VETERINARY OBSTETRICS

WILLIAMS

VETERINARY OBSTETRICS

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BY

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PREFACE

In 1909 the author attempted, under the title VETERINARY OBSTETRICS, INCLUDING THE DISEASES OF BREEDING ANIMALS AND OF THE NEW-BORN, to assemble in a single volume, obstetrics and the diseases of the genital organs and of new-born animals. Previously, these diseases had been scattered throughout the entire domain of veterinary literature, amongst contagious, non-contagious, surgical, and obstetrical affections, in a way which was perfectly natural, but was wholly inadequate for a proper conception of the diseases which affect directly and seriously the fundamental problems of reproduction.

Although the volume was well received, the author was soon compelled to realize that the plan was essentially a failure, in so far as his chief aims were involved. The basic knowledge for an enduring treatise in the field was wanting. Consequently the arrangement, as well as the material, proved defective. Possibly the volume hastened and stimulated the study of obstetrics and of the diseases of the genitalia, but the rapid advancement of knowledge in this field quickly rendered the work obsolete. In 1909 obstetrics was a conglomerate of science and empiricism, of fact and fiction. There was no conception of the tremendous importance of genital diseases nor of their relation to obstetrics, and no realization that the most important diseases of young animals were intimately related to the two preceding groups. The author had brought together, without any adequate conception of their interdependency, continuity, and identity, three groups of diseases then presumed to be distinct. Once the basic identity of the three groups became dimly visible, the need for a reconsideration of the entire subject, from a wholly new standpoint, quickly became apparent. The *need* and the *ability* to meet it were two different questions. One who wishes so to present his subject that his statements may appeal convincingly to his readers as being the truth, dislikes to think that what he writes may be scattered immediately to the winds by new discoveries. It is the common fate of scientific writers that a statement made to-day with full assurance of its correctness shall be demolished to-morrow. That is a wholly different matter from a grave uncertainty at the very foundation. It is one thing for an author to see one of his paragraphs or pages destroyed, and quite a different matter to see the cornerstone of the whole edifice broken into bits.

Although many vital questions remain unsettled, it is important that the progress in our knowledge of these diseases should be assembled, arranged, and recorded, as an incentive, and perhaps an aid, to further study. The volume of 1909 has become so thoroughly obsolete in spirit and plan as to render its revision unjustifiable. Instead, it has been decided to prepare a new volume upon obstetrics and a companion volume upon the diseases of the genital organs, including those diseases of the young animal transmitted from mother to young in utero or through the milk. It is hoped that by this plan the continuity between the diseases of the genital organs, the interference with normal parturition (obstetrics) and the most important diseases of young animals may be well maintained and the subject be handled in a fairly logical manner.

The first volume, *Obstetrics*, rewritten and rearranged upon an entirely new plan, is submitted herewith. As heretofore, the writings of other obstetrists have been drawn upon freely. It has been aimed to accord full credit to each in the proper place.

The author makes no pretence of accurate knowledge of embryology, yet realizes fully that its outlines must enter into any scientific consideration of obstetrics. At his earnest solicitation, Dr. B. F. Kingsbury, Professor of Histology and Embryology in the Medical College of Cornell University, and an acknowledged authority, has carefully revised the section upon embryology, for which the author is deeply grateful.

Some old illustrations have been discarded, and numerous new ones added, with a view to enriching the text. The author is deeply indebted for the new illustrations to Dr. Zan D. Klopper and Messrs. C. W. Redwood and John Gutsell.

Deeply conscious of the many imperfections of this volume, the author hopes that the errors are fewer and less important than those in the prior publication. If the volume adds a little knowledge, and especially if it awakens in some readers a new desire for observation and study, the author's aims will have been well achieved.

W. L. WILLIAMS.

Ithaca, N. Y.,
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CONTENTS

INTRODUCTORY 1

OBSTETRIC ANATOMY 3

THE PELVIS 3
THE GENERATIVE ORGANS 14
The Ovaries 14
The Genital Tract 17
The Muellerian Ducts 17
The Oviducts 19
The Uterus 21
The Cervix 28
The Vagina 29
The Vulva 32

OBSTETRIC PHYSIOLOGY 34

MATURATION OF THE OVISAC 40
Estrum 43
Copulation 43
Ovulation 44
Fertilization 46
Menstruation 46
EMBRYOLOGY. TERATOLOGY 47
Segmentation of the Egg 48
Formation of the Embryo 53
The Nervous System 54
Development of the Organs of Special Sense 62
The Nose 62
The Eyes 64
The Ears 66
Formation of the Digestive Apparatus 70
The Teeth 77
The Circulatory System 85
The Heart 85
The Arteries 86
The Veins 91
The Fetal Circulation 93
The Development of the Urino-Genital System 98
The Wolffian Ducts 98
The Kidneys, Ureter, and Bladder 100
The Male Reproductive Organs 102
The Testicles 102
The Limbs 107
The Fetal Membranes and the Placenta 114
The Vitelline Sac 114
The Ammon 115

The Allantois 120
The Chorion 122
The Placenta 126
The Umbilic Cord 131

PREGNANCY, OR GESTATION 134

THE FORM OF THE PREGNANT UTERUS 139
THE POSITION OF THE FETUS IN THE UTERUS 145
THE DIAGNOSIS OF PREGNANCY 150
Menstruation 151
Cessation of Estrum 151
The Uterine Seal 152
Palpation of the Uterus per Rectum 153
The Corpus Luteum of Pregnancy 155
The Uterine Arteries 157
Palpation of the Fetus per Vaginam or per Rectum 157
Abdominal Ballottement 158
Auscultation of the Fetal Heart 158
The Abderhalden Test 158
THE DURATION OF PREGNANCY 165
THE NUMBER OF FETUSES 169
TWIN PREGNANCY 170
The Diagnosis of Multiple Pregnancy 173
Arrangement of the Fetuses in Twin Pregnancy 173
ANOMALIES IN FECUNDATION 176
Superfecundation 176
Superfetation 176
The Wandering of Genital Cells 176

THE HYGIENE OF PREGNANT ANIMALS 179

DISEASES OF PREGNANCY 187

DISEASES OF THE PREGNANT ANIMAL 187
Osteomalacie 189
Dropsy of the Uterine Walls. Hydrometra 190
Dropsy of the Utero-Chorionic Space 191
Paraplegia 191
Amourosis 196
Rupture of the Prepubian Tendon 196
Hernia of the Uterus. Hysterocele 205
Rupture of the Gravid Uterus 207
Extra-Uterine Pregnancy 209
Torsion of the Uterus 215
Hemorrhage from the Gravid Uterus 238
Prolapse of the Vagina and Cervix Uteri 240
PRIMARY DISEASES OF THE FETUS AND ITS MEMBRANES 249
Dropsy of the Amnion 251
Fetal Anasarca 258

PHYSIOLOGIC PARTURITION 260

Symptoms of Parturition 268
Expulsion of the Fetal Membranes and Involution of the Uterus 280
Physiologic Presentations and Positions of the Fetus 283
Management of Normal Parturition 290
The Care of the Puerperal Animal 303
The Care of the New-Born 309

DYSTOKIA 323

Equipment For Obstetric Work 330
Appliances for Traction 330
Repellers 338
Instruments for Section 339
Obstetric Outfits 352
The Dress of the Operator 354
Position and Control of the Patient 355
The Examination of the Patient 361
The Prevention of Infection During Obstetric Operations 364
The General Handling of Dystokia 368
Obstetric Operations 372
Mutation 372
Repulsion 373
Ro.ation 375
Extension and Adjustment of the Extremities 377
Forced Extraction 381
Embryotomy 391
—in the Anterior Presentation 392
Decapitation 392
Cephalotomy 393
Amputation of Head and Neck 394
Subcutaneous Amputation of Anterior Limbs 395
Amputation at Humero-Radial Articulation 398
Detruncation 398
Destruction of the Pelvic Girdle 399
—in the Posterior Presentation 401
Amputation of the Posterior Limbs at Tarsus 401
Intra-Pelvic Amputation of Posterior Limbs 402
Evisceration 408
Miscellaneous Embryotomy Operations 410
Gastro-Hysterotomy 411
Hysterectomy 422

MATERNAL DYSTOKIA 425

Diseases of the Uterus 425
Dystokia of Contagious Abortion 430
Emphysematous Decomposition of the Fetus 430

The Uterine Inertia of Contagious Abortion 439
Induration of the Cervix 446
Persistent Median Wall of Muellerian Ducts 453
Stricture of the Vagina 453
Intra-Pelvic Hemorrhage 455
Vulvar Constriction 455
Malignant and Other New-growths 457
Dystokia Due to Displacement of the Uterus 458
Pelvic Dystokia 459
Anatomic Elevations in the Pelvic Girdle 459
Rachitis 460
Callus from Pelvic Fracture 462
Exostosis from Dislocation of Femur 464

FETAL DYSTOKIA 467

Abnormalities in the Development of, or Primary Diseases of the Fetus or Its Annexes 468
Excess of Volume 468
Diseases of the Fetus 473
Hydrocephalus 474
Fetal Ascites 477
Cysts and Cystic Degeneration of Fetal Organs 478
Hyperthrophic Glands and Fetal Tumors 479
Hypertrophy of Wolffian Bodies 481
Renal Hypertrophy 481
Anomalies in the Fetal Skeleton 481
Wry-Neck in the Foal 482
Campylorrhachis 483
Schistocormus Reflexus 485
Dystokia from Double and Triple Monstrosities 487
Twin Dystokia 491
The Development of a Normal Fetus in Abnormal Position (Bi-Cornual or Transverse Pregnancy) 494
The Primary Dorsal Presentation 495
The Primary Ventral Presentation 499
Compound, or Rotated Bi-Cornual Pregnancy 501
Abnormal Positions and Deviations of the Normal Fetus in Normal Presentation 512
Dorso-Ilial and Dorso-Pubic Positions 512
Anterior Presentations 513
Deviations of the Head and Neck 513
Lateral Deviation of the Head 513
Downward Deviation of the Head 518
Upward Deviation of the Head 521
Deviations of the Limbs in the Anterior Presentation 522
Deviation of the Anterior Limbs 522
Flexion of the Anterior Limbs at the Elbow 522

The Fore Limbs Crossed Over the Neck ... 524
Flexion of the Anterior Limbs at the Carpus ... 525
Complete Retention of the Anterior Limbs ... 529
Interlocking of the Maternal and Fetal Pelves ... 533
Deviation of the Posterior Limbs ... 535
Forward Extension of the Hind Limbs ... 535
Posterior Presentations ... 539
Flexion at the Tarsus ... 539
Complete Retention of the Posterior Limbs ... 541

WOUNDS AND INJURIES OF THE GENITAL ORGANS 544

Post-Partum Hemorrhage ... 544
Rupture of the Uterus and Vagina ... 547
Rupture of the Bladder ... 552
Rupture of the Intestines ... 552
Rupture of the Diaphram ... 553
Prolapse of the Intestine Through Ruptured Walls of Uterus ... 554
Prolapse of Bladder through Rupture in Vagina ... 555
Uterine Intussusception and Prolapse ... 555
Prolapse of the Rectum ... 579
Prolapse, or Eversion of the Bladder ... 580
Rupture of the Perineum ... 582
Vesico-Vaginal Fistula ... 589
Hematoma of the Vulva ... 590
Relaxation of the Pelvic Symphysis ... 592
Contusion of the Lumbo-Sacral Nerves ... 592
Contusion of the Gluteal Nerves ... 592
Coutusion of the Obturator Nerves. Obturator Paralysis ... 594
Coxo-Femoral Dislocation ... 596

PUERPERAL INFECTIONS 599

Puerperal Laminitis ... 599
Puerperal Tetanus ... 601

PUERPERAL ECLAMPTIC DISEASES 602

Parturient Eclampsia in the Mare ... 605
Parturient Paresis in the Cow. Milk Fever ... 611
Puerperal Eclampsia in the Sow ... 627
The Milk Disease of Sheep ... 628
Puerperal Eclampsia of the Bitch ... 629
Index ... 631

LIST OF ILLUSTRATIONS

COLORED PLATES

I. Gravid uterus of cow at full term ---------- (Frontispiece)
II. Fetal sac of cow at about one-hundred days ---------- (Opposite p. 124)
III. Gravid uterus of cow, estimated at four months. Non-gravid horn of fetal sac, necrotic, and surrounded by the exudate of contagious abortion ---------- (Opposite p. 122)

