other countries—as Italy, Spain, France, and the United States of America—is due to the introduction of these South Holland Cows.

In our own country there are districts in which it is rarely seen, while in others it is quite frequent.

With regard to *individual predisposition*, there can be no doubt that even in these predisposed breeds there are animals which suffer from parturient apoplexy more than others; and instances are reported of Cows being attacked after several consecutive births.

Plethora, no doubt, exercises a great influence in the production of the disease; for it is chiefly among well-fed Cows—particularly those kept for milk in the vicinity of large towns, which seldom or never leave their stable, and are abundantly nourished immediately before calving—that parturient apoplexy prevails most seriously and extensively. Even among Cows at pasture, when the herbage is luxuriant, the disease is far from infrequent, and the fatal cases are numerous. It is true that it may attack milch Cows in moderate, or even in comparatively poor condition; but then it will be found that their hygienic management is at fault. They may be Cows which, having been scantily fed during a long winter, are abundantly supplied with food in the spring; or they are Cows which, purchased in low condition, receive a large supply of food from their new owner. Köhne[1] states that he had occasion to observe eighty cases of this disease at Kemper (Rhenish Prussia), and that the majority were Cows which, bought lean in Holland, some time before parturition, had passed without any gradual transition from the Dutch pastures to the stables of the Rhenish feeders, where they received a large amount of food. Kniebusch[2] and others have made similar observations. It has also been remarked that a uniform, and even abundant diet, is less dangerous than an abrupt change from scarcity to generous allowance.

When pregnant Cows which have been for some time at pasture, are taken into the stable a few days before calving, they are often seized when age and other circumstances predispose them to the disease.

The risk is all the greater if the secretion of milk has been suspended for some time before calving, the Cows meanwhile receiving the same amount of food.

Permanent confinement in the stable also acts in a similar manner to abundant and stimulating food, by inducing plethora and laxity of fibre. Thus it is, that while the disease is prevalent in the cowsheds of towns, or in those from which the cattle are seldom driven out to graze or for exercise, it is almost, if not quite unknown in hilly pastures.

Age, or rather the *development of lactation*, has also a powerful influence. When the secretory function has reached a certain point, the Cow appears to become much more predisposed to an attack. Thus it is asserted that parturient apoplexy has scarcely ever been observed in a primipara, and very rarely indeed before the third Calf, when the lactiferous system has almost attained its maximum development in the more precocious breeds. In 29 cases reported by Haycock,[3] 3 occurred after the third Calf, 5 after the fourth, 16 after the fifth, 2 after the

[1] *Magazin für Thierheilkunde und Viehzucht*, 1855.
[2] *Ibid.*
[3] *Veterinarian*, 1851.

sixth, 3 after the eighth. After the third Calf, or even previous to its birth, dairy-keepers are averse to purchasing the better-bred milch Cows.

Temperature is supposed to influence the production of the disease, and especially exposure to cold. The suppression of the cutaneous functions, and the determination of the blood from the surface of the body to the internal organs, must favour congestion of these organs. Therefore it is that currents of cold air, lying on cold ground, and cold fluids ingested immediately after parturition, have been looked upon as powerful occasional causes. Sanson thinks that the sudden expulsion of the blood so abundantly contained in the uterine mucous membrane and cotyledons—and which should be only slowly diffused—forces that fluid into the neighbouring vessels, and surcharges them beyond measure; while Ayrault is of opinion that the cold air, entering the uterine cavity by its partially dilated os, drives the blood from the mucous membrane into the other viscera, suddenly checks the lochial secretion, and thus gives rise to the disease. This lochial secretion plays an important part in the genesis of the malady, according to several authorities.

Other writers suppose that the disease is more common during warm than cold seasons. In fact, it prevails in the most diverse temperatures, and it is as serious in cold as in warm weather. Sometimes the number of cases is very great, without any reference to heat or cold; then almost suddenly they subside, and no more outbreaks occur for some time. This has led to the supposition, again, that it depends for its development on a peculiar condition or epizoötic constitution of the atmosphere, but in what this consists no one has attempted to explain. Köhne says: "It is certain that when one of these periods of vitulary fever prevails, a change of atmosphere has occurred or is about to take place, though the converse is not true—for when an atmospheric change takes place we cannot predict an invasion of this fever. But if it happens that several cases of the malady follow each other immediately during a certain atmospheric constitution, we may assuredly predict a change in the weather. This change most frequently consists in a transition from settled to rainy weather, bringing about a diminution in the barometric pressure."

Some veterinarians have ascribed the disease mainly to infection—assimilating the puerperal fever of woman to the parturient *processus* in the Cow, but of this there is little evidence indeed; while others, as already mentioned, imagine that it is merely a nervous form of parturient fever, and due to blood-poisoning.

Günther, very many years ago, and a few others more recently, fancied it was produced by a *moral influence*—the removal of the Calf soon after birth, which distressed the Cow. But it was forgotten that the malady sometimes occurs when the Calf is with the Cow, and sucking; and that other creatures in which the moral faculties are more highly developed, and which exhibit great anxiety and distress on being deprived of their progeny, do not suffer from parturient apoplexy. Besides, the disease is no more prevalent in those countries or districts where the Calves are taken away from the Cows at an early period, than where they are allowed to remain with them.

Others also have attributed the occurrence of the disorder to *mental excitement* during the act of parturition; but surely this excitement must be greater with the first Calf or with the second—when the disease seldom appears—than with the third, fourth, or fifth Calf, when it is so frequent. Not only this, but it is a notorious fact that parturient

apoplexy, in almost every case, follows an easy and rapid expulsion of the fœtus without assistance, and ejection of the fœtal membranes at the ordinary time. Indeed, parturition is generally wonderfully easy and the opposite of abnormal. So much is this the case, that Köhne boldly asserts that a difficult or protracted delivery is never followed by this disease; and another authority (Banderschieren) is no less positive in declaring that if a Cow has a difficult calving, or if the placenta is retained, there is little reason to apprehend an attack of the disease. But this statement is not absolutely correct.

The more rapidly the uterus contracts and resumes its normal size, so the more danger there is of parturient apoplexy; while the longer it remains relaxed or the membranes are retained in it, so the chances are diminished. In the examination of the bodies of Cows which have died, the uterus is generally found very firmly contracted. Before the expulsion of the fœtal membranes, the disease is exceptionally rare. In a very few cases, the attack has commenced during parturition, and in still fewer before birth, when the lacteal secretion had not appeared.

Constipation and gastric repletion have been held by one or two writers to be causes, and others attribute it to over-repletion immediately before parturition.

These are the chief causes which have been given as operating in the production of this grave affection; and it will be seen that they are sufficiently numerous and diversified to prove that the nature of the disease is obscure—so far at least as its etiology is concerned. The chief points to be remembered may be stated as follows: parturient apoplexy, as a rule, attacks Cows within one to five days after parturition, and especially when that act has been easy, prompt, and natural; the animals which are affected are those of the higher breeds, good milkers, in a state of plethora, and pluriparæ; one attack predisposes to another. This leads to a consideration of the *pathological anatomy* and *nature* of the malady.

Pathological Anatomy.

Notwithstanding the numerous, characteristic, and striking symptoms which mark this disease, the *post mortem* appearances, no matter whether the animal has been killed or allowed to die, are for the most part of a somewhat varied character. In the majority of the descriptions there is much confusion, the lesions of parturient fever being mistaken for those of parturient apoplexy, and *vice versâ*, just as the two diseases are confounded with each other. In this malady the generative organs are usually little changed; the uterus may be congested—which it always is immediately after parturition, or it may even be paler than usual; but it is generally firmly contracted.

The digestive organs are also usually normal, or their bloodvessels are much distended—perhaps due to paralysis of the vaso-motor system of nerves. The rumen is distended with gas in many cases, and the third compartment of the stomach is often filled with hard dry food between its leaves, while the intestines contain somewhat hardened fæces. The gall-bladder is sometimes much distended. The lungs are normal, perhaps slightly emphysematous; at other times they are congested, or in different stages of pneumonia if foreign matters have obtained access to the air-passages. The examination of the brain has not yielded very satisfactory or constant results. Some authorities have not discovered any pathological lesions worthy of note, either in

the brain or spinal cord, or their envelopes; while others have found well-marked and important lesions. These varied from venous congestion to œdema, anæmia, and exudation. Violet, in addition to finding a quantity of foul-smelling reddish fluid in the uterus (which was not inflamed), observed congestion of the pia mater with very dark blood; there was also congestion of the vessels in the brain tissue, and a long clot in the great *vena Galeni*. In other instances a similar condition was observed; but in all the spinal cord appeared to be healthy. Bragard and others have constantly found injection of the brain and its meninges. Saake and Festal have also witnessed congestion of the vessels of the encephalon, sub-arachnoideal effusion, extravasation, and blood-clots on the surface of the cerebrum and cerebellum. Others have seen serous effusion in the lateral ventricles and traces of spinal meningitis; while Binz has observed sanguineous extravasation and gelatinous matter at the origin of the sympathetic nerve, and Fabry blood-clots at the base of the brain, with serum in the cavity of the arachnoid.

In one instance Schaack met with a clot, three-fourths of a line in thickness, covering the left side of the medulla oblongata, and serous effusion into the lateral ventricles; and in another instance an inflammatory exudate on the right side of the cerebellum. Harms has found, in many cases, air in the cerebral bloodvessels; and Noquet and others have reported alterations in the spinal cord, which was reddened, congested, more rarely covered with exudate—chiefly in its lumbar portion, and sometimes the sciatic plexus of nerves has been involved.

Nature.

With regard to the nature or efficient cause of the disease, there has been a great diversity of opinion, and even now the most eminent veterinary authorities are not at all agreed as to its pathology. With some it is a fever—a nervous or paralytic form of parturient fever—closely allied to the puerperal fever of woman, and due to blood-poisoning, the two forms only differing in degree. But it should be remarked that in this Bovine malady there is no fever; that the temperature is generally below the normal standard; and that recovery is often rapid, if not sudden.

Other writers have imagined it is a grave form of gastric fever, because there is constipation, and impaction of the digestive organs with hard dry food. But such impaction may occur at any time, and it does not give rise to the symptoms of parturient collapse, neither does it cause death so rapidly.

The more prevalent opinions as to the essence of the disorder may be classed under five heads: 1. Hyperæmia of the nerve-centres; 2. Anæmia of the nerve-centres; 3. Derangement or paralysis of the nerve-centres; 4. Alterations in the constituents of the blood; 5. The presence of something abnormal in the blood that leads to the development of the symptoms and lesions observed.

1. Hyperæmia of the Nerve-Centres.—Since 1847, when Festal read a memoir before the Central Veterinary Society of France on this disease, the opinion has been held by a large number of veterinary authorities that it is due to plethora, and consequent congestion or apoplexy of the nerve-centres. Festal found blood-clots beneath the

cerebral arachnoid membrane, which he attributed to hyperæmia. In 1853, Noquet attributed the congestion of the trisplanchnic nerves and cerebro-spinal nervous system which he constantly found, to plethora, engorgement of the stomach, and intensity of the milk-fever.

For Sanson,[1] the *collapsus* of parturition is the consequence of a sudden disturbance in the physiological condition of the uterus after parturition, consisting in the abrupt removal of blood which congested the organ at that time; as during gestation a large portion of that fluid is diverted towards the pelvic region, where the uterus is lodged. After parturition the mucous membrane and cotyledons of the organ have lost their function, and the enormous quantity of blood they contained is suddenly thrown into the circulation, surcharges the neighbouring vessels beyond measure, and produces collapse; this diversion of the blood is greatly favoured by cutaneous chills. In proof of this, at the autopsies he made, Sanson affirms that the mucous membrane and cotyledons were always found bloodless, and of a pale-yellow colour.

This theory has much analogy to that of Franck, which will be alluded to presently. In 1858, Ayrault believed that the cerebro-spinal congestion was brought about by the direct action of cold on the uterus, from which the blood was repelled. Felizet, in 1866, advanced the theory that this congestion was the moral result of removing the Calf from the Cow immediately after parturition. Professor Violet is satisfied that an easy birth suddenly diminishes the intra-abdominal blood-pressure, which affects the heart so much during pregnancy, and to which it and other organs have to accommodate themselves. Birth taking place rapidly, the heart continues to act in a fashion to which the bloodvessels, particularly the capillaries, are not accustomed, so that they gradually become distended, and finally congested; hence ruptures and hæmorrhages may occur, and a fatal termination. Others—among them Deneubourg—trace the commencement of the disease to milk-fever, the intensity of which, originated by a rapid and easy delivery, is in proportion to the development and secretory power of the mammæ. The resulting disturbance is spread over the entire economy, and favoured by the repletion of the stomach and the pre-existing plethora—suddenly increased by the mass of blood which goes to the uterus during pregnancy—as well as by the state of the nervous system in general which the pains of labour have induced, excites grave disturbance in the important functions of digestion, circulation and innervation. Hence arise disorders as much more sudden and serious as the repletion of the stomach and the plethora are great; the blood is rich and plastic, and the irritability of the nervous system—especially the ganglionic—is excited. Consequently, there is a general functional disturbance resulting from the "congesting" action of all the cerebro-spinal and trisplanchnic or ganglionic nerves.

Some have considered the disease to be essentially an encephalitis, myelitis, meningo-cephalitis, or a cerebral or medullary apoplexy, according to the character or seat of the lesions found after death. But some of these opinions are opposed by the fact that many of the lesions on which they are based are seldom observed, and that the recovery of affected Cows is often very rapid.

[1] *Journal de Vétérinaires du Midi*, 1854.

Professor Trasbot asserts that the disease is the result of spinal congestion, with consecutive paralysis.

In England the opinion has long prevailed that puerperal collapse is the consequence of cerebral congestion, generally terminating in hæmorrhage, and that the peculiar distribution of the cerebral blood-vessels in the Cow predispose to this accident. It may be noted that a similar arrangement of these vessels is present in the Pig, and that, according to some German veterinarians a disease very like the puerperal collapse of the Cow is observed in Sows after parturition in North Germany; but Thomassen[1] points out an important difference, inasmuch as in the Sows the paralysis is not complete, there is intense fever, and the animals generally recover.

2. Anæmia of the Nerve-Centres.—Many years ago, Haubner came to the conclusion that puerperal collapse was due to cerebral anæmia resulting from an *ex vacuo* hyperæmia of the abdominal organs, as Cows of a certain age were predisposed to this congestion from want of contractile power in their abdominal parietes. Werner and Prehr were also of opinion that cerebral anæmia was owing to abdominal congestion. Billings[2] supposed that an exaggerated sensibility of the uterine nerves, induced, in a reflex manner, spasm of the arterioles of the brain and kidneys, and so caused anæmia of these organs. Franck believed the condition to be owing to secondary anæmia succeeding congestion of the brain, occurring in Cows which had an easy and rapid delivery. The sudden contraction of the uterus and its diminished capacity brought about by the *post partum* pains, causes great disturbance in the blood circulation. The organ receives much less blood, and this, in ordinary cases, is compensated for by the increased afflux to the mammæ and the skin; but a chill to the latter may upset this physiological compensation, and the repelled blood is diverted elsewhere; if this be to the brain, then there is cerebral congestion and consequent œdema, resulting in anæmia by compression of the blood-vessels. There is a predisposition to serous effusions in animals after parturition, because of the hydræmic condition of their blood, and especially when there is passive congestion of the kidneys and albuminuria towards the termination of pregnancy. The great frequency of cerebral hyperæmia in the Cow, was regarded by Franck as a consequence of the division of the internal carotid into a number of small vessels before it enters the cranial cavity, as well as the formation of the *rete mirabile* from a common branch that gives off the cerebral arteries.

This theory is adopted by Göring, who edits the second edition of Franck's work on "Veterinary Obstetrics," and is accepted by many practitioners.

Werner's[3] theory is somewhat analogous to that of Franck. The vascular system is involved, as shown by the diminution of temperature and the lacteal secretion, as well as the nervous system—manifested by the general depression, loss of sensation, inactivity of the spinal cord in the dorsal region, suspended digestion, quickened action of the heart and slowing of the respiration. Too rapid evacuation of the contents of the uterus causes descent of the abdominal viscera,

[1] *Recueil de Médecine Vétérinaire*, 1889, p. 784.
[2] *American Journal of Comparative Medicine*, 1884.
[3] *Wochenschrift für Thierheilkunde und Viehzucht*, 1868, p. 363.

dilatation of the posterior aorta, and slowing of the circulation. The primary cause of all this is bad management of the Cows, and pressure of the fœtus on the stomach and intestines, diaphragm, vena cava, and posterior aorta.

3. Derangement or Paralysis of the Nerve-Centres. — Many high authorities—among them Köhne, Binz, Carsten-Harms, Wannovius, Busch, Röll, Rychner, Baumeister-Rueff, Barlow, and others—have maintained that the disease is primarily a derangement or paralysis of the ganglionic nervous system, which affects, or is extended to, the spinal cord and brain during the course of the disease. The following explanation is offered in support of this opinion. A too easy birth throws out of play a certain amount of the nervous force destined to the accomplishment of this act. Hence, there is a disproportion between the polar tension of the force conveyed by these nerves and the muscular irritability, and consequently an obstacle to the conductibility of the nerves charged with the distribution of this superfluous portion of the nerve force. Barlow thought that this disturbance in the function of the sympathetic nerves produces arrest of secretion and general congestion, especially of the brain and spinal cord. Contamine is more or less a partisan of this theory, as he explains the origin of the disease by stating that a reserve of nervous influence which is not expended in the animals that calve easily, by a reflex movement acts at first upon the spinal cord, and afterwards on the brain.

4. Alterations in the Constituents of the Blood.—The opinion has been emitted that the collapse is due to an undue preponderance of water in the blood of some Cows, during the later stages of pregnancy, and that this results in cerebral œdema after parturition. Another opinion is that the collapse is a kind of leucocythæmia, from the increase of white corpuscles in the blood during pregnancy, and after parturition.

But neither of these opinions can be reconciled with the symptoms or *post mortem* features of the malady.

A third opinion attributes the disease to an excess in the proportion of red corpuscles, and this certainly is more acceptable than those just noticed.

5. The Presence of something Abnormal in the Blood, which leads to the Development of the Symptoms and Lesions Observed. —It has long been a popular notion in several countries that puerperal apoplexy is caused by the absorption of the milk into the blood circulation; hence the designation of "milk-fever" given to the disease in England, France, Germany, etc. Lafosse's theory had something of this notion in it. According to him, the malady is due to the circumstance that the milky fluid secreted by the cotyledons, and absorbed by the chorial villi for the nutrition of the fœtus, being no longer separated from the blood after parturition, remains in the circulation and accumulates there until the mammary glands eliminate it. When these glands act promptly, the fever is imperceptible or almost nil; but if they are slow in secreting, then arises a more or less intense morbid disturbance, due more especially to the presence in the blood of a product foreign to its normal composition. Without commenting at any length on this theory, it may be sufficient to mention that in some cases of parturient apoplexy the function of the mammary glands is not suspended; though

the theory would seem to receive some support from the fact, that when the milk is abundantly secreted the animal usually recovers rapidly.

Carsten-Harms considered it an æræmia, air having entered the uterine bloodvessels by aspiration, after shedding of the placenta; and in proof of this he asserts he detected the presence of air in the cerebral vessels.

Stockfleth, Lanzillotti-Buonsanti, Zundel, Raynaud, and others, have maintained the hypothesis that the absorption of septic matters formed in the uterus from the lochia, blood-clots or tissue *débris*, acted upon the central nervous system and produced the rapid and characteristic alterations that mark the disease.

Abadie thought it was a mephitic poisoning, induced by the absorption into the blood of gases evolved in the stomach by indigestion; while Hartenstein attributed the malady to absorption of certain matters formed in the muscular tissue of the uterus, and especially to the production of uric acid during parturition.

In 1885, Schmidt-Mülheim published a theory with regard to the genesis of the disease, which has since been adopted by some veterinary notabilities. According to this authority, it is of toxic origin, and is analogous to the condition observed in Man, and known as Botulism, due to the ingestion of sausages and flesh in which a ptomaine or leucomaine has been developed. These animal alkaloids produce paralysis of the tongue, palate, pharnyx, larynx, œsophagus, etc., and even of the digestive organs and bloodvessels, and the author of this theory fancied he could trace the same morbid symptomatology in the Cow as in Man. The toxine, he believed, was generated from the albuminoid matters contained in the closed uterus. The supporters of the view that the active agent is a poison elaborated by an excessive cytolysis or histolysis of tissue—processes which, it is pointed out, are extremely rapid at the pre-parturient and parturient periods—appeal to clinical facts in its favour. The disease is most frequently seen in plethoric animals, which also yield a large quantity of milk, in which the act of parturition has been brief and easy, chiefly because the progeny is small, and in which the lacteal secretion is partially or entirely suspended; while it is rarely witnessed in lean Cows which give a comparatively small quantity of milk, are moderately fed, have exercise, and are allowed to suckle their Calves.

To the objection that, at the parturient period, tissue changes are equally active in other species, it is stated that the great difference in the placenta of the Cow as compared with that of these creatures, the larger vascular development, and the relatively enormous size of the udder, with its vast secretory capacity, predispose to such a malady. At the parturient period, it is argued, cell destruction in the Cow must go on at a rate quite disproportionate to that at which it proceeds in other animals, and that in every case the products of this cell change must in a greater or less degree gain access to the circulation. Under certain influences—dietetic, thermometric, or barometric—the milk-forming functions of the udder may be arrested, and the gland-cells be diverted from their natural function. The products of cell change being absorbed in undue quantity, may act primarily as nerve excitants, and, secondarily, as nerve depressants. Still further to confirm this hypothesis, the striking analogy between puerperal collapse and hæmoglobinuria in the Horse is adduced; and the fact that both diseases can frequently be arrested or their violence ameliorated in the early stages

by evacuants, with external and internal stimulants, is offered as additional proof; though it is not contended that the toxic agent is the same in both maladies—the agent in hæmoglobinuria acting alike on the nervous and vascular systems, while in puerperal collapse its direct action is exerted on the nervous system only—any vascular phenomena observed *post mortem* being merely the result of vaso-motor paralysis (*Walley*).

But it may be observed that even this hypothesis does not meet all the requirements of the pathologist; for if the malady were due to a toxine, surely the flesh of affected animals would prove toxic when used as food. Such is not the case, however, as all experience, experimental and other, goes to show; and there are other facts as important which cannot be explained by this hypothesis.

In trying to account for the evolution of the malady, it is necessary to remember that it exclusively affects Bovines of the female sex; that it is observed chiefly, if not entirely, in well-bred and well-fed animals which yield a large quantity of milk, are of a certain age, and usually after they have had their third calf; that it most frequently becomes manifest in two or three days after parturition, rarely before that event, and always after an easy and quick delivery; that its advent is sudden and course serious and rapid, the terminations being death or speedy recovery, generally without any period of convalescence.

It may well be questioned whether an animal toxine in the blood would produce the phenomena denoting this disease under such circumstances, apart from the fact of the innocuousness of the flesh of affected animals when consumed as food.

It must be remembered that the predisposed Cow during pregnancy and before parturition occurs, is in a state of exalted physiological plethora and high vascular tension, much beyond that of the females of any other species at the same period, owing to her organization and the great artificial development of the lacteal apparatus. In other female animals when birth takes place, the extra blood demanded for the development of the fœtus *in utero*, is now diverted to the mammary glands to supply it with the nourishment it needs for a certain time after it is born; in this way the vascular system is enabled to maintain its equilibrium immediately after parturition, and gradually to resume its normal condition as the young creature is competent to subsist independent of its parent. In the non-predisposed Cow under natural conditions this also occurs, and nothing different is observed from what is seen in the Mare, Sow, Bitch, or other creature at the post-parturient period. But when, from any cause, the excess of blood which was required for the growth of the fœtus is not diverted to its natural purpose after the young animal is born, there is a rapid transition from physiological action to pathological processes in all animals, as well as in woman, in whom, owing to constitutional fault, or causes interrupting the due course of involution, the work of metabolism or conversion of the now superfluous tissues formed during pregnancy, and of absorption and elimination, is imperfectly performed.[1]

Predisposed as is the Cow by artificial management, and possibly by anatomical and physiological peculiarities, the pathological changes which ensue more or less promptly after parturition when the vascular tension is not reduced, and the substitution of absorption and milk

[1] Dr. Barnes, *The Lancet*, December 1, 1894.

secretion for construction does not take place, are chiefly located in the nervous system, and especially in the brain. Congestion of the cerebral vessels at first, which may speedily lead to effusion of serum or hæmorrhage, is indicated by the symptoms and lesions observed in many cases; while the rapidity with which recovery sets in, and the reported success attending the adoption of a certain method of treatment, supports this opinion, and negatives that of septic infection or the presence of ptomaines in the blood as the cause of the disease—did not the history and symptoms otherwise contra-indicate such influences.

The mechanical effect on the blood circulation of a sudden diminution of pressure on the bloodvessels in the abdominal cavity, if a factor in the causation of puerperal collapse, would, it might be expected, be witnessed in other animals in which distension of that cavity during pregnancy is quite as exaggerated as in Bovines. Besides, there is no evidence that vascular engorgement of the abdominal organs is a constant feature in necropsies of Cows which have succumbed to the disease; neither is anæmia of the brain always, or even often observed.

That puerperal collapse in the Cow is chiefly, if not entirely, due to vascular disturbance, may be inferred from the physiological condition of the animal previous to attack, the clinical history, and the necroscopical appearances, no less than from the results of therapeutical measures in certain cases; and that this disturbance assumes, primarily, the form of congestion of the nerve-centres may also be accepted, as this theory forms a good basis for the adoption of a rational system of prevention and cure.

Diagnosis.

Puerperal collapse has been confounded with parturient fever and metritis, *post partum* paralysis, as well as with parturient eclampsia; so that a distinction from these is important, especially with regard to medical and sanitary measures.

The symptoms of parturient fever and metritis or metro-peritonitis, as we have described them, when compared with those of the disease now under consideration, differ so widely that a mistake should not be made if ordinary care is exercised; the thermometer will establish the chief difference, while sensibility and consciousness being present in one affection and suspended in the other, should fix the diagnosis.

In *post partum* paralysis, the animal is conscious, often bright and attentive to surroundings, generally free from fever, and eats and drinks as usual; the only symptoms usually noticeable being inability to get up, and to stand when raised.

By some authorities, and especially by Franck, it has been maintained that puerperal collapse and eclampsia are one and the same disease. But as will be noted when the last-named malady comes to be dealt with, there is a difference between these diseases, though a mistake is more pardonable here than with the preceding disorders. In eclampsia there are successive and alternating attacks of convulsions and coma; whereas puerperal collapse is marked in its later stages by coma only.

Prophylaxis.

In view of the great and rapid fatality attending puerperal collapse, and knowing that the subjects of it are hearty-feeding, deep-milking Cows in a state of extreme physiological plethora, with a strong tendency to vascular congestion of important organs, there is every

reason to lay great stress on *preventive treatment*, and to combat the predisposition to the malady by strict attention to hygiene, particularly during the last months of pregnancy and immediately after parturition. The diet should be soft and easily digested, so as to avert constipation, and the allowance ought to be rather sparing. When it is possible to permit exercise for some time before parturition, this should not be withheld. Nothing is so likely to prevent an attack of the disease than keeping the Cow in as natural and free a condition as possible, with all the functions of secretion and excretion in full play, more especially at birth and immediately after that occurrence. Exposure to cold and currents of air, and everything likely to diminish the functions of the skin, should likewise be avoided.

More special precautions have been recommended by various authorities, founded generally on the opinions they may have entertained as to the pathology of the disease; but the utility of these prophylactic measures has been more or less disputed. Bleeding during the month before parturition has been highly lauded, but there is every reason to believe that it is more injurious than useful. Others recommend the administration of nux vomica, tartar emetic, nitrate of potass, sulphate of soda or magnesia, and laxatives of various kinds—all of which may prove more or less useful; while others, again, speak favourably of milking the Cow by hand a few days before calving, and thrice instead of twice a day for a short time after that event, if the Calf is removed or cannot abstract sufficient milk. This they more particularly insist upon doing if the udder is largely developed or distended.

As Cows which have had difficulty in calving, and whose genital organs are more or less irritated or injured, are rarely attacked by puerperal collapse, it has been suggested that a counter-irritant, such as mustard, should be immediately applied to the loins or hind-quarters of those which have calved easily and are likely to become affected.

As there may be danger if the newly-calved Cow is allowed to drink much cold water, this should either be very sparingly given, or, better still, warm gruel, in small but frequent quantities, may be substituted.

Curative Treatment.

The different methods of treatment enumerated for the cure of this disease are completely bewildering, and they are so diametrically opposed to each other—from the obscurity which prevails as to the nature of the malady, it may be inferred—that we can scarcely be astonished to find that they are all more or less unsuccessful, and that the majority of the most observant practitioners are inclined to believe that recovery has followed most frequently when, without adopting active measures, the attendant has waited for the curative effects of nature—usually decided about the second or third day, only attempting to combat certain morbid conditions which might aggravate the case.

Nevertheless, it is evident that some mode of treatment must be resorted to; and that this should be based on the indications furnished by the symptoms during the course of the malady, or upon what we know of its pathology, is obvious. We shall glance at some of the means which may be employed in the curative treatment of the disease.

Previous to doing so, however, attention must be directed to the *position* of the affected animal, and we cannot do this in better terms than those

of Williams:[1] "If the Cow is already down when first seen by the practitioner, his first care must be to see that she is made to lie as near the natural position—on the sternum—as possible; and this he will do by having her packed up at the side by bundles of straw, or, what is better, sacks filled with straw, firmly wedged under the quarter and shoulder, the head at the same time being properly propped by the same means, and care being taken at all times that the Cow is prevented from injuring her head by striking it against hard bodies." It may be added that some practitioners are particularly careful to have the head well raised above the other parts of the body, especially when the animal is comatose; and this is sometimes effected by means of a halter on the head, or a rope round the base of the horns, the other end being passed over a beam in the stable. This elevation of the head prevents increased congestion of the brain, and facilitates the return of blood from that organ.

It is often beneficial to alter the position at intervals—every two or three hours; and Williams recommends that the mammary gland be also "stripped (emptied) and hand-rubbed."

The *abstraction of blood* has found much favour with many authorities. Williams says: "In the earlier stages, whether the animal is standing or lying prostrate and in a state of coma, if the pulse be not excessively weak and the heart's action almost fluttering, recourse must be had to venesection. Slow and deep breathing, with a tendency to stertor, add greatly to the necessity for immediate bleeding. The beneficial action of the withdrawal of blood is shown by the pulse becoming fuller, stronger, and better in tone. The opening into the jugular is to be a large one, in order that the blood may flow freely to relieve the congestion—to check, if possible, a further extravasation of blood or effusion of serum, and to divert its active flow into the head; but it must not be carried out so as to debilitate the heart's action. When the pulse becomes fuller and stronger, the bleeding is to be stopped; from three to five quarts will generally be sufficient."

Theoretically, venesection is to be commended. If the theory be accepted that the condition is due to hyperæmia—and it has been shown that this opinion has a better foundation than any other, then a sudden depletion of the vascular system, by which the pressure is diminished, must stop the attack. It is known from experience, says Schroeder, that after venesection the quantity of the blood soon becomes the same, through the serum taken from all the tissues, whilst the quality is greatly deteriorated by the abstraction of blood. A short time after venesection, we shall expect to find the former blood-pressure in the arterial system, but the blood far more watery than previously. From this theoretical consideration, it follows that abstraction of blood must be attended by an immediately favourable result, and under certain circumstances the whole disease may surely be cut short by it. But if all other conditions remain the same, the blood-pressure will, after some time, again reach its previous height; the quality of the blood has, in the meantime, been greatly deteriorated, and consequently the danger of the disease will be increased.

Williams adds: "The bleeding is for the purpose of removing pressure from the brain, and although the pulse may indicate stimulants rather than depletion, it will be found that as the blood flows the tone of the pulse will improve; for the weakness of the pulsation, the want of

[1] *Principles and Practice of Veterinary Medicine*, p. 418.

impulse, and debility of the heart's action, are results of brain-pressure. If, however, the surface of the body be cold, if the animal be tympanitic, the heart's action fluttering, and the pulse almost undetectable, bleeding is calculated to do more harm than good, as the heart's action would now be further impaired, and the amount of arterial blood sent to the brain diminished. For it must be remembered that the cerebral congestion is now less due to an over-abundant supply of arterial blood than to pressure upon it by venous or capillary engorgement; that, in fact, the brain—engorged as it may seem—is in an anæmic condition in regard to its arterial supply; and when this is the case, paralysis of the heart is to be prevented, if possible, by the use of stimulants."

If abstraction of blood is made from the jugular vein, the neck should be constricted as little as possible in "raising" the vessel, and as soon as it is opened the constriction ought to be removed, lest it add to the cerebral engorgement; indeed, to avoid the risk of this it has been recommended to open the mammary or other superficial veins.

A principal indication in the treatment of the disease, viewing it in the light we have done, is to *favour the cutaneous circulation and stimulate the skin* by every means in our power, and thus relieve those organs in which the blood-pressure is too considerable. With this object in view, the skin is to be well-rubbed with straw wisps, and then warmly clothed. Or the course of the spine and for some distance on each side, may afterwards be stimulated with strong ammonia liniment. Some authorities recommend the application of a mixture of croton-oil with oil of turpentine; others employ a thick layer of mustard, after the skin has been well cleansed with warm water and the hair removed; others, again, resort to sacks steeped in boiling water applied to the spine—sometimes after deep scarifications have been made. In addition to the applications of turpentine or mustard to the spine, they are often made to the limbs.

In some cases, a hot iron—the laundress's flat iron—has been applied to the back in an "ironing" fashion, and at a somewhat high temperature, a piece of flannel being interposed between it and the skin. The action of the skin can be greatly augmented by covering the body with a wet sheet, and above this a thick woollen one, surrounding the animal with plenty of litter.

Cold water or ice may be applied to the head; but this application requires care, as the resulting coryza and other complications may prove very serious, should the animal recover from the collapse.

But it must be remarked that this hydropathic treatment has proved a great success in the hands of some practitioners, who were unsuccessful with other methods. Hartenstein and Mauri,[1] for instance, have cured cases which appeared to be hopeless, by first abstracting a quantity (4 kilogrammes) of blood, then placing a wet sheet, folded in four, over the head and along the back, and keeping this constantly drenched with cold water. When the animal began to recover this douching was stopped, the body was rubbed dry and covered with warm rugs. In twenty-four to thirty-six hours recovery was complete without any medicine—another proof in favour of the congestive nature of the disease, and against its being due to sepsin, ptomaines or leucomaines.

With regard to the *tympanitis* which is so often present as a consequence of the torpidity in the digestive organs, this should be combated in the ordinary way, by the administration of stimulants. These are

[1] *Revue Vétérinaire*, June, 1889.

most effective and rapid in their action when given in the fluid form, if the animal can swallow. If it cannot, then they may be administered by means of the stomach-pump or probang, or even in bolus. Williams recommends giving carbonate of ammonia in bolus; the hand, being well oiled, is to be pushed as far as possible into the pharynx, when the dose "will slowly gravitate into the rumen." Should the medicine not act promptly, or the tympanitis be so great that suffocation is to be apprehended, then the rumen ought to be punctured without delay. This may be effected by the ordinary trocar and cannula, the latter being allowed to remain in the rumen for some time. It may be closed by a cork, which is to be withdrawn when the gas accumulates. If care is exercised, fluid medicaments may be introduced into the stomach through the cannula.

Even when the tympanitis is not extreme, but the animal is comatose and there is gastric regurgitation, it will be advisable to puncture the rumen; as by this means the entrance of food into the trachea may be prevented, by allowing the gases to escape through the cannula, instead of by the œsophagus.

Enemas are as essential as counter-irritation. The rectum should first be emptied manually, and then either enemas of warm water, or those of a stimulant or laxative nature, administered. By the rectum enemas of linseed-oil, common salt, sulphate of soda or magnesia, aloes, tobacco, oil of turpentine, camphor, etc., have been administered. The rectum forms a safe and convenient channel for the introduction of medicines, and especially those intended to act upon the torpid digestive organs, when the animal can no longer swallow. Powdered camphor in small quantities has even been introduced into the rectum to stimulate the intestines, when drugs exhibited by the mouth have failed to effect this. Enemas may be given as frequently as necessary without danger to the animal, and with ease—advantages not available by mouth administration.

The *urine* should be frequently removed from the bladder, either by pressure on the viscus through the rectum, the introduction of the catheter or nozzle of the ordinary injection syringe into the urethra, or even by passing the finger into that canal.

As has been mentioned, the *milk* should be often removed, and the udder completely emptied. Even when there is no milk, the teats should be well and repeatedly stripped.

Purgatives are in nearly every case necessary (though some authorities deny this), and they should be active, and given in larger doses than in ordinary circumstances; constipation being a constant and serious symptom, while action of the bowels may be considered a most favourable sign. The most common are sulphate of magnesia or soda, aloes, chloride of sodium, cream of tartar, linseed-oil, castor-oil, tartar emetic, ipecacuanha, croton-oil, etc.

In the great majority of instances these agents are not given alone, but in combination with other substances.

A very favourite compound in Germany is that mentioned by Köhne, the composition of which is as follows:

Nux vomica - - - -	8½ drams.
Tartar emetic - - - -	2 ounces.
Sulphate of soda - - -	18 ,,
Common salt - - - -	4½ ,,

These are boiled together for about a quarter of an hour in four pints of water, and one-fourth given every hour or every two hours.

Harms places great confidence in tartar emetic. He gives eight and a half drachms in about two pints of water, in four hours three drachms in a pint of water, and in five hours two drachms. In one serious case he gave as much as two ounces in fourteen hours. In thirty-seven cases of the disease, only two died.

When it is desired to increase the activity of any of the ordinary purgatives, croton-oil is generally added in the proportion of six to twelve—or even forty—drops, or oil of turpentine one or two ounces.

Some practitioners extol nux vomica in tolerably large doses, to aid in rousing the action of the intestines.

Stimulants—as ammonia—are often administered, and in conjunction with bleeding they may prove of the greatest service at the commencement of the attack, or they may be associated with the purgatives. If given alone, they should be exhibited in small doses and very often. Chloral hydrate has been commended.

Other medicaments have been employed—as aconite, bryonia, camphor, phosphorus, datura, quinine, gentian, digitalis, etc.—with varying success. The subcutaneous injection of some of these medicaments has been much resorted to, and some of the reports as to their effects are in their favour. Strychnine has been administered in this way, also veratrine and eserine, and their utility has doubtless been due to their action on the bloodvessels, more especially the arteries and capillaries.

When recovery commences, small doses of stimulants may be beneficial if there is much debility, and the animal can swallow readily. But in the administration of fluids when the animal is comatose or deglutition is impeded, the greatest care is necessary to prevent their entering the trachea—an accident which might prove fatal. To test whether the animal can swallow, a little cold water may be poured into the mouth from a bottle. If swallowing is difficult, then the only safe mode of administration is by the stomach-pump or probang, or directly into the rumen by the trocar and cannula. Large quantities of fluids are objectionable, and the amount in any single dose should not exceed a pint.

It must also be remembered that, if it is probable the animal will not recover, but will be killed and its flesh consumed as food, drugs of a poisonous kind, or likely to flavour the meat, should not be given. Many cases are recorded in which people have been poisoned, through eating of the flesh of Cows which had received large quantities of poisonous medicines before being killed by the butcher.

Electricity has been employed with success, both in the comatose stage and when paralysis has remained after the attack. Neumann, Holden, and others relate instances of recovery. The Leyden jar, or, better, the induction coil, may be employed.

To sum up, the treatment of parturient collapse consists chiefly in relieving the congestion of the brain (at the commencement), restoring the functions of and stimulating the skin, promoting the action of the intestines, and removing the milk or stimulating the function of the mammary gland.

All violent and heroic treatment should be avoided, as well as large doses of medicine.

Consecutive congestion or inflammation of the lungs must be treated

according to circumstances; and paralysis will be best combated by stimulation to the loins, and the subcutaneous injection of strychnine, with diuretics and purgatives.

Easily digested food in small quantities should alone be allowed immediately after recovery, and the animal must not be given any indigestible food, nor be permitted to eat hay or litter.

To prevent injury to the surface of the body, it is well to change the position of the animal two or three times a day, if soft litter—such as peat moss—cannot be procured. In turning from one side to another, the movement should be on the under part of the trunk after the limbs have been doubled under the body—not on the back; and care should be taken that tympanitis is not interfering with the respiration.

In some cases there remains a certain degree of paresis or inertia, after the more urgent symptoms have disappeared—indeed, when the animal looks bright and well, so that it will not or cannot rise. This condition has been combated successfully and promptly by the administration of an enema containing a quantity (10 to 15 ounces) of oil of turpentine.

It is judicious not to breed from a Cow which has suffered from parturient collapse, unless every precaution is taken towards the next calving period.

CHAPTER V.

Post Partum Paralysis.

In treating of the diseases peculiar to pregnancy, allusion was made to paraplegia (p. 187) as one of these. Paralysis of the hind-quarters is more frequent previous to birth than after that event, and is generally observed in the Cow. After birth, paralysis is comparatively rare, and may affect nearly the whole of the body, or both or only one of the hind-limbs. The Cow is also the animal which oftenest exhibits *post partum* paralysis. The affection may be due to parturient apoplexy or collapse—as already noticed; it may also be a result of metritis; or it may follow difficult parturition, and especially after the birth of a large Calf, or if the latter has been in a wrong position. Franck has often witnessed its occurrence after delivery, when the uterus has been half twisted. Williams gives an instance in which paralysis appeared to be due to mental disturbance!

Symptoms.

The symptoms are similar to those of *ante partum* paralysis.

The animal continues to lie, and one or both hind-limbs may be moved in a convulsive, irregular manner, or they are completely incapable of movement. In the majority of cases, however, the animal is able to turn itself over at intervals from side to side—particularly during the night. Sometimes only one leg is paralysed. Apparent paralysis is at times observed in Cows, which persist in lying after parturition, and though they can move their limbs readily, yet they will not attempt to get up; their appetite is unimpaired, they exhibit no symptoms of disease or suffering, but yield plenty of milk, and the excretions are normal.

This condition may continue for weeks or months, and often animals have to be killed in consequence of it.

Diagnosis.

There should be no difficulty in diagnosing this condition from puerperal collapse, metritis, or other affection incidental to parturition. If the paraplegia does not appear until a short time after that event, and no accident has occurred to cause it, then it has been suggested that myelitis has probably set in, and especially if the paralysis follows mammitis; in that case there is not only the loss of power, but also diminished sensation in the hind-limbs. But if due to a sprain of the back from slipping, then sensation is not impaired, and pain may be indicated on pressure of the part injured.

When due to fracture of the pelvis, crepitation may be heard on movement, or an examination per rectum will detect the damage; or if there is dislocation of the hip-joints the accident will be manifest on moving the limbs. Injury to the hind-limbs from fruitless attempts to rise when recovering from puerperal collapse, can be detected on examining them. When parturition has been very difficult, and great force has been employed in removing the fœtus, serious injury may have been done to the organs in the pelvic cavity, and the lumbar nerves themselves may be involved. Congestion of the spinal cord will produce the same symptoms, but there are, in addition, fever, pain, and sometimes convulsive movements of the limbs.

Pathology.

Little is known as to the nature of this affection. Harms and others thought it was due to injury inflicted on the sacral and other nerves during difficult parturition. The sciatic nerves are particularly liable to injury. *Post mortem* examination, however, has only furnished negative evidence of this. Franck thinks that injury to the cervix uteri may give rise to reflex paralysis; this has been witnessed in a Bitch; and reflex paralysis of the legs has been seen in woman, and ascribed to uterine injury or derangement—when this was remedied the paralysis disappeared. It is not at all improbable that the same causes will produce the same effects in animals.

In some cases the spinal cord has been found injured and its vessels congested, with blood-clots in the spinal canal; and in others the roots of the abdominal nerves have been surrounded by serous effusion.

It can easily be understood how paralysis is induced in parturient apoplexy. Williams states that it is due to inflammation and red softening of the spinal cord in the lumbar region.

Prognosis.

The prognosis must necessarily depend upon the diagnosis. The paraplegia, real or simulated, is due to various causes, and therefore the likelihood of recovery must be based upen the nature and degree of the injury.

If it is only simple congestion of the spinal cord, recovery may take place in a few days; but if decubitus persists after a week, there is reason to apprehend hæmorrhage as a complication of the congestion; though injury to the pelvic nerves will also cause the same symptoms and prolonged inability to get up. These cases are generally hopeless, as are the great majority of fractures.

Whatever be the cause, if the animal can remain standing, when got up, for ever so short a time, it will in all probability recover, though it may be lame in one or both limbs for a considerable period.

Treatment.

Treatment must also depend upon the diagnosis. When the paraplegia is due to congestion of the spinal cord, cold water may be applied to the loins continuously by means of rugs kept saturated, or at frequent intervals by a large syringe or garden hose. After a few days, blisters, or even the actual cautery, should be applied to the loins, and the subcutaneous injection of strychnia resorted to. The condition of the bowels and bladder must be attended to; the former being regulated by feeding, and if necessary by laxatives, the latter by diuretics. Electricity may be useful in some cases, and particularly when only one limb is involved.

In all cases, the state of the uterus should be ascertained, and if it is unsatisfactory, then remedial measures should be adopted with regard to it.

When the animal cannot turn itself, this must be done by its attendants; and if it is a valuable one, and the paralysis is likely to continue for some time, slinging for a short period every day may be tried.

When due to other causes, the treatment must be adapted to the circumstances of the case; with Cows, however, unless there are special reasons to the contrary, and if they are in good condition, it is often advisable to have them killed for food.

CHAPTER VI.

Eclampsia.

THERE can be no doubt that the malady described in this work as parturient apoplexy or puerperal collapse, has often been confounded with the disease known in woman as "eclampsia," and which is also witnessed, with some slight differences, in animals. For it seems to be now admitted that the eclampsia of woman and the malady of the Cow are nearly, if not altogether, identical; and the same or similar causes may be in operation in the production of both. In the first place, the eclampsia of woman is essentially epileptic or convulsive, the convulsions being of a tonic and clonic nature; and in animals convulsions are generally present, and, indeed, may be regarded as a constant symptom.

The symptomatology of the disease in the human female and in animals differs in some particulars, owing no doubt to differences in organization. In woman there are premonitory signs—such as uneasiness, headache, nausea, twitchings, sudden vertigo. Then the attack begins by rapid contractions of the muscles of the face, eyelids, and eyeballs, the latter rolling about in their orbits. These movements soon extend to the head, neck, and other parts of the body, and are rapidly replaced by tonic contraction of all the extensor muscles either of the trunk or limbs. The respiration is stertorous or suspended; the pulse—at first full and strong—is so weak that it is scarcely perceptible; the tongue is protruded from the mouth, and often bitten; foam appears between the lips, and unconsciousness is complete. The attack may last for twenty or thirty seconds; then the tonic convulsions are replaced by those of a clonic kind, preceded by a general state of rigidity. The movements are jerking, and so convulsive that they shake the whole

body. The respiration gradually returns to its normal state, and the pulse resumes its natural rhythm; the jerking of the limbs and body subsides, perspiration appears, and in from one to five minutes all is tranquil; the comatose condition which supervenes varies in duration, but the patient awakes greatly exhausted, and complaining of pain in the limbs. Œdema of the face and limbs has been observed. Exceptionally, there is only one attack; generally there are several, which may succeed each other quickly, when the patient may remain comatose between the pauses, and at the height of an attack death may take place from œdema of the lungs or apoplexy. In favourable cases the intervals become longer, the attacks themselves more imperfect and shorter, until they finally cease. The malady is considered very serious when it occurs during pregnancy, and it has been estimated that one case occurred in every 350 cases of labour.

It will be seen presently how far these symptoms in woman correspond to and differ from those observed in animals.

The disease affects the Cow, Goat, Bitch, and perhaps the Sow. It has been studied by a considerable number of observers on the European Continent, and in this country cases of it have been reported, chiefly by Storrar, Rolls, and Clark. I have only seen one case of it, the animal being a Bitch suckling too many Puppies.

Symptoms.

In the *Cow* the disease occurs at all ages, and may appear occasionally before parturition, but is most frequently observed after that event, and soon; though it may be delayed so long as the twenty-sixth day. Primiparæ often suffer, and it is said to be most frequently witnessed in Cows in poor condition. It is not always recurrent at subsequent pregnancies, in this respect differing from the affection in woman, in which it is also more commonly seen before parturition. When it attacks the Cow *ante partum*, it is believed to be usually about mid-term, and convalescence and recovery may follow without labour being induced.

The symptoms are not so urgent as in woman, and the disease is far less fatal—though during the attack consciousness is abolished, as in her, in at least the great majority of cases.

In the cases reported by Clark,[1] the attack was usually sudden, and without warning, though the Cows had not been altogether well for a day or two previously—this period probably corresponding with that of the preliminary *malaise* experienced by woman. The symptoms were: "foaming at the mouth, champing of the jaws, prominent staring eyes, excited expression, head very often turned to the side; sometimes licking at the fore-leg, stall, or some imaginary object. Some Cows I have heard bellow, others do not do so; there was twitching of the body and limbs (clonic spasm), difficulty in respiration according to intensity of the attack. The convulsions generally last two or three hours, and in the majority of cases do not reach the stage of coma, although I have had cases which have done so."

In a somewhat typical case described by Professor Mauri,[2] the Cow was four years old, and a primipara, which had calved, the placenta being expelled two hours afterwards. On the following morning the animal was seized with tremblings, refused all food, manifested breathlessness, and looked anxious. On being led to the pasture, it was

[1] *Journal of Comparative Pathology and Therapeutics*, 1893, p. 28.
[2] *Revue Vétérinaire*, 1876, p. 65.

perceived that it was weak in the hind-quarters, and in the short distance it had to travel it fell several times. It was put in a shed with a northern exposure, and its Calf being brought, it remained completely indifferent to it. At two o'clock it fell, and Mauri was sent for. He found it lying extended on the right side, the respiration appeared to be entirely diaphragmatic, and it was difficult to perceive the movements of the flanks; the pulse was imperceptible, but the heart's beats were strong. The tongue hung out of the mouth, and the air expelled carried a large quantity of foamy saliva with it. The senses appeared to be completely abolished, and the eyeballs—turned greatly upwards—looked fixed in a remarkable manner. The limbs were rigidly extended, and they, with the trunk, jerked in such a violent manner, that the whole body was shaken without being displaced. The udder was not flaccid, and milk of a good quality was readily obtained from it.

Mauri thought it was a case of parturient collapse, and ordered the necessary treatment. After six o'clock in the evening, while preparations were being made to carry out his prescriptions, the Cow got up and stumbled towards the side of the shed where its Calf was standing. During the night it ate and ruminated. Next morning at eight o'clock there was another attack. The premonitory symptoms lasted for about half an hour, and the animal lay until half-past nine. At mid-day it did not present any signs of disease. It had no more attacks, but the owner, apprehensive of future danger, sold it two months afterwards, and Mauri lost sight of it.

Calmettes[1] mentions that a four-year-old Cow gave birth to a Calf during the night in quite a natural manner, and during the following day it ate and ruminated as usual. Towards six o'clock in the evening it suddenly commenced to tremble and stagger in its hind-limbs, so that it could only walk with the greatest difficulty. At seven o'clock Calmettes noted that the hind-quarters were very feeble; the general sensibility appeared to be increased, and pressure on the dorso-lumbar region caused much pain; the skin was very hot, and the respiration deep and hurried; the pulse was strong and quick, the mucous membranes somewhat reddened, and the muffle damp. Counter-irritants were applied to the hind-quarters, and draughts and emollient enemas administered. At one o'clock in the morning he was again called. The animal had fallen on its side; the general sensibility was diminished, and the skin was very cold. From time to time it was remarked that all the extensor muscles of the limbs were convulsed, which threw the latter into rigid extension; though, when seized by the hands, they could be flexed and moved about. The sensorial functions were completely abolished, and the skin could be pricked or incised without inducing the least movement; the eye, which was generally fixed, pirouetted in its orbit from time to time, while it could distinguish nothing, and could be touched without betraying any sensation; there was also loss of hearing. At this time the respiration was about normal—eighteen to twenty respirations in the minute; the pulse was small and imperceptible; the heart's beats strong; the mucous membrane rather pale than red, and the muffle dry. During expiration there was a labial *souffle*, and an abundance of foamy saliva escaped from the mouth. The animal remained in this condition for six hours.

Towards seven o'clock next morning, when about to send for a butcher, the limbs became rigid and were seized with convulsions, which extended to the entire body. As if by enchantment, the animal placed itself on its sternum, raised its head to the normal position, and finally got up, though with difficulty. It had been in a somewhat deep coma for about an hour.

In the evening it had a second attack, there being general agitation, with hurried respiration and weakness of the hind-quarters. Soon it fell, had numerous convulsions, and manifested the same general insensibility it displayed in the morning. This continued for only three hours. Next morning it appeared to be quite recovered.

Fifteen months previously, and eight days after parturition, this Cow had another attack when returning from pasture; being suddenly seized with tremblings, it staggered and fell. In half an hour afterwards it was completely insensible, and sensationless; the respiration was almost normal, the pulse imperceptible, though the contractions of the heart were powerful, and all the symptoms already enumerated were present, but became more rapidly developed. The convulsions continued for two and a half hours.

Lafitte[2] makes mention of a Cow that calved in the most favourable manner, and four hours afterwards became agitated and restless; soon afterwards, there were convulsions of the muscles of the trunk and limbs, and so much weakness set in that the animal could not stand. The tongue was often projected from the mouth and foam flowed therefrom: the Cow could hear and see during the attack. The pulse was intermittent, and the respiration moderately increased. In about ten hours it arose and gradually recovered. Two days after, it had another and a final attack, which lasted for three hours.

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[1] *Revue Vétérinaire*, 1876, p. 67. [2] *Ibid.*, p. 70.

The same writer alludes to another Cow, which, a few hours after calving, was seized with persistent convulsions and great general weakness, which rendered standing impossible—presenting, in fact, all the symptoms of the previous case. This attack continued for three hours, and another followed on the same day. Then an interval of a day elapsed, when the fits succeeded each other so frequently, and with so much intensity, that the animal died from asphyxia.

These cases afford an illustration of the usual symptoms observed in this disease as affecting the Cow. The urine appears to have been examined in only one instance, and then albumin was present during the crisis, which lasted for three days; but it was not found when convalescence had set in.

In the *Goat* only one case has been reported—that by Lafitte.[1] The animal had been affected with metro-peritonitis following parturition, and for which it had been appropriately treated. Two days subsequently it appeared to be agitated and restless; all the muscles, and particularly those of the jaws, were convulsed; the eyes rolled about; there was abundant salivation, etc., and the creature could not stand. There was only one attack, which lasted for several hours.

The disease has been observed most frequently in the Bitch.

Hertwig,[2] who was the first to describe the malady as it affects the *Bitch*, and Zundel,[3] give a similar account of the symptoms in that animal. The latter had never witnessed premonitory signs of the disease, though Hertwig had. He says that with Bitches which are suckling, and particularly those kept in the house and well fed, it is not rare to observe a state of tetanic rigidity and incomplete paralysis, with the following symptoms: The animal suddenly commences to be uneasy and anxious; the eyes are haggard, sometimes the nose is a little hot; the respiration is very short and quick, though pressure on the chest or abdomen does not cause any pain. In a short time—about a quarter of an hour after the difficulty in respiration was observed—the animal cannot stand, but falls on its side, and lies with the limbs extended: even when raised it cannot stand. The breathing becomes still quicker—from 60 to 100 per minute; while the pulse is 100, small, hard, and irregular. Consciousness appears to be retained, but the animal refuses food and drink, and the alvine and urinary excretions are suppressed. The mammary glands are greatly engorged, hot, and abundantly provided with milk, the quality of which does not appear to be altered or injurious to the young, which usually continue to suck as before. This state continues for forty-eight hours, when death generally occurs from apoplexy and paralysis; though by proper treatment the disease may always be quickly cured. Zundel's description is almost the same, except that he says there are tonic convulsions, with clonic spasms extending rapidly to the whole of the body; sometimes there is trismus, with grinding of the teeth; constantly there is a white foam at the mouth and muscular tremblings of the jaws; the breathing is stertorous, and sensibility much diminished. There are cases in which the eclampsia appears to be merely partial, affecting only the hind-limbs, for instance, and the animal sits, the head being unaffected, and whines. The disease is continuous and without intermissions, the attacks lasting for one or two days. If no relief is afforded, the creature dies from total paralysis, due to congestion of the meninges of the brain, or from asphyxia after a spasm of the glottis.

[1] *Revue Vétérinaire*, 1876, p. 71. [2] *Krankheiten der Hunde*, 1853.
[3] *Dictionnaire de Méd. de Chir. et d'Hygiène Vétérinaires*; article 'Eclampsie.'

Mauri, in giving a similar description of the symptoms in the several cases he observed, lays stress on the difficult respiration, which is very quick, irregular, noisy, and spasmodic, the ribs being fixed in their movements, as in the horse affected with tetanus. The eyes were deviated to the left in one of his cases, and the limbs were convulsed as if the animal were receiving a succession of electric shocks.

There may be only one attack, lasting for a more or less considerable period, or there may be several following each other at longer or shorter intervals. Lafitte saw a Bitch which had given birth to two Puppies, two days previously, and which it was suckling; it had an attack of eclampsia that continued for a day, another of shorter duration on the following day, and a last and slight one the next day. The Bitch recovered, but some days afterwards the Puppies had a similar convulsive seizure, less intense, and shorter in duration. One had three attacks on the first and second days, and died; the other had only two in one day, and survived.

The same authority mentions a Bitch that, four days after parturition, had clonic convulsions of all the muscles, especially those of the jaws; there was much salivation, respiration was difficult, etc. There were no convulsions during the night, but on the following morning another attack set in, which continued until the evening, when the animal died.

In some cases, as many as six attacks have been noted in the course of a day.

With regard to the Sow, there is some doubt whether the disease described as puerperal collapse is not eclampsia. Certainly there are indications which belong to both diseases, but the probabilities are that it is the latter; though it has been classed by Franck with the first-named, which he also erroneously designated eclampsia. It has been observed and reported upon by Ellenberger, Wöstendorf and Seiler in North Germany.

In the cases Ellenberger[1] had an opportunity of seeing, the animals were attacked from three to five days after easy parturition. The appetite was partially or totally lost, the young were neglected, and the animal seldom moved about; soon it persisted in lying, and there was suppression of fæces and urine, with diminution or cessation of milk secretion. The animal lay on its side, the eyes closed, and the body temperature low; at times there were feeble convulsions. The respiration was irregular, deep-drawn, and moaning; the pulse 80 to 90 per minute; and there was great loss of sensibility. Nothing was observed about the generative organs. After twenty-four to thirty-six hours improvement took place, fæces were voided, and the animal began to pay attention to surrounding objects; the temperature rose; the pulse and breathing became normal; the appetite and milk secretion returned; and in from three to five days recovery was complete. All the Sows survived the attack. In one case reported by Seiler,[2] the symptoms were more of a convulsive or epileptic nature.

Etiology and Pathology.

With regard to the etiology of the affection in woman, opinions differ widely, and they are not less conflicting with regard to animals. The points of similarity in the disease affecting woman and the animals enumerated will have been noticed. It occurs in the Cow and Bitch

[1] *Magazin for Thierheilkunde und Viehzucht*, 1869.
[2] Canstatt's *Jahresbericht*, 1862, p. 48.

during pregnancy and within a variable period after parturition, and in primiparæ as well as in pluriparæ. The symptoms are very analogous, though consciousness does not appear to be so often in abeyance in animals as in woman. Albuminuria certainly would appear to mark a distinction, but this condition also has been noted in some animals, while it is not a constant symptom in woman; besides, the urine of affected animals has only been casually tested, and the presence of albumin in it may be as frequent in them as in the human female. The difference in symptoms may be due more to the higher organisation of woman and the circumstances in which she is placed, than to any divergence in the pathology of the malady, in the three or four species in which it manifests itself.

Scanzoni, Dubois, and some others, believed the disease to be a neurosis due to reflex irritation of the spinal nervous system. Playfair[1] quotes a number of medical authorities to show that its etiology in woman is very doubtful, though the coincident existence of albuminuria seems to prove its dependence on the retention of the elements of urine in the blood. But this theory has been controverted by the fact that a large proportion of women had albuminuria before and during pregnancy, and yet had no eclampsia; and also that albuminuria followed the convulsions and did not precede them, rendering it probable that this was induced by the same cause that gave rise to the nervous symptoms.

Traube and Rosenstein ascribed the occurrence of eclampsia to acute cerebral anæmia, due to changes occurring in the blood during pregnancy.

Another authority (McDonald) imagined it is caused by irritation of the vaso-motor centre, as the result of an anæmic condition of the blood produced by the retention of effete matters which the kidneys had failed to remove; and Haultain[2] considered it to be due primarily to renal insufficiency; this gives rise to fits, from a poisoned state of the blood causing general extreme arterial tension through contraction of the peripheral arterioles.

With regard to the etiology and pathology of the disorder in animals, Hertwig, speaking of the Bitch, thought the disease might be caused by chills, the loss of offspring, and consequent stagnation of milk, and mental emotion. Zundel asserted that it only occurred in Bitches while suckling, and only in those of the smaller breeds had he observed it, these having been well fed and being rather plethoric. Mauri also, and others, think plethora a favourable condition for the development of eclampsia, as they never observed it in lean animals; but in Cows those in poor condition appear to be as liable to it as highly-fed ones. Clark firmly believes that the primary cause, especially in post partum cases, is reflex irritation of the uterine nerve-centres, basing this belief on his observation that the attacks in the Cow occur most frequently from the eighth to the twelfth day after calving, this being the period at which the "second cleansing" appears. In all his cases the weather was unfavourable, being cold and stormy, with east and north-east winds; and this, in his estimation, was a potent factor—causing chill, which, acting directly on the nerve-centres of the uterus, produces reflex irritation of the spinal system, which again induces albuminuria.

In the only case I met with in the Bitch, I was inclined to attribute the attack to excessive lactation, the progeny being too numerous.

[1] *Science of Midwifery.*
[2] *Edinburgh Medical Journal.*

As in parturient collapse, the changes found after death are far from being constant in the human female. Depaul found cerebral congestion in very many of the women who had died suddenly from an attack, and Stoltz states he noted this condition in all his autopsies; but McDonald discovered only congestion of the meninges, extreme anæmia of the cerebro-spinal centres, and no evidence of œdema.

Diagnosis.

After the description given of the symptoms, a diagnosis of the malady should not be difficult. The history of the case, and the pregnant or parturient condition of the animal, should be of service in distinguishing the malady from epilepsy. Eclampsia in Cows might be mistaken for parturient collapse, but it should be remembered that the latter generally occurs at and after the third calving, rarely indeed during pregnancy, and usually within two days after parturition; that it is most common in fat or plethoric animals; that the animal always falls down; that though there may be excitement and struggling, there are no convulsions, and coma rapidly ensues.

Prognosis.

According to some authorities, eclampsia in animals is a very benignant disease, but others assert that when treatment is not adopted—in the case of Bitches at least—death is the ordinary termination. With the Cow it is not a serious malady. Saint-Cyr gives three deaths in eleven cases, some of which had not been medically treated. Clark had only two fatal cases during twenty-five years' practice, and these were not treated. So that the prognosis should not be unfavourable if proper treatment is timeously adopted. There do not appear to be any notable sequelæ, as a rule, though Clark mentions a case in which the animal, a Cow, lay for a month after the convulsions disappeared, and became permanently blind.

Treatment.

Hertwig recommends the abstraction of blood from the jugular, the quantity varying with the size and condition of the animals; and he asserts that frequently all the symptoms diminish considerably, or even disappear, while the blood is flowing. After the bleeding, he administers a spoonful of tea every four or six hours, with small doses of nitrate of potass. If the bowels are constipated, an enema is to be given. Zundel has been particularly successful with the syrup of chloroform, which, in small and frequent doses, keeps the animal in a state of semi-anæsthesia; the cure being terminated by a dose of laxative medicine and one or two enemas. The syrup of ether produces the same effect as the chloroform, though less quickly and surely.

Bromide of camphor has been favourably spoken of, as has chloral given by the mouth and in enema. Clark lauds belladonna as almost a specific, in doses of from two to three drachms, repeated in two or three hours, if necessary; he finds the glycerol of belladonna (equal parts of glycerine and belladonna) a most convenient preparation, as it is easily dispensed and readily miscible with water. He believes bleeding may be of service in the more urgent cases when belladonna fails to arrest the attack, though he is not much in favour of it.

CHAPTER VII.

Epilepsia Uterina.—Mania Puerperalis.

A PECULIAR nervous affection, to which the designation of "Epilepsia Uterina" has been given by Storrar,[1] might be classed with the disease which, in the previous chapter, has been named "Eclampsia," did it not differ somewhat from it, and rather resemble epilepsy, or what Harms has called "Mania puerperalis." Until its exact pathology is better defined, it will be convenient to retain Storrar's designation.

Symptoms.

The disease appears to affect the Cow only, and is marked by great agitation, sometimes fury. We cannot do better than give the symptoms in two cases, and then refer to Storrar's and Harms' evidence.

Rolls[2] was sent for in great haste to see a Cow, five years old, which had calved a fortnight previously, and had eaten the placenta. For two days before he was called in the animal had not been well, and its Calf had been removed the previous night. It had a wild, excited expression; eyes staring; ears warm; pulse full, rather strong and quick; jaws continually moving, as if in the act of biting; foaming at the mouth; the under part of the tongue purple and livid-looking. The movement of the jaws could not be stopped by holding them together, and when the animal was left to itself it was continually biting at its fore-legs, though without making a wound; when interrupted it gnawed the manger, woodwork of the stall, or anything presented to it. If hay was offered it would seize it, masticate it with the continuous and violent movement referred to, and swallow it. It took some bran-mash and chilled water, and though it partook of nothing else, it looked full, and there was the peculiar sour odour often met with in Cows suffering gastric derangement, and especially when it occurs soon after parturition. Blood was abstracted, and belladonna and linseed-oil administered. In about three hours afterwards, the convulsive movements ceased and the Cow appeared to be much better. Next day the excited expression was still apparent. Under further treatment it recovered.

Thirteen months afterwards it calved again, and when a fortnight old the Calf was removed from it. Next morning it was found to be suffering from a similar attack, the jaws moving in the same convulsive manner, but not so violently. Rolls noted that the Cow looked wild and excited; the pupils of the eyes were normal; ears warm; pulse eighty per minute, and full and strong; foaming at the mouth; under part of tongue livid; grinding the teeth occasionally; the fore-legs were wet and covered with saliva, from gnawing them. The animal was again bled and had opiates, and recovery soon took place.

Robellet[3] gives a similar instance, in which the symptoms closely resembled those of rabies. The Cow—four years old—calved four days previously, parturition being normal. On the day on which Robellet was sent for, it had refused to eat at pasture, left its companions, and constantly licked its fore-legs. In the evening it was restless, and bit everything about it. Robellet found that it had bitten the manger, rack, and food, allowing the latter to fall from its mouth without masticating it; it also seized its breast and fore-legs, but without breaking the skin. The pulse was full and sixty per minute; the eyes, unnaturally open, were red, fixed, and haggard, and the pupils dilated; the buccal mucous membrane was slightly inflamed, and a frothy saliva surrounded the borders of the lips; the respiration was normal. At times the Cow stretched out its fore-limbs, bellowed, pawed the ground with the fore-feet, and seemed to defy an invisible enemy. The handle of a stable-fork being presented, the animal seized it in a frantic manner and bit it, shaking the head violently.

These symptoms gave rise to the suspicion of rabies; but no evidence as to inoculation could be obtained. The Cow was separated from the others, secured by a double chain, and an ounce and a half of chloral administered in two doses in tea—a quarter of an hour between each dose. Several minutes after the second dose, the Cow, which had continued to show the same symptoms, hung its head, and, without staggering, fell

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[1] *Veterinary Journal*, vol. iv., p. 53.
[2] *Ibid.*, vol. ii., p. 17.
[3] *Recueil de Médecine Vétérinaire*, 1874.

like an inert mass on the ground, then rose at once of its own accord. Ten minutes afterwards the same occurrence was again noted—the Cow once more falling and jumping up; it remained in the excited condition already described. Next day all the alarming symptoms had subsided; there was no fever or excitement—nothing except slight weakness and prostration. It had fallen a third time on the previous day, then became drowsy, and remained lying for about three hours; after which it arose, apparently quite well.

Robellet's father had seen two similar cases.

Storrar relates that, in one of his cases, so savagely did the Cow bite the timber forming the front of its stall, that with one desperate effort it broke all the incisor teeth except one, entirely out of its jaw, and fractured the alveolar processes. Another Cow, some years before, so severely injured the lower jaw that the incisors could not be employed for some time; though the molars could be used when the food was placed in the mouth.

Günther[1] and Landel[2] have observed similar cases. They describe the animals as extremely excited and violent, biting everything around them—even people—climbing into the manger, running against the wall, roused to fits of fury at the slightest noise, foaming at the mouth, and sometimes tossing the head and bellowing. The pulse is hard and quick, but the heart's action is weak.

Cause.

Rolls thought that, in the case he describes, depriving the animal of its Calf was the cause of the attack; Harms ascribes the symptoms to chills, which produce brain congestion; while Storrar looks upon the malady as epileptic, dyspeptic, and uterine. "The animal affected has calved some few days previously—say from four to fourteen, or even more days; she has been heartily eating her food; giving milk very largely, or, more correctly, her milk has been remarkably rich, and throwing up, when left for a time, a very heavy layer of cream; and the usual uterine lochial discharge has been suppressed. Or the case might be thus stated: An excessive drain upon the system by the mammary glands, causing, perhaps, the suppression of the uterine cleansing, with the peculiar smell about the animal, and more marked in her milk, which is referred to by Mr. Rolls, followed by a more or less severely developed attack of indigestion. These causes act upon the nervous centres, so as to produce the extraordinary excitement which has been described. The dyspeptic signs are the more prominently shown—such as a desire to eat anything unclean in preference to good food, or coarse straw in preference to roots or hay. The bowels become torpid, and the supply of milk nearly ceases."

It is scarcely possible to believe that this condition is due to psychical influences, and it might more correctly be attributed to cerebral irritation from some physical cause—either indigestion, constipation, or deranged circulation in the brain, and related to the parturient state.

Treatment.

If indigestion or constipation is present, purgatives should be administered, with stimulant or tonic medicines, according to the indications. When there is much fury or excitement, narcotics in large doses may be given—the best, perhaps, being chloral hydrate. Belladonna might also be very serviceable. Great attention must be paid to the diet.

[1] *Geburtshülfe*, p. 145.
[2] *Repertorium der Thierheilkunde*, vol. viii.

Günther abstracted blood in large quantity, and gave extract of stramonium. He also, on the supposition that the brain was congested, applied strong stimulants to the back of the head and to the spine.

CHAPTER VIII.

Parturient Laminitis.

With the Mare,[1] a few days after foaling or abortion, there has been sometimes observed an attack of congestion or inflammation of the feet, which closely simulated the painful and serious malady known as "Laminitis," and appeared to be related to the parturient state. The disease does not seem to be very common; though Obich[2] asserts that it and metritis are the most frequent sequelæ of parturition in the Mare. It appears to have been first described by Tisserant[3] in 1846; since then it has been alluded to by Gloag and Smith[4] in England; Fabry, Guilmot, Lecouturier, Windelinck, and Deneubourg[5] in Belgium; Obich[6] in Germany; and Ayrault[7] and others in France. It has been observed also as a complication of ruptured vagina.

Symptoms.

The symptoms of the disease are those of laminitis occurring under ordinary conditions. They are suddenly manifested on the second or third day after foaling or abortion, more rarely on the fourth day, and very seldom later. In a small number of cases, inflammation of the feet has been noticed either during or immediately after parturition. Exceptionally, it has taken place within twenty-four hours after the contents of the uterus have been expelled. As a rule, there has been nothing remarkable in the case—birth having taken place naturally; sometimes, however, parturition may have been difficult.

The attack is either sudden, or only very indefinite premonitory indications are present. The animal becomes unusually restless, and moves

[1] It would appear that Bovine animals are liable to a foot inflammation after parturition, as well as Mares. Roloff (*Mittheilungen aus der Thierarztlichen Praxis in Preuszischen Staate*, 1865, 1866, p. 154) observed a peculiar inflammation of the feet of Cows, supervening on parturition. Some days after that event, the skin between the claws was observed to be reddened, swollen, and moist, and gradually the inflammation extended to the coronet and heels (*Ballen*); the skin became more tumefied and dense, and immediately above the claws was uniformly thick and red. In some cases abscesses formed at the coronet, the horn became separated, and finally the whole claw was shed. The inflammation extended to above and behind the fetlock, and the pain was so great that the animals ate but little, and consequently they soon lost condition. The hind-limbs were most frequently attacked, first one, then the other, one being always more affected than the other. The Cows had only calved a short time previously. Roloff supposed that the disease was due to contact of the skin about the hind-feet, with some substance which had escaped from the vulva after calving. He therefore insisted on the utmost cleanliness being observed; had the stalls cleaned out and sprinkled with chloride of lime every day, the hind-feet damped with chlorine water, particularly between the claws, and afterwards smeared with oil. By these measures the extension of the disease was at once checked.

[2] *Wochenschrift für Thierheilkunde*, 1869, p. 105.

[3] *Journal des Vétérinaires du Midi*, vol. ix., p. 347.

[4] *Veterinarian*, 1851, pp. 14, 258.

[5] *Annales de Médecine Vétérinaire*, 1860, 1861, 1868.

[6] *Op. cit.*

[7] *Recueil de Médecine Vétérinaire*, 1866.

its limbs—the fore ones especially—continually, while it exhibits signs of suffering. There is fever, quick and hard pulse, hurried respiration, and all the other signs of this most distressing foot-inflammation, the most marked of which at this time is the disregard of the progeny. In other cases the attack is more gradual; there is loss of appetite, great thirst, depression, hurried respiration, full, hard, and quick pulse, constipation, etc.—premonitory symptoms which may continue for two, three, or four days. The fore or hind feet may be affected. Tisserant and Guilmot say the former, Deneubourg the latter; though in some instances all the feet may be involved. The position of the animal, if standing, indicates the feet affected, and they are found to be extremely hot, the plantar arteries throbbing, and percussion of the hoof causes intense pain. During the inflammation the Mare evinces the greatest agony. If all the feet are implicated, standing may be impossible; the expression is anxious and pinched; the respiration is hurried, jerking, and plaintive, and the nostrils widely dilated; the skin is usually covered with perspiration, and the production of milk is completely checked. Indeed, the rapid disappearance of this secretion has attracted the attention of nearly every observer. In the evening perhaps, there will be an abundant supply of milk, and in the morning mulsion or suction will only obtain a few drops of a transparent or reddish fluid, though the mammæ may look as full and as well developed as usual. This suppression of its supply of food is soon testified to by the Foal, which betrays its sensations of hunger by becoming less timid, and making itself familiar with those around it.

The *duration* of the disease is from four to eight days; Franck says from eight to fourteen days. The symptoms are certainly most intense between the fourth and eighth day. The termination is generally recovery, if proper treatment has been adopted; though in some cases the malady assumes a chronic form, with the accompanying deformity and disorganisation of the feet. In rare instances, death may ensue from nervous exhaustion caused by the excessive pain; or the inflammation may run on to suppuration, and a fatal result arise from pyæmia, with purulent deposits in the lungs, brain, or other organs.

A favourable or unfavourable prognosis may, according to Guilmot, be gained from the lacteal secretion. If this returns in the course of a few days, it is a good sign.

Causes.

The cause or causes of parturient laminitis are imperfectly known. The *predisposing* cause is generally recognised to be the parturient state, though there is a wide divergence of opinion as to the way in which the disease originates. Tisserant believed that it is due to a disturbance in the functional equilibrium existing between the various organs. After parturition, and particularly after abortion, there is manifestly a disturbance of this kind; there is, as Rainard correctly states, a general superabundance of blood, and consequently a tendency to disease until the equilibrium between production and consumption is restored. Guilmot thinks that the space left by the fœtus must necessarily bring about a series of exceptional phenomena, whose point of departure is perhaps the superfluous supply of blood thrown into the circulation after parturition. Deneubourg sees in this disease and parturient collapse of the Cow, two different "modes of expression" of the same disease; and while recognising the justness of the expression employed by the old hippiatrists, that "the fever has fallen into the feet," he is

inclined to think that the morbid localisation is due to sudden suppression of the lochia. "The larger animals," he writes, "are not exempt after parturition from the depuratory process which takes place on the internal surface of the woman's uterus after delivery, and known as the *lochia;* and its abrupt suppression gives rise to a disturbance—a *fever*, which physicians designate 'puerperal fever,' and veterinary surgeons 'vitulary fever.' The disease proper to the Cow is, in our opinion, *simple vitulary fever*, which, in concentrating itself on the tendinous, articular, and perhaps muscular tissues, may become a *rheumatismal vitulary fever.* That of the Mare, until now unrecognised, is evidently due to the same cause; we cannot deny it a certain analogy with the vitulary fevers which are witnessed in the Cow, and we propose to designate it by the name of *vitulary laminitis*, to distinguish it from *essential laminitis.*"

Bouley was of opinion that parturient laminitis may be allied to that other form which so commonly succeeds intestinal congestions from accidental causes, or from drastic purgatives; and that both varieties may well be the result of a momentary paralysis of the vaso-motor nerves of the keratogenous apparatus of the foot, under the influence of a profoundly depressing action.