LIST OF ILLUSTRATIONS IN THE TEXT

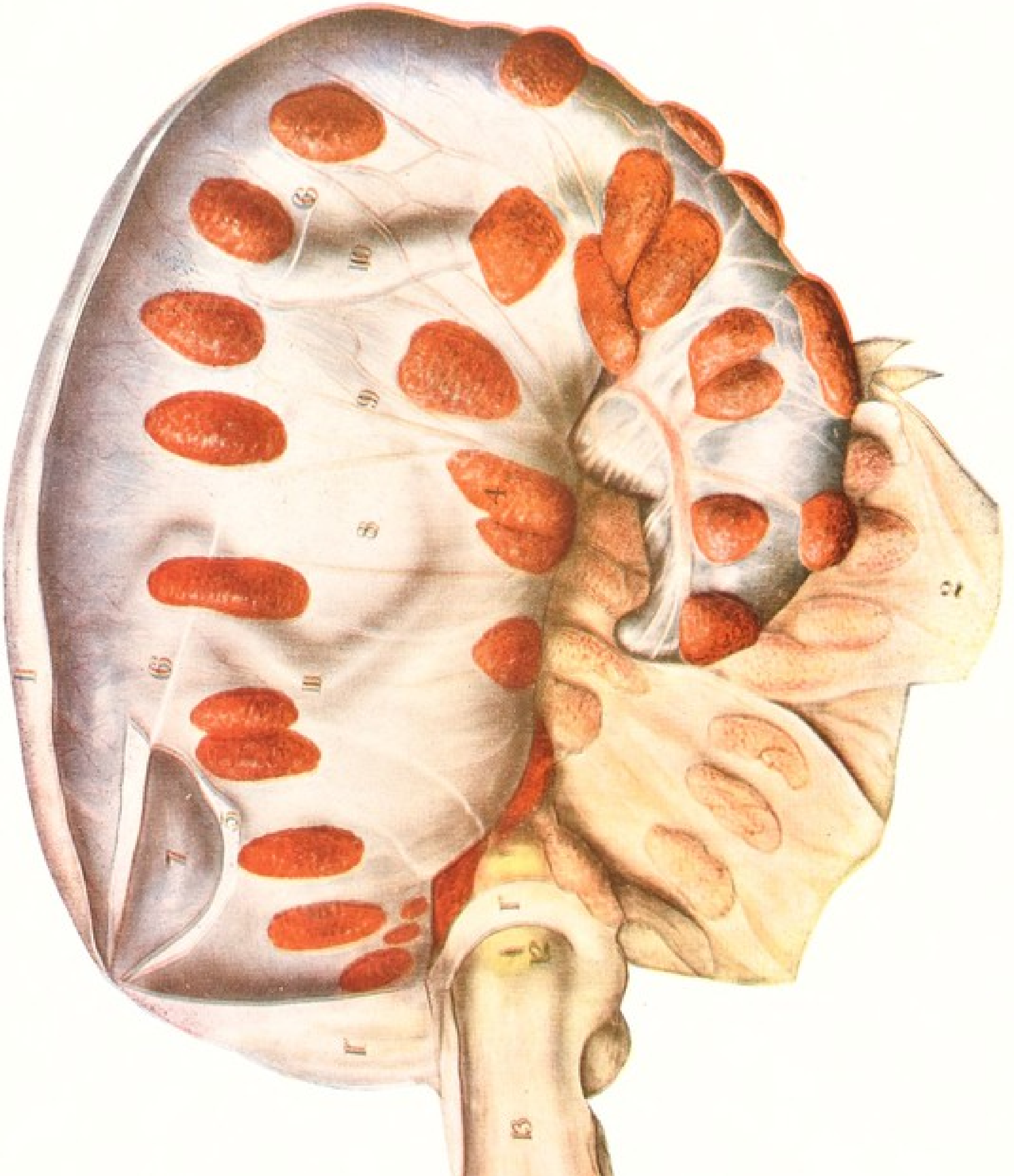
FIGURE PAGE
1. Sagittal section of the pelvis of the mare, showing lumbo-sacral nerves ---------- 4
2. Pelvis cf cow with pelvic ligaments ---------- 8
3. Non-gravid uterus of mare viewed from above, with right cornu laid open ---------- 22
4. Ovaries, oviducts, uterus and cervix of cow ---------- 23
5. Generative organs of bitch in situ ---------- 27
6. Cervixes of virgin heifers showing the annular folds of mucosa. Opened along the median line on the dorsal surface ---------- 28
7. Transverse sections through the cervix of a virgin heifer between the four annular folds. Viewed from the posterior (vaginal) end ---------- 29
8. Same as Fig. 7, viewed from the anterior or uterine end ---------- 29
9. Section of ovary of cow showing a follicle 0.6 mm., with ovum ---------- 40
10. Section of ovary of cow showing a follicle of 2 mm., with ovum ---------- 41
11. Section of ovary of sow with a nearly ripe ovum in an ovisac 5 x 7 mm., showing vacuoles in the cumulus preparatory to ovulation ---------- 41
12. Diagram of ovary of cow showing comparative sizes of follicles shown in Figs. 9, 10, 11 ---------- 41
13. A fully formed ovum of the rabbit shortly before its discharge from the ovary. (Marshall, after Bischoff) ---------- 48
14. Ovum of rabbit from the upper end of the oviduct after extrusion of the two polar bodies. (Marshall, after Bischoff) ---------- 48
15. A rabbit's ovum from the middle of the length of the oviduct, about 22 hours after copulation, showing division of the ovum into two cells, x 200. (Marshall, after Bischoff) ---------- 49
16. A rabbit's ovum from the lower end of the oviduct, about the middle of the third day, showing the morula stage, shortly before the completion of segmentation. x 200. (Marshall, after Bischoff) ---------- 50
17. A rabbit's ovum seventy hours after copulation, taken from the lower end of the oviduct just before entering the uterus and showing the condition at the close of segmentation. x 200. (Marshall, after Bischoff) ---------- 50

18. A transverse section after the hinder part of the embryonal area of a rabbit embryo at the end of the seventh day, the section passing through the primitive streak. x 80. (Marshall, after Bischoff) 52
19. Amorphus, or acardia. From cow. x ½ 55
20. Sagittal section of Fig. 19. x ½ 56
21. Spina bifida with spinal flexure 56
22. Skull of cyclops. Foal 58
23. Cyclops. Lamb. Head and neck, seen from below 59
24. Sagittal section of Fig. 23 59
25. Hydrocephalus. Calf 60
26. Hernia cerebri, pig. Lateral view of brain, seen from the left 61
27. Under surface of head of human embryo, estimated as about twenty-nine days old. x 7½ (Marshall after His) 62
28. Schistocephalus bifidus (Gurlt) 63
29. Cleft palate, foal 64
30. Left ear of human embryo, estimated at thirty-five days old. x 20 (Marshall, after His) 67
31. Ear teeth in ears of foal after removal of the mucous fistula and the teeth 68
32. Diagrammatic view of ear and skull, of Fig. 31 69
33. Schistocormus fissidorsualis subecostatus. (Gurlt) 72
34. Schistocormus fissidorsualis, showing crater-like opening in the occipital region 73
35. Sagittal section of Fig. 34 74
36. Median longitudinal, or sagittal, section through a rabbit embryo, at the end of the twelfth day. (Marshall) 75
37. Atresia ani, lamb 76
38. Three successive stages in the development of a tooth germ of a pig embryo. (Heisler) 78
39. Sagittal section through an inferior grinder of an equine embryo, 4 inches long 79
40. Sagittal section of superior molars of adult horse showing on the left normal development and on the right arrested development of the cement area 80
41, 42. Crown, and longitudinal cross section of a superior grinder of adult horse, showing absence of cement in central infundibulum and erosion of the enamel and dentinal plates 80
43. Cross section of molar of adult horse 81
44. Table surface and section of inferior molar of adult horse, showing non-fusion of dentinal lamellae, followed by infection and purulent pulpitis 83
45. Reconstruction of human embryo of about 17 days. (Heisler) 87
46. Diagram illustrating the fate of the aortic arches. (Modified from Heisler) 88
47. Fissicollis. Cervical ectopia cordia. (Gurlt) 89
48. Cervical ectopia cordis in an adult steer 90
49. Ectopia cordis; schistocormus fissisternalis (Hering) 90

50. Parovian tumor of mare, incarcerating rectum. View from right 99
51. View of 50 from left 99
52. Schematic illustration of method of incarceration 99
53. Genito-urinary system of a foal, 24 hours old, to illustrate descent of testicles and behavior of ruptured umbilic arteries 103
54. Right inguinal region of foal, 24 hours old 104
55. Pseudo-hermaphroditism of horse, showing rudimentary penis 106
56. Rabbit embryo of ninth day, seen from dorsal side. x 21 (Heisler) 107
57. Human embryo of about 28 days, showing limb buds. (Heisler) 108
58. Peromelus apus. (Gurlt) 109
59. Peromelus achirus, foal 109
60. Megalomelus perissodactylus, pig 111
61. Megalomelus perissodactylus, foal 111
62. Humeri of pig, with clavicle-like outgrowths 111
63. Foal with bent anterior metacarpal bones, showing extreme dorsal flexion of metacarpo-phalangeal articulations 112
64. Bent metacarpi, from Fig. 63 112
65. Contractions of neck and limbs of calf 113
66. Transverse section of the embryonic area of a fourteen-and-a-half-day ovum of sheep. (Heisler, after Bonnet) 115
67. Transverse section of a sixteen-and-a-half-day sheep embryo (Heisler, after Bonnet) 115
68. Transverse section of a sixteen-and-a-half-day sheep embryo with six somites. (Heisler, after Bonnet) 116
69. Schematic longitudinal sections of fetal annexes of mammalia. (Bonnet) 117
70. Schistocormus reflexus. (Gurlt) 119
71. Schistocormus reflexus, after partial embryotomy to overcome dystokia 119
72. A, embryo of the horse in its membranes. 4.2 cm. in its greatest diameter. Twenty-eight days after fecundation 121
B, the same seen from the other side. (Bonnet) 121
73. Schematic illustration of fetal annexes of the embryo of the horse, 28 days after fecundation, as in Fig. 72. Perpendicular section through the embryo and its envelopes. (Bonnet) 123
74. Schematic longitudinal section of a horse embryo at five months. (Bonnet) 124
75. Blastodermic vesicle of sheep. (Bonnet) 125
76. Swine embryo in its membranes. (Bonnet) 125
77. Section through chorion and uterine mucosa of the horse. (Bonnet) 127
78. Cotyledon of cow 128
79. Schematic sagittal section through the fetal annexes of ruminants. (Bonnet) 129
80. Fission monster, calf 171
81. Rupture of prepubian tendon in mare 199
82. " " " " " " 200

83. Rupture of prepubian tendon in mare ---- 201
84. " " " " " " ---- 202
85. Extra-uterine Pregnancy, swine ---- 210
86. Torsion of the uterus in the cow ---- 218
87. " " " " " ---- 219
88. " " " " " ---- 220
89. " " " " " ---- 224
90. " " " " " ---- 225
91. Torsion of the uterus in the ewe ---- 228
92. Fetal anasarca in twin lambs ---- 259
93. Posterior, or caudal, presentation. (Saint-Cyr) ---- 284
94. Dorsal presentation. (Franck) ---- 284
95. Ventral presentation. (Franck) ---- 285
96. Experiment heifer grown upon sterilized milk, showing clean vulvar tuft ---- 290
97. Heifer showing vulvar tuft of hairs matted together ---- 291
98. Umbilic cord of foal ---- 312
99. Cords and traction appliances ---- 331
100. Obstetric hooks ---- 335
101. Obstetric forceps ---- 337
102. Repellers ---- 340
103. Finger knives ---- 341
104. Concealed and guarded knives ---- 342
105. Long-handled cutting instruments ---- 343
106. Embryotomes ---- 345
107. Obstetric saws and sectors ---- 346
108. Wire saws ---- 347
109. Obstetric chisels ---- 349
110. Spatulas ---- 349
111. Obstetric set ---- 353
112. Schematic illustration of extension of fore limb (Franck) ---- 378
113. Method of securing the lower jaw ---- 379
114. Destruction of the pelvic girdle ---- 400
115. Intra-pelvic amputation of posterior limbs ---- 404
116. Intra-pelvic amputation of posterior limbs ---- 406
117. Pelvis of mare, with bony elevations ---- 459
118. Constricted pelvis of mare, with fracture ---- 462
119. Callus due to dislocation of the femur ---- 464
120. Hydrocephalus, foal ---- 474
121. " " ---- 475
122. Hydrocephalus, calf ---- 476
123. Fetal osteo-chondrom from abdominal cavity ---- 480
124. Section of the tumor shown in Fig. 123 ---- 481
125. Schistocormus reflexus (de Bruin) ---- 485
126. Gastrodidymus octipes ---- 487
127. Tetrachirus choristocephalus. (Gurlt) ---- 488
128. Schistocephalus ---- 489

129. Pigodidymus aversus. (Gurlt) 490
130. Compound, or rotated bi-cornual pregnancy 504
131. Compound, or rotated bi-cornual pregnancy 505
132. Lateral deviation of the head. (Saint-Cyr) 514
133. Incomplete extension of the anterior limbs 523
134. Flexure of the anterior limbs at the carpus. (Saint-Cyr) 525
135. Complete retention of the anterior limbs. (Saint-Cyr) 530
136. Forward deviation of posterior limbs in anterior presentation. (Saint-Cyr) 535
137. Retention of posterior limbs at tarsus. (Franck) 539
138. Breech presentation. (Saint-Cyr) 542
139. Rope Truss of Rainard. (de Bruin) 572
140. Contusion of obturator nerve 595



FRONTISPIECE.

GRAVID UTERUS OF COW AT FULL TERM LAID OPEN TO SHOW FETAL SAC WITH FAINT OUTLINE OF FETUS.

1. Dorsal or greater curvature of uterus. 1′. Supra-vaginal pouch of uterus. 1″. Section through uterus at cervix. 2. Right wall of uterine body and horn detached from chorion and turned down. 4. Ventral row of chorionic (fetal) cotyledons. The first two are partly hidden beneath the fetal sac against the cervix. The apex of the fetal sac is rolled outwards showing the median raphe to the left of the last four cotyledons. 5. Dorsal margin of the allantoic sac incised and turned down, exposing 7, the amniotic sac. 6, 6. Dorsal line of allantoic sac, above which only the vascular layer of the allantois extends over the amnion, closely adhering to it. 9. Umbilic cord. 10. Left fetal tibia. 11. Left fetal carpus. 12. Os uteri externum and cervix, showing the cervical canal directed along the uterine floor. 13. Vagina. 14. Vulva.

VETERINARY OBSTETRICS

INTRODUCTORY

Veterinary obstetrics is that branch of veterinary science which deals with the necessary or advisable oversight or aid during the act of parturition in domestic animals. Birth constitutes one of the most prominent epochs in mammalian existence, marking the boundary between intra-uterine, or fetal development, in which the young animal is nourished and protected within the maternal body, and the extra-uterine life, when the young animal must assume more or less independence and responsibility, partly or wholly secure its food, and provide for its safety. The subject is one of intense scientific and economic importance, as it lies at the very foundation of livestock husbandry and largely determines the ultimate success or failure of this great industry.

Giving birth to young is the culminating act of a series of complex and interesting phenomena, the perversion or interruption of any one of which may lead to the defeat of reproduction. When the act has been completed and living offspring produced, there are still incidents immediately following, essentially dependent upon pregnancy or parturition, which may jeopardize the life or usefulness either of the mother or of her young.

Successful parturition occurs only when the prospective mother is sound in the structure and physiologic development of all her organs of reproduction and of others which may have an essential relation thereto. The fetus must undergo a normal development ere it can be born in a viable state.

The study of obstetrics inevitably assumes a knowledge of all factors which necessarily lead directly to parturition and those immediate consequences of birth which affect the health of either the mother or the young. In this wider significance, veterinary obstetrics is intimately related to the study of all those dangers and diseases occurring in the process of reproduction in domestic animals and of our means for avoiding or overcoming them.