The *occasional* causes are quite as obscure. Tisserant asserts that none of the ordinary causes of laminitis are special in their operation here; while Deneubourg adds that it attacks Mares without distinction as to age, constitution, condition, or hygienic circumstances. Guilmot, however, remarks that Mares which are submitted to moderate work, and which receive an allowance of food in proportion thereto, are not attacked; while those which are fed on oats have always been the subjects affected, so far as he has been able to observe.

There is the same diversity of opinion with regard to the influence of parturition in the production of parturient laminitis. Tisserant has noticed it occurring, in the great majority of cases, in Mares which had aborted at a somewhat advanced period of gestation, or whose delivery had been laborious or very difficult, from the wrong position of the fœtus or from some maternal obstacle. Deneubourg, on the contrary, has observed it following parturition effected in the most favourable conditions, as well as after abortion or difficult labour; with Mares which had expelled the fœtal membranes, as well as with those which retained them; but never after a laborious parturition which required manœuvres more or less protracted and painful; though he adds that his brother had witnessed a case following laborious and artificial delivery. It may be noted that Gloag[1] gives an instance in which it followed an abortion at three months.

Obich attributes the disease to the action of cold upon the skin.

Treatment.

In the treatment of this disease, the rules observed in the ordinary attacks of laminitis are usually applicable. In the majority of cases the treatment need not, and should not, be heroic. If the fever runs high, sedatives—as the tincture of aconite—should be given; and it may even be necessary to administer narcotics—as chloral or opium—if the pain is very great. Some authorities recommend the abstraction of blood, either generally or locally; but many are averse to this treatment.

[1] *Veterinarian*, 1851, p. 14.

The inflamed feet should be treated with the greatest care, and for subduing the inflammation nothing can equal cold applications—either cold water, cold poultices, or even ice. Continuous irrigation is to be preferred, the water being applied by means of india-rubber tubing, which carries the fluid direct from the water-tap to the foot. The latter is thickly covered with pieces of thick flannel or tow, so as to diffuse the water around it. The shoes should be previously removed, and the wall of the hoof lowered, so as to allow the sole and frog to sustain as much of the weight as possible. It is a good plan to litter the animal on saw-dust or peat-moss.

Warm applications should never, on any account, be employed for the feet.

When suppuration is apprehended or has set in, or even when the effusion or exudation is serious, an outlet may be made between the sole and the wall, towards the toe of the hoof, for the escape of the fluid. Astringent and antiseptic lotions or foot-baths may be useful. At the commencement of the disease, and sometimes at a later period, when it threatens to become chronic, stimulating applications—even blisters—may be applied with advantage to the limbs above the fetlocks.

The diet should be light, and limited to mashes, grass, a small quantity of good hay, and nitrated water or gruel as drink. The body should be comfortably, if not warmly, clothed, and friction to the skin is often beneficial.

The Foal should be allowed to remain with the Mare, as its frequent sucking is likely to hasten the return of the milk, which is, as has been already remarked, a most favourable sign.

If constipation is present, laxatives should be administered, and emollient enemas are then, as well as at other times, most useful.

CHAPTER IX.

Mammitis or Mastitis.

In treating of pregnancy, allusion was made to the function of the mammæ, and it was pointed out that this function—except in rare cases, when it may be independent of pregnancy or the parturient period, and even manifest itself in the male sex—is, in mammals, peculiar to the period of parturition and rearing of the young. Some time before the progeny is born, the mammæ begin to enlarge; they become pendulous and their density increases, while they are more vascular; if not marked by dark pigment, their colour is observed to have changed, and the teats are considerably developed. So that at parturition the glands have attained dimensions and offer appearances very different to those exhibited a short time previously; while the fluid—the milk—provided by Nature for the sustenance of the young creature after birth, is secreted in more or less considerable quantity—generally in proportion to the development of the mammæ.

With the exception of some species—such as the Cow and Goat, sometimes the Ewe and Ass (and also the Mare among the Khirgiz), in which the secretion is maintained artificially for some time beyond its natural duration, and, with the former animal especially, almost permanently—the function is essentially intermittent: being most active

during the parturient or puerperal period, and ceasing when the progeny no longer requires milk. It is during this period that the activity of the mammæ exercises so much influence on the health of parent and offspring, and it is also at this time that these glands are most liable to derangements which are more or less serious. Even their normal physiological development, when it occurs rapidly and considerably under certain conditions, often occasions uneasiness and pain. Their temperature is increased, and they are much more sensitive than usual. But this disturbance is usually ephemeral, and rarely continues for more than a day or two. It may be relieved by "stripping" the teats—the importance of which, as a preventive of parturient collapse in deep-milkers and plethoric Cows, has been pointed out—rubbing the udder with olive-oil, or fomenting it with decoction of marsh-mallows. This might be termed the *normal* or *physiological* engorgement of the mammæ; but there is also a *pathological* engorgement to which attention has been drawn by various writers, and particularly by Zundel, and to this reference will now be made, as it is often the commencement of inflammation of these glands.

Pathological Congestion of the Mammæ.

Hyperæmia or congestion of the mammæ is not very uncommon, and all female animals are liable to it; though it is most frequently observed in the Cow, Mare, Ewe, and Bitch, in degrees varying rather with the causes which determine than the phenomena that accompany it.

Causes.

Congestion of the mammæ is due to various causes: among which may be cited injuries, exposure to cold air or water, or over-repletion—the stings of insects have also been blamed. There is generally a sympathetic excitement existing at this time, either from the animal having been immediately or recently delivered, or even when it is in œstrum. Most frequently, however, it occurs either when the progeny cannot empty the glands, when it has been removed from the parent, or when the latter has not been milked at the proper time. The tendency of the mammæ to become engorged when the lacteal secretion is not removed, is often made available with a fraudulent motive when disposing of Cows for milking purposes. The milk is not withdrawn for some time, the glands become greatly distended and assume an excessive development ("overstocking"), which may impose upon the unwary, and give rise to the belief that the animal possesses extraordinary lactiferous properties. Franck is of opinion that this congestion may be due to obstruction of the circulation in the posterior vena cava, towards the end of pregnancy. It may also arise from obstruction in the milk-ducts.

Symptoms.

When the congestion is due to accumulation of milk, the symptoms are, of course, only gradually developed; but if arising from injury, then they may appear suddenly, a certain part becoming all at once swollen, hard, and tense, but without altogether losing its softness and elasticity. There is neither redness nor great sensibility; the swelling is not œdematous, and does not "pit"; there is but little fever, and the appetite is not much affected.

An important consideration in these affections of the mammæ, is that relating to their anatomy. As was shown at pp. 32-35, in the Mare, Ewe, and Goat, they are formed of two perfectly distinct glands placed together in the inguinal region; while in the Cow they are composed of at least four glands or "quarters" in close contact, and apparently forming one mass in the prepubic region; and in the Sow, Bitch, and Cat, they are numerous and distinct from each other, and extend from the inguinal to the thoracic region. When we know that all the glands may become congested or inflamed, or only one—or even only a certain number of *acini* in each gland—we see at once that morbid conditions may give rise to very diverse symptoms, due to these anatomical peculiarities.

With the Cow, congestion may therefore be limited to one gland or "quarter"; though at the commencement the whole udder may be swollen, and localisation only occur at a later period. The same is observed with the Bitch and all the other animals with numerous mammæ: there is always at first general engorgement, before it is finally localised. The tumefaction partakes somewhat of œdema, from its readiness to pit on pressure, and there is often a doughy swelling around the udder, which, in some instances, extends to the other parts of the abdomen. The latter symptom is most noticeable in Mares, in which, in the course of a few days, the mammary swelling altogether disappears, leaving only an œdematous tumour towards the umbilicus.

The secretion of milk is diminished; at first it may be normal in consistence, and exceptionally it may offer streaks of blood, which give it more or less of a rose tint. When this condition continues, however, its degree of fluidity is changed, and it becomes lumpy and clotted, being partially coagulated in the lactiferous sinuses and canals, and the coagula of casein are evacuated at the same time as the other portions of the milk, which is sometimes nothing but pure viscid, yellowish serum, having a sweet taste; sometimes these coagula—round or cylindrical masses—obstruct the canals, and prevent the escape of the milk. Fürstenberg states that he has sometimes found casts of epithelial cells in them, and that about the third or fourth day there are globules of colostrum. This alteration in the milk may be limited to that from the affected gland or quarter; in the others the secretion may be healthy, though less abundant.

This condition most frequently terminates by resolution, and very often without treatment—the tumefaction disappearing in a very brief time, or in the course of four to eight days; though the milk may remain less plentiful for some time, and up to the eighth or twelfth day may still contain colostrum corpuscles. In other cases, the quantity of milk remains less than usual; and when relief is not afforded, we may have inflammation supervening, and the formation of one or more abscesses.

In the great majority of cases, it is probable that this condition commences in, or is limited to, the parenchyma of the gland, which receives an inordinate supply of blood. This leads to a congested condition, and consequent diminished lacteal secretion, with serous infiltration into the interlobular connective tissue. According to Fürstenberg,[1] the milk contains more particularly the solid elements of this fluid, and also the epithelium yet undergoing that change which should be completed in the acini.

[1] *Milchdrüsen der Kühe.*

This condition has often been confounded with inflammation of the udder, though it must be admitted that it sometimes constitutes the initial stage of mammitis. It may be distinguished from the latter by the non-existence of general symptoms, and also locally by the absence of the peculiar density or hardness, and the extreme painfulness and sensibility, which mark the presence of the latter.

According to Franck, this mammary œdema (or *Floss*) is peculiar to many parts of the Bavarian Alps, and he appears to consider it as inflammation of the skin and connective tissue of the gland (*Entzündung der Ueberzüge des Euters und des Zellgewebes*). It always appears some days, on occasions some weeks, before parturition, and the whole udder is involved; though one side may be more affected than the other. The swelling sometimes extends as high as the vulva, and even beyond it. Sometimes the skin is reddened, tense, and shining (*Erythema mammilarum*); in other instances it is normal. The health is seldom unaffected, and this is a characteristic feature of the disease; there is also rarely any pain, or alteration in the secretion—colostrum or ordinary milk flowing from the teat. When, however, the connective tissue is involved, there is swelling and "pitting" on pressure, the skin is reddened, and the finger indentations last for some time; there is also more pain. This latter condition has sometimes been designated the "erysipelatous" form of mastitis; though it must be observed that the secretion of milk is unaltered to any extent. It continues for about eight days.

When the skin is much inflamed, as in the erysipelatous form, Franck thinks it probable that a special cause—a kind of infection of the skin—is in operation.

Treatment.

This malady, in the greater number of cases, does not require any special treatment. If the animal eats well and is not much inconvenienced, the mammæ should be relieved of their contents either by allowing the offspring to suck, milking by hand every two hours, or draining off the fluid by the teat-syphon. When the swelling is great and the skin tense, smearing with lard, butter, or olive-oil will often give relief, and aid in dispersing the tumefaction.

When mammitis is apprehended, Zündel highly recommends inunction with camphorated pomade, which, he asserts, is almost specific in its deobstruent action. At the same time salines, and particularly bicarbonate of soda, are to be administered internally; while a moderate quantity of easily-digested food is to be given.

When the redness or inflammation of the skin has a tendency to become erysipelatous, Franck prescribes an ointment composed of sulphate of iron (one part) and lard (eight parts); or a liniment of carbolic acid (one part) and olive-oil (thirty to forty parts).

Inflammation of the Mammæ.

All the domestic animals are liable to inflammation of the mammæ; and it is somewhat frequent after parturition, though it also appears after abortion. The Cow is oftenest attacked, and from the importance of the lacteal secretion in this animal it is always more or less serious, especially as it may continue during the whole period of lactation; it generally affects the best milk-producers. It is not so common in the

Goat and Sheep, and is still more rare in the Mare. It is seldom witnessed in the Bitch, Sow, or Cat; though when it does occur in the former, it is liable to lead to the formation of neoplasms of different characters in the glands.

Various kinds of inflammation of the mammary glands have been described—such as *superficial* or *subcutaneous*, and *deep; acute* and *chronic*, *active* and *passive* or *latent*, and a *rheumatismal* form; while Saint-Cyr gives a *catarrhal*, a *phlegmonous*, and a *parenchymatous mammitis*.

The *catarrhal* form is—so far as its symptoms are concerned—allied to that which we have described as due to congestion, and consists in an inflammation of the mucous membrane lining the teats and lactiferous sinuses. This inflammation is generally caused by the retention of milk in the gland; this fluid becomes altered and coagulated, and the clots irritate the membrane and inflame it, the inflammation extending to the acini after a time. In the Cow the inflammation usually commences in one quarter or gland, and may remain limited to it; or it may extend to the other quarter of the same side, and even to one or both of the opposite side—though this is rare—by an extension of the morbid process from the acini to the interstitial and interglandular connective tissue. When more than one quarter is involved, then the disease in each varies in intensity.

When limited to the mucous membrane, the inflammation induces a kind of catarrh or special galactorrhœa which, according to Gerlach, is not at all uncommon, and accounts for the serous or watery milk sometimes given by Cows; and the same agency may lead to the spontaneous coagulation of the milk, without any acidity being present.

Symptoms.

The animal does not at first appear to be much affected, and the swollen gland or glands are evidently not very painful, the pain being probably of a dull character. The skin is tense and shining, though perhaps not reddened; the teat is greatly enlarged, hard, and somewhat sensitive to manipulation. The swelling is rather œdematous superficially, but when deeper the tissue of the gland is found to be somewhat harder, and towards the teat rather lumpy, from the presence of coagula of casein.

By mulsion, a rose or red-tinted fluid is obtained, which looks like decomposed clotted milk.

With careful and frequent milking, and attention to diet and hygiene, complete resolution may take place within three or four days; the secretion gradually becomes normal in quantity and quality, though for more days it may contain numerous colostrum and pus globules. If neglected, however, or mismanaged in treatment, the inflammation may become more serious, and attack the milk vesicles and their parenchyma—the real glandular tissues—giving rise to parenchymatous mammitis; or it may remain localised, though increasing in intensity. Then the secretion of milk is greatly diminished in the gland, and what is withdrawn by mulsion is altered—containing, as it does, mucus, pus, and clots, all emitting a highly ammoniacal odour.

This catarrhal condition may continue for a considerable time, and it may happen that the matter contained in the sinuses and ducts, becoming inspissated, escapes from the teat with difficulty, or not at all; so that, in accumulating in these cavities, it forms deposits—half milk,

half pus—which are oftentimes considerable. When they have acquired a certain volume, these deposits break up and escape, either through the teats, or by ulceration of the walls of the duct. When opened by means of the lancet, these "lacteal abscesses" discharge a large quantity of fœtid matter. Then the general phenomena disappear, the tumefaction and sensibility diminish, the suppuration—though it may persist for some time—gradually decreases, and the normal secretion of milk is finally established. In other instances, all the symptoms disappear except the clotted character of the milk, and the tendency of this fluid to coagulate in the ducts and sinuses. There it may form solid masses or concretions of variable size—from a pea to that of a nut—which become dense as dried cheese, or hard almost as a stone. They are sometimes cylindrical in shape, at other times elongated, being moulded by the part in which they are formed; they are usually movable, and may be displaced in the operation of milking; but they always constitute a more or less serious obstacle to the flow of milk. When situated at the lower end of the teat, they almost entirely obstruct the canal; higher, they render the flow of milk more or less difficult, and in all cases they may give rise to extreme distention of the gland, and lead to the formation of abscesses or parenchymatous inflammation.

An infectious or contagious form of catarrhal mammitis which has been observed in recent years, has been carefully studied by Nocard.[1] In from fifteen days to a month after a Cow has been located in a stable where the disease prevails, a quarter of the udder is discovered to have a hard lump or induration in its centre. The milk is as yet unaltered in appearance, but it is diminished in quantity, and coagulates so rapidly that it cannot be kept; finally, it becomes serous, flaky, of a yellowish tint, with sometimes an unpleasant odour which necessitates its being thrown away. If mixed with good milk it rapidly coagulates it. It has an acid reaction, and contains a special bacillus. The inflammation is at first limited to the mucous membrane of one teat, but it gradually extends to the interstitial connective tissue, which becomes so hypertrophied and indurated as ultimately to cause atrophy of the adjoining glandular acini.

The general health of the animal does not seem to be affected, though it appears to be more difficult to fatten. So long as the disease is limited to one quarter of the udder, the Cow is still useful as a milk-producer, though the quantity is of course less; but when two quarters are involved, then the animal is not worth keeping, and should be sent to the butcher.

The *phlegmonous mammitis* described by Saint-Cyr, is always more serious than the catarrhal form. It commences with several generally very well-marked febrile symptoms: the animal is dull, loses its appetite, and ceases to ruminate; the temperature is elevated, the pulse becomes frequent and quick, etc. These symptoms of general disturbance, according to some authorities, may manifest themselves three or four days before the local disorder, and occasionally diminish considerably when the latter appears; this rule, however, has numerous exceptions. What is certain is, that there are rigors and unmistakable indications of general febrile reaction at the very commencement of phlegmonous mammitis.

In a very brief period the udder acquires a considerable, sometimes a great volume—in the Cow, often reaching as low as the hocks, or even

[1] *Archives Vétérinaire*, 1884.

lower; the swelling is œdematous, "pitting" deeply on pressure; but it is hot, inflammatory, very painful, and extends beyond the gland—at times towards the vulva and umbilicus or sternum with the Mare and Ewe. Beneath the œdematory tumefaction the gland texture can be felt hard, dense, and nodulated in places; while the skin is red, tense and shining, and extremely painful to the touch. This painfulness causes the animal, at other times quiet and docile, to be irritable and fidgety, and averse to have the part touched, either for examination or milking. Progression, or even standing, is painful, the animal being evidently afraid of the hind-limbs coming in contact with the gland; so that it either stands or walks with them wide apart, especially on the affected side of the gland. The creature, for the same reason, seldom if ever lies down; when it does so, it is on the side on which the gland is least affected. There is often much restlessness and anxiety, and the Mare may show symptoms of colic. The secretion of milk suddenly ceases, and pressure on the teat only causes a small quantity of reddish-coloured grumous fluid to flow.

All these symptoms may become aggravated in four, six, or eight days, when the malady may terminate by resolution, suppuration, gangrene, or induration, according to circumstances.

Parenchymatous mammitis, or inflammation of the proper glandular and connective-tissue structures of the udder, is not, as a rule, so acute in its manifestations as the preceding, nor yet does it differ materially from it, so far as the general symptoms are concerned. The appetite is diminished, but not altogether suspended; there is much thirst, and rumination is irregular; the physiognomy betrays suffering, though not of a very acute kind; the pulse is full and quick, respiration short and hurried, and constipation is frequently present, while the urine is less abundant and dark; the temperature of the body surface is variable, and the muffle hot and dry; there are rigors, and muscular twitchings or tremblings, particularly towards the shoulders and flanks. The conjunctivæ are injected, the skin more sensitive than usual, and the Cow manifests pain when the loins are pressed upon; with the Mare the loins appear to be stiff and sore. There also appears to be lameness of the hind-limb of the affected side, due to the cause before mentioned; and when more than one quarter is attacked, the Cow seldom lies down.

The swelling of the gland is very hard and hot, but not œdematous, as in the other forms, while the skin preserves somewhat of its natural hue, and is not thickened; the subcutaneous veins are much distended over the whole surface of the gland. The intense hardness of the inflamed mass is very characteristic, and is noted throughout the whole mammæ; though it is always greater on one side than another, and sometimes only in one quarter—most frequently a posterior one in the Cow, both mammæ in the Mare. When the inflammation is intense, and has commenced in a particular part of the gland, it generally spreads rapidly until the whole quarter, frequently the whole of the udder, is involved.

From the commencement the secretion of milk is almost, if not quite suspended in the diseased gland, and much diminished in the others, mulsion only yielding a very small quantity of a red clotted fluid, mixed with blood; in very acute cases almost blood alone may escape. In other cases the fluid is composed of transuded serum, and small pieces of coagulated casein. In a short time this fluid becomes of a purulent

character; at other times it is putrescent and fœtid. Microscopically, it is found to be composed of particles of solidified casein, a few fat globules, epithelium from the milk vesicles and ducts, but more especially pus and red blood-corpuscles; sometimes bacteria and micrococci are noticed in considerable numbers. When abscess forms and ulceration takes place, bundles of fibres of elastic tissue are often discovered in this fluid. Chemically, it contains little casein, milk, sugar, or fat, but much water and albumin.

The progress of the disease is very rapid—more so than in either of the other forms; in twenty-four, thirty-six, or forty-eight hours—sometimes even in less than the first-named period—the disease has reached its greatest intensity. The attack is generally very sudden—the animal being apparently quite well when left for the night, and perhaps presenting all the symptoms described when seen again next morning. When it has reached its culminating point, it may remain stationary for two, three, or four days before passing to one of its ordinary terminations. Towards the third or fourth day the vicinity of the gland becomes œdematous, and this œdema may extend to beneath the chest and as high as the vulva—in the Mare, to the inside of the thighs and down the hind-legs.

Course and Terminations.

The course and terminations of mammitis are matters of much importance. It rapidly passes through its different phases until the fourth, rarely until the sixth day, when it terminates either by *resolution*—which seldom indeed occurs without prompt treatment; *atrophy; induration; suppuration; gangrene;* or even the *death* of the animal.

Resolution is, of course, by far the most favourable termination. In the parenchymatous form it can rarely be rendered complete, even by the most rational and vigorous treatment, after the second or third day; in the phlegmonous form it may occur so late as the fourth to the sixth day, but seldom after the eighth. It is marked by a gradual diminution in the intensity of the symptoms—general and local, and particularly in the pain, which first disappears, then the tumefaction and induration.

Saint-Cyr lays much stress on the decrease in density, with regard to prognosis. If it persists beyond the time stated above—if after forty-eight hours in parenchymatous mammitis, or six days in the phlegmonous form, the gland has not, to any marked extent, lost something of its woody hardness, there is great reason to fear that resolution will not be complete, and that some portions will remain indurated, or that the mass will become either partially or totally atrophied.

Though the subsidence of the fever and decrease of the swelling are in themselves favourable signs, yet they may be deceptive with regard to thorough resolution; and it must be recognised as more favourable when the tissue of the gland resumes its softness and suppleness, rather than when the swelling subsides rapidly and the hardness remains but little altered.

It is scarcely necessary to mention that the return of the normal secretion to the affected gland is a most favourable sign, though this does not occur very rapidly. For several days—from ten to twenty, or even more—the fluid obtained from the teat of the affected quarter remains watery, or rather serous and curdled; it contains numerous colostrum cells, and is more albuminous than caseous—coagulating readily

by heat, and having little cream or sugar. But it gradually recovers its usual composition and increases in quantity, until at last, in amount and quality, it does not differ from that furnished by the other quarters of the mammæ. It sometimes happens, however, that with regard to the lacteal secretion, though the gland regains its normal size and softness, it does not acquire its full functional activity until the next pregnancy and the next period of lactation. Complete recovery appears to take place during the period when the Cow is "dry."

With the Cow, it generally requires four to five weeks before resolution is complete; with the Goat the period is less, and it is still less with the Mare.

Atrophy of the gland occurs generally when resolution is not complete. All the indications of that change are present, though they take place more slowly; but the lacteal secretion does not return—recovery is not perfect.

The glandular *acini*, obliterated by the proliferation of the interstitial connective tissue or the inflammatory exudation which took place in their interior, are no longer capable of performing their function; and in proportion as these products of inflammation are absorbed after its subsidence, so does the diseased gland diminish in volume, and the mammæ become deformed and asymmetrical; the teat retracts and assumes an abnormal direction, and little, if any, milk can be obtained from it. On manipulation, instead of the gland structure, nothing can be felt but a very firm, dense mass, which feels like indurated connective tissue, having in its texture some isolated nodules that appear to be, and really are, lobules of the gland which have remained intact, and yet secrete the little milk that is yielded. The loss of a quarter of the mammæ in Milch Cows is, of course, a somewhat serious termination, so far as the yield of milk is concerned, as this is materially diminished. Nevertheless, the other quarters sometimes partially compensate, by their increased activity, for the injury, and the animal is otherwise in good health.

Induration is not at all an uncommon termination of mammitis, especially in the Cow and Bitch, and is often the point of departure, in the latter animal, of various and serious degenerations of the gland tissue.

This termination is to be apprehended, in the Cow, when the inflammation persists in a somewhat acute manner beyond the sixth or eighth day. Then the general symptoms diminish, the animal suffers less pain, the appetite returns, as well as rumination, if any œdema was present it has disappeared, but yet the gland does not regain its healthy character. The inflammation has gone, the morbid products are partly absorbed, but in different parts of the substance of the gland there are more or less voluminous, well-defined, and rounded masses which have an almost stony hardness, and are apparently adherent to the surrounding tissues. These are evidently indurated lobules which have not undergone resolution, and their secretory power is therefore lost.

In other instances in which the inflammation has been very intense, recovery does not even proceed so far. The febrile symptoms disappear, and the pain in the udder to some extent diminishes, as well as the swelling; though for a long time the local temperature is higher than usual, and the animal evinces uneasiness when it lies down. The induration of the swollen gland, often visible externally,

instead of diminishing, appears to increase, owing to the progressive organisation of the inflammatory products, and from the teat there can only be obtained a small quantity of yellowish turbid serum, with perhaps a few coagula of casein, epithelium casts, and sometimes even veritable diphtheritic false membranes. In such a case, all the parts of the gland so altered are irrevocably destroyed, so far as the lacteal secretion is concerned.

It is from this indurated condition that those degenerations and neoplasms arise which are met with in the mammæ of animals, but especially the Bitch. These are the adenomatous, sarcomatous, carcinomatous, enchondromatous, and fibromatous growths which have been described so often as found in the mammæ of this animal, but a consideration of which cannot be entered upon here.

Suppuration—by which is meant the formation of abscess—is a rather frequent termination of mammitis, and particularly of the phlegmonous form. The abscesses may be single or multiple, and vary in size as well as situation. Sometimes they appear immediately beneath the skin, and between it and the tunic of yellow fibrous tissue covering the gland; in other cases they are formed in the interstitial connective tissue separating the glands, or even in the interlobular tissue; while, though rarely, they may be found in the connective tissue between the mammæ and the abdominal wall

Suppuration generally sets in from the eighth to the twelfth day, and is marked by an increase, instead of a diminution, in the symptoms—augmentation of the fever, swelling, and pain. If the abscess in process of formation is superficial, the pain and redness appear to be greatest at a certain point; there the skin is at first of a bright red, but changes to a violet hue, and at the same time this part becomes more prominent and circumscribed. Soon there is fluctuation and the other indication of abscess, and if not artificially opened this takes place spontaneously, and the contained pus escapes. Then the febrile symptoms diminish, and the general condition improves; the swelling in the gland subsides, along with the pain; pus escapes from the opening for two or three weeks, and finally ceases, the wound becoming cicatrised. Recovery is now complete, and nothing remains save perhaps a small mass of indurated gland where the abscess has been. This subcutaneous or superficial abscess is not generally very injurious or serious.

It is not so, however, when the abscess is developed in the interglandular connective tissue, or in that between the mammæ and the abdomen. Here the pus is deep-seated, and it burrows or spreads wherever the resistance is least; in this way it leads to the formation of sinuses, sloughing of the skin over a wide surface, isolates masses of the glands—thus destroying their relations with neighbouring parts, and causing their mortification and total destruction. This mammary suppuration is always serious, as under the most favourable circumstances it generally ends in the animal losing a large portion of the gland; while in some cases it may cause death from the violence of the inflammation and intensity of the pain, or through exhaustion from the long-continued and profuse suppuration.

When the abscess is situated in the interstitial or lobular connective tissue, the case is no better, but perhaps worse. Owing to the nature and disposition of the tissues, which resist distention, the pain produced by the inflammation is most acute and distracting; while the

process of suppuration destroys a greater or less number of the *acini*, and the pus—deep-seated—is long before it reaches the surface of the gland, causing great havoc in doing so. Sometimes the interstitial abscess opens into a milk sinus, and partly escapes by the teat during milking. The pus is then mixed with the serum of the milk, and perhaps there are clots of casein and shreds of glandular tissue, the fluid having a highly ammoniacal odour. The pain is less, but does not cease, and it is generally necessary to make an external opening for the readier and more complete evacuation of the matter. There is generally much destruction of tissue, and cicatrisation is difficult and tedious, particularly when there are lacteal fistulæ. Not infrequently the abscesses are multiple, and in some instances there are as many as there are inflamed lobules. In other cases one abscess succeeds another, owing to the presence of dead tissue in the mass of the gland.

Even when the abscess opens externally, and the other quarters yield milk, the pus is, of course, liable to pass into that fluid, and to render it most objectionable as food. So that during the whole of the suppurative period, the services of the Cow as a producer of milk are lost. Such milk has usually a greyish tint, and often a peculiar odour—something similar to that of pus.

Fürstenberg has drawn attention to a *cold abscess*, often observed in the udder of Cows more particularly, and due to the spontaneous softening of a chronic tumour or induration—the softening being the result of fatty degeneration. The tumour loses its hardness, and the softening process gradually extends; the skin covering the mass becomes pulpy and thin, and often the tumour opens spontaneously and externally, a thick, yellowish kind of pus escaping; or it may evacuate its contents into one of the milk sinuses.

The secretory function of one or more quarters of the mammæ may be quite destroyed—a serious result with valuable Milch Cows.

Gangrene of the whole or a portion of the udder, is not an unusual termination of mammitis, and is, of course, the most serious one, except the death of the animal. It may be limited or diffused. The first frequently succeeds phlegmonous mammitis, and particularly when suppuration and diffuse or deep-seated abscess exists. In such a case the suppurative process has isolated a large portion—say a quarter—of the mammæ by the pus burrowing around it, and thus cutting off its nutrition—the bloodvessels being the last to give way to ulceration. The dead gland is encapsuled by its fibrous covering, and there it may remain for some time unless removed by a large opening—though sometimes the capsule gives way, and the mortified mass is found lying on the ground among the feet of the animal. In this way Nature gets rid of the diseased portion, and recovery becomes possible. The gangrene is generally limited by a dense band of fibrous tissue. In many cases surgical interference is necessary when the mammæ mortify; and when this is judicious, and the animal is not too weak or exhausted, success is complete; though, of course, the lacteal apparatus is mutilated and greatly damaged.

When diffuse, gangrene of the mammæ is generally fatal. All the domestic animals appear to be liable to gangrenous mammitis, but more especially the Cow, Mare, and Sheep, the latter being oftenest attacked.

The symptoms are described as extraordinarily intense from the very commencement. There is great depression of strength, and the animal

looks prostrated; the appetite is lost, rumination ceases, the heart beats loud and frequently, and there is grinding of the teeth and convulsive tremors. At the same time the udder swells enormously, the tumefaction extending along the abdomen and up the perinæum. At first œdematous, hot, and extremely painful, the swelling soon becomes emphysematous, cold, and insensible; the skin, which was previously intensely red, assumes a violet, then a grey, leaden, or dark hue, and is cold and clammy—vesicles containing a limpid or reddish serosity appearing on its surface; the mammary gland can now be readily enucleated by making an incision through the skin.

The general symptoms become more grave; the animal appears to be completely exhausted, trembles continually, and the pulse becomes imperceptible; at last the creature falls extended on the ground and dies—sometimes within ten or twelve hours, rarely longer than a few days, after the commencement of the attack.

Death sometimes occurs in phlegmonous and interstitial suppuration. Then the intense pain continues, or becomes still more excruciating; the animal is continually moaning, lying down and getting up again, as the recumbent posture increases the agony, by making pressure on the mammæ; the temperature is elevated; attempts to milk, which cause the utmost distress, only result in obtaining a few drops of reddish or semi-purulent fluid from the teat. All food and drink are refused; emaciation sets in rapidly; the animal is indifferent to everything around it; the expression is haggard and anxious; the conjunctivæ are livid; the respiration is quickened and often noisy; the muffle is dry and sometimes cracked; the pulse is thready or imperceptible, and there are constant tremblings; the prostration is soon so extreme that the animal falls, perhaps turns its head towards its shoulder, and dies without a struggle.

Ewes are very liable to mammitis during the "yeaning" or lambing period, and in very many instances it assumes an almost epizoötic prevalence, and the fatal gangrenous form. This is more particularly observed in large flocks, where gangrenous mastitis may be said to be the rule. Of this there are many instances to be found in veterinary literature, and particularly those given by Toggia, Yvart, D'Arboval, Roche-Lubin, Lafosse, Nocard, and others. That recorded by Yvart, as occurring in the Alfort flock in 1833, is interesting. Kotelmann[1] gives a very good description of the disease, as he observed it. In the majority of cases he saw only one half of the udder affected, and generally first around the teat, extending thence in every direction. The seat of the inflammation was in the substance of the udder—the gland parenchyma, the swelling being hard, and the skin covering it light red; the pain was very great. Before the inflammation had reached its culminating point, a thin serous fluid (*milchwasser*) dropped from the teat, and when the latter was squeezed curdled milk, or milk in firm clots about the size of a pea, was obtained. The affected Ewe kept apart from its companions, did not eat, looked very dull, head and ears drooping, back arched, hind-limbs widely separated, and movement difficult, the hind-leg towards the inflamed side of the udder being most slowly and cautiously extended, as if lame; when both mammæ were affected, the gait was markedly straggling, and the steps short. When the Lamb attempted to suck, the Ewe sank to the ground from pain, and could not rise again without assistance. Sometimes in the evening the

[1] *Zeitschrift für die P. Thierheilkunde von Nebel und Vix*, 1836, p. 423.

quarter yielded good milk, and in the morning blood or reddish-coloured serum would be found dropping from the teat. In twenty-four hours from the commencement of the disease, death not unfrequently ensued. If, in the first twelve hours, the malady did not yield to antiphlogistic treatment, the skin covering the part and the hard gland, hitherto hot, became cold, painless to the touch, and assumed a dark-blue, glazed appearance. Then an œdematous swelling showed itself in front of the udder, and which soon extended to the umbilicus and sternum, along the side of the body, and down the thigh to the hocks. The development of this œdema was a sure sign that gangrene had commenced in the mass of the diseased gland, and the sanious fluid which could be drawn from the now insensitive teat was a further proof of this condition. When this change took place, the animal seemed to be much easier ; it looked livelier, began to graze and eat, and even to ruminate. But the dark-blue colour of the udder, and the œdema extending therefrom, were unmistakable signs of approaching death, which usually occurred in thirty-six hours, when operations on the udder and scarification of the swelling did not avail.

This form of mammitis attacked young and old, good and bad, among the Ewes, but more particularly those of the improved foreign breeds —the Ewes that reared weakly Lambs which could not sufficiently empty the udder, and which were well fed.

Kotelmann believed that this insufficient evacuation of the mammæ, mechanical injury to the teat, etc., was the cause.

Pathological Anatomy.

In the majority of instances, the interlobular connective tissue is the principal seat of the inflammation, particularly when the disease has been neglected. The layers of this tissue enveloping the lobules and acini are swollen and infiltrated, and compress, or even efface, the proper substance of the gland, as well as the vessels of the part. It is this swelling and infiltration which cause tumefaction of the mammæ ; though the inflammation of the proper gland-tissue will bring about the same results. Retention of the milk is caused by the inflammatory infiltration of the connective tissue surrounding the milk ducts and canals. When inflammation has gone on to suppuration, we find, on section of the affected part, the gland tissue more or less occupied by large and small abscesses, adjoining healthy connective tissue; these abscesses may be isolated, or communicate with each other and form one large irregular cavity. Sometimes there is necrosis of the ligamentous bands which form the principal septa between the glands, and in this way are produced fistulæ or secondary abscesses, which may open externally or into the milk sinuses. These latter are generally lined by a large quantity of cylindrical epithelium; in severe cases their walls are thickened and of a dark colour; their cavity, as well as that of the teat, being dilated with the altered fluid. The matter in the abscesses varies exceedingly in its composition. Along with cylindrical epithelium are blood-corpuscles, fat-crystals, fragments of yellow elastic tissue, colostrum corpuscles, and an extraordinary quantity of micrococci of various shapes.

The interlobular connective tissue is thickened, dense, and like tendon or cartilage (sclerosis). The gland tissue itself has, instead of a yellow tint, a marbled aspect; in chronic cases calcareous salts may even be found in the textures. So that parenchymatous mammitis is not only

an inflammation of the acini, but also of the intervening connective tissue, involving the lymphatic system ; consequently, there is reason to suspect the disease to be infectious.

When circumscribed gangrene has occurred, and elimination of the diseased part is accomplished, the dead mass may weigh as much as five or six pounds in the Cow ; it is somewhat regularly oval, but rather flattened and discoid in the Mare ; the colour is a light or pale yellow, and in consistence it is pulpy but not elastic, and the finger cannot be easily passed into its substance ; traces of its lobulated structure can still be perceived, and if a section be made of it, all the characters of the mammary gland can be made out in its interior.

In diffused gangrene, however, the glandular tissue is deep-red in colour, softened, and filled with pulpy cavities ; the ducts and sinuses are distended or choked with coagulated milk, pus and serum, the whole forming a diversely-coloured fluid. In the veins are sometimes blood-clots, variable in colour and consistency ; gas and fœtid fluids escape from the tissue on section ; and the œdema is found to be due to infiltrations of yellow serum in which are brown and greenish streaks. This fluid, examined microscopically, has much the appearance of that found in animals which have died from septicæmia. Shreds of necrotic tissue are also met with.

Causes.

Mammitis appears to be due to the most diverse causes. Among the principal predisposing causes, the first is lactation—the disease appearing immediately before or soon after parturition ; and the animals whose mammæ are most active at this period, are those most frequently attacked. In the great majority of cases in the Cow—in which animal it is most serious—it follows within a month after parturition. It is true that, in certain maladies—as foot-and-mouth disease, cow-pox, sheep-pox, etc.—the udder may be affected at any time ; yet the lactation period—that when the mammæ are at the height of their function, is the time when this inflammation is generally met with. With those animals whose milk is only utilised to rear their progeny, sudden separation from their young without any precautions is often noted as an exciting or predisposing cause. The great activity of these glands in the Cow, and the long time during which this activity is maintained, is, there can be no doubt, one of the chief reasons why this animal so often suffers from this affection.

Mechanical causes may produce this inflammation—such as contusions, wounds,[1] injuries in milking[2] or sucking, blows from the head of the young creature, etc. Parenchymatous inflammation of the gland may also be due, according to Franck, to a deep purulent wound in

[1] Götze (*Sachs. Jahresbericht*, 1867, p. 92), quoted by Franck, mentions an instance in which the posterior part of the udder of a Cow became inflamed, and soon there was a severe attack of mammitis. When the animal was killed, a large abscess was found in the gland, and in it were two common pins which Götze thought might have penetrated there from the rumen.

[2] In those countries where the milk of Ewes is utilised, like that of Cows, in the production of cheese—as at Roquefort, where cheese bearing this name is largely manufactured—mammitis appears to be very frequent, and has been attributed very often to the rough handling the teats and udder receive in milking.

Roche-Lubin says that he has often witnessed shepherds acting so violently in milking, that the Ewes could scarcely breathe, staggered in their hind-limbs, and sometimes fell from the pain and shock.

the canal of the teat, especially that produced in dilating this channel, or in the removal of papillomatous tumours from this part.[1]

In these cases infection may occur from the wound itself, or through micro-organisms passing into the canals from without. In support of the latter view, which will be referred to again, we may mention that Viseur has attributed catarrh of the membrane lining the milk-ducts and sinuses to the too frequent employment of the teat-tube or syphon; this more or less paralyses the sphincter of the teat, and through the relaxed aperture the air, charged with germs, irritates and inflames the membrane.

"Overstocking" of the udder with milk has generally been considered a very likely cause in the production of inflammation. The sudden removal of the young, imperfect milking, etc., have also been blamed. Franck, however, appears to doubt the influence of mammary distention, and some observations and experiments would tend to prove that this does not always cause inflammation. For instance, Cows which had suffered from mammitis, and had temporarily lost the function of one or two quarters of the mammæ, were found at the next lactation period to have recovered the secretory power of these glands, but the excretory canal in the teat was obliterated. Consequently, great distention occurred, and this was not relieved by an artificial opening. Nevertheless, no inflammation ensued; after the third day there was a marked diminution in the turgescence of the quarters, and in about eight days they had resumed their normal volume. And Kehrer has experimentally shown that extreme distention may not cause inflammation, by closing two teats of a pregnant Bitch with collodion, and so securely that at birth the Puppies could not remove it. The corresponding glands were much distended with milk, but no inflammatory action was set up.

The influence of cold and wet, and especially the former—particularly when animals rest with the udder on the ground—has also been ascribed as a cause of mammary inflammation, but probably there is some exaggeration in this; as Cows which are seldom housed suffer less, perhaps, from this malady than those kept in warm cowsheds. Cold winds or draughts in cowsheds have been especially alluded to as operating powerfully in its production; and though these and lying on cold ground do not produce the disorder so frequently as is imagined, yet there can be no doubt that while the udder is very active, and it is in a state of almost constant hyperæmia, it will be more susceptible to alternations of temperature, particularly if the animal is rendered delicate by high feeding and an artificial existence.

Certain atmospherical conditions—as electrical storms—have been supposed to exert some influence also; and extensive outbreaks of mammitis have certainly been observed to coincide with these disturbances—the udder being attacked with a kind of phlegmonous erysipelas.

[1] Noquet (*Recueil de Méd. Vétérinaire*, 1851) alludes to a Cow in which, in consequence of mammitis, for six months the two posterior quarters of the udder lost their power of secreting milk. It afterwards calved, and the sinuses of these quarters were filled with milk, but none could escape, owing to the teat-canals being closed. By means of a knitting-needle, artificial passages were made, but these became deep purulent fissures. When Noquet first saw the Cow, three-quarters of the mammæ were enormously swollen and gangrenous. Deep scarifications were made, and repeated dressings applied; while camphorated draughts were administered internally. The three quarters were destroyed, leaving only the left anterior quarter. Half a year afterwards all had cicatrised, and there remained only a fistula. The animal was in good condition, and was therefore slaughtered.

Faulty hygiene has been looked upon as aiding in the development of mammitis; filthy and badly ventilated dwellings being greatly blamed as tending to generate a miasma, which exerts a special influence on the udder.

Plethora has been imagined to be, if not an exciting, at least a predisposing cause, and so has hot weather. Bardy gives a description of an epizoöty of mammitis which was said to be due to the Cows consuming ranunculaceous plants, which were very abundant in the fields where the animals grazed. The people in the locality assured him that this always occurred when these plants were most plentiful in certain years.

Mammitis sometimes complicates or accompanies vaginitis, metritis, peritonitis, etc., according to some authorities.

There is much reason to believe that a particular form of mammitis is due to a putrid or septic infection, and Franck is one of the strongest supporters of this view. Indeed, he asserts that the majority of cases of mammitis are of septic origin; and he has experimentally proved the correctness of his statement. For instance, he has repeatedly injected into the teats of healthy Cows, pus from the udder of those affected with mammitis, or fluid from putrid flesh, as well as putrid blood, and within twenty-four hours an acute inflammation of the corresponding quarters has been observed. This inflammation occurred in Cows whose udder was in active function, as well as those which were "dry." The uninjured epithelium of the milk sinuses and vesicles is, therefore, not protective of the gland like the pavement epithelium of the vagina; for it has been shown that when putrid flesh or blood-fluid was injected into the uninjured vagina of Ewes and Cows, no inflammation was set up.[1]

[1] One of Franck's experiments is instructive. A Cow which gave only a small quantity of milk, had, on February 26, 1875, a quantity of fresh pus from the udder of another Cow suffering from mammitis, and diluted with ten times its bulk of water, injected into the teat of the left anterior quarter. Next day this quarter had all the appearance of being affected with parenchymatous inflammation. The other three quarters were generally intact. The secretion from the diseased quarter was yellow, creamy, and pus-like. It only contained pus-globules in great quantity, and these were studded with micrococci; there were also some epithelial cells, milk globules and small masses of coagulated casein. On February 28, the inflammation had extended to the left posterior quarter.

In another experiment he injected some putrid flesh-fluid into the milk-duct of a teat. Next day this quarter of the udder was affected with acute parenchymatous inflammation; the milk was curdled, purulent, and contained large numbers of pus corpuscles and micrococci. In a few days the adjoining quarter was likewise involved.

In the veterinary journal of the University of Pisa (*Giornale di Anatomia, etc., degli Animali*, 1875), Professor Rivolta describes a form of mammitis prevailing among Sheep in the neighbourhood of Pisa, towards the end of winter and commencement of spring, and to which he has prefixed the designation of "septic." He gives it this designation because, when it begins at a certain part of the mammary gland, there is noted a kind of putrefaction of the juices of the skin, as well as of the gland itself; and besides, in the sero-sanguinolent fluid in the connective tissue of the gland are remarked a very active element in the process of putrefaction, in the presence of *micrococci* and *bacteria*.

The disease appears to be perfectly distinct from the gangrenous mammitis, and the gangrenous or anthracoid erysipelas, described by various writers. It is a local malady which usually invades the gland, extending at a certain rate of progress, and most frequently proving fatal. It ordinarily commences in the neighbourhood of, or in one of the teats; if the latter, it offers a circumscribed œdematous tumefaction, while the surface of the skin thereon is intensely red. This red patch rapidly assumes a grey colour, and finally becomes almost black. Sometimes blood escapes from the affected teat. This œdematous swelling and discoloration gradually extend, and in a more or less brief period of time have invaded one-third or one-half of the udder—not even sparing the tissue of the gland. The whole of the affected part is then tumefied, doughy, some-

The structure of the teat and arrangement of the milk-sinuses and ducts in the Mare, Ruminants, and Swine, are, in the opinion of Franck, favourable for the reception of infection; and this accounts for the readiness with which parenchymatous inflammation of the udder occurs very early in foot-and-mouth disease, the virus of this specific malady finding its way from the surface of the gland into the teat. The wider prevalence of mammitis in close sultry weather during summer, than in cold winter weather, may be accounted for by the readiness with which organic matters putrefy. By the way of infection, those extensive outbreaks of mammitis which occur among flocks of sheep may also be explained. Those cases of the disease which follow abortion, or accompany metritis or vaginitis, may also be attributed to auto-infection, instead of metastasis; indeed, in Franck's view those maladies which lead to the formation of putrid or septic matter—such as parturient fever, omphalitis in the progeny, retention and putrefaction of the afterbirth, etc.—may all be productive of mammitis in this way. Disease of the progeny may also give rise to it, the infection being conveyed to the teat by the young in the act of sucking. The hands of milkers or others, or soiled litter or ground on which the animal lies, may also be the means of conveying the infection. Franck believes that the column of milk in the sinuses and ducts is first tainted, and that this is effected through the milk at the end of the teat—a drop or two of which may be suspended therefrom. A chemical change is thereby brought about in the milk, and this altered secretion leads to the inflammation, which is secondary. An alteration in the character of the milk is, it will be remembered, one of the first symptoms—if not the first—of mammitis. Consequently, "dry" Cows, or those to which the infection cannot obtain access, are not attacked by the malady; and "dry" Cows suffering from foot-and-mouth disease never have parenchymatous mammitis.

In 1884, Nocard had an opportunity of confirming Franck's views while investigating an enzoöty of mammitis that had prevailed among a number of Cows for six years. In milk from the affected udders, he constantly found a special micro-organism which could be readily cultivated in milk and other fluids; when the twelfth culture of this germ was injected into the teat of a Cow or Goat the milk become acid and clotted, and the tissue of the gland after a time was denser than in health. This injection had no effect on the Bitch.

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what consistent, slightly or not at all sensitive, and dark or black in hue. The line of demarcation between the healthy and diseased portion is perfectly defined; the former being of a rosy colour, and normal in size and consistency. The diseased condition spreads beyond the udder to beneath the abdomen, and when an ulcer appears on the gland, discharging a fœtid sanguinolent fluid, the animal then becomes depressed and feverish, debility and emaciation set in, and the creature succumbs to an attack of septikæmia.

The numerous necroscopical examinations made by Rivolta confirm, in his opinion, the distinction he has established between this special malady and erysipelatous mammitis. With regard to the causes, the shepherds affirm that the malady attacks those sheep which are kept for a long time on a thick bed of litter; others, again, assert that it appears when they are allowed to pasture in the open air, and are not confined. The same uncertainty prevails with regard to its contagiousness. The shepherds carefully isolate the affected animals: and it would seem that, by their doing so, the disease is limited to those first attacked.

Rivolta is of opinion that this form of mammitis is produced and maintained by special *micrococci* and *bacteria*, which penetrate by the teats, or at some part of the skin covering the gland.

Several Italian authorities, and among them Brusasco, Oreste, Metaxa, and Provizano, have drawn attention to a peculiar disease of Goats and Sheep, accompanied by the gradual loss of milk. Often lameness is observed, and within fourteen days the secretion of milk is reduced to one-fifth of the usual quantity. This fluid soon becomes sour. The disease appears to be contagious, for it could be produced by injecting the milk from affected Sheep into the teats of healthy Sheep and Goats. All the animals so experimented upon became affected, the period of incubation being six, twelve, fifteen, or twenty days. The secretion of milk ceases in from eighteen to thirty days.

In the gangrenous mammitis of Sheep which Nocard investigated, and which was due to a micro-organism, it was found that five drops of the altered milk from a diseased gland, when injected into the teat of a healthy Sheep, produced the disease and caused death in forty-two hours.

Tuberculosis of the udder is sometimes a cause of mammitis, and in all cases, when severe, it diminishes the secretion of milk. The mammæ are greatly enlarged, hard, and nodulated, and softening of the tubercular masses may give rise to isolated or diffused abscesses.

Complications.

With Ruminants, the digestive organs are generally involved in the disturbance, and require attention. Inflammation of the joints (arthritis) is a frequent complication of mammitis; any of the articulations may become affected, but the patellar and tarsal appear to be the most predisposed. Septic infection and pyæmia are grave complications, and appear when gangrene or extensive suppuration is present. There are also the degenerations and new formations in the mammæ which complicate the malady when chronic, or subsequently.

Prognosis.

The prognosis of mammitis is generally unfavourable, unless the inflammation is superficial and limited, not severe, and treatment is adopted early.

When the inflammation, and particularly in the Cow, attacks the whole of the mammæ, it is then most serious, and rarely indeed can a favourable result be prognosticated. When the inflammation is localised and not likely to extend, and particularly when the suppuration is superficial, the results may be trifling—provided always that judicious treatment is early adopted and energetically carried out. With cattle and sheep at pasture, mammitis is often a most serious disease, from the fact that its existence is generally not perceived in time to check it, and the causes which produced it are perhaps still in operation. The permanent induration or sloughing away of one or more quarters of the mammæ, is always to be apprehended when the inflammation is interglandular or interstitial, and especially when it is acute. Gangrene, and even death, may result; indeed, the gangrenous termination of mammitis is fatal in nearly every case.

Treatment.

However slight the attack or mild the form of mammitis may be, in view of the serious consequences which it may entail, treatment should be prompt and judicious; as in two or three days alterations may be produced in the secretory apparatus of the gland which medical skill may be unable to amend.

When the udder or quarter is simply engorged with milk, nothing more has to be done than to thoroughly remove this fluid. This, of course, cannot be accomplished at once, and it may be necessary to milk the animal several times during the day—five or six times, or even every one or two hours. When this causes pain, the milking should be gently performed; and if pressure on the teat causes so much disturbance that the fluid cannot be withdrawn by hand, then the teat-syphon (Fig. 221), well oiled should be passed into the milk-duct; should it be necessary to retain it there, then the ring-syphon (Fig. 222) may be employed, its retention being effected by a cord or tape passed through the rings and tied over the animal's loins. In all cases in which hand-milking causes pain, and is likely to increase the evil it is intended to

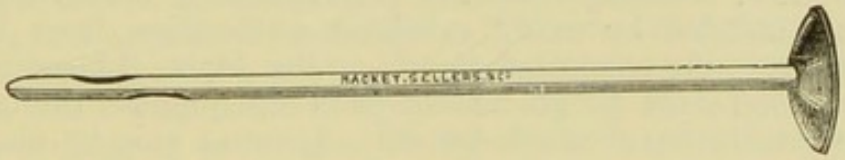

Fig. 221.

TEAT SYPHON.

avert, the teat-syphon should be resorted to.[1] It may be necessary to remove the progeny for a day or two, or allow it access only to the healthy quarters, if the animal is suckling; and should it be required to lessen the secretion of milk until the gland has recovered its normal condition, this may be effected by a suitable diet, and perhaps a dose of laxative or purgative medicine. Application of vinegar to the gland has been recommended; painting it over several times with a solution of cocaine might be useful.

When the pain has diminished it is generally advisable to allow the progeny to withdraw the milk.

Should the gland remain hard, tense, and painful, and the superficial

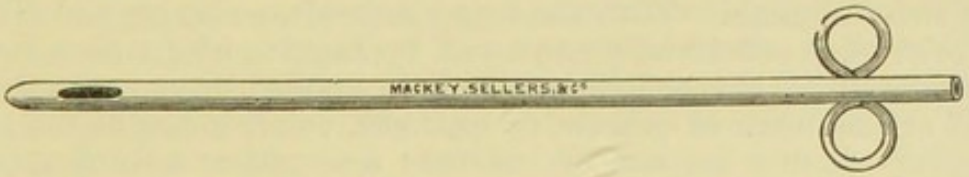

Fig. 222.

RING TEAT-SYPHON.

veins be gorged with blood, much relief will be afforded by bleeding from the corresponding mammary or "milk" vein, if a Cow.

The animal should not be exposed to cold or draughts, and it may be advisable to cover the body with a large blanket. If fever is apprehended, enemas may be administered, in addition to the exhibition of nitrated gruel.

Should coagula or solid caseous concretions have formed, they must be removed. This may be accomplished by moving the masses up and down, when possible, by careful and gentle pressure. When they can be easily displaced, they may then be pushed down to the end of the

[1] Franck very properly drew attention to the necessity for thoroughly cleansing these syphons in boiling water or carbolic acid solution. The danger of conveying infection to other quarters of the mammæ, or to the udder of healthy animals, is obvious unless this precaution is adopted.

teat, and pressed through. A coagulum or concretion as large as a nut has been extracted in this manner. When it is too voluminous, however, it may be necessary to introduce a sound carefully into the canal, in order to break it up; or it may even be required to incise the teat, when the mass is too large and dense to be got rid of in this way.

Retention of the milk is sometimes due to atresia or obliteration of the milk canal in the teat, and will then demand an operation which will be referred to presently.

When phlegmonous or parenchymatous mammitis is present, the treatment must be energetic and adopted early, in order to prevent those serious alterations in the gland which take place so rapidly.

In the Cow, bleeding from the corresponding mammary vein has been recommended by many excellent authorities, from the speedy relief it gives to the congested gland; in the Mare, if bleeding is necessary, the blood must be abstracted from the jugular, though this can rarely be productive of much benefit. Leeches may be most usefully employed, locally, for the smaller animals, and Bouley has even had recourse to them with great advantage in the Cow.

In inflammation of the gland, emptying it of its secretion, or removing from it the products of the inflammation, must be scrupulously observed. Milking by hand must be persisted in for brief but frequent periods, even though only a few drops of serum be withdrawn each time. The teat-syphon may sometimes be usefully introduced; but its employment requires much circumspection when the inflammation is acute. With the smaller animals, as the Bitch, milking is not so urgent.

The general treatment must depend upon the condition of the animal and the nature and degree of the disturbance, and must be, in principle, that of all inflammation. The local treatment is a matter of much importance, and here we find the most diverse recommendations.

Zundel, Baumeister and Rueff, Gillibert, and others, have lauded the advantages to be obtained from the application of collodion, particularly with small animals. With the larger animals, as Mares and Heifers, it has been most successfully employed by Zundel, who adds a few drops of castor-oil to the collodion, which is applied either over the whole gland or the inflamed quarter or quarters, commencing at the teat, the orifice of which must not be covered; a second or a third application may be made. The evaporation of the ether produces a salutary degree of cold, while the continuous layer of cotton, closely adhering to the surface of the skin, affords equable compression and support by its contraction when the ether evaporates.

Astringent and refrigerant applications have always held a high place in the treatment of mammitis, and every authority has his own favourite application. In this way we have cold water, either alone or with the addition of ice, acetate of lead, or Goulard's extract; clay tempered with vinegar or salt water; evaporating lotions of various kinds, etc. These applications may be usefully and safely employed when there is merely congestion, or at the commencement of slight inflammation; but when the inflammation has become fairly established, and there is exudation, they increase the tension, and, without allaying the pain, promote induration. So that, as a rule, they are to be avoided until the inflammation has been greatly subdued, when they may be resorted to with some advantage.

Emollient applications, and especially when warm, afford more

satisfactory results. In this direction warm fomentations and poultices appear to be most grateful to the animal, and to dissipate the inflammation most readily. They must not be too hot, as the skin of the udder is so thin that it is easily injured by inordinate heat. Poultices of linseed-meal, oatmeal, marsh-mallows, dough, etc., covered with olive-oil, laudanum, opium, or extract of belladonna, are especially to be recommended, in preference to fomentations which require much time; and as they cannot be applied continually, the udder often suffers from the reaction—the change from heat to cold, though this may to some extent be obviated by drying the parts well, and smearing them with lard. An excellent poultice is furnished by *spongio piline*, which, if covered externally by oiled silk, and holes made in it for the teats to pass through, makes an excellent and clean cataplasm when steeped in warm water and applied to the udder. Williams recommends "spent" hops, which are very light, contain much moisture, are soothing, and do not irritate when they become dry. The drying of a poultice can be averted by placing it in a piece of waterproof material or oiled silk. Poultices and other applications of this kind are best retained by a wide-tailed bandage, in which are holes for the teats, and which, passing upwards on each side at the flank, and back between the thighs, is secured over the loins and croup. This bandage is at all times beneficial in relieving the pain and congestion, by the support it affords the swollen organ. It should therefore be adopted early.

Lotions of belladonna, opium, tincture of camphor, poppy-heads, etc., are convenient applications, and if warm do good; but to prove efficacious they must be applied frequently, and at the commencement of the disease. A sponge, or rubbing in with the hand, is the best means of applying them. Fürstenberg recommends continuous tepid alkaline lotions applied by the hand for twenty-four to thirty-six hours; and Schaack asserts that, employed at the commencement, they have a remarkable effect—often arresting the inflammation in that interval, the swelling disappearing in one or two days.

Rychner states that nothing can equal the success resulting from the employment of alkaline lotions. The owners of cattle in Switzerland are well aware of this, and as soon as they observe the slightest alteration in the milk of a Cow, they take a handful of wood-ashes, which they moisten with milk, and making a lotion of the mixture rub it on the udder. Rychner is of opinion that the potash in the ashes prevents the coagulation of the milk in the udder—this coagulation being, according to him, the point of departure or initial phenomenon of mastitis. For this reason he gives the following recipe, which has obtained more success than any other, when applied before the inflammation had attained its greatest intensity:

Potass - - - - - - -	1 part.
Water - - - - - - -	2 parts.
Olive-oil - - - - - -	5 ,,

These are to be well mixed, and then four or five parts more water are to be added. Often, after five or six hours, during which nothing could be drawn from the teat except a small quantity of thin curdled milk, there is obtained a whitish-yellow fluid, more like pus than milk, which is a very favourable sign.

Ointments and embrocations of various kinds are also employed—as those of belladonna, henbane, morphia, camphor, laurel, etc. In

England, the extract of belladonna is much used as an application to the inflamed gland. Rychner recommends an ointment made with soft soap and this extract; Hertwig gives his testimony in favour of camphorated pomade; while some prefer simple lard. Strong mercurial ointment has been greatly extolled as an anodyne and emollient, and justly so. Its constitutional effects should be watched, and care must be taken that the progeny is not allowed to suck the teat.

Stimulating applications should not be employed, unless the disease is in a chronic form, and then their effect must be noted.

When suppuration appears to be inevitable, this process should be expedited by every means, so as to concentrate the pus at one point, if possible. The warm poultice or fomentations should be continued, and it may even be advantageous to apply mercurial ointment, ammoniacal liniments, and such other "maturatives" as blisters. The abscess is to be treated according to general principles; it should be opened as soon as fluctuation can be detected, and for this purpose the bistoury or lancet may be employed; though some practitioners prefer the actual cautery, which, they believe, does not entail so much risk of hæmorrhage, favours the exit of indurated parts, affords a better means for the escape of pus, and the resulting wound heals up more readily. When opened, the wound demands only ordinary treatment—cleanliness, detersive or stimulant dressings, carbolic oil or lotion, etc. To prevent the opening closing too early—which it may do when the abscess has been opened by the bistoury, it will be necessary to introduce a small tent of lint or fine tow.

Sometimes several abscesses are developed simultaneously or successively in the tumour, and are separated from each other by thin septa. In such a case, having opened the largest abscess, it often happens that the pus from the others drains through the opening, converting it into a fistula. In such circumstances, a counter-opening must be made; and if there is any necrotic tissue to be found, it should be removed. In all operations on the mammary glands, the incisions should be carefully made, and no larger than is absolutely necessary.

When the abscesses are deep-seated in the texture of the gland or the connective tissue, it frequently happens that, in opening them, one or perhaps more of the milk-ducts are wounded, and then we may have "lacteal fistulæ." From these the milk escapes, and this renders their cicatrisation difficult and tedious, if the gland is active. The treatment must chiefly consist in the application of caustics to the walls of the fistulæ, in order to hasten granulation—the nitrate of silver, chloride of zinc, tincture of iodine, or even the actual cautery, being generally resorted to. Sometimes a cure cannot be effected until the gland has become "dry." In some cases a pitch plaster or one of marine glue is useful, or the pressure of a broad elastic band when the fistula is situated at the base of the teat.

The occurrence of gangrene is always serious, though of course it is not so grave when limited as when diffuse. It generally leads to the loss of one or more quarters, or even to the death of the animal from icorrhæmia or septikæmia. When limited, little can be done, and in some cases it is best to wait for the spontaneous elimination of the dead portion: waiting and watching the process, supporting the strength of the animal, accelerating the separation of the dead from the living tissues, favouring the free escape of pus and putrid matters, so as to hinder their absorption, making counter-openings, and applying anti-

septic dressings—as chloride of zinc, carbolic acid, permanganate of potash.

In other cases, it may be necessary to expedite recovery by excision of the mortified mass. In order to do this, it is sometimes, but not always, requisite to cast the animal, and to fix it as for castration. The opening by which the pus escapes is enlarged, and the tissues still adhering to the living parts of the gland are separated from it by the fingers, keeping clear as much as possible of the arteries, which should be ligatured, if injured. When the separation is complete, ligatures may be placed round the principal vessels—the ligature being a piece of narrow tape or ribbon, as their walls are fragile and easily torn. If any hæmorrhage occurs, the actual cautery or perchloride of iron may be employed to subdue it. The wound is then to be dressed with disinfecting and stimulating applications, until it ceases to give off a bad odour, and is throwing out healthy granulations. The animal must be well fed, and its strength sustained by stimulants and tonics if necessary.

When gangrene threatens to become diffuse, there must be no hesitation in resorting to deep scarifications, in order to limit its ravages; these allow the escape of the septic fluids, which would impregnate the healthy tissues if permitted to remain; and the isolation of the diseased parts may be still further secured by plunging the actual cautery deeply into them, and applying oil of turpentine, carbolic acid, perchloride of iron, or tincture of camphor to them and into the wounds. It is often advisable to trace a line around the gangrenous part, so as to circumscribe it. When it is surrounded by a ring of inflammation, then emollient poultices may be applied to hasten its separation; indeed, if the part is quite dead, it may be judicious to cut into and remove as much of it as can be done—cauterising the wound well with the hot iron or perchloride of iron, and afterwards dressing it with chloride of lime, carbolic acid, and other antiseptics. At the same time, antiseptic medicines, tonics, and stimulants, should be administered internally. It might be well worth trying the injection of antiseptic agents—such as carbolic acid, tincture of iodine, etc., into the gangrenous tissues, by means of deep incisions and a Pravaz syringe.

Induration following mastitis can rarely be remedied, but it may be useful to continue the inunction of ointments which contain preparations of mercury—as the iodide, or iodine for a certain time. Armatage recommends the following ointment to be applied once a day, with smart friction:

Soft soap - - - - - -	½ lb.
Mercurial ointment - - - -	1 oz.
Camphor ointment - - - -	4 ,,
Extract of belladonna - - -	4 drams.

Or the following tincture:

Tincture of iodine - - - - -	6 oz.
Tincture of opium - - - -	2 ,,
Soap liniment - - - - -	4 ,,

Frequent and gentle milking may also prove serviceable, as well as dry friction.

As a preventive measure when infection is apprehended—as in retention of the placenta, metritis or vaginitis, etc.—it is advisable to inject

a weak solution of carbolic acid (2½ per cent.) or alum (2 per cent.), up the teat by means of a glass syringe, always after milking; the fluid should be at a temperature of 95° Fahr. Franck has proved the value of this precaution, and also its utility as a remedial measure; indeed, Armatage had previously recommended the injection of weak solutions of carbonate of soda or potash in mastitis. Franck has employed a ten per cent. emulsion of carbolic acid as an injection in artificially-produced mastitis (sixty grammes daily), and by this means suppressed the development of micrococci and bacteria in the milk, as well as prevented curdling of that fluid in the ducts and sinuses. Solutions of alum—ten per cent., 100 grammes injected daily—appeared to be also beneficial in this direction. And Nocard successfully treated the chronic catarrhal form of mammitis in which he found a special bacillus, by injecting up the teat of the affected quarter a four per cent. tepid solution of boric acid; this was done after milking in the evening, at intervals of eight days, two or three repetitions being sufficient. The induration of the gland gradually diminished, the milk resumed its ordinary characters, and the bacillus disappeared from it. In order to prevent the spread of the disease, the person who milked the cattle, before doing so, washed his hands and the teats of the animals with a three per cent. solution of carbolic acid, the affected cows being the last to receive his attention. Their milk was kept apart and given to pigs.

Armatage recommends that animals suffering from gangrene of the mammæ should be removed from those which are pregnant, "as great excitement will be produced by the odour of decomposition," and abortion is probable.

CHAPTER X.

Agalactia.

"Agalactia," or absence of milk in the mammæ, is not uncommon in animals, particularly the Mare and Cow, and more especially in those which have not been bred from for a long time, or which have brought forth their first young, though themselves aged. This absence of secretion may occur even when pregnancy has been normal and has reached its full limit. The udder is small and soft, and attempts at milking only result in the production of some drops of yellowish matter, followed sometimes by a few drops of white watery fluid. There appears to be a want of development in the lacteal apparatus, which various causes concur in producing. The principal of these causes are: previous or present chronic disease in the mammæ; atrophy of these glands; exhaustion following disease; severe labour; insufficient food, either during or immediately after pregnancy; natural debility, emaciation, etc. In some instances the milk gradually appears some time after parturition, and a tolerable quantity is secreted; but in the majority of cases it is either not produced at all, or only in very small quantity. This condition is very unfortunate for the progeny, which will suffer from hunger if not observed, and must either be artificially reared, or put to another animal to be suckled.

The treatment of this condition frequently proves unsuccessful. It must chiefly consist in giving good food, particularly of a leguminous kind, with aniseed and fennel, fennel-seeds, water fennel, *Meum mutellinum*, antimonials, and other agents which are likely to stimulate the

secretory function of the mammæ. Great attention must be paid to the digestive organs, and the teats should be frequently stripped and the mammæ rubbed, either dry or with some stimulating application.

Macorps[1] records a case in which the udder was rubbed with brandy, friction applied to the abdomen, and warm milk and fennel-seeds administered; in two days the milk began to appear.

When the absence of milk is due to disease of the gland, this must be combated according to the indications.

CHAPTER XI.

Injuries to the Teats.

Fissures.

The chief injuries to the teats consist of wounds, in the form of *fissures* or "cracks," which are most frequently witnessed in the Cow a few days after parturition; and though apparently unimportant, they nevertheless may become very troublesome and serious if neglected, and even lead to mastitis and icorrhæmia or septicæmia; while they render the animal fidgety and averse to being milked or suckled—the latter being especially inconvenient, particularly in the case of the Foal.

Causes.

These injuries are generally produced by the powerful traction of the young creature on the teat while sucking, and mainly when the teat is empty, the milk scanty, and the skin very thin and fine—as in primiparæ. Even when the milk is abundant but the skin thin, these fissures may occur. The teat is alternately distended by milk—when it is covered and softened by the externally warm saliva and buccal secretions of the progeny, in the act of sucking—then retracted and corrugated when emptied. At the bottom of the folds the epidermis is rendered soft, and its cells become loose and swollen; these finally, instead of forming a continuous layer capable of protecting the subjacent derm, give rise to a whitish unctuous pulp, which accumulates at the bottom of the corrugations. When this is removed a sore is left, and the development of this sore is hastened by cold, which still further corrugates the part; as well as by want of cleanliness, contact with dirty litter or manure, which irritates the organ; besides the act of milking or suction, which extends the sore in length and depth. It may be that certain conditions of the saliva in the young creature also lead to irritation. Cows with voluminous udders and long teats are often the subjects of this injury.

Symptoms.

The sore appears as a more or less deep, narrow, and sinuous ulcer, running transversely around the teat, and having indurated, thickened, raised margins, greyish at the bottom, or very red and erythematous, and containing a variable quantity of the thick unctuous matter just mentioned. The teat is apparently not much deformed—at least after milking, when it is retracted; and the fissures might readily pass unperceived. Then it is necessary to pull the end of the teat gently, in order to discover them.

When superficial, they are not so troublesome as when deep, irritable,

[1] Canstatt's *Jahresbericht*, 1860.

and bleeding; then they are extremely painful, and the animal refuses to be suckled or milked, while attempts to handle the teat cause the creature to offer great resistance.

These fissures have an almost natural tendency to increase in depth, so long as the young creature is suckled. Sometimes they form at the very extremity of the teat, and the sinus and milk ducts become inflamed, the viscid matter secreted becomes firm and blocks up the canal, which may ultimately be completely obliterated, causing retention of the milk, inflammation of the gland, and perhaps leading to a fatal termination.

Treatment.

Fissures in the teat should not be neglected, however slight they may appear to be. They might be prevented by cleanliness and care, and keeping the animal from draughts of cold air. It is a good plan, particularly with primiparæ, and especially the finer bred Cows, to examine and wash the teats for a short time after parturition, and if there is a tendency to sores, to dress them with some bland substance—as lard, glycerine, or olive-oil.

When fissures are present, and especially when they are deep, an essential condition for their recovery is preventing the progeny from using the affected teat or teats. By this abstention, and the use of the teat-syphon (well disinfected every time) to empty the gland, recovery in the most serious cases is comparatively rapid, and sometimes even spontaneous.

Emollient lotions are generally recommended, and the ordinary fluid is the milk drawn from the teat, which is to be frequently applied during the day, the part being well cleaned with a soft cloth after each application. This and other mild emollients may be useful when the injuries are very slight and superficial; but when they are more serious, or a rapid recovery is important, then recourse must be had to more efficient remedies. For this purpose, perhaps nothing is better than carbolised glycerine (1 to 20), or, in very severe cases, a watery solution of silicate of soda. Dry dressings—as iodoform or boric acid—may be employed in some cases; an ointment composed of tannic acid 3 parts, water 2 parts, and lard 25 parts, has been recommended. It may expedite recovery to touch the fissures lightly with nitrate of silver, and to cover the teat with an india-rubber capsule or ring.

Obliteration of the Galactophorus Sinus.

This may result from fissures, disease, or growths of various kinds, or it may be congenital (atresia), and is most frequently observed in the Cow. It may be either partial or complete.

Symptoms.

When due to fissures or disease, the symptoms are gradually developed; but when the occlusion is congenital, they suddenly appear either immediately before or after parturition, when the gland becomes active. Then the udder is distended, but no milk issues from the teat; the distention increases, and if relief is not afforded inflammation and suppuration may result. On examination of the end of the teat in congenital atresia, pressure—as if in milking, and if the skin alone be the obstacle—will cause a slight prominence where the opening of the sinus should be, the milk being felt in the sinus. Should the occlusion extend

higher, and the whole or a portion of the sinus be obliterated, then this prominence will not be produced, and the obstacle will be discovered towards the base of the teat.

Occlusion brought about by inflammation, hypertrophy of the mucous membrane lining the sinus, or the development of any growth—as a wart—does not occur suddenly ; and in milking it will be observed that the stream of fluid gradually becomes smaller, until at last it can only be drawn drop by drop, or its flow has completely ceased.

Treatment.

When the occlusion is only due to the skin—which is not uncommon in primiparæ—a small crucial incision made through it by the bistoury or lancet is generally all that is necessary. The sinus of the teat is distended with milk by pressure from the base, and the prominence at the end is then incised. To prevent the wound closing, a small bougie is introduced into the sinus for four or five days until the wound has cicatrised ; it should only be taken out at milking-time. Fürstenberg states that he has seen the opening thus made remain permeable during the whole period of lactation, but close again when this period expired ; and a second operation had to be performed at the next calving.

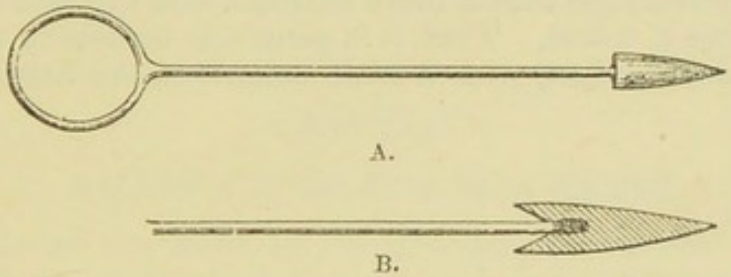

Fig. 223.

Lüthi's Perforating Sound.

A. Half the Natural Size. B. Natural Size and Section of the Cone.

When the obstacle is in the sinus of the teat, at the narrow part of the canal, and immediately above the sphincter, a fine trocar or stocking-needle, previously cleaned in boiling water and dipped in carbolic acid solution, must be passed into it and through the obstruction, when the milk will flow. To prevent closure, the cannula of the trocar or a teat-syphon may be inserted for some days, the opening being closed by a cork except at milking-time. Or a solid gutta-percha sound may be employed until an artificial mucous membrane is formed, removing it when milking.

When the canal is only partially obstructed and the milk yet flows, the introduction of a small feather—pigeon's—or a piece of thick catgut, will, with a little patience, gradually effect dilatation. But should it not suffice, and particularly if a wart is the cause of obstruction, an incision will be necessary. Various instruments have been proposed for this operation, but Lüthi's sound (Fig. 223) is perhaps the best. This is an iron wire about eight millimetres long and two in diameter, having a ring at one end, and at the other a steel cone screwed on to it. This cone has a very sharp point, and both sides have cutting edges at the base or widest part. It is passed into the opening of the teat, pushed through the obstacle, and then gently turned round from side to side until no resistance is felt. Then it is withdrawn, and a bougie or teat-

syphon, or a piece of thick carbolised catgut, introduced. Zundel mentions that Lüthi and Strebel have been very successful by this method of operating.

In all cutting operations on the teat, every precaution must be adopted for the prevention of mastitis; and this must chiefly consist in following out the antiseptic method of treatment of the incisions as closely as possible.

Fistula of the Teat.

We have seen several cases of fistula of the teat which proved very troublesome to cure during the period of lactation. From injury or disease, an opening is established between the milk sinus and the side of the teat; so that the milk, instead of passing through the canal in the extremity, escapes in a jet at the side, and its flow is nearly constant. This is a source of loss, and has often an unpleasant appearance. If it is decided to cure the fistula during the lactation period, and the opening is towards the middle of the teat, then the ring teat-syphon must be kept in the sinus for some time, and the fistula treated according to surgical principles. When the fistula is towards the extremity of the teat, however, the case is more difficult, and the teat-syphon only too often renders it worse. Then it is generally necessary to wait until the Cow is "dry," when, with a little attention, the fistula is readily cured.

BOOK VI.

DISEASES AND ABNORMALITIES OF THE YOUNG ANIMAL.

The diseases and abnormalities of the young animal, observed immediately after birth, are, many of them, of the greatest importance, and deserve far more attention than they have yet received in this country. Their consideration forms an appropriate complement to what has been said as to the pathology of the parturient state of the parent; and a notice of them, however brief and imperfect it may be, is all the more necessary, as few, if any of them, are referred to in works on veterinary medicine or surgery. They will be described in the following order:—(1) *Asphyxia*, (2) *Umbilical Hæmorrhage*, (3) *Persistence of the Urachus*, (4) *Umbilical Hernia*, (5) *Œdema of the Umbilicus*, (6) *Inflammation of the Umbilical Cord*, (7) *Arthritis*, (8) *Indigestion*, (9) *Gastro-intestinal Catarrh*, (10) *Dysentery of Young Animals*, (11) *Retention of Meconium*, (12) *Eclampsia of Young Animals*, (13) *Tetanus Agnorum*, (14) *Cyanosis*, (15) *Skin Dryness*, (16) *Imperforate Anus*, (17) *Imperforate Vulva and Vagina*, (18) *Imperforate Prepuce*, (19) *Occlusion of the Eyelids*, (20) *Occlusion of the Auditory Canal*, (21) *Tongue-tie*, (22) *Cleft Palate*.

CHAPTER I.

Asphyxia of the New-born Animal.