Few branches of veterinary science are of more acute importance to the veterinarian than obstetrics, because generally the questions arising are pressing emergencies which brook no delay. This is especially true of the young veterinarian when called to deal with dystokia or difficult parturition. Many veterinarians are licensed to practice without having participated at all in actual obstetric clinic work and quite devoid of any helpful knowledge of the subject. Accordingly, when a young veterinarian is confronted with a severe case of dystokia he faces one of the most perilous and trying situations in his professional career. He has no opportunity to consult a work of reference. He has little opportunity to consult with a colleague. Devoid of personal experience, probably defective in technical education upon the essential points involved, he must proceed at once to victory or defeat. If he fails, perhaps some layman supported by experience intensifies the embarrassment of the beginner by overcoming the difficulty. There are few failures experienced by the beginner in veterinary practice more embarrassing or humiliating. Not rarely the most skilled veterinarian must bow to defeat in dystokia, but in his case the barrier is recognized as insurmountable, while the young man's failure may be referred to his want of practical knowledge.

OBSTETRIC ANATOMY

The Pelvis

The pelvis plays a highly important passive role in reproduction. The attachment of the vulva to the pelvis constitutes the fixed base of support for the vagina, uterus, oviducts, and ovaries. It is this attachment to the pelvis which enables the walls of the uterus and vagina to contract effectively upon the fetus and propel it toward the vulva at the time of parturition. Since the fetus must traverse the pelvic canal during parturition, the success of the birth act is dependent, amongst other things, upon the amplitude of the pelvic canal in comparison with the dimensions of the fetus.

The chief obstetric interest in the pelvis is in the internal faces of its walls. The pelvis constitutes a bony girdle forming the posterior body wall. Into its cavity extends the posterior prolongation of the peritoneum. In the non-pregnant female the pelvic cavity contains the rectum, vagina, uterus, and, in ruminants, the oviducts and ovaries.

The pelvis is composed of the sacrum and the coxae, or ossa innominata, with their ligaments. The first two or three coccygeal vertebrae may be regarded as participating somewhat in the formation of the pelvis, since they contribute to the formation of the pelvic roof.

The sacrum consists of a series of anchylosed vertebrae, varying in number in the different species of domestic animals: in the horse and ruminants five, in the pig four, and in carnivora three. In sagittal section it presents the form of a truncated cone with its base articulating anteriorly with the last lumbar vertebra and its apex posteriorly with the first coccygeal bone. In cross section it is triangular, with its base inferior. The lateral surfaces offer roughened facets for articulation with the coxae. The inferior surface contributes to the formation of the pelvic roof, is concave from before to behind, essentially plane from side to side, and shows transverse lines of demarcation between the individual vertebrae, in the form of ridges varying in prominence with species, age, breed, and individual. It is alleged that the sacrum varies according to sex. The articular elevations are, it is claimed, less prominent in the female. I have not been able to verify this claim by the study of specimens.

The spinal canal extends through the sacrum and is occupied by the terminal nerves of the spinal cord. The inferior surface

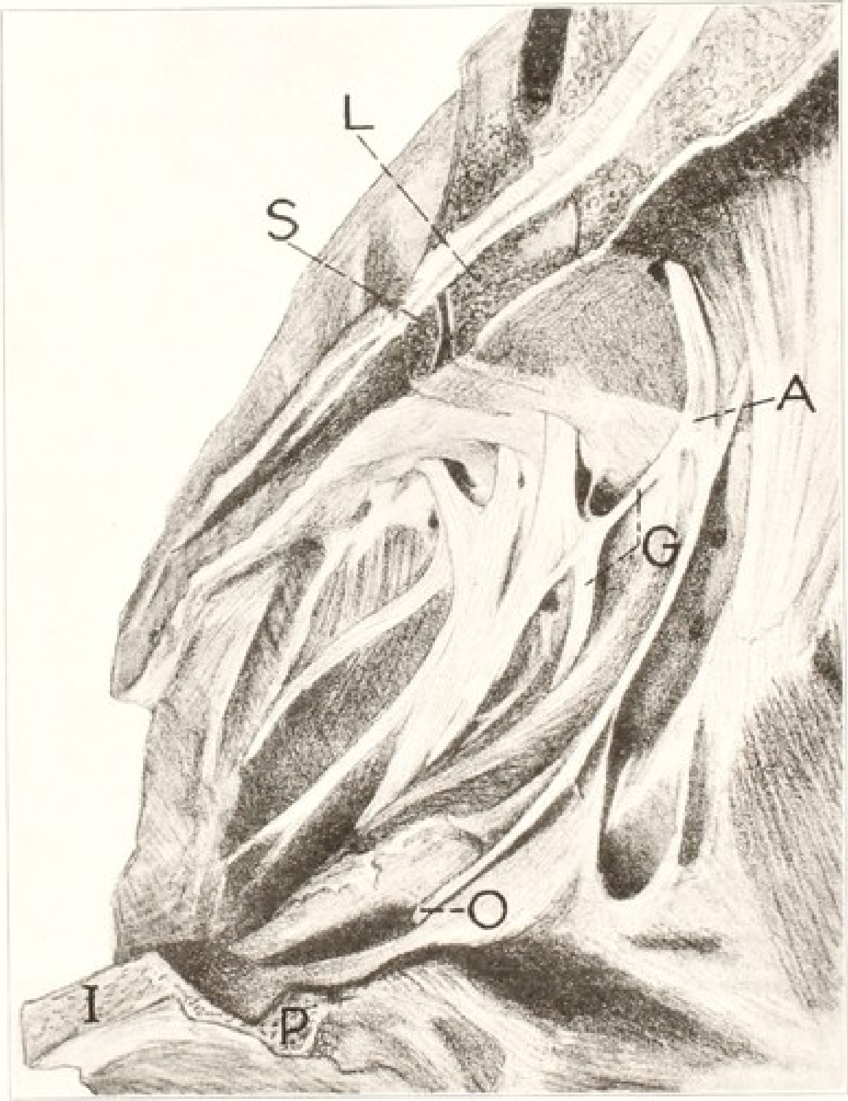


FIG. 1. SAGITTAL SECTION OF THE PELVIS OF THE MARE, SHOWING LUMBO-SACRAL NERVES.

S, first sacral vertebra. L, last lumbar vertebra. A, last lumbar nerve, passing over the lumbo-sacral eminence. G, gluteal nerves. O, obturator nerve entering foramen.

of the bone shows a series of paired openings, through which the sacral nerves emerge to take a prominent part in the formation of the lumbo-sacral plexus. The sacral nerves emerge in such a manner as to render mechanical injury to them during parturition very improbable. The lumbar nerves contributing to the lumbo-sacral plexus, especially those from the last lumbar pair which contribute to the anterior gluteal and obturator nerves, have to pass over the promontory marking the lumbo-sacral articulation, *A*, Fig. I, in such a manner that they may be, and not rarely are, crushed between the bony ridge and some unyielding part of the fetus during its passage through the pelvic canal. The obturator nerve may also be injured in a similar manner at *O* in Fig. I as it enters the obturator foramen (See Contusions of Lumbo-Sacral Nerves).

The two coxae, or ossa innominata, are elongated, flattened bones, widely expanded at each extremity, where they are composed chiefly of cancellated tissue, and constricted in the center, where they partake more of the structure of long bones. Above and anteriorly, they are briefly separated from each other by the intervening sacrum, with which they articulate by means of an almost immovable joint. Below and behind, they converge to form the pelvic floor, in which, on either side of the median line and about midway from behind to before, occur two large oval openings, the foramina ovale. The two bones unite on the median line to constitute the ischio-pubic symphysis and, becoming anchylosed early in life, serve, with the aid of the sacrum and the well-nigh immovable sacro-iliac articulation, to complete the pelvic girdle. Near the middle of each coxa, on the infero-external face, is the acetabulum, or cotyloid cavity, which articulates with the femur.

Each coxa is composed of an ilium, ischium, and pubis, which constitute separate bones during early fetal life, but become fused in most species of domestic animals prior to birth, to constitute a single bone. By the anchylosis of the two coxae at the ischio-pubic symphysis, they become a continuous structure. Ordinarily the pelvis of a domestic animal of breeding age is a continuous bony girdle, uninterrupted by cartilage or ligament except for the short and firm inter-osseous sacro-iliac ligaments. The general direction of the ossa innominata is obliquely downwards and backwards from the sacrum, the two coxae curving at first outwards and later inwards.

The ilium, the largest of the three portions, is flat and triangular in outline. Its supero-external face is concave and is occupied by the gluteal muscles; the infero-internal face is largely occupied inwardly by the articulation with the sacrum and laterally by muscular insertions. The postero-inferior angle of the bone is contracted and rounded to form the iliac shaft, and ends by concurring with the ischium and pubis in the formation of the acetabulum. The two ilia extend obliquely downwards and backwards from their sacral articulations. Their inner borders are concave. They attain their greatest distance from each other soon after leaving the sacrum, near the great sciatic notch, at the point where the flattened anterior portion merges into the shaft, whence they converge slightly as they approach the cotyloid cavities. The ilia form the major portion of the lateral walls of the pelvic inlet.

The ischium is an irregularly triangular, flattened bone, constituting the most posterior portion of the pelvis and concurring with the pubis in the formation of the pelvic floor. It occupies an almost horizontal position in the horse and most domestic animals, but in the cow its posterior portion is directed upwards and backwards so that the bottom of the ischial notch is about two inches higher than the pubic brim and the fetus, during its expulsion, must pass obliquely upwards and backwards, instead of horizontally backwards. Anteriorly, it constitutes the posterior boundary of the foramen ovale; antero-externally, it concurs in the formation of the acetabulum, where it articulates with the ilium and pubis. On the median line it unites throughout its anterior part with the corresponding bone of the opposite side, constituting the posterior portion of the pelvic symphysis.

The postero-external angles of the ischia are tuberous, constituting the ischial tuberosities, between which is the receding angle known as the ischiatic notch, the depth of which is fixed by the extent of the tuberosities and the width by the degree of divergence of the two bones.

The ischiatic notch varies greatly with species and individuals. Some authors contend that it is more ample in the mare than in the horse. This contention is not well established. If the difference exists, it is not sufficiently marked to constitute a means for differentiation between the sexes.

The ischium is of little obstetric significance in domestic animals, except possibly in the cow, where the notch may be very deep and narrow and the tuberosities, being very prominent and directed sharply upward toward the coccyx, tend to limit the dimensions of the pelvic outlet and constitute a barrier to the passage of the fetus.

The pubis is a flattened bone placed transversely at the anterior border of the pelvis. Articulating on the median line with the corresponding bone of the opposite side, it constitutes the floor of the pelvic inlet. Posteriorly, it articulates with the ischium and concurs with the ilium and ischium in the formation of the acetabulum.

In the mare and the cow, there appears commonly a sharp elevation on the median line at the anterior end of the symphysis pubis, surmounting the pubic brim and projecting upwards into the pelvic cavity. In many individuals the projection is so marked that it endangers the integrity, and sometimes causes a penetrant wound of the vaginal or uterine floor when it is impinged between the sharp, bony elevation of the pubis and some portion of the fetus while the latter is passing over the prominence under great pressure.

The relations between the ossa innominata and the sacrum and between the sacrum and the spinal column are maintained by a series of ligaments and muscles. The sacro-iliac articulation is very rigid. The two ilia are closely applied to the sacrum by means of roughened articular surfaces and connected by short and very strong inter-osseous ligaments.

The integrity of the sacro-iliac articulation is further preserved behind by the sacro-sciatic ligament and in front by the prepubian tendon and the muscles contributing thereto.

The sacro-sciatic ligament arises from the transverse spinous ridge of the sacrum, commencing immediately behind the sacro-iliac articulation and extending to the posterior extremity of that bone. Passing downwards, it is attached along the supero-external border of the ilium and ischium from the sacro-iliac articulation, backwards to the ischial tuberosity. The two ligaments thus consist of wide and thick aponeurotic sheets, which form the greater portions of the lateral pelvic walls and occupy all that area comprised between those portions of the sacrum and ilium posterior to the sacro-iliac articulation and between the sacrum and the external border of the ischium to the summit of

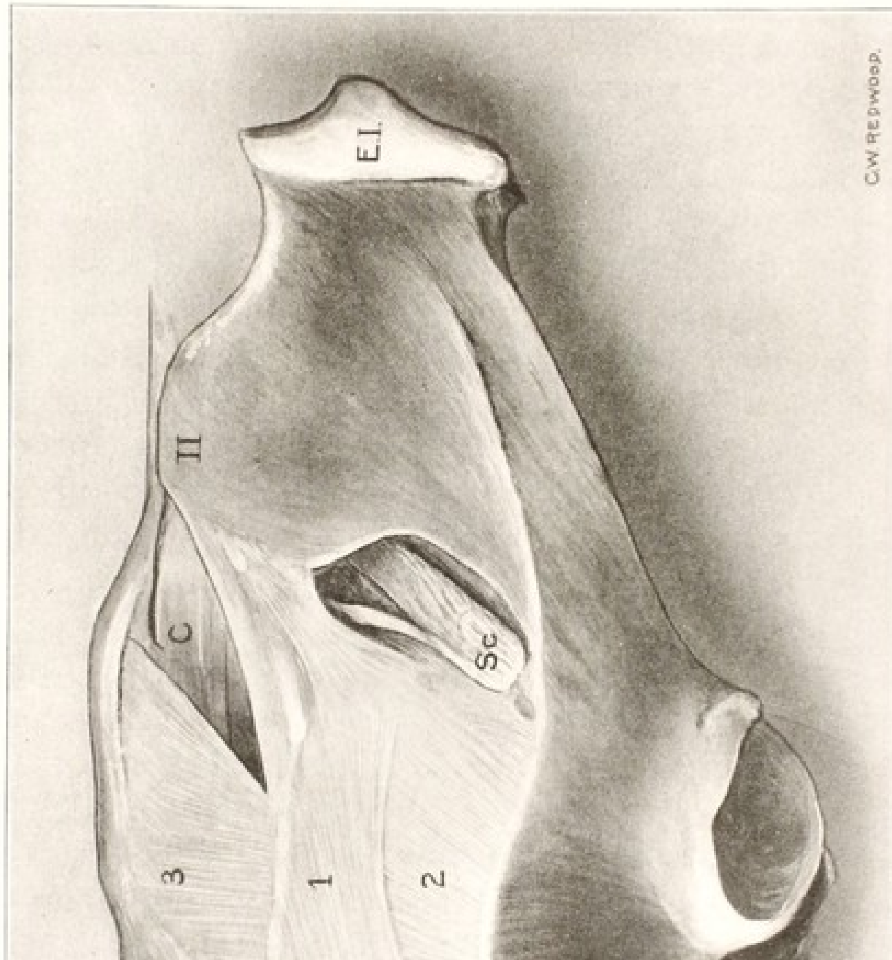


FIG. 2. PELVIS OF COW WITH PELVIC LIGAMENTS.