At p. 265, under the head of "Suspended Animation," allusion was made to asphyxia of the new-born animal—a condition similar to that of the new-born child—and brief mention was made of the measures necessary for restoration. The immediate cause of this condition was also referred to. It has been recognised that when animals are submitted during pregnancy to insufficient food, to severe exertion, have suffered from chest disease, or from colic a short time before parturition, or when labour has been difficult and protracted, the young creature at birth is often so exhausted that it lies apparently dead—all the tissues being pale and flaccid and the body low in temperature, while the heart's beats and the respiratory movements are very feeble or quite imperceptible.

There may also be syncope or asphyxia from plethora or cyanosis; asphyxia may likewise be due to interrupted circulation in the umbilical cord, and intra-uterine respiration.

Apparent death, or suspended animation, must be treated in the manner indicated at p. 265. The mouth and trachea should be cleared of mucus and amniotic fluid, if any of the latter has passed into the air passages; as it may give rise to pneumonia should the creature be resuscitated and live for a short time. With the Calf or Foal, it is possible to pass an elastic tube or catheter through the nostril into the trachea, and by means of a syringe to remove much of the fluid therefrom.

Aspersion of the skin with cold water, or flicking it with a wet towel, may also be useful in stimulating the respiratory nerve-centre, by the reflex action it induces. This is more particularly indicated when asphyxia is due to an excess of carbonic acid in the blood. Stimulation

of the skin may also be useful in this direction. Direct electric stimution of the phrenic nerve might be attempted. Artificial inflation of the lungs should not be tried until the mouth and fauces have been cleared of mucus; this may be effected by suction, which has a very beneficial action otherwise. Indeed, some authorities prefer aspiration to inspiration or blowing into the mouth; and Albert[1] has restored 41 out of 47 cases of apparently dead animals by aspiration or suction.

Transfusion of blood by the umbilical vein might prove useful; between one-half and a litre of blood should be sufficient for a Foal or Calf, according to Franck. The fumes of ammonia or some other powerful volatile irritant may be applied to the nostrils. A few drops of brandy might also be poured into the nostril.

CHAPTER II.

Umbilical Hæmorrhage.

HÆMORRHAGE from the umbilical cord does not appear to be a very common accident; nevertheless, it does sometimes occur, and in some cases so copiously as to cause death. It ensues immediately after birth, rarely after some days; and it may continue for a short or long period—producing more or less debility, or even dissolution. The hæmorrhage is generally due to imprudence in cutting the umbilical cord too near the abdomen, or to laceration of the vessels of which it is composed, during difficult parturition, when violent traction tears it close to the abdominal ring; in very rare instances it may be due to a varicose condition of the vessels. Zundel alludes to a predisposition to umbilical hæmorrhage—a kind of hæmophilia. In one or two instances the bleeding has been induced by either the mother, the young creature, or its companions sucking or pulling at the remains of the cord.

In the Foal the hæmorrhage may take place from the artery, as that vessel is firmly attached to the umbilical ring; with Ruminants it takes place from the vein, because of the existence of the *ductus Arantii*, and the retraction of the artery within the abdomen.

Treatment.

When the bleeding is trifling and not likely to continue long, little, if anything, requires to be done; but when it is copious and continuous, active and prompt treatment must be adopted.

If the cord is extremely short, astringents—as alum, tannic acid, etc.—may be tried, or such hæmostatic agents as the sesquichloride of iron, nitrate of silver, etc., or even the actual cautery in a fine point. If, however, the cord is sufficiently long, it is better to apply a ligature; this will check the bleeding, and the cord will slough away in four or five days. In applying the ligature, however, the operator must be careful not to include a portion of intestine within it; and when there is much infiltration of the cord, as sometimes happens, the serum should be got rid of, as much as possible, by squeezing with the fingers or scarification, in order that the ligature may exercise sufficient compression.

Artificial respiration is sometimes required when syncope or asphyxia is present, and this alone often causes the hæmorrhage to cease.

The transfusion of blood may be urgently demanded in extreme cases.

[1] Henke's *Zeitschrift für Staatsarzneikunde*, vol. xxiii., p. 279.

CHAPTER III.

Persistence of the Urachus.

In studying the development of the fœtus the urachus was described (pp. 82, 94), and it was pointed out that it is a canal formed by the middle portion of the allantois, which passed through the umbilical ring, and during fœtal life communicated with the bladder, from which it conveyed the urine into the allantoid sac. After birth this canal is obliterated, its walls become a thin cord, and the bladder is retracted within the pelvic cavity, the urine then passing through the urethra. It not unfrequently happens, however, that, from accidental circumstances or some malformation, the canal of the urachus is only partially, or not at all obliterated after birth; consequently, the urine continues to escape by drops or in a thin stream from the umbilicus or umbilical cord. This condition is far more frequent in Solipeds than in Ruminants, owing to the urachus—like the umbilical artery—being firmly attached to the umbilical ring in the former, and therefore not at once withdrawn into the abdomen, as in the latter, when the umbilical cord is divided at birth. Therefore it is that escape of urine from the navel is very seldom noticed in the Calf; while in the Foal it is often witnessed, particularly when the abdominal ring remains very open, or the cord is excised close to the body. This condition has, however, been seen in Calves.

It appears to be more frequent in male than female animals, and is most serious in the former; in the latter, the discharge of urine by this abnormal channel often ceases spontaneously, only passing at first in drops; whereas, in the male it generally escapes in a stream, little or no urine being discharged from the urethra.

Treatment.

In some cases scarcely any treatment is necessary, the escape of urine ceasing in a few days after birth; and when interference is demanded, a cure can generally be effected in a short time if the urethra is pervious. Bénard[1] mentions an instance of this accident, in which death occurred two days after applying a ligature to the urachus; it was then discovered that the urethra was imperforate, so that the urine could not be expelled at all. It is therefore necessary, before adopting remedial measures, to ascertain whether the urethra is patent.

When the urachus protrudes sufficiently from the umbilical ring, a ligature may be fastened firmly around it. When it is close to the abdominal ring, and consequently too short to be tied by the ordinary ligature, it must be secured by a curved needle. The Foal is thrown on its left side, and the operator, holding the needle armed with the thread in his right hand, seizes the urachus—which is covered by the skin—between the thumb and index-finger of the left hand, and pulls it outwards; the needle is then passed through behind the canal, including as little of the skin as possible, and the ends tied. If there is any doubt as to the patency of the urethra, the ligature should only be partially tightened until the nature of the obstruction is ascertained and removed. When this is done, then the ligature may be firmly tied, when the urine escapes freely by the natural channel.

[1] *Recueil de Médecine Vétérinaire*, 1828.

In those cases in which the urachus cannot be secured by this procedure, astringents or caustics—such as the sulphate of copper—may be successfully employed. Beneficial results have been obtained by the application of a strong vesicant around the umbilical ring, the tumefaction caused by it closing the opening. The actual cautery has also been most successfully employed, particularly in a fine point.

CHAPTER IV.

Umbilical Hernia.

Exomphalis, omphalocele, or *umbilical* or *navel hernia*, is not at all rare in young animals, and is perhaps most frequently observed in Foals and Puppies; it does not appear to be so common in Calves, and in Pigs and Lambs it is seldom seen. It would appear to be more prevalent in some countries or regions than in others. Marlot states that in every score of Foals or Mules bred in France, one is so affected. The hernia or rupture may appear at birth or some time after, and may continue during the life of the animal if no measures are adopted to cure it; it may be *congenital* or *acquired*. The *congenital* form is produced during fœtal life, when a portion of the digestive and biliary apparatus is contained in the umbilical cord. The embryonic connective tissue, or Whartonian gelatine, in which are imbedded the two umbilical arteries and vein (two in the Calf and Pig), is very abundant at the elliptical opening named the umbilical ring—through which also pass the urachus, the omphalo-mesenteric vessels, and a portion of intestine. After birth the umbilical cord shrivels, and the Whartonian gelatine becomes condensed and organised, forming a fibrous membrane that closes the umbilical opening and, gradually contracting, brings the two edges together; these unite, and soon nothing is left to mark the situation of the opening, except a short lozenge-shaped fibrous cicatrix. The intestine had previously been withdrawn into the abdomen, the urachus becomes contracted after birth into a thin ligament, while the blood-vessels are obliterated.

It sometimes happens, however, that the process of cicatrisation is either prevented, retarded, or interrupted; consequently, the umbilical ring continues more or less patent, and certain viscera either remain in it, or are pushed into it by internal pressure, and lodged in the pouch formed externally by the skin. In this congenital hernia, the vein or veins and the arteries are separated by the misplaced viscera, the former being usually in front, the latter behind.

The lesion may be observed at the moment the animal is born; and after the cord is ruptured it may happen that the abdomen remains open and the viscera are exposed; the creature then generally succumbs quickly.

Acquired or *accidental umbilical hernia* usually appears soon after the cord has withered, or within a few months after birth.

A *true* and *false* exomphalus have been described: the first being that just mentioned, in which hernia takes place through the umbilical ring; while the second is due to an accidental opening in the neighbouring aponeurotic or muscular tunics of the abdomen, and is in reality ventral hernia—occurring, as it generally does, after birth and in adult animals. Various kinds of umbilical herniæ have also been alluded to,

according as the viscus is intestine or omentum, or both; thus we have *enteromphalus*, *mesentero-* or *epiplomphalus*, and *entero-epiplomphalus*. The last is most frequently observed in Carnivorous animals.

Causes.

We have just alluded to the cause of congenital hernia. Acquired or accidental hernia may be due to severe or sudden muscular exertion; as when the Foal or Calf runs or jumps very actively during its gambols, or when pursued, or in falls. It is sometimes produced when the young creature is separated from its parent, and being kept in an isolated place, it rushes about and cries energetically. Umbilical hernia has also been known to follow an attack of colic, and after constipation or diarrhœa.

There appears to be generally present, in umbilical hernia, a certain organic predisposition, due to the suppressed or imperfect organization of the Whartonian gelatine; and it has been remarked that common-bred animals are more liable to it than those of the higher breeds. Nevertheless, in all those in which it manifests itself—no matter what the breed may be—there is usually constitutional debility present, due in many instances to the mother having been ill-fed and badly cared for during pregnancy. Zundel says that there are years in which the accident is unusually frequent, and particularly when much rain prevails, as then the food of Herbivorous animals is more aqueous than at other times. Low, wet, marshy pastures are also believed to predispose to hernia; as in them the tissues become soft and relaxed, and the digestive organs inordinately bulky; Foals and Calves kept in these situations have the belly voluminous, and the extrinsic pressure weakens the abdominal walls. Bénard, Hamon, Cruzel, Bouley, and others, believe in heredity as a predisposing cause. Mares which were affected with umbilical hernia when young, have produced foals which presented this lesion.

Pathological Anatomy.

The hernial pouch or sac is nearly always lined by peritoneum—the peritoneal investment being produced at the same time as the hernia. In some instances, however, the peritoneum gives way to the pressure of the viscera, and then the walls of the sac are composed only of connective tissue and skin. The latter is frequently so much stretched that it becomes thinner, and in Puppies is generally quite transparent.

Marlot says that the sac is usually composed of five layers: 1. The parietal peritoneum; 2. A very fine fibrous layer constituted by the fascia transversalis; 3. A kind of dartos formed by the tunica abdominalis; 4. The panniculus carnosus muscle; 5. The skin—the whole being connected by connective tissue. But this arrangement is far from being constant. The opening of the hernial sac corresponds to the umbilical opening, which is elongated, and measures in the Foal from 1½ to 3½ inches in length, its width being variable, but never exceeding 2 inches. The viscera contained in the sac are usually the small intestine, omentum, free colon, and the point of the cæcum. Lanclot, Bénard, Delafond, Hertwig, and others, have sometimes found the urachus in the sac, as well as intestine; but in congenital hernia the urachus can scarcely fail to be absent, and we may also have the umbilical veins. It rarely happens that there is any adhesion between the hernied organs and the sac containing them, inflammation being

rare; the sac seldom indeed contains any serum, and is therefore in immediate contact with the misplaced viscera. When ascites is present, however, serous fluid may then be present, and constitute the diseased condition termed "hydro-enteromphalus."

Symptoms.

The symptoms of umbilical hernia are, as a rule, entirely local. There is a round or pyriform tumour situated in the region of the umbilicus or "navel," varying in size in different individuals and species —from that of a pigeon's egg to a child's head, or even larger. The size also varies in the same individual at different times, according as the digestive organs are full or empty, the attitude standing or recumbent, at rest or undergoing active exertion, or the duration of the hernia— the older it is, the larger the tumour. It is usually soft, fluctuating, easily depressed by the finger, and as readily resuming its ordinary size and shape; when recent, however, it is often tense and not depressible. Sometimes it has a doughy feel and fluctuates much, and at other times it is flaccid, according as the portion of intestine which it contains is empty or filled with alimentary matters. It is nearly always indolent, and in the large majority of cases can be reduced by throwing the animal on its back, by manipulation externally, or by taxis internally. The tumour soon returns, however, especially when the animal lies down or moves about; closing the nostrils or causing the animal to cough, will also produce its immediate appearance.

When the sac has been emptied by pressure or taxis, the opening in the abdomen can then be perceived. As a general rule, the volume of the tumour corresponds to the dimensions of this opening, which is sometimes elliptical, at other times nearly or completely circular; in false or accidental hernia it is usually irregular in outline. The borders of the opening feel tense and resisting.

On applying the open hand against the tumour, the vermicular movement of the intestine can be ascertained; careful taxis may lead to the discovery of a loop of intestine in the sac; while auscultation may detect the rumbling of the displaced viscus.

When the tumour is not reducible, this is generally due to the presence of an accumulation of fæcal matters or other substances in the intestine. Inflammation is rare, and is usually due to contusions or other external influences. Strangulation of the intestine is likewise far from frequent.

Prognosis.

Umbilical hernia is not a serious condition in young animals, except in rare cases. Sometimes spontaneous recovery takes place; in the great majority of instances a cure is easily effected; and even when the hernia persists there is but little danger, health and utility being seldom interfered with. When the hernial sac is occupied by omentum only, and the abdominal opening is small, there is much less danger than when the intestine is involved, while spontaneous recovery is much more probable. In adult animals umbilical hernia is often a serious accident; and its gravity generally depends on the volume of the tumour. Complicated hernia is always dangerous.

Though not at all serious in itself when affecting young animals, yet from their diminished value and the expense of treatment, umbilical hernia may become a cause of much loss.

Marlot estimates that in France this accident causes a loss of more than a million francs to French agriculture. We know nothing as to its prevalence in this country.

Diagnosis.

The diagnosis of umbilical hernia is not difficult, so long as it is uncomplicated. If, however, the tumour is hot, painful, and œdematous, it may be mistaken for an abscess or a recent traumatic hernia ; it may also assume the appearance of an indolent fibrous tumour or a "cold abscess," when the contained intestine is filled with fæces.

It is not easy to distinguish between enteromphalus and epiplomphalus, even when there is no complication. Causing the animal to cough may enable the expert not only to diagnose the presence of umbilical hernia, but also whether it is of the omentum or intestine, the effort producing enlargement of the tumour when the intestine is misplaced.

Treatment.

We have stated that umbilical hernia in young animals often disappears spontaneously ; and though there are several ways in which it can be remedied artificially, yet unless there are reasons to fear complications, or a cure is desired early, it may be well to consider whether it is not advisable to wait—at least for some time, to see if spontaneous recovery will take place. It is well known that during the lactation period, the small intestine, which is at this time the most developed portion of the alimentary canal, instead of occupying the left flank, lies immediately on the floor of the abdomen ; but as the young creature grows and its diet is changed from milk to the food on which it is for the future to subsist, this intestine is gradually removed from the umbilical region by the development of the cæco-colic mass, which occupies its place. In this manner, the natural changes occurring in the digestive apparatus may bring about a spontaneous cure of the hernia.

It may be, therefore, advantageous to wait for some time before resorting to treatment ; allowing the young animals good tonic food in small quantity at a time, to prevent undue development of the abdomen after weaning, and bathing the tumour with cold water or some mild astringent lotion.

When treatment has to be resorted to, it is generally recognised that, for the Foal and Calf, autumn is the best season, as the animal is older and stronger, and less likely to suffer from the necessary operations. The methods of treatment comprise (1) *bandaging*, (2) *topical applications*, (3) *constriction*, (4) *operations for complications*.

1. Bandages.—A truss or retaining bandage for the cure of umbilical hernia, consists essentially of a wide girth or roller placed around the body, by the aid of which there is maintained over the tumour, and against the umbilical opening, a pad intended to prevent the viscera from again descending when the hernia has been reduced. By this means temporary mechanical occlusion of the opening is obtained, until the physiological and permanent closure of the latter can be effected, and its borders are firmly united.

There are various bandages which may be usefully employed with this object—the chief *desiderata* being sufficient solidity, simplicity, fixity, and ease for the animal. Marlot has proposed a truss for which

he claims solidity, fixity, and elasticity. This consists of a kind of well-stuffed saddle, from the four corners of which pass leather straps, which are buckled to two girths—one of which is of canvas webbing, and passes round the chest; the other, of india-rubber webbing, goes round the belly, and maintains a pad against the umbilicus. This pad is a wide, but not very thick cushion stuffed with horsehair, and which a broad longitudinal band uniting the pectoral and abdominal girths prevents from slipping backwards. In Italy, the Massiera truss is employed. This is also a kind of small saddle with two wide girths passing under the chest, that presses against the sternum and epigastrium a plate of iron, the posterior extremity of which, corresponding to the umbilical ring, and covered by a leather cushion stuffed with horsehair, is applied to the seat of hernia. In Germany, Strauss's apparatus is in vogue. This likewise consists of girths disposed in a similar manner, with a kind of martingale to prevent them gliding backwards. If a pad is used, Lafosse recommends that it should not be too convex or elevated in the middle.

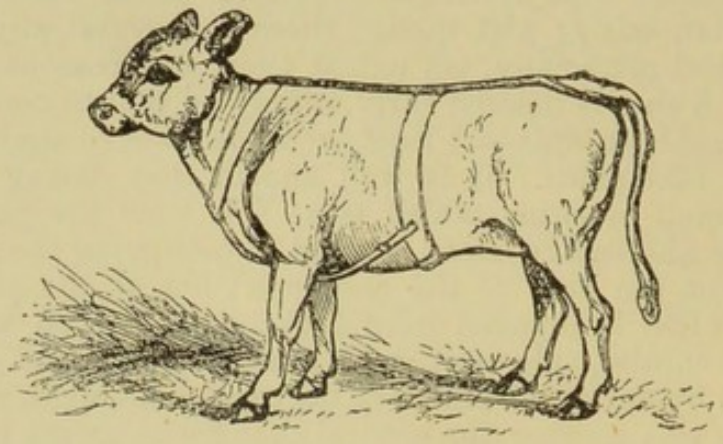

Fig. 224.

ARMATAGE'S TRUSS APPLIED FOR UMBILICAL HERNIA.

Armatage advises the employment of a similar arrangement or harness, which furnishes a compress at the proper part; it is merely a number of straps, capable of being shortened or lengthened, as may be necessary in order to fit animals of different sizes (Fig. 224).

It usually requires from one to three months to effect a cure, the period depending chiefly on the size of the hernia. A tonic regime hastens recovery.

Some veterinary surgeons combine agglutinative agents with the use of the truss—employing, for instance, a pad steeped in a mixture of pitch and turpentine.

Before the truss is applied, it is, of course, necessary to reduce the hernia, and place the pad exactly over the umbilical opening.

Trusses are chiefly objectionable from the long time they must remain on the animal, and the tightness with which they must be applied in order to act beneficially. This inconveniences and often injures the young creature, and not infrequently causes it to fret, impairs its appetite, and induces loss of condition; and though highly recommended by Marlot, Lafosse, Perosino, Schreger, Strauss, Ungefrohrn,

and many others, they are not always to be preferred to other methods of treatment.

2. Topical Applications. — Topical applications have been for centuries employed for the cure of hernia, Celsus having recommended the use of sulphuric acid, which was resorted to at a later period by the early hippiatrists; and since 1833, when it was brought to notice by Hertwig, it has been used in Germany, being applied to the tumour every two or three days. The subcutaneous serous infiltration and the plastic exudation in the hernial sac, drive the misplaced viscera into the abdomen, and, in becoming absorbed afterwards, produce obliteration of the cavity and its opening. Blisters act in the same way; and applications of alcohol, creosote water, and other agents, have been largely resorted to. But Girard, D'Arboval, Bénard, and Mignon have asserted that these topical applications are very uncertain, and even dangerous, as the irritation produced readily causes adhesion between the wall of the sac and the organs it contained, and thus renders reduction impossible.

But in 1848, Dayot, and more recently other veterinarians, had drawn attention to the value of nitric acid cauterisation in umbilical hernia. The acid is applied to the skin covering the tumour until at first an eschar is formed, and, finally, detachment of the cutaneous hernial sac is achieved. In order to effect this, the hair is removed from the skin, and by means of a spun-glass brush or cotton-wool fixed on a glass rod, nitric acid of commerce is applied around the base of the tumour at first; then over the other part it is used in sufficient quantity, and with friction, so as to destroy the skin and ensure its speedy mortification and sloughing. Experience has proved that the more profound the disorganisation the more certain is the beneficial action. According to Lafosse, it requires from 24 to 32 grammes of acid for a hernial tumour the size of a fist; and the friction, which ought to be as equable as possible over the whole surface, should be continued for three to five minutes—supposing the animal to be quiet and the rubbing not interrupted. A smaller quantity of acid and less friction may be employed to herniæ which are not so considerable in volume, and are covered by fine skin. When the animal has to be thrown and placed on its back, the quantity of acid and amount of friction must also be diminished. Dayot recommends that the application be repeated once or twice in the hour, according to the thickness of the skin; but it has been found that one application is generally sufficient, fifteen days being allowed to elapse in order to watch the result. If at the end of this time the skin is not destroyed, the application may be repeated.

The nitric acid produces a yellow eschar, which, if not dry on the first day, soon becomes soft, unctuous to the touch, and easily destroyed. With the formation of this eschar there is much swelling, either immediately on the application of the acid, or soon after; in some cases there is but little if any swelling. The tumefaction is due to the action of the nitric acid on the subcutaneous connective tissue, which becomes infiltrated, and causes a uniform pressure on the hernied mass; this leads to the latter being pushed into the abdomen and kept there as if by a truss. The œdematous swelling established external to the tumour, is oblong and depressed in the centre, in consequence of the diminished elasticity of the central portion of the escharified skin; in a few days it is gradually absorbed and becomes more consistent, while the skin in

the centre becomes dry and hard, like parchment. Instead of the hernia, there is now only a newly-formed mass of fibrous tissue, which is gradually lessened in volume, condensed, and partly absorbed, like cicatricial tissue. At the same time the cauterised skin begins to be thrown off at the margin, the process of separation extending to the centre, where it takes a long time to be completed, because of the remains of the umbilical cord. When completely detached, there is a granulating healthy-looking wound left, which may have some fibrous masses in its middle. This suppurates, dries, becomes covered with a crust, and is gradually furnished with epithelium. In retracting, the wound contributes largely in closing the hernial opening, while the indurated skin which continues for some time to adhere to the abdominal walls through the medium of the condensed connective tissue, contributes its share. In about a month cicatrisation is finished; the cicatrix remains destitute of hair, and often of pigment.

According to the testimony of Zundel and others, this mode of treating an umbilical hernia is prompt and speedy. There is generally no occasion to throw the animal down, and one assistant only is necessary; it is rarely followed by accidents. These do occur, however, and the most serious and frequent is the escape of the intestines through the eschar, about eight days after the nitric acid has been applied. This unfortunate result has been attributed to excessive cauterisation when the skin is thin and fine, though it may also occur from the animal rubbing or tearing off the sloughing cuticle when the pain or itching are troublesome. To obviate this accident, Rey, Lafosse, Legoff, and others recommend the employment of a bandage, and quietude after the operation. Reynal has observed peritonitis as a consequence of nitric acid cauterisation, and Lafosse mentions a case of tetanus due to this treatment.

When the cauterisation has not been sufficient, a relapse is likely to occur; Lafosse has observed one in twenty successful cases. This insufficiency is generally noticed on the following day, in the absence or trifling amount of swelling; but the cauterisation must not be attempted again in less than two or three weeks.

Hertwig, as has been mentioned, recommends sulphuric instead of nitric acid, and applies it in lines, night and morning, for two days, by means of a glass rod. Œdema soon sets in, and it may be increased by rubbing the cauterised surface with oil of turpentine and oil (one to two). The sulphuric acid, however, appears to be less prompt than the nitric. Strong blistering ointment applied at intervals of three days; chromate of potass ointment (one to three) rubbed in once a day for five minutes at a time, on two consecutive days; solution of bichloride of mercury, and other topical irritants, have all been more or less successfully employed. Even the actual cautery, in lines and points, has been resorted to; but the beneficial effect to be derived from it is uncertain, and at best it is very painful.

Bouley[1] draws attention to Luton's method of subcutaneous injections for the cure of congenital herniæ in infants, and believes it will be found more advantageous than any other treatment yet attempted for umbilical hernia in animals. Luton's method consists in the subcutaneous injection of a few drops of common salt solution around the hernial tumour, by means of the ordinary subcutaneous-injection syringe. Under the irritating influence of this injection œdema sets in, and this mechanic-

[1] *Recueil de Médecine Vétérinaire*, 1877.

ally repels the contained viscus, the margins of the abdominal opening come into apposition, and, with the connective tissue, are inflamed and soon unite.

The needle of the syringe must not pass beyond the subcutaneous connective tissue.

3. Constriction.—Constriction of the hernial sac has been largely resorted to for the cure of umbilical hernia, with the view of destroying it by mortification, causing adhesion above the part where this has taken place, and including secondary cicatrisation when the sac has sloughed away. The constriction is produced by *ligature*, *clams*, and *suture*. To apply these, the animal must, in nearly all cases, be thrown; but before this is attempted, the tumour should be well examined, in order to ascertain if it is reducible, if there are adhesions, the extent of the abdominal opening, and the limits within which the constricting apparatus should be applied.

The best position for reduction and constriction is the dorsal. The animal, if a Foal, should be cast on a good bed of litter, and placed on its back. Very often the change of position reduces the hernia; if not, gentle manipulation and pressure will effect this, and then the empty sac is pulled well away from the body, and the operation completed.

The oldest procedure is ligaturing the entire mass of the hernial sac by a piece of cord tied firmly round it, close to the body. This produces at first a merely mechanical occlusion, but subsequently this is physiological—exudation and organisation of the plasma thrown out by the inflammatory process set up, producing adhesion of the peritoneal surfaces. A piece of whipcord answers very well for this ligature, but it must be drawn very tight around the neck of the sac, in order to produce its immediate and consecutive effects.

To keep the ligature in place, some practitioners pass one or two wooden pegs through the sac where it is encircled by the ligature; these prevent the twine being displaced by the swelling which quickly supervenes. Sometimes a ring is employed, which is less in diameter than the umbilical opening, and through which the hernial sac is passed before the ligature is made.

Some authorities prefer a double ligature, made by passing a double cord through the base of the sac by means of a sacking-needle, and tying each separately or entirely round the sac. Sometimes the ligatures are multiple; and Legoff has recommended the employment of several ligatures passing through the sac from apex to base, each becoming tighter as the abdomen is neared.

Ligatures are very simple and easily applied, but they have their drawbacks, and these have led to their disuse. Among their disadvantages are uncertainty in their action—which is sometimes too intense, at other times insufficient; the sac often sloughs off before adhesion has taken place to such a degree as to sustain the weight of the abdominal viscera; and it has been pointed out that there is risk of including or wounding the intestine.

Very favourable results obtained by the *elastic* ligature in castration have been reported by Guérin;[1] this ligature might prove effective in umbilical hernia.

The procedure by *clams* is often resorted to, particularly when the hernia is serious. The ordinary wooden clam (Fig. 225) may be employed,

[1] *Recueil de Médecine Vétérinaire*, 1877.

or one of iron, either hinged at one end or tightened by screws. To render the coaptation of the two branches of the clam more perfect, and to prevent the instrument slipping when tumefaction sets in, as well as to produce more prompt inflammation, adhesion, and gangrene, various contrivances are in use. Borhauer has used a clam, in the branches of which are a number of holes placed opposite each other, through which wooden or metal pins can be passed when the instrument is fixed on the sac. Other practitioners employ a clam with toothed branches, the teeth perforating the walls of the sac. Armatage recommends an iron

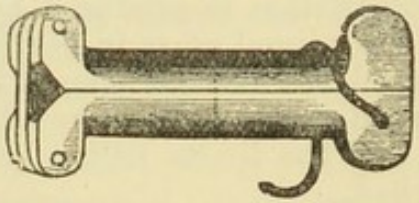

Fig. 225.

Umbilical Clam.

screw clam, one branch of which has a long deep groove, and into this fits a narrow projecting ridge on the opposite branch (Fig. 226). To apply the clam, he gives the following directions: "The animal is secured and placed on its back. The skin over the rupture is drawn together by the fingers in a flat fold, corresponding with a central longitudinal line through the abdomen (*linea alba*), and elevated from the parts beneath, in order to cause the intestines or omentum to descend. The clam is then put over the skin, as close to the abdomen as possible, and the screws tightened. The pressure must not be too severe, or the

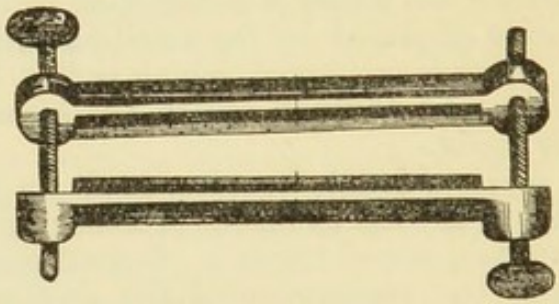

Fig. 226.

Armatage's Iron Umbilical Clam.

parts will drop off too soon, and possibly the intestines may escape. The operation, therefore, requires to be carefully watched."

Degive[1] has improved upon this method, by introducing two strong steel needles through the skin and margins of the umbilical opening—guiding their points so as to prevent injury to the intestine, by a finger passed through a small incision at the base of the tumour. Above these needles, *i.e.*, closer to the body, the clam is applied; this can be tightened to the necessary degree by the screw at each end. In order to prevent displacement of the clam when the needles are withdrawn, some small steel pins are passed through the skin immediately beneath it.

[1] *The Veterinary Journal*, 1894, p. 156.

Sutures are frequently employed, and there are various ways of using them. One method is the "twisted" suture, which is applied as follows: The hernial sac is included between two round pieces of hard wood or iron, which are drawn tightly together by whipcord passed round their extremities before and behind; double sutures are then passed through the sac, one of which is tied to the piece of wood on one side, and the other to that on the other side—so that the sac is completely invested between the wood and ligatures, which divide it into two portions. Another procedure by suture is to make a thick longitudinal fold of the skin covering the hernia, to pass the suture needle—armed with a waxed thread or cord—as near to the muscles as possible, and about three to four inches from the ring, from before to behind, or one side to the other; the needle is again passed through in the contrary direction, about half an inch from the first perforation, and the two portions of suture firmly tied, so as to draw the skin together like the mouth of a sac. Sutures are then passed through the sides of the pedicle and tied, so as to include the whole of the skin in the multiple loops. A cure by this procedure is usually effected in about fifteen days. The only objection to the operation appears to be the danger of wounding the intestine by the needle. To obviate this, some operators, after reducing the hernia, pull the empty sac well away from the abdomen, and pass it through a partially split piece of lead which is applied close to the belly; then the needle can be used without risk, as the lead—which is secured *in situ*—forms a shield as well as a truss, and prevents the descent of the intestine until adhesion has taken place.

When the hernia is irreducible or strangulation has taken place, then it will be necessary to carefully open the sac. Should adhesion have taken place between the latter and the intestine, or between the skin and peritoneum, this must be broken up; if the umbilical ring has to be incised in order to return the viscus, this may be effected by a probe-pointed bistoury. The incision should be no longer than is absolutely requisite.

The after-treatment of operation for hernia must be conducted on surgical principles, and according to the necessities of the case. Easily digested food, in small quantity and frequently, should be given until the cure is effected.

CHAPTER V.

Œdema of the Umbilicus.

TUMEFACTION, or rather "œdema" of the umbilical region, is not at all uncommon. Often it is simply due to an effusion of serum in the connective tissue of the umbilical cord, and sometimes to an infiltration of blood in this part and the surrounding connective tissue.

The accident is usually produced by contusion and laceration during birth, though at times it may also be caused by the young creatures, when two or more are together, sucking and pulling at the remains of the umbilical cord. It may also be due to chronic inflammation of this part, or the formation of abscess in the umbilical ring.

The accident is readily recognised; the swelling is often very considerable, and always cold to the touch. It often persists a long time in Bovine animals; and Zundel says that it then constitutes a grave

defect in young Bulls, which it mechanically prevents from copulating. When due to sclerosis of the connective tissue, it is usually persistent.

Treatment.

Cold applications and compresses have been recommended in the way of treatment, as well as lotions of arnica, camphorated spirits of wine, preparations of iodine, mercury, etc. These often fail, however, and it is generally better to resort to scarifications or leeches at once, to be succeeded by hot water fomentations. When the swelling is chronic and due to a blood clot, which is sometimes the case, Baumeister recommends enucleation.

CHAPTER VI.

Inflammation of the Umbilical Cord.

Inflammation of the umbilicus, or *omphalitis* (the so-called "*navel-ill*" of shepherds), is a serious accident, and often terminates fatally. It consists essentially in inflammation of the umbilical vein, which sooner or later involves the adjoining tissues, and is often followed by suppuration and pyæmia, which causes the death of the young creature. It is rare indeed that the inflammation remains of a simple kind throughout its course. As a rule, it is not merely an omphalo-phlebitis, but involves the abdominal portion of the umbilical vein. There is a thrombus, which soon suppurates; a fistula appears at the umbilicus, the umbilical vein is inflamed as far as the liver, to which the thrombosis extends, and the portal and hepatic veins may even be affected. As a consequence, the most serious accidents may arise. Embolic infarction of the lungs, liver, or other organs is likely to occur, with gangrene, septicæmia or pyæmia.

Symptoms.

The inflammation commences soon after birth. The remains of the umbilical cord, in the normal condition, quickly dries up and withers, as it were, within a few days after the creature is born. When inflamed, however, the part appears to be moist, and projects from the abdomen as an enlarged, compact, and hard mass, from the centre of which flows a small quantity of thin, unhealthy, purulent-looking fluid that soils the surrounding skin. The peculiar tap-like appearance of the umbilical cord, its density and high temperature, with the discharge therefrom, will lead the careful observer to recognise the existence of omphalitis.

A probe can be readily passed into the umbilical vein, which remains patent to a considerable extent. The local symptoms are often overlooked at the commencement, and the first general signs of omphalitis observed are usually dulness, arched back, indifference to the teat and to surrounding objects, persistent recumbency, fever, and hurried panting respiration when general infection takes place, and embolism of the lungs is occurring. As the malady progresses, great prostration is manifest; there is swelling at the umbilicus, and intense pain on manipulation of that region: the eyes are dull and injected, the mouth very hot and dry; the pulse is so small and quick as to be scarcely perceptible; the bowels may be constipated and the fæces scanty, or obstinate diarrhœa may supervene; the urine is greatly diminished in quantity; the mucous membranes frequently assume a yellowish tint;

soft, fluctuating swellings, containing a yellow gelatinous fluid, often appear on various parts of the body; the creature refuses to suck; indications of colic or peritonitis are sometimes manifested, with enterorrhagia; and in the majority of cases death rapidly ensues.

Not infrequently the phlebitis is most intense in the internal abdominal portion of the vein, and the pus, instead of freely escaping from the external opening, accumulates in the canal to such a degree as to form a large swelling at the umbilical ring, which might be mistaken at the first glance for a hernia. When this swelling has been opened, about half a pint of pus escapes in some instances.

When a fatal termination does not quickly follow from septikæmia, or from embolism of some important organs, through detached portions of the thrombus being carried into them by the circulation, we may have chronic morbid conditions of a pyæmic character set up, which are characterised by metastatic inflammation of the serous membranes in various parts of the body, and particularly of the articulations. Indeed, it is now recognised by the highest Continental veterinarians, that the destructive arthritis or "joint disease" of Foals, Calves, and Lambs is attributable to omphalo-phlebitis. Inflammation of the joints—especially of the hocks—has often been accidentally produced by the inflammation excited through ligaturing the umbilical cord.

Metastasis to the iris, choroid coat of the eye, diarrhœa, tumefaction of the lymphatic glands, abscesses in the muscles and other parts, etc., have been observed as a result of inflammation of the umbilical cord.

Pathological Anatomy.

In animals which have died or been killed in consequence of this disease, the walls of the umbilical vein throughout the course of the vessel are much thickened, and the communication with the portal vein entirely interrupted by a blood clot. The vessel is filled by a yellow pulpy mass, foul-smelling in some cases, odourless in others; while its *intima* is detached, and forms part of the contents. In the abdominal cavity we may find effusion, exudation, and adhesion of various viscera, with peritoneal hæmorrhagic spots. The portal and other abdominal veins often contain matter similar to that in the umbilical vein; the liver is enlarged, in some cases atrophied, clay-coloured, and almost bloodless. The lymphatics of the liver and mesentery are usually nodulated, swollen, and infiltrated. The lungs in many instances exhibit intense hæmorrhagic infarction, lobular pneumonia and its consequence, and particularly purulent broncho-pneumonia. In special cases, to be alluded to hereafter, the joints are swollen and inflamed, and their capsules contain pus. When the creature lives until it becomes cachectic, fatty degeneration of the muscles, with ecchymoses in various parts of the body, is nearly always noted.

Causes.

The causes of omphalitis are numerous. They may be enumerated as follows: the admission of air or foreign matters to the interior of the umbilical vessels; bruises or injury to the umbilicus, either during birth or afterwards; irritation of this part either by the litter, manure, or urine; the habit which certain females have of licking the umbilicus of their progeny, or of young creatures to suck the remains of the umbilical cord of each other; rupture of the cord close to, or within the abdomen;

improper food given to the mother; exposure to cold and wet; and infection. Bollinger admits that in certain establishments, in consequence of over-crowding, the omphalitis of young animals may become erysipelatous, and be due to an analogous infection to that which produces the oftentimes fatal inflammation of the umbilical cicatrix in new-born children in maternity hospitals. Rueff asserts that omphalitis is more frequent in some years than others.

There can scarcely be any doubt that, as Franck remarks, this inflammation is due to contact of the atmosphere with the umbilical wound, and to the ingress of germs which excite zymosis; or to contact with filth or putrid matters containing these germs.

There can scarcely be a doubt, also, that the manner in which the umbilical cord is divided at birth has an influence in the production of this inflammation; indeed, the separation or rupture of the cord necessarily produces a wound that is readily absorbent under all circumstances, until the remaining portion attached to the umbilicus becomes dry and shrivelled. The exposed umbilical vein and artery in the Foal, the double vein in Ruminants, also increase this readiness to receive infection, and consequent tendency to phlebitis; and these vessels are occasionally laid quite bare when the cord is divided close to the umbilical ring, and their protecting sheath is removed.

Franck gives an instance of this accident, which was witnessed in the breeding sheds of the Munich Veterinary School. A Cow brought forth twin calves, one of which—A—had the umbilical cord ruptured in the usual way, while the other—B—had it torn asunder in a markedly abnormal manner. Alongside this Cow stood another which had recently calved, then was attacked with puerperal fever, and eventually succumbed to that disease. The after-birth of this animal was allowed to lie behind the Cow which had given birth to the twins; so that there was no lack of infection-producing material—the floor, straw, implements, as well as the hands of the cowmen, being impregnated with it. The calf—B—which had the umbilical cord abnormally ruptured, became affected with omphalitis; while the other—A—with the wound better protected, escaped infection and remained in good health.

This cause of omphalitis must be frequently and extensively in operation among the Lambs of flocks of Ewes when abortions occur among these, or when putrid matters are discharged from the vulva, or even when gangrenous or septic mammitis is present among them. It is often remarked that omphalitis sometimes appears among a greater number of Lambs on a particular pasture; and it is extremely probable that careful investigation will lead to the discovery that many of these outbreaks are largely, if not entirely, due to septic infection of this kind. Franck has observed such occurrences in extensive cowsheds, when sometimes of ten to fifteen Calves born within a few days of each other and kept together, half the number have become affected with this inflammation of the navel, and the remainder has escaped.

It must be remembered, too, that the discharge from one diseased umbilicus may afford sufficient material to infect a great many newly-born animals, should circumstances prove favourable.

Not only may contamination take place through actual contact with objects soiled or impregnated by such infective material, but the air itself, or flies, may prove media for its conveyance to the umbilical wound. There may also be a special infection, as a consequence of over-crowding in badly-ventilated dwellings—something analogous to

the puerperal infection observed in certain maternity and other hospitals.

A malignant and a benignant form of omphalitis have been described by various authorities; but the distinction, if it really exists, is of no practical importance, and it is perhaps advisable, in so far as treatment is concerned, to consider the disease always as malignant. It would appear to be fully ascertained that septic infection gives rise to far more serious and destructive inflammation than that due to entrance of the air, or an aërial ferment, into the wound or open vessels of the cord.

As has been remarked, this inflammation of the umbilical cord is more frequent in Calves and Lambs than in Foals; and the reason for this is probably due to the fact that in the former there is a *ductus Arantii*, which is absent in the latter. There may also occur a kind of aspiration of air into the umbilical vein. However this may be, it must not be forgotten, when considering the etiology of omphalitis and its frequency in different species of animals, that putrid or septic diseases are much more common in Cows and Ewes than Mares, and that the latter do not so often receive manual assistance during parturition; so that they are less liable to parturient fever and other septic disorders which might involve their offspring.

When the remains of the umbilical cord are once fairly dried and shrivelled, omphalitis is very seldom, if ever, witnessed.

Ulrich[1] reports that he saw an extensive outbreak of the disease in a flock of Lambs, many of which died from abscess in the liver. He attributed the outbreak to feeding the Ewes on rape-cake. Changing the food to oil-cake, and administering Glauber salts to the Ewes, checked the malady. Franck was inclined to think that infection may have had something to do with the outbreak.

Treatment.

The *prophylaxis* of omphalitis, or purulent phlebitis of the umbilical cord, is very important, and must be based on knowledge of the etiology of the malady. This has just been alluded to. Cleanliness is absolutely necessary, and the young creature should be protected from every possible source of septic infection. The danger will be greatly obviated if the extremity of the umbilical cord is dressed immediately after birth with a concentrated solution of carbolic acid, which destroys germs, keeps away flies, and renders putrid matters innocuous, while it quickly shrivels up the cord itself. This preventive treatment is strongly to be recommended for Lambs, and particularly when there have been abortions among the Ewes, retention of dead Lambs or the placental membranes, or any other likely cause of putridity on a sheep-run or pasture. The same measure is applicable to the Calf and Foal under similar conditions, but in all cases care must be observed not to apply the acid to the parts surrounding the umbilicus.

Curative treatment must be principally of an antiseptic kind. At the commencement it should be chiefly local, and the applications most likely to prove beneficial are lotions of carbolic acid, boric acid, salicylic acid (particularly if fever runs high), salicylate of soda, permanganate of potass, borate of soda, alum or other astringent. If the umbilical vein is readily accessible, one of these lotions may be introduced into it, either by a fine bone probe wrapped round with lint, or by a syringe.

[1] Canstatt's *Jahresbericht*, 1860, p. 41.

Franck states that a five per cent. solution of carbolic acid may be passed in this way into the abdominal portion of the vein of small Calves; this vessel can be penetrated to a distance of nearly ten inches. He does not approve of injecting the solution, because of the danger of injuring the portal vein.

If suppuration is superficial, the same lotions may be used, or the part may be cauterised with solid nitrate of silver.

When the inflammation is very intense, several authorities recommend recourse to vesicating agents; others employ ammoniacal liniment, and Rueff advocates tartarised antimony ointment.

When there is danger of general infection, or this has already occurred, then the internal administration of antiseptic agents must be resorted to. Franck recommends salicylate of soda in doses of about one gramme every hour. Carbolic acid, sulphite of soda, quinine, or other agents of this class, may also be given with advantage.

Constipation may be averted by castor-oil or a suitable diet—skimmed milk alternately with new milk. Preparations of iron may also be administered; and if the young creature is still at the teat, its dam should be well fed.

Franck notes that, during the course of omphalitis, the most serious complication is inflammation of the umbilical artery, the existence of which can generally only be detected on the *post mortem* examination of an animal which has died, or been killed because of the disease. This complication is more frequent in the Foal than the Calf, probably because the vessel is torn at the umbilical ring in the first, and in the abdomen in the second. The peripheral portion is thickened and contains a reddish-coloured thrombus, or it is filled with a puriform breaking-up mass, and often the vessel is surrounded by, or imbedded in, an abscess; a sharp line of demarcation separates the inflamed from the healthy portion. General infection or pyæmia rapidly follows umbilical arteritis.

CHAPTER VII.

Arthritis.

Disease of the joints of young animals, occurring soon after birth, has been for a long time recorded in districts or regions where breeding is largely carried on; the animals affected belonging to the Equine, Bovine, and Ovine species—much less frequently are Dogs and Pigs attacked. In France it is usually known as the "Arthrite" or "Paralysie des Jeunes Animaux," in Germany as the "Fohlenlähme," "Kalblähme," and "Lämmerlähme"; and in this country—where it has evidently been but little studied, it has been popularly known as "Joint Ill," and technically as "Scrofulous Disease of the Joints," or "Specific" or "Constitutional Synovitis."

The disease was first described, we believe, by Brugnone;[1] then it was noticed by Roupp,[2] Lecoq in 1828, Strauss[3] in 1831, Bénard[4] in

[1] *Trattato delle Razze de' Cavalli.* Turin, 1781.
[2] *Recueil de Médecine Vétérinaire*, 1825.
[3] *Darrsucht der Föhlen.* Vienna, 1831.
[4] *Recueil de Médecine Vétérinaire*, 1832.

1832, Träger[1] in 1839, Noll in 1840, Darreau[2] in 1842, Anacker[3] in 1848, Roloff[4] in 1865, and Bollinger[5] in 1873 and in 1875.[6] In England, perhaps the most valuable description of the malady which has appeared is by Walley.[7] It has been more particularly described as it occurs in the Equine race in Normandy, by Lecoq and Darreau, and in Poitou by Terai; in North Germany by Träger, Bollinger, Strauss, and Roloff. In the Bovine species, it has been portrayed as it prevails in Bourbonnais, by Bénard and Gay; in Switzerland, by Anacker, and in Bavaria by Bollinger. In the Ovine species, Röll describes it as existing in Hungary, Haubner in Saxony, Kuers in Prussia, and Chambert and Cauvert in the South of France. Walley alludes to its principal features as it is witnessed in Lambs in England.

In some years it prevails very extensively, and appears to be almost enzoötic in some portions of the above-mentioned countries.

By some authorities it has been supposed to be a constitutional disease, by others as scrofulous in its nature; while others, again, consider it as essentially pyæmic, and a sequel of purulent omphalophlebitis.

Roloff is of opinion that the affection is due to an alteration in the blood—to a diminution in the amount of mineral salts in that fluid—a veritable cachexia, in fact, allied to rachitism or osteomalacia. In this view, the inflammation which attacks the joints and is symptomatic of the disorder, should be attributed, primarily, to a cachectic or scrofulous diathesis, and, secondarily, to the traction exercised by the ligaments, connective tissue, and periosteum imperfectly attached to the soft and unequally consistent bones, when the animal moves.

Walley defines it as an inflammatory affection of the synovial membrane of the joints, of a specific character; hence the terms "Specific Synovitis" and "Specific Arthritis."

Causes.

If there is some diversity of opinion as to the etiology of this joint disease of young animals, there is absolute unanimity as to its predisposing cause—the period of youth, as it only appears during lactation. This fact disposes of its constitutional or hereditary nature, and has inclined some veterinary pathologists to attribute its occurrence to an alteration in the composition of the milk of the parent.

Darreau believed that the malady is more frequent among Foals which do not receive the first milk, which contains colostrum; but this view is not borne out by other observers. Roloff witnessed its advent in such a manner, that he thought it must be sometimes congenital. Walley stated that the causes are entirely local, and can be traced to an impure or anæmic condition of the milk of the dam, as the result of improper systems of management, or giving food deficient in the necessary constituents of the blood. Hence, he asserted, it is seen when Ewes have been fed on an abundance of turnips, without a sufficient allowance of hay or corn, particularly if the turnips are decaying, or have been unduly forced with artificial manures.

[1] *Föhlenkrankheiten.* Berlin, 1839.
[2] *Recueil de Médecine Vétérinaire*, 1842.
[3] *Kalberlähme.* Zurich, 1848.
[4] *Fohlenlähme.* Berlin, 1865.
[5] *Zur Kentniss der Fohlenlähme*, Virchow's *Archiv*, Band, 58, 1873.
[6] *Deutsche Zeitschrift für Thiermedicin*, 1875.
[7] "Joint Ill in Lambs," *Veterinary Journal*, 1876, p. 406.

It has also been remarked that it often occurs on heath lands which are much exposed, and have been top-dressed with marl; but the appearance of the malady only when the young creatures are at the teat, rather negatives the idea that exposure has anything to do with it. It has likewise been noted that when Ewes are fed on decaying turnips or mangold-wurtzel, the Lambs are frequently the subjects of effusions of lymph between the muscles—the effusion being arrested when corn is given to the Ewes.

Walley insisted upon an altered condition of the milk as the cause of the disease. "That it is due to, and must be associated with, an altered condition of the mother's milk, is proved by the fact that it only attacks young animals while sucking the dam; that the Ewes coincidentally die from malignant parturient fever (though it must be borne in mind that it is not necessary that the Ewe should exhibit any external symptoms of a diseased condition of the blood); and that it is frequently found to disappear on farms which have been heavily limed and drained, and also when a different system of management has been adopted. Again, the general *post mortem* appearances bear a strong resemblance to those of distemper in the dog, especially of the hepatic form of the disease; and the enlarged and softened state of the liver, where external symptoms have not been manifested, points to disease of a typhoid character, brought on by the imbibition of impure milk." He enumerates the exciting causes, as "exposure, cold damp pastures (hence the more frequent localization of the disease in the joints), neglect at birth, allowing the young animals to become covered with mud and dirt, thus preventing the dam licking them, excess of wet weather, etc."

Roloff, as just mentioned, thought the development of the disease was due to the insufficient ingestion of calcareous salts; and as the malady is originated during intra-uterine life or the sucking period, it is evident, he added, that it is in the regime to which the dam is submitted during gestation, when the osseous system of the fœtus is being developed, and when suckling, that the cause of the disorder must be especially sought for. Careful analyses have shown that the ash of the herbage or hay in the localities where the malady makes the largest number of victims, does not contain more than six to eight per cent. of lime salts, while that of good quality should have from eleven to thirteen per cent. It is also remarked that this form of arthritis sometimes prevails in those places where osteoclasty of cattle is frequent: and this coincidence, it is affirmed, should indicate a common origin of the two affections—a defective supply of calcareous salts, and particularly of the phosphates. This deficiency is sometimes noticed when the food is relatively of a rich character; though then the amyloid and proteic constituents are in excessive proportion.

Bollinger, whose scientific and most valuable researches in comparative pathology entitle his opinions to the greatest consideration, entertained different views as to the origin of the malady; and his anatomo-pathological investigations in this direction are of the highest interest and importance. His observations on the disorder commenced in 1869, at the Government Stud at Graditz, Silesia, where it prevailed enzoötically and caused considerable loss. In that year forty-seven Foals were attacked, and in 1870 twelve. Nineteen cases were not very serious; but of the other forty, twenty-nine succumbed—a mortality of 72 per cent. of those affected. The Foals were generally seized with it (75

per cent. of the cases) during the three weeks succeeding birth. Of the forty Foals above alluded to, twenty were ill within the first eight days, ten in fifteen days, and the others in the fourth or sixth week. The period of the malady was, of course, related to the foaling season—April, May, and June. After an attentive study of the symptom and making *post mortem* examinations, Bollinger came to the conclusion that there is a complete analogy between the arthritis of Foals—particularly in the lesions observed—and the results noticed as a consequence of omphalitis in infants. In his opinion, this joint disease, with its complications, is due to metastatic pyæmia, which has its point of departure in the purulent omphalo-phlebitis described in the preceding section of this work.

In a more recent publication, Bollinger returns to this subject; and after alluding to his former opinion, founded on literary studies and clinical observations, that the lameness or disease of the joints which attacks Foals and Calves during the first weeks after birth, are due to primary alterations in the apparatus of the circulation, viz.—inflammation of the umbilicus and umbilical vessels, he gives further evidence in support of this supposition. The autopsies of the Calves which form the subject of his second communication, will be noticed hereafter; but it may be mentioned that they afford indubitable evidence of the existence of purulent omphalo-phlebitis and its consequences. As in Foals, so in Calves, he traces the origin of joint disease to violent inflammation of the umbilical veins. He notes that in Calves—which have a *ductus venosus Arantii* and Foals have not—the direct opening of the vessels into the posterior vena cava, as well as the general implication of the latter, causes a proportionately larger number of cases in them than in Foals. The influences at work in the production of omphalitis have been enumerated; but Bollinger lays great stress on the want of care, which is, as a rule, bestowed on the umbilical cord in newly-born animals, and compares this neglect with the scrupulous attention paid to that of infants, which is severed and bandaged immediately after birth; while the former have to lie with an open wound in all kinds of filth, and are thus readily exposed to inoculation with poisonous or injurious matters, which cannot be excluded even from stables built specially for the purpose, and kept thoroughly clean. If the navel wound of an infant were exposed to the filth which young Foals and Calves have to lie in, it would be quite as liable to blood-poisoning as animals, and to the consequent affection of the joints.

Bollinger contests the influence of food in the production of the disease, as strong, no less than weak, animals are attacked; it also appears when every kind of diet is given to the parent.

He also denies that it is produced by chills, and attributes its advent chiefly to pyæmic or septic infection. He compares the enzoötic appearances of joint lameness with the endemic outbreaks of pyæmia and septicæmia (or puerperal fever), and points out that the only real difference between man and beast lies in the simultaneous appearance of puerperal fever epidemics with pyæmia in infants. One point is certain, he adds, and that is that there is a physiological and anatomical difference between woman and the domestic animals. The anatomical structure of the placenta and its villi, and its relations with the *placenta materna*, are of such a nature in animals as to prevent (on the normal detachment of the placenta) any rupture of bloodvessels, and consequent hæmorrhage. In other words, if delivery has been successfully

accomplished, no injury in the shape of wounds or abrasions is inflicted on the inner surface of the uterus; and owing chiefly to this fact is the inflammatory reaction and consecutive lochial fever reduced to a minimum among animals, the introduction of poisonous matters (be they vegetable organisms or other injurious substances) into the uterus being rendered much more difficult; while we frequently find instances of the pyæmic process, due to inflammation of the navel and its vessels, among sucking animals, with the parent—except in the case of the Cow—this process is rare.

Symptoms.

The symptoms of this form of arthritis are variously enumerated. The principal is extreme difficulty in moving, which is often noticed without any other premonitory indication. The movements are painfully and reluctantly performed, so that the young creature generally persists in lying. Around the epiphyses of the bones, and consequently near the articulations, there is swelling not only of the proper tissues of the joints, but also of the surrounding connective tissue, with hot, œdematous, and very painful infiltration of the region. From the very commencement the symptoms are most acute, and similar to those of ordinary arthritis; and they are rendered more marked by the least movement, the lameness being then extremely great; generally all the joints are involved. The fever is extreme, the respiration hurried, and the visible mucous membranes highly injected; sometimes, and especially with Lambs, there are *quasi* tetanic spasmodic contractions. The appetite is lost, but thirst is intense, and the suffering creature will often be observed dragging itself along the ground to reach water or the teat of its dam. Not unfrequently there is at the same time a debilitating diarrhœa or dysentery, and sometimes in Lambs a purulent nasal discharge.

The progress of the disease is sometimes very rapid, death occurring in twenty-four or forty-eight hours after the manifestation of the earliest symptoms. This rapid course is, however, rare, and the animal may live for twenty or thirty days, or even longer. Recovery is also rare, and death is the usual termination; it is quite exceptional that the disease becomes chronic. The malady usually ends in suppuration, which nearly always becomes general, numerous abscesses forming around the joints, the capsules of which contain pus; there are also purulent deposits in other regions of the body. Generally after the fourth day, when the joints are greatly swollen, the hair falls off in these parts, and a yellowish or citron-coloured fluid, then pus, begins to exude through the skin, which sloughs away; the ligaments are also involved in this sloughing process, and at last the articulations are completely disorganised. In some cases the limb is only retained by remains of tendons, the bones being exposed, the articular surfaces destroyed, and the odour almost insupportable. The complications may be pneumonia, pleurisy, pericarditis, and the usual indications of pyæmia.

In Foals, Bollinger noted, as the chief symptoms, violent fever with very hurried respiration; the animals did not suck so much as usual, and if lively and attentive at the commencement of the disease, they quickly became extremely weak and torpid. They also became emaciated, and the coat was harsh and lustreless; often there was nasal catarrh and discharge, tumefaction of the submaxillary lymphatic glands, sometimes

capillary bronchitis, and generally diarrhœa. With the majority there was tumefaction of certain joints, and particularly of the hocks. In addition to the swelling, there were heat and pain, with great lameness. Not infrequently there were immense subcutaneous abscesses. Stupor eventually set in, and the creatures looked as if half asleep; then coma was soon manifested; there was dysenteric diarrhœa, the dejections being quite fluid, greyish-coloured, and extremely fœtid; while the visible mucous membranes had often a yellowish tint, denoting the existence of icterus.

In Lambs the symptoms are similar to those just enumerated. Walley described them as follows:—A general febrile condition of the system, as shown by the injected state of the mucous membranes; quick, irritable pulse, irregularity of the bowels, hurried respiration, and refusal to suck. The animal persistently lies, and if made to move does so unwillingly and very stiffly, with the back arched, and placing as little weight as possible on the affected limb or limbs, which are usually flexed, even in recubation, to remove pressure—this persistent flexion ultimately leading to contraction of the tendons and distorted limbs. If the disease continues, the muscles waste, causing the affected joint to appear larger than it really is. The characteristic swellings usually appear in the hocks, knees, and stifles, though they are not by any means confined to these particular joints. In character they are round, have a doughy feel, are intensely painful to the touch, very hot, immovable, and increase in size. Thus they are like, yet dissimilar to, rheumatismal swellings—like them in being located in the joints, and being hard, round, and tender; unlike them in being stationary, and attacking the internal structures of the joints—the primary lesions in rheumatism being confined to the external ligamentous structures of these organs, and when attacking the interior of the joints formative processes are evidenced; while in "joint-ill" degenerative processes predominate. As the disease progresses, and life is prolonged, the animal becomes emaciated, diarrhœa sets in, the wool falls off, and a variety of changes are detected in the joints. Erysipelatous inflammation makes its appearance in various parts of the skin of the body, especially at the external orifice of the urino-genital organs, at the postero-inferior part of the abdomen, and round the navel, in the latter position constituting "navel-ill." Local dropsies are frequent under the jaw and other dependent positions—as the navel, which is said to be *pocked*. If blood is abstracted during life, or collected after death, and set at rest for a time, it deposits a peculiar dark-coloured, grumous mass at the bottom of the vessel, composed, so far as can be seen by the microscope, of altered blood-cells. This deposit lacks the firmness of the other parts of the clot, and bears a close resemblance to half-fermented damson pulp. Bacteria are developed in the blood shortly after death, and long before any putrefactive odour can be detected. Absorption of pus into the blood—pyæmia—is indicated by elevation of the temperature, fœtor of the breath, diarrhœa, dark yellowish-red colour of the mucous membrane, gnashing of the teeth, rigors, and hectic fever—the latter being present also in ulceration of the joints.

In the latter, the swellings become softer and very irregular in outline, from bulging of the more flaccid portions of the synovial membrane and skin; and, from portions of the effused lymph becoming liquefied, fluctuation is produced—other portions remaining solid. The fluctuating swellings extend along the thecæ or sheaths of the tendons—two joints

often becoming in this way connected with each other; finally, the skin over the most prominent portions of the joint becomes absorbed, ulcerates, and if not divided by the lancet or by accidental violence, bursts—allowing the escape of the contained fluids and semi-solid matters, and being followed by sinuous ulcers, caries, or abscess proper, of the joint. The sinuses may extend a considerable distance from the joint, and discharge an ichorous unhealthy fluid, accompanied by fœtor if bony or ligamentous structure is involved. In some cases the exuded lymph simply becomes liquefied and absorbed, without any external opening being formed; in others—*i.e.*, when the lymph is plastic and the constitution strong—it undergoes healthy organisation, and remains as a part of the joint, producing, however, permanent thickening, distortion, and stiffness.

Prognosis.

From what has been stated, it will be seen that the prognosis with regard to this disease must always be unfavourable, especially when the creature is very young. The mortality reaches as high as forty, fifty, sixty, and even more per cent. Indeed, Darreau states that eighteen out of every twenty Foals die; and Lecoq says that the breeders in Normandy have an axiom, "Poulain boiteux, poulain perdu."

Pathological Anatomy.

According to Roloff, the predominant lesions are the characteristic alterations of rachitism and periostitis. The cartilage uniting the epiphyses to the shaft of the bones is soft from cellular proliferation, and injected in places by hæmorrhagic spots; the periosteum is also thickened, injected, and here and there detached from the bones; while towards the diarthrodial surfaces the bone tissue is greatly involved. There are, in fact, all the lesions of arthritis, but they are of a much more serious character than those observed in adult animals. The synovial membrane is highly inflamed, and there is great infiltration of the connective tissue around the joints.

Reynal has found in the intra-articular cavities of the joints, deep-yellow-coloured clots streaked with red, and elastic and firm, which are nothing more than false membranes that have had time to form in the short space of two to five days.

Walley remarked that, in Lambs, the *post mortem* appearances are *general* and *local*. The *general*, in the earlier stages, are effusion of lymph between the intercostal muscles, beneath the pleura and into the lungs, and in other organs; with hyperæmia or engorgement of the small bloodvessels of the mucous membrane of the stomach (fourth compartment) and intestines.

If the disease has existed for any length of time, erysipelatous exudations are found under and within the structure of the skin of dependent parts, or effusion of serum (dropsy) into the connective tissue and the various cavities of the body. The large bloodvessels—even those of the brain—are filled with dark, grumous, damson-coloured blood; the structure of the brain is dark; the liver is often enlarged, friable, and full of minute abscesses, which give it a mottled appearance that is frequently mistaken for tuberculosis; all the organs and tissues are tinged with the colouring matter of the bile; the small vessels of the omentum are charged with blood, and the mucous lining of the fourth division of the stomach is congested and black wherever the milk has lain in con-

tact with it. In many cases the urachus is black—a bluish-black hue extending some distance along the mucous membrane of the bladder. The umbilical vein is also black, and filled with a cheesy material—degenerated lymph, or coagulum of blood.

The *local* appearances—*i.e.*, in the joints—are, in the first stages, inflammation of the synovial membrane, which in a short time extends to the ends of the bones and to the ligamentous structures—the whole having an intensely scarlet hue, which diminishes in a few days. Coagulable lymph becomes effused into the cavities of the joints, forming perfect casts of their interior, and filling up the interspaces between the bones. In time, the exuded lymph commences to soften and break down, and owing to the contraction of the mass the fluid portion is pressed out, and intermixes with the degenerated lymph. Fluid is also thrown out from the irritated vessels of the joint, and aids in the softening of the lymph. After a time suppuration is thoroughly established, and pus cells are distinguished by the aid of the microscope. The sheaths of the tendons running over the fronts of the joints becomes excessively inflamed, and the bloodvessels of the ligamentous structures are filled with scarlet blood. The cartilage covering the articular ends of the bones becomes ulcerated and blackened, as is also the cancellated structure of the bones themselves; extravasations of blood, from perforation of the coats of the vessels, take place, the coagula either undergoing degeneration or healthy organization. In the latter case, distinct granulations are formed, which, on recovery of the animal, fill up the cavities produced by the lymph. The flakes of lymph which are found floating in the fluid contents of the joints or adherent to their sides, are often mistaken for scrofulous deposits. If animals have lived sufficiently long, multiple pyæmic abscesses are found in the various organs and structures of the body. Blood from deceased Lambs introduced into the veins of a Dog, has given rise to the formation of multiple hepatic abscesses.

From this description of the pathological anatomy of the malady, there can scarcely be any doubt as to its pyæmic or septic origin, and this is further demonstrated by the description of its morbid anatomy by Bollinger.[1]

[1] *Deutsche Zeitschrift für Thiermedicin*, 1875.—A male Calf born at the Agricultural School of Strickhof, near Zurich, showed symptoms, soon after birth, of inflammation of the umbilicus. As the joints began to swell, and there was no hope of saving the animal from the effects of the dreadful joint disease—"gelenkseuche"—it was destroyed eight days afterwards. The body was dissected an hour after death, but the examination was imperfectly made. The umbilical ring was discovered to be still open; it formed a circular aperture about two centimetres in diameter, the sides of which were covered with ulcers and a greenish-yellow pus. The umbilical veins and the joints had been thrown away, and therefore the investigation could not be continued. Projecting about the upper margin of both lungs were several cuneiform tumours of a dark-red colour, and of a solid consistency. In the pericardium was a quantity of pale serum, in which floated loose stringy fibres. In the cavity of the heart were a few detached fibres and blood-clots. Beneath the endocardium were various-sized patches of ecchymoses and blood extravasations. Nothing abnormal was observed in the liver and kidneys except bloodlessness.

Another Calf was born at the same establishment on February 6th. Its birth had been laborious, and the umbilical cord was divided in the ordinary natural manner. The animal did not appear to be as lively as it ought. About eight days after birth a swelling showed itself in the neighbourhood of the navel; this, however, disappeared after the application of poultices. Fourteen days after birth the Calf could not stand, and painful swellings appeared on the inner aspect of the knee joints. Until this time the creature had a good appetite, and had taken a plentiful supply of milk regularly every day. On February 27th, the appetite entirely failed, and on the 28th the Calf was

The result of his autopsies, together with the symptoms observed during life, led Bollinger to the conclusion that the development of the pathological process is as follows: inflammation of the umbilical vessels, notably the vein, with its decomposed and softened thrombus, which passes into the vena portæ, and forms the point of departure or source of a metastatic pyæmia, and from it embolism of the lungs is sometimes directly originated; or at other times, in consequence of alteration in the blood, which is septic, and of the general character of the inflam-

killed, in order that the carcase might realise something. The most important organs were sent to Bollinger, and their examination yielded the following results: There was *purulent emphalo-thrombo-phlebitis, with thrombosis of the portal vein; fibro-purulent gonarthritis of the stifle joints and purulent peri-arthritis; purulent tracheo-bronchitis, embolic infarction of the lungs, commencing endocarditis of the mitral valves, and generalised icterus.* The parts surrounding the stifle joints were of a pale-yellow colour, infiltrated with a sero-purulent fluid, and moderately thickened. In the cavity of the joints there was a tolerable quantity of dark-tinted serum, and on the synovial membrane more especially was a mass of yellowish-green and firm fibro-purulent matter, about two centimetres thick, which projected into the synovial cavity. The cartilages of the joints were covered with similar matter, and in some places they were quite rough. The entire capsule of the joint was inflamed, softened, and purulent. The trachea and bronchial tubes contained a quantity of muco-purulent fluid, which, in the latter, formed itself into one mass. The mucous membrane was pale; the almost bloodless lungs had ecchymosed spots beneath the pleura, and in one place were two wedge-shaped masses the size of a pea, which on being cut open were found to contain pus in the centre. The heart and pericardium were normal, with the exception of the mitral valve, which was of a dark-red colour, thickened, and exhibited hæmorrhagic infiltration in places; by means of the microscope, a notable cellular opening could be perceived in the connective tissue close to the hæmorrhage. The spleen was of normal size, but pale and bloodless; the liver was enlarged, full of blood, icteric in tint; in parts were small, subperitoneal hæmorrhagic deposits. The umbilical vein was distended throughout its entire length; its walls were considerably thickened, and the inner surface was of a dirty-grey colour, rough, uneven, and studded with greyish-white puriform deposits. This alteration in the umbilical vein extended as far as its junction with the posterior vena cava, which, owing to the closure of the *ductus venosus*, is not in direct communication with the umbilical vein. Where the latter enters the portal vein was a purulent cloaca, beyond which was a large thrombotic puriform mass that obliterated the cavity of the latter vessel as far as its bifurcation. As fatty degeneration of the heart was suspected from its appearance, the tissue of that organ was examined microscopically, but it was found to be normal. The voluntary muscles in the vicinity of the diseased joints, and which appeared very pale to the naked eye, were only clouded with granular matter. The puriform contents of the umbilical vein consisted of fatty granular detritus, in which it was difficult to detect pus corpuscles; bacteria could not be found in any number. The liver offered indications of a violent icterus, and exhibited all the alterations of acute parenchymatous hepatitis, with marked granular degeneration of the hepatic cells.

In the three autopsies of Foals made by Bollinger at Graditz (*Virchow's Archiv.*, 1873), he found double broncho-pneumonia of the anterior lobes of the lungs, pulmonary abscesses, purulent arthritis, intra-muscular abscesses, caries of the bones, and fatty degeneration of the muscles of animal life, particularly in the neighbourhood of the affected joints; as well as fatty degeneration of the heart tissue, liver, and kidneys. In the intestinal canal were lesions of catarrhal enteritis, accompanied by hyperplasia of the mesenteric glands. Neither in the animals when alive, nor at their autopsy, were there any of the signs of rachitism mentioned by Roloff. The umbilical cord was unfortunately not examined.

On another occasion, the same excellent veterinary pathologist examined the bodies of two Foals—one three weeks, the other five weeks old, which had succumbed to this malady. In these there was inflammation and thrombosis of the umbilical vessels, continuation of the thrombosis of the umbilical vein (in process of suppuration) into the portal vein, which was also affected with thrombosis, as well as its hepatic ramifications. In one of these cases there was likewise thrombosis of the pulmonary artery, double pleurisy with pericarditis, purulent arthritis affecting several joints, vast intra-muscular or subcutaneous abscesses, and cutaneous erysipelas. In the other case there were pulmonary abscesses, circumscribed pleurisy, purulent irido-choroiditis, and, finally, in addition to general anæmia there was great tumefaction of the bronchial and mesenteric glands.

mations, there are metastatic inflammations of the serous and synovial membranes (pleurisy, pericarditis, arthritis), of the lungs, iris and choroid coat of the eye, abscesses in the muscles and connective tissue—in a word, the entire series of clinical and anatomical alterations which constitute the complicated arthritis of Foals.

More recent investigators have detected special micrococci in the fluids and tissues, to which the origin of the disease must be attributed. The most important of these is the *Streptococcus pyogenes*, to which the more diffuse suppurations may be due; and the *Staphylococcus pyogenes albus* and *Staphylococcus aureus*, which probably produce the more localised lesions due to inflammation. These find easy access to the body through the umbilicus when circumstances are favourable.

Treatment.

Curative treatment of this form of joint disease being, under the most favourable circumstances, very unsatisfactory unless it is adopted at the very commencement, the greatest importance must be attached to *preventive* measures, and especially if the malady is enzoötic. On the Continent, those veterinarians who adopt Roloff's view lay great stress on the necessity for preserving the young animals, and particularly the female parents, from the effects of improper feeding. The latter are to be well fed during pregnancy, and aliment rich in earthy salts is to be given. In addition, bone-dust is to be mixed with their prepared food, or with bran, meal, or oil-cake.

When it is continually prevalent in districts, it is recommended to improve the pasture lands, and to restore to them, by means of top-dressings, the mineral elements abstracted by the growth of forage or the herbage consumed by the animals grazing upon them. Attention is drawn to the fact, that in a hundred days a medium-sized Cow will remove from the soil about a kilogramme of phosphoric acid, which is present in the milk yielded during that period.

But as there is every reason to believe that the malady is of septic origin, the preventive measures recommended for omphalitis must be adopted.

Curative treatment, as has just been said, is generally unsatisfactory, and this not only from the comparatively small value of the animals affected, and the difficulty in applying remedies to them, but also from the very serious nature of the disease, and the character of the tissues involved. Even when the life of the creature affected with arthritis is preserved, only too frequently its health and condition are irretrievably impaired.

The umbilicus should be treated as in omphalitis, a solution of corrosive sublimate (1 to 1,000) being a good dressing, and some of the same solution may also be injected into the umbilical vein; this may be repeated twice or thrice daily for the first few days, the animal being placed on its back during the application. If the urachus is involved and open, a solution of boracic acid (2 drachms to 16 ounces of water) should be injected into it; it should not be ligatured. Hot water fomentations ought to be applied to the abdomen, and the animal should be kept in a clean cool place, great attention being paid to the diet.

Zundel remarks that counter-irritants to the joints augment the pain and increase the debility, and emollients have only a doubtful effect. In the hands of Strauss, refrigerants were productive of good results,

the inflamed joints being enveloped afterwards in linen bandages. Anodyne lotions and embrocations have also been recommended, in order to allay the pain and irritative fever; as well as the application of tincture of iodine before the suppuration period. When suppuration is established, the abscess should be opened at the proper time.

Tonics have been given with advantage, as well as cod-liver-oil, castor-oil, and even ordinary oils and fats. These not only aid in the assimilation of earthy salts and nitrogenous matters, but to some extent act as a laxative—a service of some importance. Small doses of sulphate of magnesia or soda, or even aloes, may also be given with the last-named object, or to produce continuous purgation for some time.

With regard to the treatment of the disease in Lambs, Walley advises that those affected be removed from the dam, and receive milk from healthy animals. This milk may be mixed with beaten-up eggs, and good nitrogenised gruels may also be allowed. "Place in dry, warm houses, and give gentle aperients — as castor-oil—or better, a small dose of mercury with chalk; follow up by febrifuges and diuretics, as nitrate of potash and camphor, with nitric ether, or carbonate of ammonia; if much pain is evinced, give small doses of opiates —Dover's powder being the best agent of this class; or inject a small quantity of the solution of morphia underneath the skin of the joints. In the course of a few days, tonic treatment should be adopted, as the administration of iron, alternated with iodide of potassium; or mineral acids with cinchona, or other vegetable tonics; and allow a little wine, good old ale, or porter." The same authority recommends, as local treatment, the application of a strong blister—as the compound tincture of iodine ointment—all round the joint, at the commencement of the disease; and when the subsequent inflammation has subsided, to keep the joints at rest and in their proper position by the use of light splints and bandages, leaving the joint exposed for further observation. As soon as any tendency towards "pointing" in suppuration is perceived, the joint is to be opened freely, the inflammatory products removed, and the interior washed out with a solution of carbolic acid in glycerine and warm water—one part of the first, two of the second, and forty or fifty of the last. Afterwards, pads of soft lint or linen and tow, saturated in carbolised oil (one to eight or ten) should be applied, leaving an aperture inferiorly for the escape of discharge; the dressings are to be renewed every day. Mild caustics or astringent lotions are to be applied if granulations project above the skin. If the ends of the bones are carious, they must be scraped, and nitric or muriatic acid applied; should sinuses have formed, they must be obliterated by the use of setons, or laying them open with the knife, and treating them afterwards as ordinary wounds. "In treating the results of this disease, it must be borne in mind that in young animals the reparative processes go on very rapidly; and that what appears to be a very formidable wound, is soon converted into a comparatively simple one. Animals, too, may, with a little trouble, be fattened and their flesh utilised; few can be preserved for breeding purposes."[1]

As salicylic acid is unrivalled for its antipyretic properties, and particularly in inflammation of the fibro-serous membranes, its internal administration should be tried in this arthritis of young animals. The

[1] The flesh of animals which have been suffering from this disease should be interdicted as food, as it is positively dangerous to those who consume it.

soda salt (salicylate of soda) is the best form, perhaps. The internal administration of other antiseptic remedies—as preparations of carbolic acid and boracic acid, sulphite of soda, quinine, etc., might also be tried.

CHAPTER VIII.

Indigestion.

INDIGESTION sometimes attacks young animals soon after birth, and is perhaps most frequently observed in Calves, seldomer in Lambs; in Foals and the young of Carnivora it is rarely met with.

Causes.

The principal cause would appear to be too rich milk, or even milk difficult of digestion from its poorness, or from its containing some extraneous ingredient to which the young creature is not accustomed. The quantity of milk may also prove as potent a cause as its quality. Therefore it often happens, that too copious sucking after abstinence will give rise to an attack; and among Calves reared by hand, those which receive artificial food of improper quality or in undue quantity, are frequently the subjects of indigestion. An alteration in the milk of the Cow, produced by fatigue, or bad food or water, will also lead to the same accident; while altered secretions in the stomach of the Calf itself—as too much acidity—will undoubtedly cause coagulation of the milk, and, as a consequence, indigestion.

Indigestion is often witnessed in high-bred Calves which are unnaturally forced, in order to produce greater and premature development.

Symptoms.

The young animal looks dull and dejected, and evinces uneasiness or suffering; the movements are torpid; the coat is dry and staring; it yawns now and again, and there are sharp gaseous eructations which cause it to elevate its head. Soon it refuses to suck or to partake of food, and the nausea is more marked; there may be vomiting of coagulated milk; the breath has an acid odour, and the tongue is coated with a white or greyish fur; the abdomen is swollen and tympanitic, and pressure made towards the upper part of the right side, as well as along the cartilages of the ribs, causes pain; flatus is expelled when diarrhœa—the fæces being yellow and fœtid—sets in, which is frequent—though constipation is not rare; and at this period symptoms of colic are often noted, and the respiration is at times hurried. The diarrhœa is a means of cure; though should it persist too long, inflammation of the stomach and intestines may ensue. Then there is emaciation, the abdomen is retracted and flanks tucked up; fever is present; signs of great pain are manifested; the dejections are small in quantity, and consist of a yellow glairy mucus, mixed with lymph or false membranes.