1, central portion of sacro-sciatic ligament. 1′, perineal border of ligament. 2, ischial portion. 3, sacral portion. 4, depressor coccygeus muscle. II, internal ilial tuberosity. CC, coccygeal muscles. EI, external ilial tuberosity. Is, ischial tuberosity. Sc, sciatic nerve.

the ischial tuberosity. This broad and powerful ligament furnishes attachment for the vulva and for numerous powerful muscles, serves to prevent the posterior portion of the pelvis, or ischia, from receding downwards from the sacrum, and forms a strong and somewhat flexible and yielding wall to the pelvic cavity. Under the pressure of parturition, it yields enough to permit the constricted outlet to equal in dimensions the larger bony inlet of the pelvis.

The powerful prepubian tendon arises from the pubic brim and finds attachment in front, through the linea alba and the contributory muscles, to the ensiform cartilage of the sternum. It prevents the pubis and ischium from passing upwards and backwards toward the sacrum when the body weight is thrown upon the coxo-femoral articulation, which lies behind the iliosacral joint. It plays a very important part in the large herbivora, especially in the mare, where it sometimes becomes ruptured during advanced pregnancy, resulting in a hernia of the gravid uterus and a destruction of the normal relation of the pelvis to the spinal column. (See Rupture of Prepubian Tendon). In addition to these ligaments, the great dorsal and the psoas muscles serve an important function in maintaining the relations between the pelvis and the spine.

The pelvic cavity is somewhat conical in form, with the base of the cone presenting forwards to constitute the inlet, which is somewhat greater than the outlet. This difference is counterbalanced by the fact that the inlet is the only really non-extensible portion of the pelvis, so that in practice, other things being normal, if a fetus can traverse the bony inlet it can pass through the outlet because of the yielding of the sacro-sciatic ligaments. In woman the relations between the sacro-pubic and bisiliac diameters of the pelvis are inconstant, resulting in a spiral passage, which leads to a rotation of the fetus on its long axis during parturition in order to keep the greater dimensions of the fetal body in harmony with those of the bony girdle through which it is passing. In domestic animals the cavity is rectilinear and the fetus is expelled in a direct, instead of a spiral line.

In cross section, the pelvic cavity is oval in outline, departing but little from circular. Its perpendicular diameter is usually slightly greater than the transverse for the entire length of the passage, though these relations may be reversed. The ratio between the perpendicular and transverse diameters does not vary materially between the inlet and the outlet. The central axis of the pelvic channel approaches the horizontal, but is in most species directed somewhat obliquely upwards and backwards from the inlet to the outlet. This is especially notable in the cow, where the pelvic floor is quite oblique and concave from before to behind, the bottom of the ischial notch being ordinarily about two inches higher, in the standing cow, than the superior surface of the pubic brim. Consequently, if the cow is standing while the fetus is being expelled, the latter must be forced upwards along an inclined plane. In the mare the pelvic floor is almost horizontal and the ischial tuberosities are wide apart.

The measurements of the pelvic cavity vary widely in different species, breeds, and individuals, rendering it impracticable to make any but the most general statements regarding the dimensions of the pelves of domestic animals. The variations in size of the animals of a given species is extreme, owing to artificial selection in breeding, growing here a giant, there a pigmy. Horses vary commonly between 2500 and 250 pounds in weight, with corresponding variations in the pelvic dimensions. The differences in size of individual animals and of their pelves are even greater in dogs.

The most important diameters of the pelvis, from the obstetrist's standpoint, are those of the pelvic inlet: the pubio-lumbo-sacral, measured obliquely forwards and upwards from the pubic brim to the lumbo-sacral articulation; and the bis-iliac, expressing the distance between the two ilia at their point of greatest divergence. It is here that the measurements are immutably fixed. The pelvic inlet is completely surrounded by solid bone—the pelvic girdle. The constituent parts of the girdle are firmly anchylosed, except for the sacro-iliac articulation, which is itself virtually without movement. The articulating surfaces are very extensive, greatly roughened, without intervening synovial membrane or cartilage, and everywhere firmly held by short, stout, inter-osseous ligaments. Without possible change in area or form of the pelvic girdle, the fetus must pass through it to be born. In the mare and the cow, the superficial area of a cross section of the fetal chest or hips is greater than that of a cross section of the pelvic inlet of the mother. It is the capacity of these and other portions of the fetal body to be liberally displaced from their usual positions which renders birth practicable. In solipeds and ruminants, the volume of the chest and hips—not the head—is the determining factor in parturition. Only in carnivora, and to a lesser degree in swine, does the veterinarian encounter a formidable impediment to birth in the comparatively unyielding fetal head, which must traverse the unyielding pelvic girdle. It is well to note that in woman, where the fetal head is so large that it constitutes the chief factor of resistance, and in carnivora, in which the conditions are somewhat analogous, the fetal cranium is not at all so completely ossified as in solipeds and ruminants, and admits of some change in form.

When the pelvic girdle has been passed, the pelvic measurements decrease, but the pelvic walls become yielding. Writers on veterinary obstetrics generally place the chief emphasis upon the bis-iliac dimensions already mentioned and the vertical diameter, the distance from the pubic symphysis to the middle of the sacrum. On either side of the vertical diameter however, the bony pelvis is displaced by the yielding broad ligaments. The vertical diameter from the pubis to the middle of the sacrum or the vertical diameter at any point posterior thereto as far back as the posterior end of the sacrum is smaller than the pelvic inlet. The transverse diameters, either between the supracotyloid crests or the ischial tuberosities, are less than the bis-iliac diameters, but the decrease in size is counterbalanced by the yielding broad ligaments. These ligaments, three to four inches wide in the mare and cow, originate from the lateral processes of all the sacral vertebrae posterior to the sacro-iliac articulation and are inserted along the superior ilio-ischial border to the ischial tuberosity (see Fig. 2). Especially relaxed at the time of parturition, they permit portions of the elastic fetal body to push out between the sacral border and the ilio-ischial line, and thus find room for passage.

Various authors, taking their measurements of pelves quite naturally from the animals of their own country, show a wide divergence of results. Baumeister and Rueff found the pubio-lumbo-sacral diameter varying between 9 and 10 inches in a mare of average size; Carsten-Harms 9.5 inches; Arloing 9 inches; and Saint-Cyr 8.75 inches. The pelvis of the cow of about 1,000 pounds has an average pubio-lumbo-sacral diameter of about 8.5 to 9.5 inches; a bis-iliac diameter of 7 to 8 inches; and a vertical diameter of 6.75 to 7.75 inches. The pelvis of the ewe or the she-goat has a vertical diameter of about 4.7 inches and a transverse diameter of about 3.1 inches. The pelvis of the bitch varies widely in its dimensions, ranging from 2 to 2.5 inches in the sacro-pubic and 1.2 to 2 inches in the transverse diameter. Similar variations occur in the measurements taken by the various observers of the other diameters of the pelvis of the mare and of other animals. Pelvic measurements, because of their great variations, are of no material obstetric value. Some investigators have attempted to establish rules for determining approximately the diameters of the pelves of living domestic animals. Thus far they have been unable to turn pelvimetry to practical account in veterinary obstetrics, in contrast with human practice, where it acquires fundamental importance on account of the frequency of pelvic deformities, which often render normal parturition impossible. Even if the pelvic dimensions could be learned clinically, they would avail little.

Pelvic deformities from systemic bone diseases occur rarely in domestic animals, partly because the osseous system is far more mature at birth than in man, but far more because a pelvis weakened by disease is subjected to no such strain in quadrupeds as in man. The quadruped bears usually upon its posterior feet only about 45 per cent. of its total weight, which is largely made up of the weight of the limbs themselves and of the muscles connecting them with the trunk. The actual weight resting upon the pelves of domestic animals is inconsequential and represents less than 25 per cent. of the total body weight, while in man the pelvis needs endure the entire body weight, except the legs themselves. The pelves of domesticated animals are sometimes seriously deformed as a result of fractures, tumors, and dislocations, which may render parturition difficult or impossible. Pelvimetry in domestic animals is impracticable usually in the two chief groups of cases where the size of the pelvis has to do with dystokia. When the pelvis is deformed as a result of tumors, fractures, dislocations, or rickets, the constriction is rarely recognized until dystokia occurs. The veterinarian is then called and faces the question of overcoming the difficulty. He must determine, after manual exploration, his method of procedure by a rough comparison of the fetus as related to the capacity of the pelvis.

In a second group of cases—excessive volume of the fetus—pelvimetry fails the veterinarian, as he can not recognize this, even if called to do so, until he encounters the consequent dystokia, which in itself demonstrates the disparity between the size of the pelvic canal and that of the fetus. The veterinarian is rarely consulted regarding the amplitude of the pelvis, either prior to breeding or during pregnancy, and seldom has an opportunity to prevent dystokia of this character.

It has been asserted that sexual differences exist in the pelves of domesticated animals, especially in the horse. This I have been wholly unable to verify. It is claimed that the pelvis of the mare is more ample than that of the stallion or gelding, that its foramen ovale is larger, that the ischiatic notch is broader and shallower, that the sacrum has less prominent articular ridges—in other words, that the pelvis of the mare is especially constructed as an organ of reproduction in a manner to facilitate the passage of the fetus at the time of parturition. Examining critically a number of equine pelves, I have found among them those of stallions or geldings fulfilling the description given by some anatomists as typical of the mare in every regard, and, vice versa, the pelves of mares meeting fully all the alleged characteristics of that of the male. So far as I have been able to determine, it is impossible to identify by the form or size of the pelvis the sex of any species of domestic animal.

THE GENERATIVE ORGANS

The genital system of the mammalian female consists of the ovaries, oviducts, uterus, cervix, vagina, and vulva.

I. The Ovaries

In protozoa, reproduction is effected by the division of a single nucleated cell into two parts, alike in form and size. The completion of the division establishes two new individuals, which supplant the parent. Reproduction in the higher forms of animal life proceeds, in a somewhat analogous manner, from two specialized cells—the ovum and spermatozoon. These fuse to constitute a new cell, which proceeds to divide. The resulting new cells multiply and become specialized to form a new individual.

The ovaries are the essential reproductive glands of the female. They perform the fundamental generative function by elaborating the ovum, or egg, which, after being discharged from the ovary and fertilized by the spermatozoon, becomes a distinct, but in mammalia not immediately an independent being. The fertilized ovum is still dependent for a time upon the oviducts for its transportation to the uterus, upon the uterus for its nutrition and protection during pregnancy and its expulsion at fetal maturity, and upon the milk from the udder of the mother as food immediately after birth.

The size, form, and location of the ovaries of domestic animals differ greatly according to species, breed, age, and individual; even the two glands in the same animal are not ordinarily alike and may vary greatly in size and form. The ovary of the mare is much the largest seen in the domestic animals, reniform, very dense owing to its thick tunica albuginea, with a smooth surface which is elevated here and there in many cases by the presence near the surface of cysts varying from less than 0.25 inch to 2 or more inches in diameter. The gland attains its maximum size when the animal has reached the age of three or four years, and begins to atrophy at ten to fifteen years, to become very small and fibrous as age advances. The ovary of the young mare is usually 3½ to 4 inches in its greatest diameter and weighs about

4 ounces, while in the aged it may shrink to 1½ inch in its greatest diameter and in weight to ½ ounce. The ovary of the cow is much smaller than that of the mare, varying in its greatest diameter between 0.25 and 2 inches and weighing about 0.25 to 0.5 ounce; it is oblong and generally regular in outline; its tunica albuginea is only moderately dense. The ovary of the sow is comparatively very large. The numerous ovisacs appear prominently on its surface in such a manner that the most superficial of them stand out entirely beyond the general ovarian surface attached to the body of the organ by a somewhat constricted neck. The ovary of the cat is very small, oblong, with pointed extremities, and of a bright scarlet color, with the ovisacs standing out thickly over the surface in a way suggesting a mulberry.

The ovary of the bitch is very small, livid in color, even in outline, and, unlike those of other domestic animals, is completely enveloped in the pavillion of the oviduct, except for a minute oblong opening of so small size that the ovary can not be readily exposed to plain view through it.

The ovary in the embryo is formed beneath and on either side of the notochord just posterior to the kidney. It arises from the deeper layers of the peritoneum and descends later into the peritoneal cavity, carrying with it the superficial peritoneum. The peritoneal layers approach each other behind the ovary, to form a double layer, which serves to preserve its attachment to the sub-lumbar region. Between the two folds, the vessels and nerves pass to the gland.

The location of the ovary in the adult varies much with species, but apparently the size of the gland, when normal, has little or no influence upon its position. It rests upon the superior surface of the anterior border of the broad ligament of the uterus, naked in most animals but closely invested in the bitch by the pavillion of the oviduct. The pavillion of the oviduct in other animals than the bitch is attached by one of its fimbria to the ovary near its hilus, and its connection with the uterus is further maintained by the utero-ovarian ligament, composed largely of connective tissue and pale muscle fibers. The ovary is also influenced in its position by the round ligament, which is analogous to the gubernaculum testis of the male. Arising like the latter from the skin and dartos at the point where the fundus of the scrotum of the male normally appears in the given species, it extends up through the inguinal ring behind the peritoneum, to become attached to the uterine cornu, or oviduct, not far from the ovary. These attachments tend to cause the ovary to follow a line of descent comparable to that of the testicle, but normally it becomes arrested in its migration at some point between its place of origin and the internal inguinal ring. In the bitch, it remains closely applied to the sub-lumbar region, immediately behind the kidney, virtually at its point of origin. In the mare, its movement is arrested early and it remains rather firmly suspended not far behind the kidney and above the middle of the posterior part of the abdominal cavity. The ovary of the ruminant lies loosely in the pelvis, alongside the cervix uteri or the base of the cornu, behind the internal inguinal ring. The ovary of the sow floats quite freely in the peritoneal cavity and at times passes out through the inguinal ring and comes to rest in that part of the perineal region corresponding to the scrotum of the boar. The same displacement of the ovary occurs rarely in bitches. It is possible in any species. In general it may be said that in the elongated uteri of multiparous animals the ovaries are situated further forward than in the uniparous or biparous genera. The location of the ovary is further modified by the pregnant state. The gravid uterus, in its descent, drags the gland downwards and forwards.