Indigestion runs its course rapidly in the Calf—in the majority of cases only occupying two, three, or four days. It may be considered a serious condition, as death often occurs. As it is frequently induced by causes which are in operation for some time, even when recovery takes place relapses are to be apprehended; at last the stomach and intestines become inflamed, and enteritis brings about a fatal termination.

Under the most favourable circumstances it causes loss of condition, and often retards growth.

Treatment.

Preventive treatment is to be based on the predisposing or exciting causes just enumerated. Over-repletion with milk should be guarded against, and if the animal is being reared artificially, great care must be paid to the diet. If at the teat, the food and water of the mother should be attended to; and if the milk is too rich, this may be remedied by giving less stimulating food. With Mares which are worked during the suckling period, the milk is often retained for a long time in the udder, and becomes altered; on returning to the Foal, this is ravenously hungry, and over-gorges itself with the unhealthy fluid. The preventive measures are obvious in such a case.

Indigestion may be due to an insufficiency of oily matters in the milk of the mother; here the diet of the latter must be altered.

The *curative* measures in mild cases are simple. Some French and Italian veterinarians recommend the administration of barley-water or very weak beef-tea, and if there is not speedy amendment they prescribe a spoonful of rennet, which, they assert, readily effects a cure.

When the indigestion is due to acidity, alkaline agents—as carbonate of potass or soda, lime-water, calcined magnesia, etc.—and afterwards castor-oil—are generally effective. A mild purgative—such as castor-oil, manna, cream of tartar, olive-oil, or a dose of glycerine in albuminised water—is very useful, even when diarrhœa has set in. Manna has proved an excellent remedy for Lambs, and even Calves. When constipation is present, enemata of soap and water may prove serviceable. Vegetable bitters—as tincture of gentian—and mild stimulants, are often beneficial; much success has attended the administration of a spoonful of very finely-powdered vegetable charcoal, given twice a day mixed with water in which an egg has been beaten up.

When there is pain and uneasiness, chlorodyne will be found an excellent medicine, particularly if diarrhœa has persisted for some time. Of course, a change of regimen is generally necessary. In chronic indigestion of Calves, Philippi omits all medical treatment, which he asserts is usually found to be inefficacious in these cases, and puts them to be suckled by Cows which have newly calved, dieting them carefully at the same time.

CHAPTER IX.

Gastro-intestinal Catarrh.

According to Friedberger and Fröhner,[1] by its etiology and course, as well as in the treatment to be adopted, the gastro-intestinal catarrh of young animals differs essentially from the same affection in adults. It has been confounded with the dysentery of young animals, and in the first edition of this work, this error was committed; indeed, for more than a century the two diseases have been, and are even now, described as one. But a distinction must be made, and they are separately dealt with here.

[1] *Lehrbuch der Speciellen Pathologie und Therapie der Hausthiere*, vol. i., p. 199. Stuttgart, 1887.

Symptoms.

The early symptoms vary somewhat, according to the exciting causes. Sometimes they are suddenly manifested, and at other times they are so gradually developed that they do not attract attention for a day or longer. With sucking animals the principal symptom, diarrhœa, is usually preceded by slight anorexia, dulness, and weakness; but with animals which are weaned, and especially if the attack is due to drinking very cold water or an external chill, the first signs are fever and general disturbance—the temperature of the body being irregularly distributed, limbs cold and muffle dry, and much nervous depression—sensory and motor. Diarrhœa soon sets in, the dejections quickly becoming watery, and frequently energetically expelled; they are not long before they are fœtid and mucous, yellow or greenish-gray in tint, spumous and foul-smelling, and containing fibrinous flakes or clots; at a later period they are blood-streaked or sanguinolent, and ejected at very short intervals, soiling the hind legs and tail, and by their acridity causing the hair around the anus, perinæum, and thighs, to be shed.

Usually there is tenesmus and signs of colic, the animal standing with its back arched and its feet drawn together. The skin is dry and there is horripilation; the debility becomes extreme, and the exhalations most offensive. Tympanitis is often present, the gases accumulating in the rumen and intestines of the Calf producing great distension—though this may be present before, during, and after the diarrhœa stage, being due to abnormal fermentation.

In some cases death occurs within a few days or as many weeks, and is generally the result of exhaustion, anæmia or hydræmia; though sometimes the disease is complicated by catarrhal pneumonia—a consequence, probably, of pulmonary atelectasis, which is so frequent in weakly new-born creatures.

Etiology.

With animals at the teat, it is recognised that the health or alimentation of the mother has a powerful influence in the production of this diarrhœa. Constitutional diseases, anæmia, debility and disturbance in the digestive apparatus or in nutrition, which are usually accompanied by alterations in the milk, have an unfavourable effect on young animals; infectious maladies—such as aphthous fever, generalised tuberculosis, etc., are very inimical to the progeny; while simple congestion of the udder and mammitis may be the cause of gastro-intestinal catarrh in the Calf.

The food consumed by the parent has likewise an influence on the quantity and quality of the milk which the progeny receives. When it is too rich or too poor in nitrogenous constituents, or of inferior or bad quality, it may produce diarrhœa in the young; or excessive fatigue will so alter it as to render it no less objectionable; while certain medicaments given to the mother will irritate the intestinal mucous membrane of the offspring.

Irregular lactation, cold, or cold and wet, overgorging with rich milk, and constipation from any cause—as when the meconium is retained in the intestines from the first milk or colostrum not being allowed—all these may induce gastro-intestinal catarrh. With weaned animals this may also be due to inopportune weaning; improper food, which gives rise to acetic, butyric, or lactic fermentation, and so irritates the stomach and intestines; cold and damp weather; as well as the ingestion of

injurious foreign matters, and the presence of entozoa in the digestive canal.

Of course, the occurrence of the disease is favoured by general predisposing causes—such as innate weakness or great sensibility of the digestive organs, disease of the mesenteric glands, etc.

Pathological Anatomy.

The changes observed after death in fatal cases, are not unlike those seen in the same malady in adults; though in some instances in which the morbid process has been very intense, the alterations do not always correspond with the symptoms observed during life. The stomach usually contains large masses of dense clotted milk (casein) in sucking animals, and in those which are weaned there are similar masses of undigested matters. The mucous membrane of the stomach and intestines presents variable appearances—redness, tumefaction, follicular catarrh, acute ulceration; with atrophy, thickening, granulation, pigmentation, etc., in the chronic form; the mesenteric glands are enlarged. Emaciation is marked, and all the signs of anæmia or hydræmia are present.

Prognosis.

The prognosis must always be carefully given, and will be based on the cause or causes of the attack. It is generally unfavourable when the diarrhœa and tympanitis have continued for a considerable time.

Treatment.

If possible the exciting cause should be removed; and with sucking animals the condition of the parent should be more particularly attended to, in the direction already indicated. The diet of the young animal must be regulated according to circumstances, and especially in the allowance of milk, which ought to be given in small and frequent quantities, and diluted with lime water. Calves should not be weaned until they are from four to six months old, and Lambs not under three or four months—the weaning being gradual, and the food given easily digested and non-irritating.

The diarrhœa is to be combated by gum or linseed mucilage, raw eggs, gelatine water, decoction of malt, almond milk, rice pulp, etc. It may be necessary to clear out the intestines by means of a mild laxative—as castor-oil, or sulphate of soda, or magnesia in small doses. When the diarrhœa is due to intestinal fermentation, the carbonates of soda or magnesia may be advantageously administered, in addition to the castor-oil. Three to five drops of creosote have been prescribed for the Calf, and a half to one drop for the Lamb, in a mucilaginous excipient; also creolin, salicylic acid, and some other antiseptics. Should the diarrhœa be due to worms, these will probably lead to their expulsion.

When the diarrhœa is very intense, opium and rhubarb have rendered good service, as well as Dover's powder, tincture of opium, or, perhaps better still, chlorodyne. Styptics or astringents are likewise useful when carefully given; and astringent enemas—as solutions of alum or tannin (1 per cent.), or nitrate of silver or lead ($\frac{1}{2}$ per cent.) have been recommended.[1] Filliatre[2] has been particularly successful with enemas of tar water, prepared by mixing a small quantity of vegetable tar (150 grammes) in boiling water (6 litres); when tepid one-third of a

[1] Friedberger and Fröhner, *op. cit.*, vol. ii., p. 389.
[2] *Recueil de Médecine Vétérinaire*, 1886.

litre is given in enema every half-hour until the diarrhœa is arrested. In some cases this rapidly ensues. Milk diluted with one-fourth of the tar water is to be given as food, and the treatment must be continued for two days.

CHAPTER X.

Dysentery of Young Animals (Dysenteria Neonatorum).

The peculiar dysentery which attacks young creatures while at the teat has for very many years attracted particular attention, because of its specific nature, its almost incurable character, and the great mortality which attends it; but as yet it is perhaps the infectious diseases of animals of which least has been ascertained. Known by various names in different animal-rearing countries (as "White Scour" in England—the "Weisse Ruhr" of the Germans, and the "Diarrhée des Jeunes Animaux" of the French), it is generally acknowledged that Calves are far more frequently attacked than other animals; though it is also an extremely fatal disease among Foals. Brugnone[1] long ago asserted that it is one of the maladies which cause most destruction among Foals in breeding establishments; and to my own knowledge, it is sometimes a most serious scourge among the young thoroughbred stock in this country. It is also a fatal malady among young Lambs; and it is observed in piggeries and kennels as a very destructive disorder. It appears to be much more frequent among animals reared in dwellings than among those at pasture, and seems to be related to the artificial way in which they are kept.

Like the pyæmic polyarthritis of young animals, it is one of the most fatal disorders to which they are liable. According to Röll it is very prevalent in some parts of Austria, and in one region alone, of 3,318 Calves, 1,196 were attacked, of which 1,152—97 per cent.—perished; in 1884, in the same districts the mortality was 55 per cent.

In the order of frequency, the Calf stands first; then the Lamb, the Foal, the Dog, and the Cat.

It sometimes haunts breeding-stables and cowsheds for years, and among Calves is seen more frequently in some localities than others—low-lying districts being perhaps more often and severely visited than elevated, dry situations.

Epizoötic abortion and this disease have been noted to co-exist, and it has been supposed there is some relationship between the two maladies.

It generally appears within a few days after birth—from the first to the third; beyond the fourth day it is much less frequent. In some instances the young creatures are affected before they have sucked; so that the milk could not have had any influence in its production.

Symptoms.

The symptoms are described as somewhat similar in all the species it attacks. In *Foals* it usually appears within the first three days after birth. The animals are dull and restless, and the dejections are mucous, or very fluid and extremely fœtid; while the expired air and cutaneous exhalations often have a foul odour. The eyes become sunk

[1] *La Mascalcia*, Turin, 1893.

in their orbits; great debility sets in; thirst is intense; the abdomen is retracted; and in some cases a cutaneous eruption is observed, which is generalised or is located in the parts around the anus.

More than a century ago, Brugnone described the symptoms in the Foal as follows: The diarrhœa commences two or three days after birth; a yellow, acrid, sometimes purulent-looking fluid is evacuated; the animal becomes rapidly emaciated, and is nearly always lying; it is weak and staggers about, sucks little or none at all, and at last falls into a state of complete marasmus. During the first period, it is not rare to observe a general ophthalmia occur: the humours of the eyes are turbid and these organs are painful; tears flow continually; the eyeballs become buried in their sockets and are atrophied; and vision appears to be lost.

When the *Calf* becomes affected, it ceases to suck, if it has begun to do so; for Franck has known the diarrhœa to appear immediately after the Calf was born and before it went to the teat—indeed, it was dead before it could do so; though in the great majority of cases it has two or three good meals from the udder before acute diarrhœa sets in. When it no longer sucks, it becomes uneasy and bellows; the fæces, expelled violently, are at first very soft, then fluid and white (mucous diarrhœa), or mixed with particles of casein (white dysentery), and very often streaked with blood; at a later period the evacuations are continuous and made involuntarily. Exhaustion is rapid and the creature cannot rise; convulsions occur frequently, similar to those witnessed in infantile diarrhœa; saliva or foam flows from the mouth; the expired air has a sour or fœtid odour, and great emaciation is observed. There may be slight tenesmus, and the anal opening is dilated as if the sphincter were paralysed; while the air passing into the rectum produces a peculiar sound. Towards the end the creature lies immovable, and dies without a struggle in from one to three days. Allusion has been made to its fatality; in Bovines from 50 to 100 per cent. die, and in many outbreaks it kills all the Calves in an establishment; if any chance to survive an attack, they are sickly and feeble for a long time.

The *Lamb*, when attacked, also ceases to suck and becomes dull and very weak; the dejecta are watery and mucous, and foul-smelling; frequently there is tenesmus; and the temperature may rise to 106° Fahr., though it quickly falls again. The respiration is hurried, and foam and saliva accumulate about the mouth. The disease generally manifests itself within three days after birth; Nikolski[1] gives its appearance as 30 per cent. the first day, 40 per cent. the second day, 25 per cent. the third day, and only 5 per cent. for the fourth and succeeding days. It runs its course, on the average, in from one to three days; though in some cases death may ensue in a few hours.[2]

[1] *Veterinary Archives of St. Petersburg*, 1885.

[2] With regard to the disease in Lambs, Benedikt (*Sächsen Jahresbericht*, 1871, p. 140) describes it under the head of "typhous diarrhœa in Sheep" (*Typhöse Ruhr bei Schafen*). He writes: "At the commencement of lambing-time, the Lambs are observed, soon after birth, to be dull and dejected; they do not care to suck; there is great debility; the eye is dull and sunken; there are involuntary evacuations of a fœtid, brownish-yellow colour, which are ejected some distance; and in three or four hours death ensues. In all the cases the Lambs appeared to be quite healthy when born; but in two or three hours afterwards they began to exhibit these symptoms, and during the first, seldom the second, day they perished. On examination of the carcase, bright-red spots were observed in the true stomach and intestines, which contained matter having an unpleasant odour. The Ewes remained healthy."

Pathological Anatomy.

There is nothing very characteristic in the alterations observed after death. The intestinal mucous membrane is covered by a muco-purulent exudate containing numerous bacteria; the epithelium is desquamated in different parts, and the corium and Peyer's patches are tumefied and softened; while in acute cases the contents of the intestine are sanguinolent. Ulceration is not present, probably owing to the very brief duration of the malady. The mucous membrane of the true stomach (fourth compartment) is congested on the summit of its folds, particularly in the pyloric portion; it is also ecchymosed and infiltrated, frequently looking as if it had been sodden, while there are often traces of hæmorrhage; this compartment generally contains clots of casein which have an acid reaction.

General anæmia of the body is most marked, and in some cases there may be evidence of globular broncho-pneumonia, induced by fluids obtaining access to the air passages.[1]

[1] Franck is, perhaps, the best authority on this malady, and his observations are of great importance, not only from the care with which he studied it, but also from the scientific manner in which he investigated its pathological anatomy. He examined a number of bodies of Calves which had recently died of the disease, and always found the same characteristic alterations, of which the following are given as typical:

A Bull-calf of the Algäuer breed, which died on the third day after birth, the second day of the disease. Weight 37·4 kilogrammes. The remaining portion of the umbilical cord is perfectly dry. The hind parts are somewhat soiled by fæces, the eyes are deep in their sockets; there is no meteorismus. Eight incisors are cut. There is a remarkable and general bloodlessness observed, and this is more particularly noted in the digestive organs, which look very white. (This anæmia was present in all the cases to the highest degree: so much so, indeed, that the tanner who bought the skins thought they were from calves which had been slaughtered in the ordinary way, *i.e.*, bled to death—"white veal.") The umbilical artery is, at the torn extremity, retracted, dark-red in colour, and contracted towards the pelvic opening; it is distended by a dark-red blood-clot, which extends as far as the aorta. The umbilical vein is not inflamed, but contains a quantity of dark, small blood-clots (these were not always present); it had been torn through towards the outer half of the navel-ring, so that both divisions were visible. The urachus is ruptured at the inner portion of the umbilical opening. Around the latter are a number of generally small ecchymoses. The abdominal cavity is filled with a dark fluid, which extends through the second and third compartments of the stomach, as far as the fourth compartment. This fluid is also found in the mouth and pharynx, as well as in the trachea; though none is observed in the lungs. In the true stomach is discovered a greater quantity (about one and a half litre) of curdled milk, in which were dirty-white masses of casein; this fluid has an acid reaction—making litmus paper double-red: its normal condition. The mucous membrane of this portion of the stomach is œdematous, of a dirty yellowish-red colour, with traces of *post mortem* solution. In the third compartment are a number of isolated ecchymoses about the size of a pin's head. The intestines are quite empty, and their lining membrane is covered by a thin layer of purulent-looking matter, which has a feeble alkaline reaction. Peyer's glands are slightly swollen, somewhat injected, but otherwise normal. The cæcum is remarkably void of solid or fluid contents, and is full of gas. The liver is very small, pale, clay-coloured, and bloodless; the little gall-bladder is completely empty; the spleen is normal. The lungs are speckled red; at some points the patches are reddish-brown; the organs are permeable to air. The cavities in both sides of the heart are full of dark, coagulated blood, and beneath the epicardium are a number of small ecchymoses. Otherwise the heart and its valves are very healthy. The dura mater of the brain is strongly attached to the cranium. The sinuses are dark-coloured, and full of coagulated blood. The brain is remarkably anæmic; its lateral ventricles are distended by a clear serous fluid; the rete mirabile at its base, and the neighbouring membranes, are also distended by coagulated blood.

Microscopic examination of the blood and the blood-clots in the heart, umbilical vein and artery, proved that these were perfectly normal. The red and white corpuscles in them were unaltered, and there were no special organisms; the colour of the blood was not diminished. All those appearances which are particularly noted in putrid diseases—as in puerperal fever, and particularly in septicæmia, were absent. The liver-cells were

Etiology.

From its mode of origin and extension, as well as its course, this disease is now generally recognised as due to micro-organisms, though their exact characters are not yet accurately ascertained. The best authorities class it with the miasmatico-contagious maladies, transmissible from a diseased to a healthy animal, the infecting agent being most abundant in the excreta. Kotelmann[1] asserts he was successful in conveying the malady from the Calf to the Lamb; though Gutmann[2] did not succeed in producing it by making animals ingest diseased excreta. Neither could Franck produce the disease; for though he administered in milk a quantity of the intestinal matter (which swarmed with bacteria) to Sheep, Goats, and Rabbits, no positive result was noted. This, however, can scarcely be deemed a satisfactory experiment; and it would be better to try the effects of the morbid products on sucking calves or other creatures at the teat.

According to Roloff,[3] it is due to a "stable miasma"; while Obich,[4] who was the first to differentiate it from gastro-intestinal catarrh,

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certainly partly filled with fat granules, but there was otherwise no indication of fatty degeneration.

A very special feature of the disease was always found in the microscopical examination of the contents of the true stomach and small intestine. In these were discovered great quantities of epithelium, and crowds of minute organisms. This purulent-looking matter appeared to be a kind of bacteria-pulp (*Bakterien-brei*). Besides innumerable micrococci, there were also immense numbers of vibratile staff-shaped bodies (*schwingende Stäbchen*). In the present state of uncertainty of the question with regard to minute vegetable organisms, Franck declines to give an opinion as to the species to which the last-described bodies belong.

[1] *Archiv. für Wissenschaftliche und Praktische Thierheilkunde*, 1885, p. 298.

[2] Ellenberger's *Jahresbericht* for 1883, p. 93.

[3] *Mittheilungen aus der Thierärztlichen Praxis*, 1875, p. 119. Roloff says: "The malady will suddenly appear in a cowshed, and vanish again after a time, without any alteration having been made in the feeding or management of the Cow. I was consulted in a case of this kind, where, in a large cowshed, during eight weeks every Calf produced therein had perished. The Calves were generally, about the second day after birth, uneasy; they bellowed, appeared to be suffering from abdominal pain, had no appetite, rapidly lost condition, passed watery stools, and died within twenty-four hours. All remedies tried—among them, large doses of opium—were useless. Some of the new-born Calves were fed on skimmed milk, others on boiled milk diluted with water, while others received no milk at all, but were fed on oatmeal gruel with which preparations of iron were mixed—but all to no purpose, as they died all the same. The feeding of the Cows was in every way good, and had not varied from that of other times, when this disease did not appear. Roloff therefore concluded that the mortality was due to a miasma in the shed; consequently all the Cows which had not yet calved were removed to another dry and airy shed. In this they brought forth at various times, and the Calves remained healthy."

In a second instance, the malady broke out suddenly in a cowshed at the commencement of 1874. The Calves were apparently healthy when born, but in about two days they became unwell and soon died in the usual way. As an experiment, some new-born Calves were not allowed to get milk from their parent, but were fed on milk from Cows in other sheds where the disease did not exist. On the second day, however, the Calves sickened all the same, and succumbed. The feeding of the Cows was modified, but without benefit.

In a third instance, Roloff mentions that, for a long time, all the Calves in a large cowshed had perished in a similar manner, and though many of them had not received any of their mother's milk—some of them no food at all—yet it made no difference. This instance was particularly conclusive that the milk of the parent was certainly not the cause of the disorder. The Cows near their time for calving were moved from this shed into another some distance away, and the change was attended with the happiest results.

[4] *Wochenschrift für Thierheilkunde*, 1865.

thought the infecting agent must be volatile, and gives instances which he believed proved it to be so.

Franck admitted the possibility of intra-uterine infection through the genital canal, and in this way he explained the appearance of the disease in the young animal so soon after birth; while Ellenberger and Fröhner[1] think it probable that this intra-uterine infection is realised by the transmission of an infective catarrh of the vagina and uterus of the parent to the digestive mucous membrane of the fœtus. In this respect it is interesting to note, that when pregnant Cows are transferred from an infected to a healthy stable, and soon after calve there, their progeny may still be attacked. But if the transfer has taken place so long as six weeks or two months before parturition, then there is indeed but little risk of the young creatures being seized with this dysentery.

The malady is most intense during permanent stabling; with the advent of grazing, when the cattle are driven to pasture, it begins to disappear, and is no more heard of until the pregnant Cows are again stabled and commence to calve. Bad food, cold and wet, and other similar influences, will not cause the disease, though they may more or less predispose to it.

Diagnosis.

The diagnosis of the disease is established by the very rapidly fatal diarrhœa prevailing in an enzoötic manner, and at or soon after birth.

The only disorder it might be mistaken for is the gastro-intestinal catarrh already described; but, as will be seen, it is different to that disease, which usually appears at a later period of life, and has a milder course.

Prognosis.

The prognosis of this disease in generally unfavourable. Nearly all the young animals seized with it perish; and when a few recover, it is either through energetic and appropriate treatment, from their being attacked in a less severe manner, or from being endowed with greater vital tenacity. And even those which recover are usually so reduced in strength and condition, and convalescence is so protracted and unsatisfactory, that there is little if any profit in rearing them. As a rule, all those born about the same period succumb; but after the malady has prevailed for one or two years in a shed, it assumes a milder form, and more recoveries are recorded. When the disease appears in small cowsheds, where there are fewer calves and comparatively more space, it is much less to be dreaded. Sometimes it disappears from a cowshed for some months. Old calves are not so readily affected, and recover more readily. Weaned calves which are fed on fodder, appear to enjoy immunity from attack.

Treatment.

As with every other animal malady, *preventive* treatment is the most important with regard to this dysentery of young animals. Attention to hygiene is very necessary at all times, and more so when the disease has shown itself in a stable or shed. It is much the safer plan, however, to remove all pregnant animals from the dwelling in which it has appeared, and the longer the interval which elapses between their removal and the occurrence of parturition, so the more likelihood there

[1] *Op. cit.*, vol. ii., p. 391.

is of their progeny escaping. If moved in three to four, or four to six weeks before parturition, their safety may be fairly assured. The stable or shed in which the malady has occurred should be well disinfected, and, if possible, left unoccupied during the grazing season. The floor particularly demands attention, as it is not at all improbable that the infection is retained there; if possible, the floor should be renewed. Strong carbolic acid, or chloride of lime wash, must be freely employed, and especially where the excreta from the sick animals have fallen. Thorough disinfection of the building with sulphurous acid or chlorine gas is advisable.

With regard to *curative* measures, but little, unfortunately, can be said. The history of the outbreak may suggest the nature of predisposing causes, and furnish indications for their removal.

With regard to medical treatment of the affected animals, this should commence with a slight laxative—such as castor-oil—to be followed by doses of opium and calomel or Dover's powder, if deemed desirable; but there have been so many drugs recommended, that it is difficult to say, without actual experience of their use, which should be adopted. Hertwig had a recipe which he averred was almost a specific; it is as follows:

Pulv. rad. rhei	- - - -	4·0 grammes.
,, magnes. carb.	- - -	1· ,,
,, opii pulv.	- - - -	2· ,,

This is to be given to the Foal or Calf in 100 to 120 grammes of camomile tea, or in fifty grammes of whisky—the dose to be repeated in twelve hours if necessary.

Salicylate of bismuth in two drachm doses for Foals and Calves, as well as salicylate of iron, has been highly spoken of.

A mode of treatment said to be very effective in Italy, is the following: Salol, 2 drachms; oxide of bismuth, 4 drachms; carbonate of lime, 1 oz. Mix and divide into six equal parts or doses, the first two doses to be administered at an interval of two hours, and the other four every four hours. Each dose is to be given in a glass of camomile infusion, to which add, if the animal is very ill, half a glass of good wine. A cure is almost always obtained in two or three days, and there is no necessity to prolong the treatment after this. The remedy has failed only in those cases where it has been applied too late. The antiseptic washing of the Cow's udder is also recommended, and the disinfection of the stables. During the treatment the Calf should not be forced to take milk, but left to do as it likes.

Tannic and salicylic acids, 2 drachms of each for a dose, given once or twice a day in an infusion of camomile, to affected Calves, have also been prescribed. Creolin in one gramme doses, dissolved in water, and administered three times a day, has been favourably reported upon.

Zundel speaks of enemeta of starch or dextrine, or water slightly carbolised; and he particularly recommends those composed of a dilute solution of permanganate of potass (1 or 2 to 100). Franck suggests the employment of tepid enemas of the neutral salicylate of soda (about ten grammes *per diem*), in doses of one or two grammes.

If the animal can take food it should be given in small quantities, and each meal of milk is to be diluted with about one-fourth of lime-water, to prevent the formation of curd in the stomach. In more

serious cases, milk should be withheld, and instead of it may be substituted well-boiled gruel made with wheaten flour, Liebig's farinaceous food, or even eggs and beef-tea may be administered.

The patient should be kept warm and comfortable; warm baths have sometimes proved useful.

CHAPTER XI.

Retention of Meconium.—Constipation.

The contents of the intestines—the meconium—are generally expelled immediately after birth, when the umbilical circulation is first interrupted. When the meconium is retained much longer it is abnormal; and this perhaps occurs more frequently with the Foal than other creatures. The prolonged retention of the meconium gives rise to constipation, and this is often a serious condition. The animals in which it occurs are generally weakly, and not well developed.

Causes.

Constipation is usually observed in Foals which have been dropped in February or March, and whose dams have been fed exclusively on dry fodder during the winter. This result is still more likely to follow if the dams have been worked until near foaling-time. Their milk is then deficient in those purgative qualities which are so necessary for the new-born animal. It is the same with Cows which have been stall-fed all the winter with dry food; and the Calves are almost certain to suffer from retention of the meconium if deprived of the first milk, even if the mothers have been properly fed.

Symptoms.

One or two days after birth the Foal appears to be uneasy, refuses to suck, has tenesmus, makes efforts to defecate, exhibits symptoms of colic, rolls on the ground, and often looks towards the abdomen; the back is arched, micturition is suspended, pulse and respiration are frequent, the eyes are injected, and there is grinding of the teeth. Enteritis sets in, and death takes place in struggles and convulsions.

The symptoms are similar in the Calf: the abdomen is very much retracted; the respiration hurried; the back is raised when the creature is standing, though it generally persists in lying; it moans continually; refuses to suck; and is very restless.

Treatment.

The *preventive* treatment consists in attending to the feeding and condition of the pregnant animal some time before parturition. The young creature should be fed on the first milk its parent yields; if this cannot be given, then the animal should have a dose of castor-oil.

The curative treatment must be directed towards removing the meconium from the intestines. This may be effected by giving a soap or oil enema, or previously removing as much as is accessible to a well-oiled finger.

That which is beyond reach of the finger, Franck recommends to be brought away by means of a flexible, but not too weak, noose of wire. The Cow should have an abundance of fluid to drink, and this may be

rendered slightly laxative by the addition of cream of tartar or sulphate of soda.

If the constipation persists, purgatives may be administered. These may be castor-oil, manna, sulphate of soda, aloes, etc. If there is pain from 10 to 20 drops of chlorodyne in water should be administered. Frequent enemas will aid the action of the purgatives.

Sometimes constipation is due to giving too rich food, or, in artificial rearing, to an excessive allowance of meal or flour. The treatment will be the same.

CHAPTER XII.

Eclampsia of Young Animals.

This nervous affection has been observed in the Calf, Pig, and Dog within a variable period after birth, and presents somewhat the same features as that disease (*eclampsia infantum*) in young children.

Symptoms.

In the *Calf* no premonitory symptoms have been observed, except that perhaps when it goes to the teat it is not so lively as usual, lags behind the other Calves, and is rather unsteady on its limbs. Before it catches the teat, or very soon after, it is suddenly and violently seized with spasms of the voluntary muscles; all the limbs become rigid, the jaws are convulsively champed, and foam flows from the mouth; in a few minutes the creature begins to bellow loudly and repeatedly, and to perform strange antics—jumping forward as if thrown by a powerful spring, and heedless of injury. The eye looks haggard and wild, the respiration is hurried, and the heart beats tumultuously. When held, it continues to struggle and bellow; at last exhaustion ensues after an hour or two, and if the Calf does not succumb it lies in a state of extreme lassitude for a long time; then it gradually regains its faculties, and in the course of some days is well again; but for some months it does not look thriving, and not infrequently there is a renewal of the attacks before that time elapses.

The animal may die from the first or second attack—rarely it has more than two. Revel[1] states, that of eleven Calves on a farm, five were affected—three males and two females; the males perished at the first seizure, but the females survived it, though one of them died from a second attack three days subsequently, the other remaining well.

In the *Pig* the symptoms are similar. Before the seizure the creature perhaps sucks less than usual; it begins to cry and become restless—running here and there and standing up against the side of its sty, screaming loudly; suddenly the screams cease, the animal falls down in convulsions; the respiration is noisy, the eyes pirouette in their orbits, the masseter muscles have clonic spasms, the limbs are violently agitated, and there is loss of sensation and consciousness. The attack may continue for a variable period—from fifteen minutes to an hour or more, and death may occur at the first, second, or third attack—it is usually the second.

In the *Dog* the symptoms differ very little from those just described.

[1] *Revue Vétérinaire*, 1879, p. 356.

Treatment.

Little can be done for this disease in such young animals, beyond giving antispasmodic remedies—such as chloral hydrate, bromide of potassium, and the tincture of valerian in enema. Attention should also be paid to the food of both mother and offspring, and if constipation is present it may be combated by the means already mentioned.

CHAPTER XIII.

Tetanus Agnorum.—Tetanus Neonatorum.

Tetanus, or a form of that disease, is not infrequently witnessed in Lambs, and sometimes it is so prevalent that it is regarded as enzoötic or epizoötic. It cannot be considered as in any way allied to tetany in children.

It most frequently affects Lambs of the finer breeds, and usually during the first two or three weeks after birth.

Symptoms.

The earliest symptoms are weakness, loss of vivacity, and diminished appetite; then the limbs become stiff and the gait stilty, the back is arched, and the neck and legs undergo convulsive contortions, so that there is difficulty in rising or walking. The cramps extend gradually to other parts of the body, until at last the animal cannot move, and to obtain food it has to be carried to the mother's teat, where it needs to be supported.

There is generally constipation at the commencement of the attack, but at a later period diarrhœa sets in, though there is no fever.

Under ordinary circumstances the animal succumbs in about eight or ten days—rarely after several weeks—in a state of marasmus, the fatal termination being preceded by grinding of the teeth, diarrhœa, convulsions, and not infrequently complete paralysis.

Etiology.

It is believed that, in many outbreaks, the Lambs are predisposed to the disease through improper feeding and management of the Ewes, whose milk may be obnoxious from the food they receive. Exposure to extreme heat and cold, and particularly to cold winds, is supposed to have much influence in the production of the malady.

Pathology.

Little appears to be known as to the pathology of the disease, but it is evidently nervous—in its origin at least; though no alteration has as yet been detected in the spinal cord to account for the tetanoid symptoms. Only the characteristics of general anæmia, with sometimes congestion of the true stomach and intestines, have been hitherto noted.

Prognosis.

This is generally unfavourable, as a complete cure is very rare; while delicate Lambs perish quickly, those which become convalescent are a long time before the rigidity leaves their limbs; they do not thrive, and often succumb to some other disease.

Treatment.

Preventive treatment must be directed to keeping the Ewes in a healthy condition by proper feeding, and sheltering them from the weather if this be severe at lambing time. The Lambs should also be kept from cold winds and wet, especially if they are of the more delicate breeds.

With regard to medical treatment, it is recommended to give a purgative at the onset of the disease, and especially if there is any reason to apprehend that the meconium is retained in the intestines. Chloral hydrate or chlorodyne may be given in small and frequent doses, alternated with sulphate of quinine. Friction may be applied to the limbs, either without or with some stimulating liniment.

CHAPTER XIV.

Cyanosis.

At page 105, in describing the fœtal circulation and the modifications which occur in it at birth, it was mentioned that the lungs then become the organs of respiration, and rapidly increase in capacity, while the thorax enlarges in a commensurate degree; the pulmonary artery also dilates to admit the increased flow of blood, and the ductus arteriosus is obliterated to prevent mingling of the arterial and venous blood. It was also stated that the ductus venosus likewise aids in the isolation of the two kinds of blood, by becoming atrophied; as does also the occlusion of the foramen ovale, though the latter opening not infrequently remains intact in young animals. Remarking upon the patency of the foramen ovale, it was stated that, as a rule, this accident did not greatly affect the circulation; for when the heart contracts, the auricles are isolated by the narrowing of the orifice and the elevation of a valve.

Cases occur, nevertheless, in which, either from the persistence of the foramen ovale, with perhaps defective auricular contraction, or an abnormal disposition of the large bloodvessels at their origin, the arterial and venous blood is mixed, and we have the condition known as cyanosis or the "blue disease." Then there is a deep-blue or violet coloration of the visible mucous membranes, more or less debility and difficulty in respiration, especially during exertion, coldness of the limbs and surface of the body, and a great predisposition to hæmorrhage.[1]

Cyanosis may occur in otherwise well-developed individuals, and be due to a congenital adhesion between the lungs and pleura or pericar-

[1] Vernant (*Recueil de Méd. Vétérinaire*, 1887, p. 592) was called to see a Calf which had been born the previous evening, and with such ease that it was found behind the Cow, no one being present at its birth. It was viable, in very good condition, fat, and so well developed that it looked as if fifteen days old. But it could not stand, and lay constantly in the sternal position, refusing to suck. The symptoms it presented were markedly those of asphyxia; the tongue was half-protruded from the mouth, the eyes prominent, the respiration plaintive and hurried, and the flanks very agitated. When raised it could not stand; its limbs were constantly and convulsively moved, and were unable to sustain the weight of the body.

The animal was bled at the tail, but this afforded no relief, and in forty-eight hours after birth it died. The lungs were then found to be collapsed, and looked very congested; the anterior extremities of the lobules floated well in water, but the entire mass was rather heavy. The foramen ovale was incompletely closed, so that the two auricles could communicate with each other; the opening was as large as a five-franc piece, and the auricular septum was extremely thin.

dium; it is also a symptom of asphyxia, and is sometimes witnessed in colic in the Horse, complicated with meteorismus; it likewise accompanies certain forms of poisoning.

When due to the first-named causes, this condition is manifested during or immediately after birth; it is only in rare instances that it is developed at a later period. It is needless to mention that such a conformation is beyond remedy, though animals so affected will sometimes live for a long time; Zundel has seen a horse seven years old which was in this condition.

CHAPTER XV.

Skin Dryness of the New-born Animal.

Obich[1] is, to my knowledge, the only writer who has alluded to this peculiar condition of the Foal at birth. He says: "In the case of some primiparous Mares, a fatal accident often happens to their progeny. When parturition takes place without anyone being present, the young creature, on being expelled from the mother, continues lying away from her until its skin is dry. The consequence is that the Mare does not care for it, does not lick or attend to it, and opposes all attempts to compel her to suckle it. For some days constraint is necessary, and much trouble and danger may be incurred before she is accustomed to it. This may be averted if the new-born creature is rubbed over with the 'after-birth' (placental membranes). The instinct of the Mare impels her then to lick and fondle her offspring, and to take to it kindly and in a natural manner."

CHAPTER XVI.

Imperforate Anus.

Imperforate anus is not a very rare occurrence in new-born animals; it has been observed in Foals, Calves, Pigs, and Lambs. The latter appear to furnish the largest number of cases. This condition is, of course, very serious unless surgical aid is quickly afforded, and even then the young creatures are not always saved.

The meconium cannot be evacuated, nor yet the residue of the milk the animal may have ingested after birth; whence results an accumulation of irritating matters in the intestines, which give rise to inflammation, and this quickly causes death.

This occlusion or imperforation may exist in various degrees. There may be merely a membrane covering and occluding the anal opening; the borders of the anus may be adherent to a greater or less extent; the rectum may be more or less absent or incomplete; or it may open into the genito-urinary passages instead of at the anus.

Symptoms.

When no fæces can be expelled, usually towards the second or third day after birth, uneasiness and symptoms of acute colic are manifested; the animal does not suck, the abdomen becomes distended, expulsive

[1] *Wochenschrift für Thierheilkunde*, 1869, p. 105.

efforts and pawing are observed, yet nothing is passed. The animal shows signs of great pain and misery, and if help is not afforded it dies in agony.

In young female animals in which the rectum is absent, it often happens that the intestine opens into the vagina, and the fæces are expelled by that canal. Rainard has witnessed this malformation in several Fillies, and his attention was also drawn to four young Pigs—male and females—in which the anus was absent. They were the litter of one Sow. It is therefore well to ascertain, in the case of female animals destitute of an anus, whether the meconium or fæces pass by the vulva.

Treatment.

The symptoms lead the veterinary surgeon to examine the defecating organs, and to discover the character of the obstruction. If there is only a simple membrane occluding the anus, this projects like a large vesicle, owing to the pressure made upon it by the fæces. This membrane, which is really the skin, has usually a deep red tint, and is soft and thin, offering but little resistance. The prominence it forms is quite soft and pits on pressure. In such a case all that has to be done is to incise the membrane—in a crucial manner, if deemed best. A long, narrow, sharp-pointed bistoury is the most suitable. After well ascertaining the entrance to the rectum, the skin is punctured, care being taken not to allow the knife to pass too deep; a director may be employed to complete the incision, and to guard the intestine from injury. No sooner is this incision made than the meconium escapes; then the crucial division may be made with a pair of sharp scissors. The index finger should be introduced as far as possible into the intestine, to make certain that all is right there.

In order to prevent the opening closing by cicatrisation, a suppository or tent may be introduced into the rectum, and withdrawn every now and again in order to allow the fæces to be expelled—injections assisting in the latter; or the angles of the divided skin may be snipped off by scissors, so as to hinder their union. The lips of the wound are subsequently lubricated by a little carbolized oil or grease, and, provided inflammation does not set in, recovery is certain.

When the prominence is not present, and yet there is complete occlusion, with all the above-mentioned symptoms, the operation is more difficult. The perineal raphe is sought for, as on its course the anus should be found. This is carefully felt, when the prominence formed by the end of the intestine will be discovered. Then a short incision is made through the skin only, in the middle line; the subcutaneous tissues are dissected away until the bulging of the intestine is reached; this is drawn outwards between the lips of the wound by forceps or a ligature, an opening is made into it, and the contents removed. The margins of the opening are then secured to the borders of the external wound by some fine sutures, and attention is paid to the parts during the healing process, in order to prevent the artificial anus becoming too contracted.

When the rectum is absent to a more or less considerable extent (in some cases it is reduced to a mere fibrous cord), then but little benefit can be conferred. In a few instances nature has effected a partial remedy, in establishing an artificial opening by ulceration through organs and textures, and the fæces have escaped by the fistula. Rainard mentions this natural colotomy as occurring in two young

Horses. An artificial opening may be made either in the perineal or abdominal region; but it is rare indeed that the animal is worth the trouble and risk.

In those female animals in which the rectum communicates with the vagina, Rainard makes the following remarks with regard to operation. As the part of the vagina which has the opening into the rectum is never very deep, a half S-curved sound is introduced by one of its ends into the normal track, and pushed into the rectum until it reaches the *cul-de-sac* in it. With a bistoury, an incision is made where the anus should be; the skin and subcutaneous connective tissue being divided, the index finger is passed into the wound in search of the curved sound in the rectum. When met with, an assistant takes the sound, while the blade of the bistoury is made to glide over the nail of the index finger, and the intestine opened by it. The same finger is pushed into this new opening, and serves to guide the bistoury in dilating the incision as much as may be deemed necessary. After the skin and connective tissue are incised, a trocar of sufficient size may be employed to puncture the intestine.

CHAPTER XVII.

Imperforate Vulva and Vagina.

IMPERFORATION, atresia, or occlusion of the Vulva is not infrequently observed in new-born animals, they being often found after birth without any apparent opening into this passage, the labia of which are adherent. The adhesion may be general or partial. In the former case the urine cannot escape; or it may be expelled through the urachus by the umbilical opening. When the retention is complete, the bladder soon becomes distended and ruptures, and death quickly ensues.

Complete occlusion is always a serious condition, as there is no precise indication as to where the urethra opens, or even if it exists at all; so that it is scarcely possible to make an artificial opening for the passage of the urine with perfect and permanent success. When the labia are merely adherent, then there is no difficulty, and not much danger, in the case. The adhesion being destroyed and the labia freed, the urine is no longer retained and the malformation is remedied. The only precaution necessary is to prevent the labia again becoming united; this is easily effected by dressing the raw margins with oil or grease, and, if need be, keeping them apart until healed.

When occlusion is only partial, the interference of the operator may or may not be deemed necessary, according to circumstances; but it will be generally most judicious to enlarge the opening to its natural dimensions before the animal becomes full-grown.

Imperforate Vagina is much less frequent than imperforate vulva. Nevertheless, it is sometimes met with in new-born creatures. The danger is the same as in the other malformation, as the external opening of the urethra is situated below the pubic symphysis, immediately anterior to the entrance to the vagina. Consequently, the urine may be retained and the animal will soon perish from rupture of the bladder, peritonitis, etc.

All that can be done in such a state of affairs, is to compensate for the absence of the natural canal by making an artificial opening, and

to prevent it from closing by introducing a dilator, and keeping it there (removing it, of course, from time to time) until there is no danger of closure.

When the obliteration is only partial, the case is not so serious; and, provided the urine escapes at all freely, surgical interference may not be necessary—at least until breeding-time arrives.

CHAPTER XVIII.

Imperforate Prepuce.

IMPERFORATE prepuce of new-born creatures is evidently a very unusual occurrence, as it is scarcely mentioned in veterinary literature. Brugnone notices it as occurring in Foals, and he recommends that an artificial opening be made in the prepuce where the natural aperture should be; the lips of the wound are to be kept apart by any suitable contrivance, which may be secured *in situ* by attaching tapes to it, and passing these round the body, securing them over the loins. When this artificial opening is not made, the same grave results follow as in complete occlusion of the vulva.

This operation is successful only when the urethral canal is patent throughout its length; when it is occluded also, the operation will no longer be attended with benefit, and the operator must then endeavour to discover where the obstruction is, and either overcome it, or make an opening somewhere for the escape of the urine.

In some instances, when the orifice of the urethra is occluded, the urine escapes by a congenital opening in some part of the canal. When this opening exists at its upper surface, the defect receives the name of *epispadias*, and when at its lower *hypospadias*. Such a malformation has been seen in the Dog, Lamb, and Goat; it is not of much importance, so far as the flow of urine is concerned. If the opening is near the end of the urethra, the urine runs into the prepuce, and passes thence; but if it is more behind, between the scrotum and ischium, it then flows over the skin, abrades it, and dust and dirt accumulate; this, together with the repulsive odour of the decomposed urine, renders the case very unpleasant to the eye and nose.

Treatment is only too often unsuccessful, and it is always troublesome. It is least so when the opening is near the termination of the urethra, as then the defect is more accessible and easier remedied.

CHAPTER XIX.

Occlusion of the Eyelids.

OCCLUSION of the eyelids has been witnessed in Foals, Calves, and other young animals. Of course we do not allude to the natural occlusion of the eyelids of Puppies, Kittens, and young Rabbits, which prevents their seeing for some days after birth.

This accidental occlusion of the eyelids presents itself in two forms. In one, the margins of the upper and lower eyelids are only adherent; and in the other the eyelids are, in addition, adherent to the eye itself throughout their entire surface.

The first variety is alone curable, and in order to disunite the eyelids, the operator, after producing local insensibility by the application of cocaine, proceeds as follows: Securing the head of the creature in the hands of an assistant, the upper eyelid is elevated by another assistant by means of a pair of forceps. The operator himself seizes the lower lid by the same means, and pulls it as far as possible from the eyeball beneath; then taking a pointed bistoury or sharp scissors in his right hand, a small puncture or notch is made between the margins of the lids, in such a manner as to injure neither, if possible, and much less to wound the eye. A grooved director is passed into the puncture in the direction of one of the canthi of the eye, the bistoury is run along it and separates the two lids; the director is then turned towards the other canthus, and the same procedure is followed. If the scissors are used the director is not necessary. All that is required after the operation, is to apply a little lard to the borders of the lids, should there be any tendency to re-adhesion.

CHAPTER XX.

Occlusion of the Auditory Canal.

Occlusion of the auditory canal is much less rare than that of the eyelids, and when it exists deafness is the consequence, as well as dumbness. It is the latter condition which most frequently attracts attention, and leads to the discovery that the real and serious defect is deafness. Then a small prominent tumour is detected in the place of the ear, or where the external auditory canal should be. This tumour is rather soft, and can be readily seized by forceps, when it may be punctured with a bistoury or a lancet and a crucial incision made through it, or it may be resected by forceps and scalpel or scissors.

When the membrane forming the covering of the tumour is removed, a quantity of grey cerumen is found obstructing the canal; this can be extruded by pressure, injections of tepid water, or a small scoop. To hinder the closure of the canal, a little morsel of lint or fine tow is placed in the ear, and retained there by a bandage round the head. With the Dog, which is most frequently affected in this way, the bandage requires to be more carefully fixed than with other animals, as it uses its paws and does not rest until the covering is removed.

If both ears are affected, one only should be operated upon at a time; and, as a rule, it is better to wait until the slight inflammation which follows the operation subsides, before the other ear undergoes the same treatment.

So far as hearing is concerned, the result is often negative; indeed, Rainard confesses that, of the large number of Dogs he operated upon, not one recovered its hearing.

CHAPTER XXI.

Tongue-tie.

Another congenital defect of young animals is what is called "tongue-tie"; it is most frequently observed in Calves,[1] and is similar to the

[1] Tyvaert (*Annales de Méd. Vétérinaire*, June, 1877) observed this condition on six occasions in calves.

condition in children which goes by the same name—being characterized by the frænum linguæ being too narrow from above to below, and too much prolonged forward, sometimes extending to the root of the lower incisor teeth. This anomaly greatly hinders the prehension of food and swallowing of fluids; the Calf, if drinking out of a bucket, vainly plunges its face into the fluid as far as the eyes. The teat is seized with difficulty, and the tongue is so limited in its movements that it cannot be protruded to lick the nostrils, as is the custom with Bovine and some other creatures. The defect is often unperceived, and the young creature loses condition, becomes weak, and eventually succumbs.

The treatment is very simple. It consists merely in dividing the frænum to such an extent that the organ may recover its liberty of movement. Immediately after the operation, the creature protrudes its tongue to lick the blood which escapes, and it can drink with ease. The wound heals in a few days without any precautions.

CHAPTER XXII.

Cleft Palate.

I CAN find no mention of this congenital defect in animals, though of its occurrence there can be no doubt; as some years ago I saw a thoroughbred Foal with a cleft palate at the Eltham Stud Stables. When it sucked or drank a large portion of the fluid escaped by the nostrils. The animal was not submitted to treatment, and I do not know what became of it. The fissure may have closed as the creature grew up.

If the cleft remains permanent, operative treatment might be attempted. The procedure would, of course, depend upon the extent of the fissure and the species of animal to be operated upon.

ADDENDUM.

Infectious Abortion.

So much attention has been recently directed to this important subject, because of its increasing prevalence and the heavy losses it occasions among breeding stock, that it has been considered necessary to add some information which has come to hand since the sheets (pp. 216-226) dealing with it were printed off.

There can be no doubt that in those instances in which abortions occur on an extensive scale, so as to assume an enzoötic or epizoötic character, and to continue in certain localities or establishments for years, infection is the chief, if not the only cause; the agencies usually supposed to operate in their productions merely acting as predisposants, by weakening the constitution.

In addition to the authorities mentioned as having proved the existence of an infecting agent in the genital discharges, Lehnert[1] must be alluded to as having induced abortion in Cows at the end of twelve and twenty days, by introducing into the vagina of pregnant Cows mucus from that of animals which had aborted accidentally; while Trinchera[2] has produced a vaginal catarrh and abortion in from nine to thirteen days, by inoculating the purulent vaginal discharge from a Cow just aborted, and the matter obtained by scraping the surface of the chorion expelled by another which had likewise met with the same accident.

It is now recognised by the most competent veterinary authorities that the disease—for so it must be considered—is eminently infectious or contagious, and that it may be transmitted either directly, or through the intervention of certain media—as infected urine, fæces, or litter, by attendants on the animals which have aborted, by the veterinary obstetrist who has recently removed the placental membranes from an animal that has aborted, or even by the male animal in the act of copulation. Whether the infecting agent produces its effect if it obtains admission through the respiratory, digestive, or circulatory organs is not yet ascertained; but there is every probability that it finds access to the interior of the uterus through the vagina and cervix, as in parturient fever, and developing in the fœtal envelopes, produces alterations there sufficient to kill the fœtus without affecting to any considerable extent the health of the female. This occurs after each conception; so that repeated abortions eventually lead to sterility by causing the uterine mucus to become acid—a change which is fatal to the spermatozoa.

Galtier[3] is of opinion that though the disease chiefly affects the Bovine species, yet it is transmissible to other domestic species, and offers

[1] *Sächsen Jahresbericht*, 1878.
[2] *La Clinica Veterinaria*, 1888.
[3] *Journal de Médecine Vétérinaire de Lyons*, 1890.

some characters common to the pneumo-enteritis of the Pig (Swine plague) and Sheep (the pneumo-enteritis prevalent in the Alps).

In a German periodical[1] recently published, a summary of the views of forty-five Danish veterinary surgeons is given on this malady. It is concluded that there can be no doubt as to the infectious character of abortion, and that it can be propagated from stable to stable, or cowshed to cowshed by infected animals—male or female; immunity is acquired after two or three years, as the disease disappears of itself from an establishment if no new animals are introduced, though getting rid of those which abort and replacing them by others may continue the scourge for an indefinite period. When the herd is not renewed the prevalence of the malady decreases spontaneously, the abortions gradually become fewer, and the accident only occurs towards the end of pregnancy, finally ceasing.

The treatment found successful in combating the disease in Denmark consisted chiefly in rigorous disinfection of the stables or cowsheds twice a year, by cleansing them and washing with a 1 per cent. solution of chloride of lime; though the stalls, walls, etc., were, when possible, washed once a week, and the drains flushed every day. Animals about to abort were immediately isolated, and looked after by a special attendant who was not allowed to go among healthy pregnant animals. The fœtal membranes were removed within twelve hours after abortion, and, together with the fœtus, buried in lime; while the genital cavity was repeatedly washed out with a 1 per cent. solution of creolin, or $\frac{1}{2}$ per cent. of lysol, until all vaginal discharge had ceased. Cows which had aborted were not put to the Bull until two or three months had elapsed, so as to prevent extension of the infection, and afford a better chance for their becoming pregnant again. Even Cows and Heifers in infected places and apparently healthy, received a vaginal injection before copulation; afterwards the parts about the tail and vulva were carefully washed every day with a mild disinfectant. The Bull employed in an infected locality was treated in a similar manner, the parts about the generative organs being cleansed and disinfected before and after service.

It is most important that animals from infected herds or studs be not introduced among healthy pregnant Cows or Mares, unless every precaution is taken against contamination; and if these suspected animals are pregnant they should certainly be isolated until parturition is completed.

With regard to the symptoms, there is not much to be added to what has been already stated. Abortion generally occurs in the Mare from the fourth to the ninth month of pregnancy, in the Cow from the third to the seventh month. Before it happens the vaginal mucous membrane is observed to be reddened, and pimple-like elevations about the size of a millet-seed are often seen on its surface; while there is a reddish-tinted discharge from the vagina, and the diminished yield of milk has the consistency of colostrum. In about three days after the appearance of the vaginal discharge abortion occurs, but the discharge frequently continues for a considerable time afterwards.

[1] *Deutsche Zeitschrift für Thiermedicine und Vergleichende Pathologie*, xxi., 1895.

INDEX.

A.

Abdominal evisceration, 550
Abdominal fœtation, 175
Abdominal muscles, rupture of, 621
Abdominal taxis, 329
Abnormal anterior presentation, 433
posterior presentations, 460
quantity of placental fluid, 381
retention of the fœtus, 198
Abnormalities of the young animal, 701
Abortion, 204
artificial, 294, 561
enzoötic, 216, 749
epizoötic, 216, 749
infectious, 216, 749
sporadic, 205
Accessory cotyledons, 87
Accidents after parturition, 564
of pregnancy, 191
After-pains, 268
Agalactia, 696
Aid after labour, 263
during labour, 256
Alæ vespertilionis, 39
Albuminuria during pregnancy, 190
Alimentary canal of fœtus, 108
appendages of, 109
Allantoic liquid, 83
Allantois, 81
differences in other animals, 84
Amaurosis during pregnancy, 190
Amnion, 79
differences in other animals, 81
Amniotic acid, 80
Amputation of the limbs, 544
of the fore limbs, 545
of the hind limbs, 547
of the uterus, 600
Anasarca of fœtus, 387
Anatomy, obstetrical, 1
Anidian monsters, 178
Anomalies in pregnancy, 169
in the fœtal membranes, 380
in the placenta, 367
in the umbilical cord, 373
Ante-partum paresis, 187
prolapsus of vagina, 191
rupture of the uterus, 194
Anus, imperforate, 743
Apoplexy, parturient, 636
Appendages of the fœtus, 75
Arbor vitæ uterina, 40
Area proligera, 71
vasculosum, 71
Arthritis, 718
Articulations of the pelvis, 8
Artificial abortion, 294, 561
passage for the fœtus, 297
premature birth, 561
Ascites in fœtus, 387
Ascitic hydrometra, 181
Asphyxia of the new-born animal, 701
Atresia of anus, 743
of os uteri, 365
of vulva, 745
Attention to the mother during and after parturition, 256
to the offspring, 265
Auscultation of the uterus, 146
Axis of the pelvis, 26

B.

Ballottement, 146
Bandages or trusses, 594, 707
Bladder, inversion of, 608
rupture of, 620
Blastoderm, 70
Bones of the pelvis, 2
Broad ligaments of uterus, 39
Bulb of the ovary, 51

C.

Cæsarian section, 340, 554
Calving fever, 636
Canal of cervix uteri, 40
Cancerous tumours, 347
Capacity of pelvis, 21
Causes of parturition, 228
Cavity of pelvis, 12
Cephalo-ilial positions, 473, 478
-sacral position, 477, 481
Cephalotomy, 540
Cerebral congestion during pregnancy, 189
Cervix uteri, 39, 44
canal of, 40
digital irritation of, 295
induration of, 361
rigidity of, 354
spasm of, 354
structure of, 41, 44

Changes in the ovum, 68
Chorda dorsalis, 71, 96
Chorial cotyledons, 90
Chorion, 75
differences in other animals, 77
frondosum, 85
schirrous, 367
Cleft palate, 748
Clitoris, 29
Coccyx, 6
Colic, 184
Collapse, puerperal, 636
Colostrum, 271
Comparison between manual and mechanical force, 531
Complete deformity of the pelvis, 290
Complications of ruptured vagina, 616
Condylomatous tumours, 348
Constipation in pregnant animals, 184
of young animals, 739
Constriction of vagina and vulva, 370
Contorsio uteri, 309, 341, 343
Contractions in fœtus, 392
Cords and bands, 499
Cornua of uterus, 39
Corpus luteum, 53
Cotyledonous milk, 91
Cotyledons, fœtal, 86
maternal, 90
Cough during pregnancy, 190
Cramp, 188
Craniotomy, 540, 542
Cresyl or cresol, 634
Crotchets, 511
Crotchet-forceps, 517
Cup-and-ball pessary, 589
Cyanosis, 742

D.

Death of the fœtus, 259, 394
Decapitation, 542
Decidua serotina, 91, 130
vera, 217
Decollation, 542
Detruncation, 548
Development of the circulatory system, 104
of the digestive apparatus, 108
of the embryo, 71
of the fœtus, 96
of the genito-urinary organs, 110
of the locomotory apparatus, 101
of the nervous system, 97
of the organs of sense, 98
of the ovaries, 51
of the respiratory apparatus, 107
of the skin and its appendages, 100
of the uterus, 46
periods of, 115
Deviation of the uterus, 306
Diagnosis of multiple pregnancy, 163
Diameters of pelvis, 15
Diaphragm, rupture of, 620
Differences in Fallopian tubes, 48
in pelvis according to sex, 19
in vulva of other animals, 29
Diffused placenta, 93
Digital irritation of the cervix uteri, 295
Dimensions of the fœtus at birth, 126
Diminution in the size of the fœtus, 296
Diseases incidental to pregnancy, 181, 182
of the fœtus, 381
of the young animal, 701
Disproportion in size between male and female, 375
Distorted monstrosities, 416
Division of the body of the fœtus, 548
Dorso-pubic position, 427
Dorso-supra-cotyloidean position, 428
Double monstrosities, 398
Ductus arteriosus, 107
venosus of Aranzi, 94, 95, 106
Duration of pregnancy, 148
Dysenteria neonatorum, 733
Dysentery of young animals, 733
Dystokia, fœtal, 372
general considerations on, 279
maternal, 289
due to abnormal positions, 427, 457
anterior presentation, 426
displacement of the uterus, 297
dorso-lumbar presentation, 473
fore limbs, 433
head, 443
head and fore or hind limbs, 455, 459
hind limbs, 428
malpresentation of fœtus, 424
morbid alterations in the generative organs, 344
multiparity, 421
pelvic constriction, 289
posterior presentation, 456
sterno-abdominal presentation, 478
transverse presentations, 472
employment of force in, 523

E.

Eclampsia, 661
during pregnancy, 189
in young animals, 740
Ectopia cordis, 403
Embryo, development of, 71
Embryotomy, 532
instruments, 534
preliminary arrangements for, 540
Emphysema of fœtus, 391
Employment of force in dystokia, 523
Endo-metritis, 625
septica, 629
Enlargement of the genital canal, 296
Enzoötic abortion, 216
Epilepsia uterina, 668
Epispadias, 746
Epizoötic abortion, 216
Establishing an artificial passage for the fœtus, 297
Eutokia, definition of, 1
Evisceration, 549
abdominal, 550
thoracic, 550
Evolution in dystokia, 492
Excess in growth of hair of fœtus, 379
in volume of the fœtus, 374

Exomphalus, 704
Exostoses on pelvis, 291
Expelling powers in parturition, 228
Expulsion of the fœtus, 234
of the fœtal membranes, 238
Extension and flexion in delivery, 493
External generative organs, 27
surface of pelvis, 12
Extraction of fœtus, forcible, 295
Extra-uterine pregnancy, 173

F.

Fallopian tubes, 47
differences in, 48
Fecundation, 64
Female generative organs, 27
Fibroid tumours, 348
Fimbriæ of Fallopian tube, 47
Fissures in the teats, 697
Fistula of the teat, 700
recto-vaginal, 616
vesico-vaginal, 618
Fœtal cotyledons, 86, 90
dystokia, 372
envelopes, 75
puncture of, 295
retention of, 564
membranes, anomalies in, 380
disease in, 380
Fœtus, abnormal retention of appendages of, 75
artificial passage for, 297
death of, 259, 394
development of, 96
diminution in size of, 296
diseases of, 381
forcible extraction of, 295
mechanical means for extraction of, 498
periods of development of, 115
physiological phenomena in, 118
positions of, 242
presentations of, 241
weight and dimensions of, 125
Force, comparison between manual and mechanical, 531
employment of in dystokia, 523
means for developing, 528
Forceps, 517
Forcible extraction of fœtus, 295
Fractures of pelvis, 291
Free-martins, 161
Frequency of monstrosities, 415
Functional modifications after parturition, 268
Functions of placenta, 93
Funic souffle, 147
Funis, 23

G.

Galactophorous sinuses, 33
obliteration of, 698
Gastro-hysterotomy, 340, 554
Gastro-intestinal catarrh in young animals, 730
Gelatine of Wharton, 93
Gemelliparous pregnancy, 153
General care of offspring, 266
General considerations regarding dystokia, 279
General mutations of the fœtus, 493
Generation, 57
Generative organs, 27
external, 27
female, 27
internal, 36
Germinal vesicle, 50
Germinative area, 71
Gestation or pregnancy, 127
anomalies in, 169
duration of, 148
gemelliparous, 153
influence of, 181
multiparous, 153
pathology of, 169
signs of, 138
Glandulæ utriculares, 41
Glandulæ vaginæ, 31
Graafian vesicles, 49
maturation of, 63
Gubernaculum testis, 112

H.

Hæmatomata, 349
Hæmorrhage, post partum, 574
umbilical, 702
uterine, 611
vaginal, 615
Halter, head-cord, or head-collar, 501
Heart, rupture of, 621
Hernia of the bladder into the vagina, 351
of the intestines, 611, 615
of the uterus, 193, 297
umbilical, 704
Hippomanes, 83
Hock presentation, 462
Hooks, 511
Horizontal diameter of pelvis, 26
Hydatid cysts, 180
Hydramnios, 185
Hydrocephalus, 381
Hydrometra, 180
Hydrops amnii, 185
Hydrops uteri, 180
Hydrothorax in fœtus, 387
Hygiene of pregnant animals, 166
Hymen, 30, 369
persistent, 369
Hypospadias, 745
Hysteria, 189
Hysterocele, 193, 297
Hysterotomy, vaginal, 331

I.

Ilium, 3
Imperforate anus, 743
prepuce, 746
vagina, 745
vulva, 745
Indigestion in young animals, 729
Induration of the cervix uteri, 361
Infectious abortion, 216, 749
Inflammation of the mammæ, 676
of the umbilical cord, 714

Influence of food on the fœtus, 376
Influence of pregnancy on ordinary diseases, 181
Injuries to the teats, 697
Inlet of pelvis, 14
Internal organs of generation, 36
Internal surface of pelvis, 13
Interstitial fœtation, 175
Intestines, development of, 108
hernia of, 611, 615
rupture of, 620
Inversion of the bladder, 608
of the uterus, 576
of the vagina, 603
Ischio-pubic symphysis, 9
Ischium, 4

L.

Labour pains, 229
protracted, 258
tumultuous, 257
Laceration of the uterus, 609
of the vagina, 613
Lactation, 271
Lamina dorsalis, 71
Laminitis, parturient, 671
Laws of teratology, 411
Leucorrhœa, 624
Ligamentum ovarii, 49
Lipomatous tumours, 348
Liquor amnii, 80
Lithopœdian fœtus, 201
Localised placenta, 93
Lochia, 269
Locked fœtuses, 424
Lordosis, 291

M.

Mammæ of Mare, 32
congestion of, 674
differences in other animals, 34
inflammation of, 676
Mammitis, 190, 673, 676
atrophy succeeding, 681
catarrhal, 677
during pregnancy, 190
induration succeeding, 681
infectious, 678, 688
parenchymatous, 678
phlegmonous, 679
Mania puerperalis, 668
Manual and mechanical force considered, 531
Mastitis, 673, 676
Maternal cotyledons, 86
Maternal dystokia, 289
Maturation of Graafian vesicles, 63
Means for developing necessary force, 528
Mechanical means for the extraction of the fœtus, 498
Mechanism of parturition, 239, 250
Meconium, retention of, 739
Menstrual discharge, 60
Menstruation, 59
Metritis, 625
phlegmonosa, 629
Metro-peritonitis, 625, 629
Metrorrhagia, 197
Metrotomy, 600
Micrococcus septicus puerperalis, 633
Milk, 272
Milk-fever, 270, 636
Modifications in the uterus during pregnancy, 128
Moles, 178
Monstrosities, 394
classification of, 395
distorted, 416
double, 398, 420
double-headed, 417
frequency of, 415
origin of, 411
simple, 396
treble, 398
Acephalian monstrosities, 396, 405
Acephalus, 396
Amorphus, 396
Androgynus, 398
Anencephalian monstrosities, 405
Anidian or zoomylian monstrosities, 406
Aschistodactylus, 397
Atretocephalus, 397
Atretocormus, 397
Autositic, 401
Camylorrhacchis, 398
Camylorrhinus, 397
Celosomian monstrosities, 402, 418
Cephalotridymus, 398
Cormotridymus, 398
Cryptodidymus, 400
Cyclocephalian monstrosities, 405
Cyclopean monstrosities, 416
Cyclops or monophthalmus, 397
Dicephalus, 399
Dicranus, 399
Diphallus, 398
Diprospus, 399
Dipygus, 399
Ectromelian, 402
Emprosthomelophorus, 400
Epigastrodidymus, 400
Eusomphalian monstrosities, 407
Exencephalian monstrosities, 404
Gastrodidymus, 400
Gastro-thoracodidymus, 400
Hemiterics, 401
Hermaphrodites, 398
Heteralian, 409
Heterocephalus, 399
Heterodidymus, 399
Heterotaxies, 401
Heterotypian, 409
Ischiodidymus, 400
Megalocephalus, 398
Megalomelus, 395
Melotridymus, 398
Monocephalian monstrosities, 400
Monocranus, 399
Monomphalian monstrosities, 407
Monophthalmus, 397
Monosomian monstrosities, 409
Nanocephalus, 396
Nanocormus, 396
Nanomelus, 396
Nanosomus, 396

Monstrosities, Octopus, 400
Omphalo-chronodidymus, 400
Omphalositic, 401
Opisthomelophorus, 400
Parasitic, 401
Perocephalus, 396
Perocormus, 396
Peromelus, 396
Perosomus, 396
Pleuromelophorus, 400
Polygnathian, 409
Polymelian, 410
Pseudencephalian monstrosity, 404, 416
Pseudo-hermaphroditus, 398
Pygadidymus, 400
Schelodidymus, 400
Schistepigastrico-sternalis, 403
Schistocephalian monstrosities, 406
Schistocephalus, 397
Schistocormus, 397, 402
Schistocormus fissisternalis, 403
Schistocormus reflexus, 403
Schistomelus, 397
Schistosomus, 397
Schistosomus contortus, 403
Somatotridymus, 399
Symelian monstrosities, 402
Syncephalian monstrosities, 407
Sysomian monstrosities, 409
Tetrachirus, 400
Tetrasculus, 400
Thoracodidymus, 400
Trigeminal monstrosities, 398
Morbid adhesion between fœtus and uterus, 368
Morsus diaboli, 47
Mother and progeny, supplementary observations on, 562
Mutations of the fœtus, general, 493
partial, 493
Multiparity, dystokia from, 421
Multiparous pregnancy, 153
diagnosis of, 163
positions of fœtuses in, 164
Multiple placenta, 93
Muscles of vulva, 29
Myomatous tumours, 348

N.

Navel-string, 93
Necessary aid in normal parturition, 255
Normal anterior presentation, 427
posterior presentation, 457
Normal parturition, 227
Nymphomania, 63

O.

Obliteration of the galactophorous sinus, 698
of the os uteri, 365
Obstacles independent of presentations and positions, 372
Obstetrical anatomy, 1
operations in, 483
physiology of, 55
Occlusion of the auditory canal, 747
of the eyelids, 746
of the uterus, 369
Occlusion of the vagina, 618
Œdema during pregnancy, 184
of the umbilicus, 713
Œdematous hydrometra, 181
Œstrum, 59
Offspring, attention to, 265
general care of, 266
Omphalocele, 704
Omphalo-mesenteric vessels, 94
Organic modifications after parturition, 275
Origin of monstrosities, 411
Os innominatum, 2
Osteomalacia, 183
Os tincæ, 40
Ostium abdominalis, 47
uterinum, 47
Os uteri, 40
obliteration of, 365
Outlet of pelvis, 16
Ova of Naboth, 41
Ovarian fœtation, 174
Ovaries, 48
development of, 51
differences in, 51
Oviducts, 47
Ovula Nabothi, 41
Ovum, changes in, 68

P.

Palate, cleft, 748
Palma plicata, 40
Papillomatous tumours, 348
Paralysis, post partum, 659
Parametritis, 629
Paraplegia of pregnancy, 187
post partum, 659
Partial mutations of the fœtus, 493
Parts into which crotchets may be implanted, 515
Parturient apoplexy, 636
collapse, 636
eclampsia, 661
fever, 625, 629
laminitis, 670
Parturition, 227
accidents after, 564
causes of, 228
expelling powers in, 228
mechanism of, 239
necessary aid in, 255
normal, physiology of, 227
pathology of, 622
sequelæ of, 268
signs and course of, 232
Partus præcipitatus, 257
Pass- or porte-cords, 509
Pathological congestion of the mammæ, 674
Pathology of parturition, 622
Pathology of pregnancy, 169
Pavilion of Fallopian tube, 47
Pelvic cavity, 12
openings in, 14, 16
tumours in, 293
Pelvic cellulitis, 615
symphysis, relaxation of, 619

Pelvimetry, 21
Pelvis, 1
Pelvis, articulations of, 8
axis of, 26
bones of, 2
capacity of, 25
cavity of, 12
complete deformity of, 290
diameters of, 22, 26
differences in, 6, 17
according to sex, 19
exostoses on, 291
external surface of, 12
fractures of, 291
internal surface of, 13
openings in, 14
Perinæum, 31
rupture of, 617
Periods of development, 115
Persistent hymen, 369
urachus, 704
Peritonitis, 611, 615
Physiological phenomena in the fœtus, 118
absorption, 120
circulation, 122
nervous functions, 119
nutrition, 121
secretion, 124
Physiology of parturition, 227
Pica, 183
Placenta, 85
anomalies in, 367
differences in, 86
diffused, 92
fluid of, 80
functions of, 85, 93
multiple, 81
polycotyledonary, 86
prævia, 87, 380
tufted, 86
zonular, 92
Placentæ, 86
Placental fluid, 80
abnormal quantity of, 381
Placentulæ, 78, 86
accessory, 86
Pluriparous gestation, 153
Polysarcia of fœtus, 391
Porte-cords, 509
Positions of the fœtus, 242
in multiple, 137, 164
at parturition, 242
in pregnancy, 164
in the uterus, 137
Post partum hæmorrhage, 574
paralysis, 659
paraplegia, 659
Pregnancy, 127
accidents of, 191
anomalies in, 169
course of, 176
diagnosis of, 177
diseases incidental to, 181, 182
duration of, 148
in bitch, 153
in cat, 153
in cow, 151
Pregnancy, duration in goat, 152
in mare, 149
in pig, 153
in sheep, 153
extra-uterine, 173
gemelliparous, 153
multiparous, 153
prolonged, 375
pseudo, 178
signs of, 138
of material, 149
of rational, 138
of sensible, 143
spurious, 178
symptoms of, 176
terminations of, 176
treatment of, 177
uniparous, 153
Pregnant animals, diseases of, 181, 182
hygiene of, 166
Preliminary precautions and operations, 484
Prepuce, imperforate, 746
Presentations of the fœtus, 239, 241
Prolapsus of the bladder, 608
vagina, ante partum, 603
vesicæ, 608
Protracted labour, 258
Pseudo-pregnancy, 178
Puberty, 57
Pubis, 4
Puerperal collapse, 600, 636
Puncture of the cranium, 541
of the fœtal envelopes, 295

Q.

Quadrigemellar pregnancy, 156
Quintuple pregnancy, 157

R.

Rectal exploration, 145
Recto-vaginal fistula, 616
Rectification of presentations and positions, 487
Red colostrum, 190
Reduced number of fœtuses, 375
Relaxation of the pelvic symphysis, 619
Reproduction, 55
Repulsion, 492
Retention, abnormal, of the fœtus, 198
of the fœtal envelopes, 564
of the meconium, 739
Retropulsion, 487
Rickets, 183
Rigidity of the cervix uteri, 354
Rotation, 491
Rupture of abdominal muscles, 621
of bladder, 620
of diaphragm, 620
of heart, 621
of intestines, 620
of perinæum, 617
of sacro-sciatic ligament, 621
of uterus, ante partum, 194
post partum, 609
of vagina, 613
of water-bag, 234
Rutting, 59

S.

Sacro-coccygeal articulations, 9
Sacro-iliac articulations, 9
Sacro-lumbar articulation, 8
Sacro-sciatic ligament, 11
  rupture of, 621
Sacrum, 5
Sarcomatous tumours, 347
Schirrous chorion, 367
Sequelæ of parturition, 268
Serous cysts, 349
Sexual maturity, 57
Signs of pregnancy, 138
  material, 149
  rational, 138
  sensible, 143
Simple monstrosities, 396
Single placenta, 93
Sinus lactei, 33
Skin dryness of the new-born animal, 743
Spasm of the cervix uteri, 354
Sporadic abortion, 205
Spurious pregnancy, 178
Sterility, 65
Stricture of uterus, 369
Succus intestinalis, 84
Superfœtation, 169
Suspensory ligaments of uterus, 39
Sutures, 591
Symphysis, pelvic, relaxation of, 619
Symphysiotomy, 561
Symphysis, ischio-pubic, 4

T.

Taxis, abdominal, 329
  vaginal, 331
Teats, structure of, 33
  fissures in, 697
  fistulæ in, 700
  injuries to, 697
Teat syphon, 691
Teratology, laws of, 411
Testes muliebres, 40
Tetanus agnorum, 741
Tetanus neonatorum, 741
Thigh and croup presentation, 467
Thoracic evisceration, 550
Thrombi or hæmatomata, 349
Thrombus of the vagina, 619
  of the vulva, 619
Tokology, definition of, 1
Tongue-tie, 747
Torsion of the uterus, 309
  in the cow, 312
  in the mare, 340
  in other animals, 343
Traction, degree of, 524
  direction of, 524
Traumatic lesions of genital and neighbouring organs, 609
Treble monstrosities, 398
Trusses, 594, 707
Tubal fœtation, 174
Tubuli lactiferi, 33
Tumours in fœtus, 394
  in pelvic cavity, 293
  in vicinity of genital organs, 353
Tumours, cancerous, 347
  condylomatous, 348
  fibroid, 348
  lipomatous, 348
  myomatous, 348
  papillomatous, 348
  sarcomatous, 347
  utero-vaginal, 344
Tumultuous labour, 257
Turning, 491

U.

Umbilical cord, 93
  anomalies in, 373
  differences in, 94
  dimensions of, 94
  hæmorrhage from, 702
  hernia of, 784
  inflammation of, 714
  obstacle to birth, 373
  vein, 94
  vesicle, 84
    differences in, 85
Umbilicus, œdema of, 713
Urachus, 83, 94
  persistence of, 703
Uterine arteries, 41
  cysts, 180
  dilator, 359
  inertia, 422
  milk, 91
Utero-vaginal tumours, 344
Uterus, 39
  amputation of, 600
  deviations in, 306
  differences in, 42
  direction of, 134
  form of, 39, 132
  hernia of, 193
  influence of on other organs, 135
  inversion of, 576
  laceration of, 609
  modifications in, during pregnancy, 128
  occlusion of, 369
  position of fœtus in, 137
  reduction of, 585
  reposition of, 385
  retention of, 588
  rupture of, 609
    of ante partum, 613
    of, during birth, 610
  sensibility of, 131
  situation of, 39, 134
  structure of, 39, 128
  torsion of, 309, 340, 343
  volume of, 128
Utricular glands, 41

V.

Vagina, 36
  atresia of, 370
  complications in rupture of, 616
  differences in, 38
  imperforate, 745
  inversion of, 603
  laceration of, 613
  occlusion of, 618

Vagina, rupture of, 613
. thrombus of, 619
Vaginal bulb, 28
constriction, 370
cystocele, 351
exploration, 146
fœtation, 175
hysterotomy, 551
irrigations, 295
taxis, 331
Vaginitis, 622
Valvula vaginæ, 369
Venereal œstrum, 59
Ventral fœtation, 175
Version, 491
Vertical diameter of pelvis, 15, 22, 26
Vesicle, umbilical, 84
Vesico-vaginal fistulæ, 618
Vesicula alba, 84
Vomiting during pregnancy, 184
Vulva, 27
atresia of, 370
differences in, 30
imperforate, 745
thrombus of, 619
Vulvar atresia, 370

W.

Water-bag, rupture of, 234
Weight of fœtus at birth, 125
Wharton's gelatine, 93
Whartonian jelly, 93

Z.

Zonular placenta, 93

THE END.

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