The functional activity of the ovary modifies its size and form. During the breeding life of the animal the cortex, or peripheral area, of the ovary is largely composed of egg columns, or masses, consisting of germinal cells arranged in the form of a hollow sphere. Resting upon an intruding mass of genital cells is a specially developed cell, the ovum. The spheroidal hollow mass of cells contains a fluid, the follicular liquid. When estrum, or "heat", is approaching, an ovum (in uniparous animals) or ova (in multiparous) matures, the ovisac becomes distended with follicular fluid, presses aside the superposed ovarian tissues, and attenuates or destroys the tunica albuginea at the involved point. In most animals the active ovisac pushes its way above the general ovarian surface as a hemispherical cyst with very thin walls. In the mare it regularly protrudes just at the hilus of the gland, where it is not readily apparent. The ripe ovisac—or ovisacs—ruptures at the close of estrum, producing a lesion, which usually behaves differently according to whether the discharged ovum becomes fertilized and undergoes development into a fetus or, failing of fecundation, perishes. The crater resulting from the rupture of the sac becomes filled with lymph, blood, or other products of the disturbances of the tissues. Should the ovum perish, the lesion tends to heal rapidly, the blood and lymph in the crater are resorbed, and from its walls there forms a characteristic tissue, known as the corpus luteum of estrum. In the cow and in most other animals it is identical in form, consistence, and volume with the corpus luteum of pregnancy, but its color differs. In the non-pregnant cow it is chocolate-colored. Prior to the next estrum, it atrophies.

Should the ovum become fecundated and undergo normal development, the corpus luteum forming in the crater is almost always markedly yellow, lemon, or orange. It projects beyond the ovarian surface. It persists regularly up to the time of parturition or abortion and for a varying length of time thereafter. It is known as a *true corpus luteum*. The size and form of the ovary are accordingly modified by the presence of a ripe ovisac or ovisacs or of a corpus luteum. After the ovisac has ruptured, there is soon present the corpus luteum, or corpora lutea, of estrum or of pregnancy. In the cow the corpus luteum is frequently larger than the remainder of the ovary—approximately ⅝ to ¾ inch.

II. The Genital Tract

1. The Muellerian Ducts

The Oviducts, Uterus, Cervix, and Vagina

The beginning of the genital tract in the small embryo consists of two parallel rods, which later become excavated to form tubes—the ducts of Mueller—extending from near the posterior body opening upwards and forwards to the region of the ovary. Eventually the two ducts fuse at their posterior ends, producing a single tube. The ducts become differentiated, through specialization in their development, into four essentially separate segments, each having its distinctive function. The anterior segment constitutes the oviduct, or Fallopian tube, dilated at its anterior end to form the ampulla, or pavilion. The oviduct con-

2

stitutes a conduit through which the spermatozoa of the male may pass from the vagina and uterus to the ampulla, there to meet and fertilize the freshly discharged ovum. It serves then to transport the ovum, fertilized or unfertilized, to the uterus. The second, or middle portion of the genital tube constitutes the uterine cavity, in which the fetus may find lodgment, attachment, nutrition, and protection during its development. The third segment consists of the cervix, which acts as a barrier between the uterus and the vagina. The fourth, or posterior segment—the vagina—extending from the uterus to the vulva, serves first as an essential copulative organ and later as a passage for the fetus at the time of birth.

The distance to which the fusion of the Muellerian ducts extends and the extent of the specialization of the different areas modify greatly the form and relations of the various segments. The entire genital tube, having a common embryonic origin, has a similar structure, characterized chiefly by three coats—peritoneal, muscular, and mucous. The peritoneal layer, which invests the genital tract almost completely, is derived from the peritoneum of the body wall, behind which the ducts of Mueller originate. At the anterior extremity the genital tract opens, through the pavilion of the oviduct, into the peritoneal cavity. The peritoneum stops at the margin of the pavilion, to be succeeded by the mucous membrane of the oviducts.

The genital tract is supported by the broad ligaments, which consist of two peritoneal layers resulting from the departure of the genital tube from its seat of origin behind the peritoneum. Along the line of their attachment to the genital tube, the peritoneal investment is interrupted to the extent of the area between the two peritoneal folds occupied by the vessels, nerves, pale muscle, and connective tissue fibres constituting the body of the ligament. At the posterior extremity of the genital tract, where it opens into the cloaca of the embryo, the peritoneum is reflected upon neighboring organs and the genital tube is surrounded by the intra-pelvic connective tissue, so that eventually the peritoneum covers, in addition to the oviducts and uterus, only the more anterior portions of the vagina. The fusion of the two Muellerian ducts, to form the vagina and uterus, destroys the contiguous median walls of the tubes as far as they coalesce, and the adjacent tubes become a single canal. The broad ligament varies greatly in its form and amplitude according to species and the functional activity of the genital tract. In the bitch, cat, and sow, in which the anterior extremities of the uterine cornua remain throughout the life of the animal about as far forward as the posterior border of the kidney, the broad ligament maintains its anterior attachment to the abdominal wall at or near the point of origin of the ovary just behind the kidney; in the ruminant, where the ovary and the anterior ends of the uterine cornua are turned backwards to the immediate vicinity of the internal inguinal ring, the parietal attachment of the anterior border of the ligament likewise moves backwards for a considerable distance so that the middle of the recurved cornu tends to project forwards beyond the anterior margin of the ligamentous attachment. When the uterus of a quadrupedal mammal becomes gravid, the weight of the fetus drags the occupied portion downwards and forwards until the organ comes to rest upon the abdominal floor in front of the anterior point of fixation of the ligament to the abdominal wall. The genital tube is further maintained in its position by its attachment posteriorly to the vulva and also by the round ligament of the uterus, which has been described on page 15.

The muscular walls of the genital tubes are composed of transverse and longitudinal layers of pale fibres, varying greatly in the different sections of the tract and also according to whether the animal be pregnant or not.

The mucous coat of the genital tract offers the greatest possible variations and assumes widely differing and highly important functions, according to the particular area occupied.

2. The Oviducts

The oviducts, formed from the anterior, or ovarian extremities of the Muellerian ducts, are two long, tortuous tubes, varying in length and other characters according to species. Their length is much greater than the distance from the anterior extremity of the uterine cornu to the ovary. This distance is fixed by the utero-ovarian ligament. In some animals the oviducts are naked and clearly visible. In the bitch they are hidden in the abundant fat of the broad ligament. The utero-ovarian ligament in the dog and cat is very short, so that the anterior end of the uterine cornu is virtually in contact with the ovary, while the oviduct, 3 to 4 inches in length, is thrown into numerous folds, to terminate in the immediate region of its origin, so that casual observation, without dissection, might lead to the assumption that the oviduct was well-nigh absent, whereas it is very similar in actual length to that of other species. When divested of any concealing coverings of peritoneum, fat, or other tissues, the oviduct appears as a very convoluted white cord about 0.1 inch in diameter, of variable length in different species of animals. It is very firm to the touch and gives a sensation much like its analogue in the male, the vas deferens. After it is dissected out from the surrounding tissues and its numerous abrupt curves are carefully eliminated, a very fine sound, as one of the tail hairs of a horse, may be inserted at one opening and passed through its entire length. While technically the oviducts complete a communication between the peritoneal cavity and the exterior, the tubes are virtually impassable, except to ova and spermatozoa. They do not under usual conditions permit the forcing of liquids through their canal when intra-uterine injections are made under comparatively high pressure. Clinically, they are also well-nigh proof against the passage of bacteria. Rarely some organisms, such as those involved in abortion and retained placenta in cows and other animals, travel along the oviducts, causing disease of them or, reaching the ovary, induce abscess or other disease, causing sterility.

The intimacy of contact between the peritoneal covering of the oviduct and the muscular walls varies according to species. The investment is very close in ruminants and the sow, so that the ducts are readily seen without dissection. In the mare the duct is surrounded by much connective tissue, which serves to conceal it from view until the peritoneal and fibrous coverings are dissected away. In the bitch the concealment is further accentuated by large amounts of adipose tissue.

The oviduct opens anteriorly through the ostium abdominale into the pavilion of the tube and posteriorly into the uterine cornu through the ostium uterinum, which usually projects somewhat as a small eminence into the cavity of the cornu.

The muscular coat of the oviducts is characterized chiefly by its density, which gives to it an almost cartilaginous consistency, and its paleness, which amounts almost to translucency. The superficial layer of the mucosa of the oviducts consists of ciliated columnar epithelium with the cilia vibrating toward the uterus. The oviduct is the most rigid and undilatable portion of the genital tube. It provides passage for the migration of the spermatozoa of the male, which, in spite of the movements of the cilia in the contrary direction, advance from the uterus toward the ovary, in virtue of their inherent power of movement, meet the ovum in the pavilion, and fecundate it. Later the oviduct conveys the ovum, fecundated or not, from the ovary to the uterus. In this function the cilia play an essential part. In rare cases the fecundated ovum lodges in the duct and undergoes partial development, to constitute tubal pregnancy, but the undilatability of the duct serves, as a rule, to cause a rupture of its walls and leads to the escape of the fetus from the duct into the peritoneal cavity, either to cause sudden death of the mother from hemorrhage or to constitute extra-uterine, or abdominal, pregnancy.

3. The Uterus

The uterus—a musculo-membranous sac, designed for the reception, nutrition, and protection of the ovum—finally takes the initial part in the expulsion of the fetus at the time of birth. The uterus varies greatly in form and disposition, dependent partly upon the degree of fusion which has occurred between the two tubes. There are generally recognized a uterine body and two cornua, each having essentially like functions in varying degrees. In the rabbit there exists no uterine body, but two distinct tubular uteri opening separately into the vagina. In the bitch, cat, and sow the uterine body is limited in extent and physiologically unimportant, rarely containing even a portion of a fetus except while in transit at the time of birth. The two cornua are extensive, and in them develop the fetuses, so that physiologically the horns represent the two separate uteri of the rabbit. In ruminants the uterine body is larger and assumes higher importance physiologically, while the cornua remain relatively large. The one, two, or more fetuses are habitually located almost equally in the body and the cornua, so that they represent a middle stage in the transition between the double uterus of the rabbit and the single uterus of woman, physiologically devoid of cornua. In the mare the uterine body becomes relatively more important than in the ruminant.

The relative sizes of the cornua and of the uterine body bear a close relation to the number of young brought forth at a given birth. In multiparous animals, there are two uteri, as in the

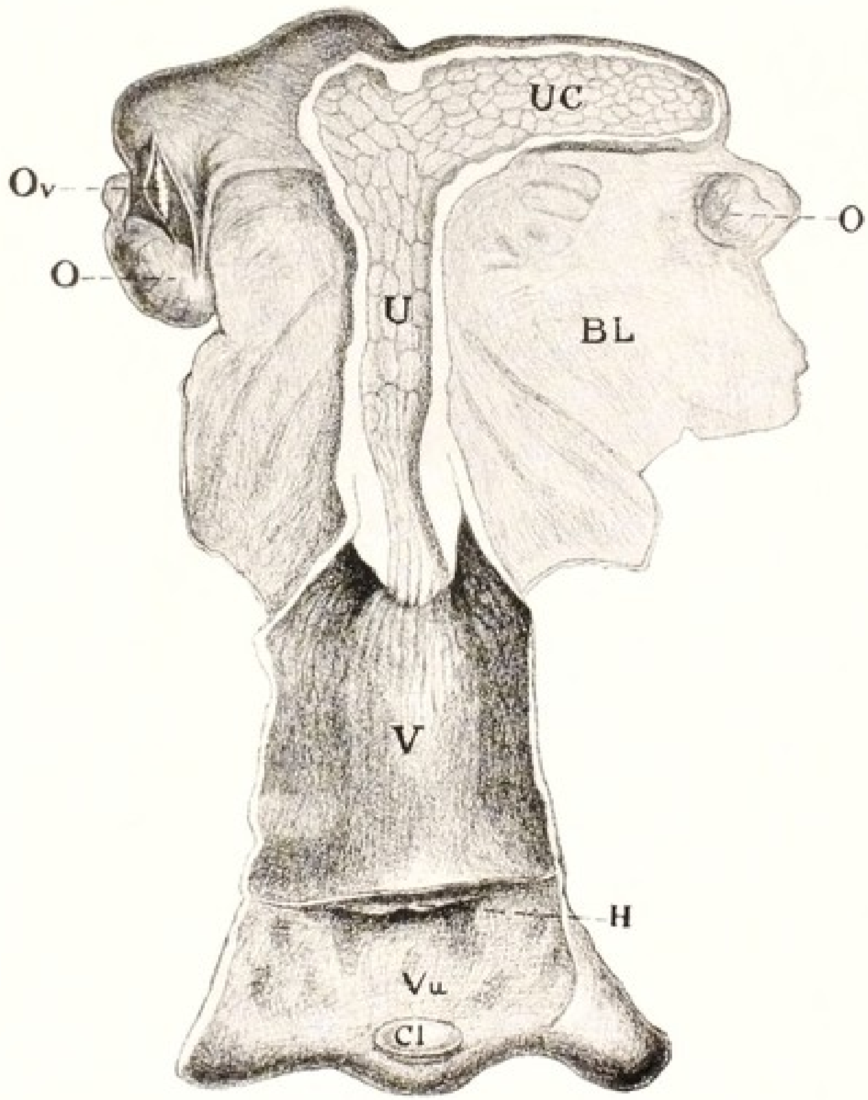


FIG. 3. NON-GRAVID UTERUS OF MARE VIEWED FROM ABOVE, WITH RIGHT CORNU LAID OPEN.

O, O, ovaries. Ov, oviduct. U, uterus. UC, uterine cornu. BL, broad ligament. V, vagina. Vu, vulva. Cl, clitoris. H, hymen.

rabbit, or the two extensive cornua with functionally unimportant uterine body, as in the bitch, cat, and sow. In ruminants, which are largely biparous, the uterine body and cornua become approximately equal in extent and function. In the normally uniparous mare, the cornua are smaller than the body. In woman, the uterus is virtually without cornua.

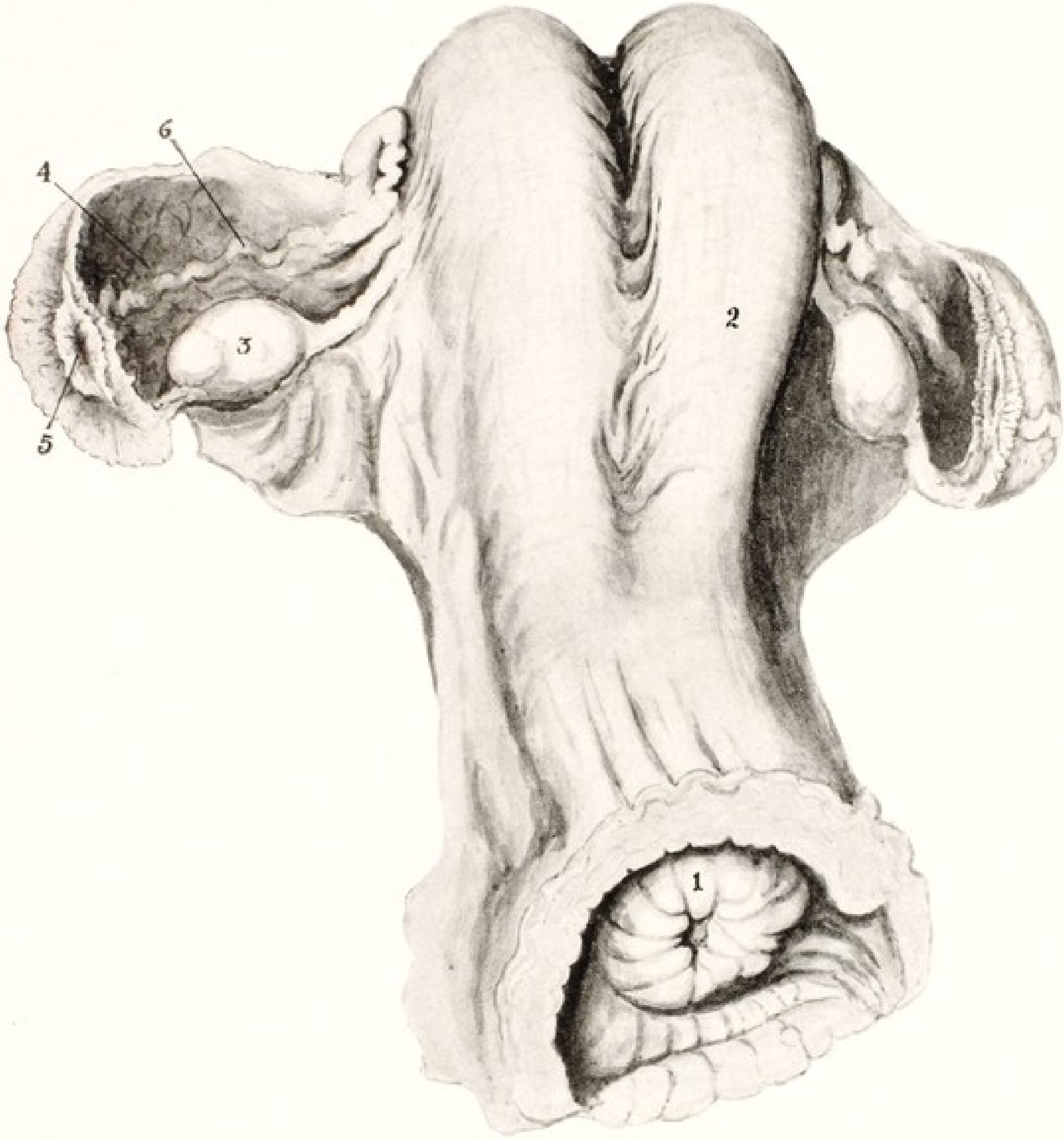


FIG. 4. OVARIES, OVIDUCTS, UTERUS AND CERVIX OF COW.
1, os uteri externum ; 2, right cornu ; 3, ovary ; 4, ovarian ventricle ; 5, ostium abdominale of the oviduct, 6.

The uterus and its cornua, within the above limitations, are uniform in their plan of structure and function. They consist of three coats : mucous, muscular and peritoneal.

The mucous coat constitutes the essential physiologic basis of the organ. The mucous epithelium is very elaborate, consisting superficially of columnar cells, embedded deeply within which are numerous tubular structures of a glandular character, the utricular glands, believed to secrete the so-called *uterine milk*, which is presumed to play an important role in the nutrition of the ovum pending the formation of the embryo and the establishment of its intricate connection with the mucous membrane through the chorion. Yet more important, it is through a special elaboration of the uterine mucosa that the highly intricate and essential maternal placenta is formed, to constitute a physical and physiologic bond between the mother and fetus during the span of pregnancy. The uterine mucosa apparently exerts a distinct bactericidal power and ordinarily prevents the gaining of a habitat by bacteria in the uterine cavity. In the non-gravid uterus, as is common with distensible hollow organs, the mucous membrane is thrown into numerous longitudinal folds, which facilitate prompt and extensive dilation of the cavity without violence.

The muscular coat consists of two somewhat differentiable groups of longitudinal and circular pale muscle fibers, which increase during pregnancy in size, activity, and, it is believed, to some extent in number. The proportion of the longitudinal to the circular fibres varies.

The peritoneal layer of the uterus, which is derived from that of the abdominal walls, envelops the organ completely except at the points of continuity with the oviducts and vagina and the interstice between the two peritoneal sheets of the broad ligament at their points of uterine attachment.

The uterus is retained in position by its broad ligaments and by its continuity anteriorly with the oviducts and posteriorly with the cervix. The *round ligament* of the uterus, arising from the skin, or dartos, in the region normally constituting the fundus of the scrotum in the male, and passing up through the inguinal canal and abdominal ring and thence to the cornu, or oviduct, is functionally of scant interest as a ligament of fixation. The uterus is located immediately beneath the rectum, with its two cornua passing obliquely outward and forward on either side.

The uterus of the mare, with its cornua, constitutes a somewhat crucial organ: the horns leave the body laterally at right angles or somewhat recurved. The uterine body is oblong, flattened somewhat from above to below, varying from 5 to 8 inches in length and 1½ to 2½ inches in width. Anteriorly, the cavity of the uterine body of the mare is continuous with that of the two cornua, without a distinct line of demarcation beyond an abrupt turn at right angles or a slight recurvation to its long axis. Each cornu is much like the body. The cavity of each is essentially equal to that of the body, and the combined length of the two is greater than that of the body. They end obtusely not far from the ovary. Each presents at its apex a conical projection in which there is an opening, the os uterinum, or uterine orifice of the oviducts.

The peculiar crucial form of the uterus—the two ample horns with the bases of their cavities directly opposite, so that they have a common long axis—renders bicornual, or transverse pregnancy so easy, as indicated in Fig. 3, that it occurs not infrequently, resulting in a variety of transverse presentations and causing some of the most serious dystokias known to the veterinary practitioner.

In ruminants the uterine body is less pronounced in size, when viewed exteriorly, and even less upon section, while the cornua are much longer, quite tapering, and more ample than in the mare. The two cornua separate at a very acute angle, for a time extend forwards almost parallel to each other, and then, becoming somewhat more divergent, curve downwards, outwards, backwards, and finally upwards, to end alongside the cervix within the pelvis. The uterine body and cornua are much denser, narrower, and more cylindrical than in the mare. The cornua taper gradually from their bases at the uterine body to their apices, where they pass almost insensibly into the oviducts.

The broad ligaments of the uterus of the mare arise from the abdominal walls in the sublumbar region, beginning not far posterior to the kidneys and extending from this point obliquely downwards, backwards, and medianwards into the pelvic cavity, where the two layers of peritoneum become reflected from the vagina upon the bladder, rectum, and pelvic walls. Compared with the broad ligaments of other domestic animals, they are limited in extent, especially transversely, causing a comparatively rigid fixation of the uterus and, since their anterior attachment is approximately in a direct line with the long axis of the cornua, the entire organ is held well forward in the abdominal cavity. The broad ligaments of ruminants, as compared with those of the mare, are much more ample transversely, while antero-posteriorly they are much less extensive. Their anterior point of attachment to the abdominal parietes is much farther posterior than in the mare. This variation in disposition and relations of the broad ligament produces two well-marked clinical differences obstetrically. In the non-gravid uterus of the cow, the anterior parietal attachment of its broad ligament is already posterior to the anterior curvature of the uterine cornua, which in the gravid uterus becomes sharply accentuated, so that almost the entire organ rests anterior to its ligamentous attachments to the abdominal parietes. In the cow and ewe, the broad ligaments become largely powerless in preventing the pregnant organ from revolving upon its long axis, so that torsion of the uterus becomes quite common, while in the mare the more rigidly fixed organ, with the anterior parietal attachment of the ligament much farther forward, serves to render the displacement comparatively rare. In ruminants, the comparative amplitude of the ligaments, with their anterior point of parietal attachment but little anterior to the pelvic inlet, permits more readily than in other animals inversion and prolapse of the uterus and vagina.

In multiparous animals the broad ligaments are necessarily very extensive and uniformly have their anterior point of attachment to the abdominal walls far forward in the post-renal region. In the bitch, the ligament at its anterior border is very short, so that the ovary and ovarian end of the cornu are closely fixed in the sublumbar region, just posterior to the kidney, tending to stretch the cornu between this anterior, sublumbar attachment and the vagina. The ligaments are exceedingly ample, except at the anterior border, and are much broader than the distance from the parietal attachments to the position of the cornu, resulting in a large antero-posterior fold in the ligament, which drops down on the lateral side of the cornu and covers it in a double fold of broad ligament (Fig. 5). Unlike in other domestic animals, the broad ligaments of the bitch are uniformly the seat of extensive deposits of fat, which cause them to resemble the gastric omentum in general appearance.

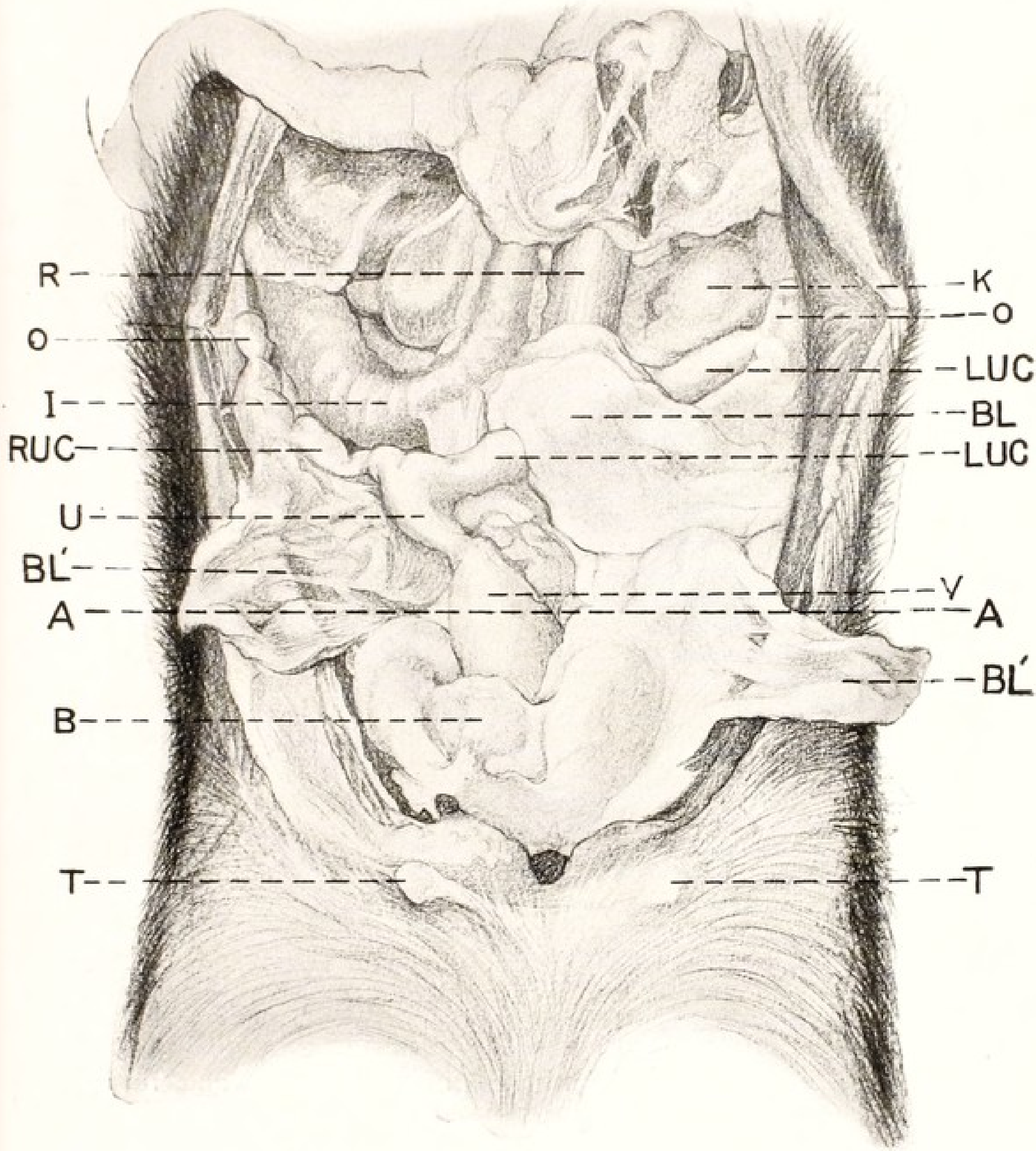


FIG. 5. GENERATIVE ORGANS OF BITCH IN SITU.

TT, two posterior teats. B, bladder. V, vagina. U, uterus LUC, LUC, left uterine cornu with a portion of its broad ligament, BL, lying across it. RUC, right uterine cornu with its broad ligament, BL′, turned outwards exposing the full length of the cornu. OO, ovaries. R, rectum. K, left kidney. AA, dotted line indicating level of the external ilial tuberosities.

4. The Cervix

The cervix, or neck of the uterus, consists of a powerful, sphincter-like segment of the genital tract, serving to separate anatomically and physiologically the uterus from the vagina. It is continuous anteriorly with the uterine body and posteriorly with the vagina. It is a tubular organ having walls very much thicker than those of the uterus or vagina and very dense and rigid. In the cow especially the walls are intensely rigid and hard like cartilage. In rigidity the cervix is closely analogous to the oviducts. In function, too, they are analogous: the one acts as a powerful guardian of the anterior, or peritoneal open-

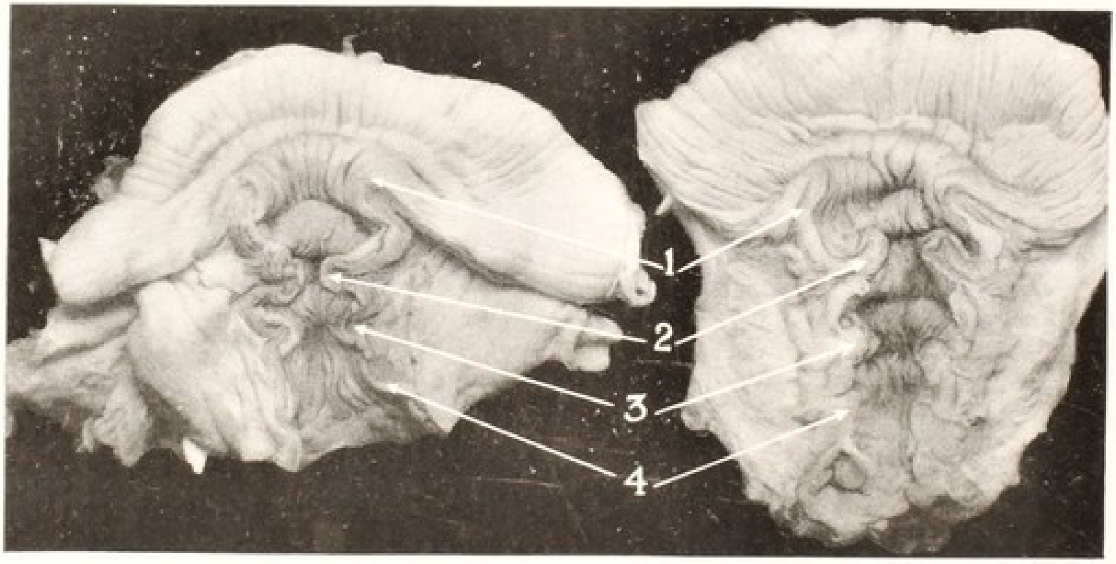


Fig. 6. Cervixes of virgin heifers showing the annular folds of mucosa. Opened along the median line on the dorsal surface.
1, first or vaginal ring (labiae of the os uteri externum). 2, second, 3, third, and 4, fourth annular ring.

ing of the uterus; the other of the posterior, or vaginal portal. The cervix varies in size in the different genera and in individuals. The posterior end of the cervix projects posteriorly into the vagina as an obtuse cone, 1½ to 2½ inches in the mare and the cow. The cow has the longest and most powerful cervix: it is 3 to 5 inches antero-posteriorly and 2 to 3 inches transversely. Its muscular walls are so rigid, and its circular muscle fibres so contracted, that the canal is well nigh undilatable, except under the influence of estrum or parturition. The cervix of the mare is shorter than that of the cow and the walls far thinner and more pliable, rendering its canal readily dilatable.

The cervical mucosa is very complex. It is thrown into deep and ample longitudinal folds, which upon cross section (See

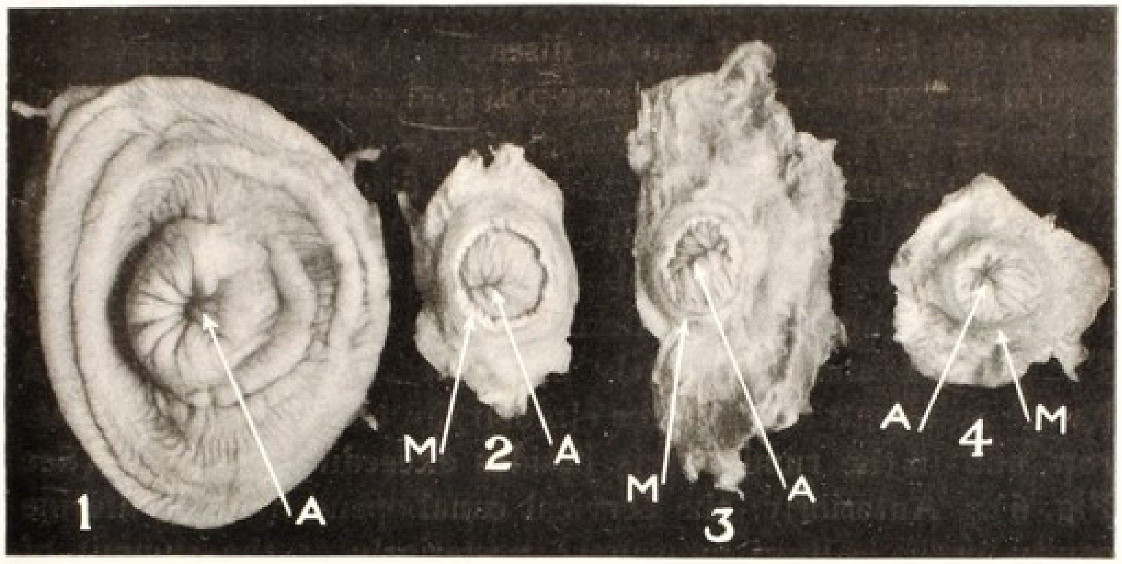


FIG. 7.

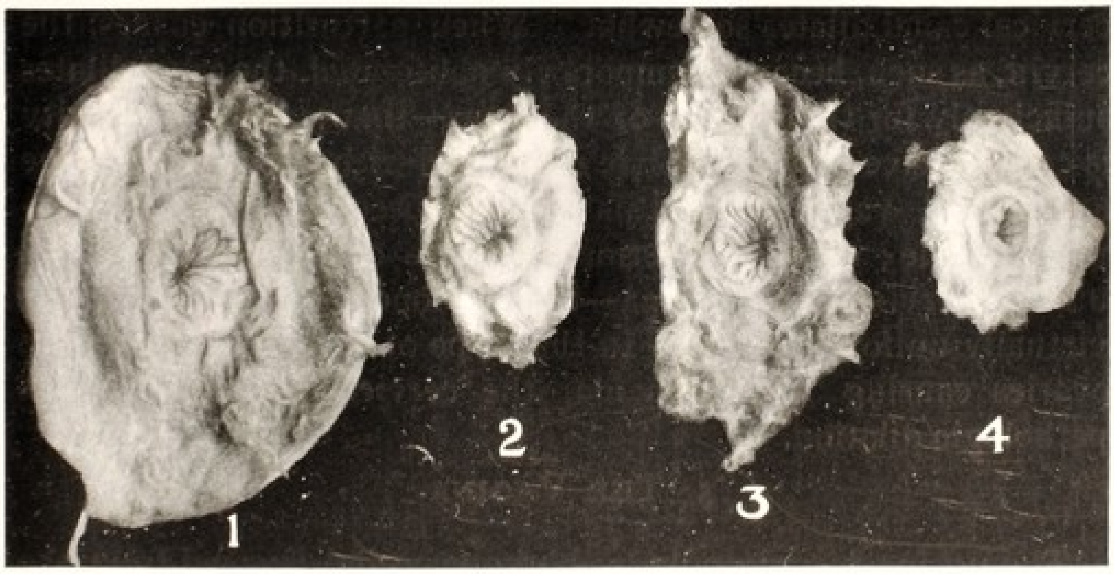


FIG. 8.

FIG. 7. Transverse sections through the cervix of a virgin heifer between the four annular folds. Viewed from the posterior (vaginal) end. A, A, A, A, the cervical canal. M, M, M, M, the muscular wall of the cervix. 1, 2, 3, 4, first, second, third, and fourth annular rings.

FIG. 8. Same as Fig. 7, viewed from the anterior or uterine end.

Fig. 7 and 8) are seen to radiate centralwards from the basal mucosa, the summits of the rugae converging to meet at the central axis of the cervical canal. The cervical mucosa of the ruminant is also thrown into very ample circular folds, with the summits, or free surfaces, directed vaginalwards. In the cow these circular folds measure one-half to three-fourths of an inch from the base to the free summit. and in disease may become elongated to several inches, to constitute large polypoid masses. The cervical mucosa is rich in special mucous glands, which during pregnancy elaborate the uterine seal—a very tough, firm, adhesive structure completely sealing the cervical canal from the uterus to the vagina and constituting a highly elaborate and efficient barrier against invasion of the pregnant uterus by infection from the vagina. The cervical canal, elaborately barricaded by mucous folds and by the firm contraction of the circular muscles, is extremely narrow, and in the ruminant is besides exceedingly crooked (See Fig. 6). Anteriorly, the cervical canal opens into the uterine cavity by the os uteri internum ; posteriorly at the summit of the conical projection into the vagina by the os uteri externum.

During estrum the muscular walls of the cervix relax and the cervical canal dilates somewhat. When parturition ensues, the cervix, as such, becomes temporarily obliterated, the canal dilates sufficiently for the passage of the fetus—that is, until its cavity is co-extensive with the pelvic cavity and with the cavities of the uterus and vagina. At this time it becomes virtually nonrecognizable ; all the posterior segments of the genital tract—uterus, cervix, and vagina—become one continuous tube of virtually uniform calibre. In that type of cystic disease of the ovaries causing nymphomania, the cervical canal undergoes pathologic dilation.

5. The Vagina

The vagina is a musculo-membranous canal, formed from the fusion of the posterior ends of Mueller's ducts and extending from the cervix to the vulva. It begins at the os uteri externum and ends posteriorly at the position of the hymen, just anterior to the meatus urinarius, where the vulva succeeds it. In the cow, incomplete fusion of the Muellerian ducts in the vaginal segment is evidenced occasionally by a muscular column of varying size stretching from the roof to the floor of the vagina on the central line, just against, but free from the vaginal end of the cervix.

The vagina of the mare is eight to twelve inches in length and capable of lateral distension to the full size of the pelvic cavity. It is lined with squamous epithelium. Its mucosa is thrown into longitudinal folds, which, when at rest, lie in contact with each other.

The mucous membrane of the vagina has in its deeper portions numerous mucous glands which serve to keep the surface at all times moist and which become especially active during sexual excitement and at the close of pregnancy. The muscular coat does not differ fundamentally in arrangement from that of the uterus, though less in volume.

In the mare, the peritoneal covering extends backwards from the anterior extremity three to five inches, where it becomes reflected upon the rectum, bladder, and pelvic walls. In the posterior portion of its course, the vagina is surrounded by the loose pelvic connective tissue, which permits comparatively free movement.

The function of the vagina is chiefly copulative, receiving the penis of the male during coition. During parturition, it affords a passage for the fetus from the uterus to the vulva.

In the mare and the cow the vagina frequently becomes ballooned during manual exploration of the organ, owing to an inflow of air at the moment of inspiration. During exploration the vulva is propped open by the hand or arm of the operator, permitting the air to flow in, distending the vagina so that it fills the pelvic cavity completely from side to side and from roof to floor, presenting a vast cavity with smooth, rigid walls, which are in close contact laterally with the bony or ligamentous pelvic walls, superiorly with the sacrum except in the area where the rectum intervenes, and inferiorly with the pubis except for the urinary bladder. The ballooning of the vagina of the mare or the cow is readily induced by intra-vaginal manipulation, by the injection into the organ of bland, tepid fluids, or by various other means. When the moist hand is introduced into the organ at the time of estrum, marked inflation generally occurs at once.

III. The Vulva

The vulva, located immediately beneath the anus, constitutes the posterior termination of the genital canal. Instead of being derived from the mesodermic Muellerian ducts, like the preceding organs, the vulvar epithelium originates from the ectoderm of the embryo. Anteriorly the boundary between the vagina and the vulva is marked by the *hymen*, a transverse membranous expanse stretching across the genital canal, which represents the partition between the termination of the hind gut and the proctodeum of the embryo, in the lower, or genito-urinary division of the cloaca. Generally it atrophies and almost or wholly disappears in domestic animals before birth, but at times it persists, either as vertical bands stretching across from the roof to the floor of the vagina or as a circular expanse largely closing the genital canal except in its center. Rarely in domestic animals the hymen persists as an impervious membrane. The vulva opens externally by means of a vertically elongated slit, bounded upon either side by the labiae vulvae, which meet above and below to form the superior and inferior vulvar commissures.

The vulvar labiae are covered externally by a very fine skin. In the mare the growth of hairs is inconspicuous; in the cow, there is a prominent tuft of hairs about the inferior commissure. The parts are so scantily haired that their color, which as a rule is simply that of the adjacent skin, becomes very conspicuous. In dark-skinned mares with white faces, eyes, and feet, the cutaneous covering of the vulva tends also to be devoid of pigment. The prominence of the pigmentation of the skin of this part serves as an aid in the clinical diagnosis of the venereal diseases of horses, in which important discolorations occur.

The muscles of the vulva, which are chiefly circular, are divided into two groups—the posterior and anterior constrictors. The posterior constrictor, situated within the vulvar lips, constitutes a true sphincter, analogous to those about other body openings. Above, its fibers become lost in the perineum and the sphincter ani; below, some go to the base of the clitoris and some pass downwards, to become lost in the skin and other tissues on the inside of the thighs. The office of this group is that of a sphincter. Their contraction brings about the closure of the vulvar opening. The anterior group of muscle fibers invests the vulva in the region of the hymen, just anterior to the meatus urinarius, where, by their contraction, they produce a constriction on the vulvo-vaginal border line.

Through the medium of the surrounding aponeuroses, the vulvar muscles acquire continuity with the ischium, sacrum, and postero-superior border of the sacro-sciatic ligament, thus affording the vulva a secure attachment to the posterior opening of the pelvis and furnishing a fixed base upon which the entire genital canal may act in parturition. This fixation enables the uterus, when contracting, to force the fetus back toward and through the cervical canal, the vagina, and the vulva. It is this fixed base of attachment which enables the contracting uterus at the time of parturition to dilate and virtually efface the cervical canal, obliterating all its mucous folds and increasing its calibre sufficiently to afford room for the passage of the fetus.

The vulvar mucous membrane, continuous with that of the urinary bladder and the vagina, is covered with squamous epithelium and contains numerous mucous glands, which are largely displaced near the labial margins and about the clitoris by sebaceous follicles, the secretions from which are odoriferous, especially during estrual periods, when the odor becomes very marked in a manner characteristic of the species.

Within the vulvar cavity are to be noted the meatus urinarius, clitoris, and vaginal bulb. In the mare the meatus urinarius, or terminal opening of the urethra, is located along the floor of the vulva at a distance of three to four inches from the external opening. The urethral canal passes obliquely downwards and forwards through the vaginal floor to the urinary bladder. In most animals the meatus urinarius is comparatively small and inextensible. In the mare it is large and freely dilatable. With patience, one, two, or more fingers may be passed gradually through it into the bladder, and it is not rare to find the opening, in heavy, coarse animals, sufficiently large to admit without great difficulty the entire hand. The amplitude of the meatus urinarius in the mare is of special significance clinically, as it favors eversion and prolapse of the bladder, an accident not particularly rare in this animal, though extremely so in others. In the cow the narrow meatus urinarius is further guarded by a valvular membranous fold directed from the posterior border forward in a manner which is claimed to prevent the penis of the bull from accidentally entering the urethra and wounding the bladder as a result of the violent copulative thrust of that animal. Nevertheless, one instance is recorded in which, it is claimed, a fatal rupture of the bladder was caused in copulation.

The clitoris is composed chiefly of erectile tissue like that of the corpus cavernosum of the penis. The clitoris of the bitch, like the penis of the dog, contains a small bone. The functions of the clitoris are not important, although it is alleged to exert an influence upon sexual excitement. In observations upon a large number of sows from which the clitoris had been removed by an empiric, the operation had no influence upon estrum or fecundation and all bred normally. In the mare it is frequently removed for the relief of nymphomaniac vice, but the results are in controversy.

OBSTETRIC PHYSIOLOGY

Reproduction

The specific function of the generative organs is the procreation of the species, including conception, the intra-uterine nutrition and development of the fetus, and its expulsion after a certain degree of development. The further nutrition of the new-born by milk from the mammae, until the young has acquired sufficient development to enable it to lead a wholly independent existence, is also a highly essential reproductive function. As the two sexes in mammalia are wholly distinct, before conception can take place a conjunction of the male and female—coition, or copulation—must occur. In each individual there are more or less apparent vestiges of each part of the genital apparatus of the opposite sex, but these naturally become arrested in their development in the embryonic stage and remain wholly functionless. Rarely, we meet with anomalies (hermaphrodites) in which the analogous organs of both sexes develop more or less completely. Less rarely, the development in one individual of some of the male organs (testes) is observed, with some of the female organs (uterus and vagina). Those animals partaking of a bisexual nature are, so far as observed, uniformly sterile. In other instances (freemartins) all genital organs may be arrested in the embryonic stage and the animal remain virtually asexual.

Before reproduction becomes possible, the breeding animal must have reached the period of puberty, or sexual maturity, which is marked by the advent of sexual desire. When this period has been reached, ova mature in the ovary of the female and spermatozoa in the testicle of the male. Up to this time, the reproductive organs are dormant in so far as their specific functions are concerned. Puberty, or sexual maturity, occurs at varying ages in different species, breeds, and individuals, depending upon the food supply and rapidity of growth. It occurs quite uniformly in both sexes prior to the completion of growth. There seems to be a tendency towards early puberty in short-lived species and late in those which normally have a long span of life, but the rule is inconstant.

The rate of reproduction, which varies greatly in different species, is dependent chiefly upon three factors: the duration of sexual competency, the number of young brought forth at a given birth, and the frequency of parturition. As a rule the larger animals are uniparous; the smaller ruminants biparous; and carnivora, swine, and rodents multiparous, bringing forth from three to twelve or more young at a given time.

The frequency of parturition varies greatly. The minimum lapse of time between two births is fixed by the duration of pregnancy, which amongst domestic animals finds its extremes in the four weeks of the rabbit and the twenty-one months of the elephant. In the larger animals there is usually an interval between parturition and the power to conceive. In the mare this interval is very brief, normally but eight or nine days. It has been alleged that the nursing of young inhibits frequently the advent of estrum and ovulation in the mare. The claim is not at all clear. Breeders usually recognize that the mare quite uniformly comes in estrum at the eighth or ninth day after parturition and that this first estrum is the most favorable time to secure conception. This may be mere tradition. Perhaps it is an error due to the fact that the mare which has suffered from some genital disease at foaling time may fail to be in estrum at the eighth or ninth day, and consequently she will probably not conceive readily at a later date—not because she was not bred on the eighth day, but because she is diseased. The resumption of the power of conception after foaling needs be very prompt, or annual breeding becomes impossible, since the duration of pregnancy is about eleven and one-third months—exceeding twelve months in some cases—leaving on an average about three weeks in which pregnancy may recur, if a second foal is to be born within a year. Under such conditions it is natural that the mare does not usually produce a foal each year over an extended period, but instead, when used especially for breeding purposes, produces ordinarily but two foals in three years, or even less. Exceptionally, mares breed annually for ten, twelve, or more consecutive years. The foal, born in a well matured state, quickly able to travel long distances for food or water, to flee rapidly from pursuing predatory animals, and in addition enjoying highly efficient maternal protection, needs live about three years before giving birth to young.

The rabbit, since conception normally recurs within a few hours after giving birth to a litter of young, may breed each month. The young of the rabbit are born in a state of utter helplessness against enemies and unable to procure food independently. The mother is not competent to afford effective protection against foes.

Not all animals born reach maturity. Growth and development after birth are predicated upon the available food supply and immunity from disease, accident, and predatory animals. Speaking generally, it may be said that in the wild state the probabilities of maturity are in inverse ratio to the rapidity of reproduction. In the natural state, fewer of the young reach maturity than under beneficent domestication.

The rapidity of the increase of a species is modified also by the available nutritive surplus of the mother. Generally speaking, the larger the animal the lower the nutritive reserve. The greatest drain upon the nutritive supply is that upon the muscles of locomotion. Large animals need move over a more extensive area in order to obtain sufficient food. The greater the body weight, the greater the drain upon the nutritive supply. The maintenance of nutrition of the body of the parent must necessarily take precedence over the production of young. The latter must be limited constantly by the nutritive reserve of the parent after the necessities for her own existence have been supplied. The drain upon the maternal system in the production of young is very great in all mammalian animals, but differs widely according to species. In a mare weighing 1,500 pounds, the new-born foal may weigh about 125 pounds—eight per cent. of her body weight—to which must be added an additional demand of the young, in the form of milk as food, covering a period of five, six, or even more months after birth.

The nutritive demands of the young of the mare extend over eleven and one third months of pregnancy and five, six, or more months of nursing—a total period of about one and one-half years. Her average rate of producing young is reduced to approximately one in two, or two in three years. In the cow there is a greater nutritive reserve. The young is about ten per cent. larger, as related to the size of the mother, than the young of the mare. The intra-uterine term of existence is shortened from about eleven and one-third to nine and one-third months, and the period of sucking is also reduced somewhat, thus materially decreasing the demands upon the maternal system, with a corresponding increase in reproductive power and rate of increase of the species.

In nature, where there is neither room nor food for all the young which might be born, conditions which modify the birth rate and the percentage of young which shall mature successfully serve to maintain a balance in animal life. Among domestic animals, where food and protection are provided by man, the control of the numbers of animals is brought about through such agencies as slaughtering the immature animals for human food (ruminants and swine), the direct control of numbers by killing the surplus new-born (carnivora), castration, and the prohibition of breeding by sexual segregation.

The character and abundance of food exert a well defined influence upon the number of young produced. A highly nutritive and well balanced ration with other favorable environment tends greatly to increase fecundity.

In multipara the young are relatively smaller than in unipara and parturition occurs more frequently. In the sow parturition occurs twice annually and the number of young may reach ten or more at each birth. A sow weighing three hundred pounds may thus give birth to twenty pigs in a year, each of which may weigh two pounds, or a total of forty pounds, equal to thirteen per cent. of the maternal body weight.

The completeness of development of the fetus at birth varies widely and the demands upon the nutritive reserve of the mother correspond to the degree of embryonic evolution attained by the young prior to birth. The new-born rabbit, after four weeks of intra-uterine life, is a very immature animal, incapable of locomotion, its eyes not open, and its body almost naked of hair; the young Guinea pig, after the same duration of intra-uterine existence, is born with a dense coat of hair, with eyes open and its locomotory apparatus so completely developed that it can move about with almost the same celerity as its dam. The young of carnivora are born in a very immature state, while those of ruminants and solipeds are well developed and early ready to follow their dams at will. In each case, there are probably advantages to the mother and the offspring. The rabbit, depending wholly upon flight for protection against foes, would evidently suffer a serious disadvantage from a greatly increased body weight due to the presence in the uterus of a number of very large fetuses. The bitch also, in the natural state, depending upon the chase for her food, would be hampered by a great weight due to well developed fetuses.

Reproduction is a complex physiologic process, accompanied by or associated with phenomena which bear an important relation to each other. In approximately the following order, there are observed the maturation of the ovisac—or Graafian follicle—estrum, copulation, rupture of the ovisac, fecundation, and possibly menstruation. The chain of phenomena is finally completed by pregnancy, parturition, and the nutrition of the new-born.

MATURATION OF THE OVISAC

Estrum

The ovaries consist at first of a mere thickening of the peritoneum, due to an elaboration of its epithelial cells. The external cell layer becomes columnar. The cells of the deeper strata assume a more or less cuboidal form, to constitute the germinal cells, and certain of their number become distinctly larger than the others, to form the *primitive ova*. The deeper

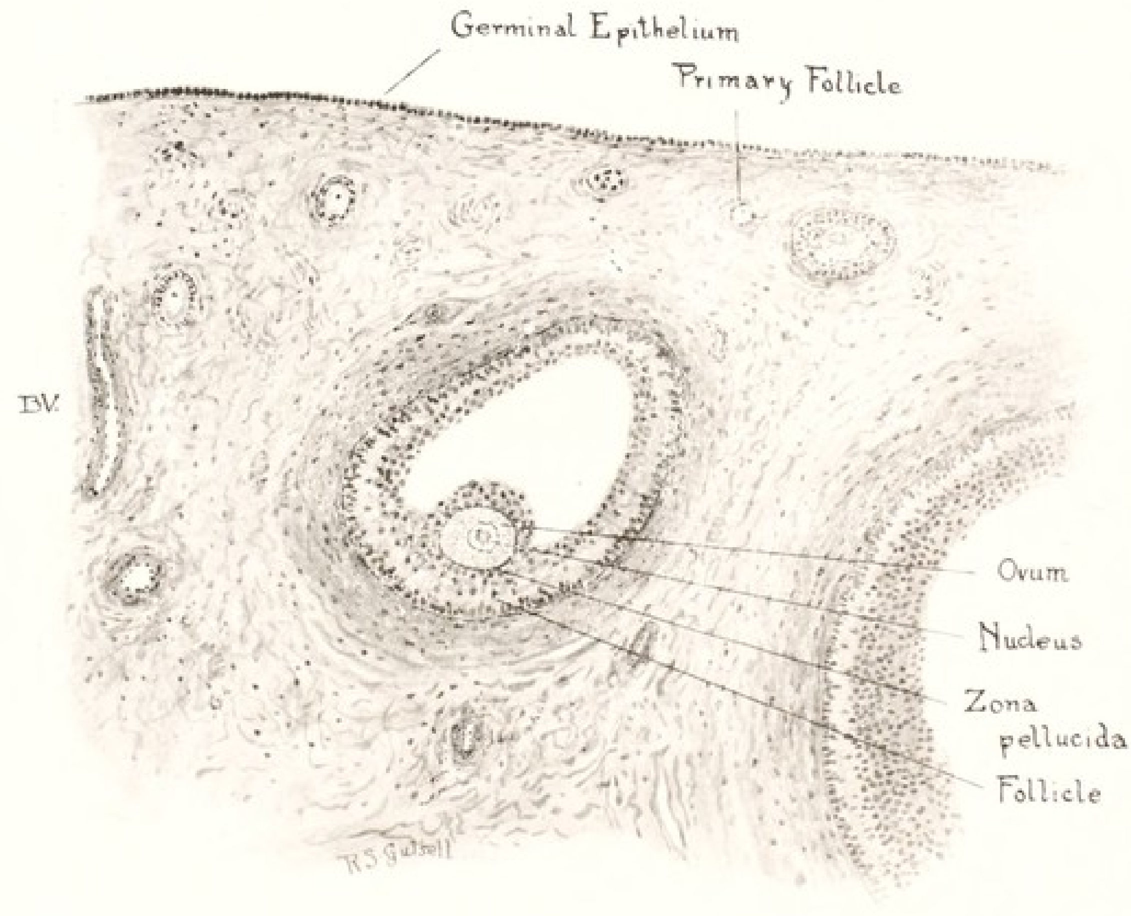


Fig. 9. Section of Ovary of Cow showing a Follicle 0.6 mm., with ovum.

epithelial layers are broken into irregular columnar masses, or *egg columns*, through the growth among them from below of blood vessels and connective tissue. Prior to birth, in those young which are born in a well developed state, and shortly after birth in the immature young like that of the rabbit, some of the primitive ova become materially changed, to constitute *permanent ova*. In the cell masses the *permanent ova*, developed

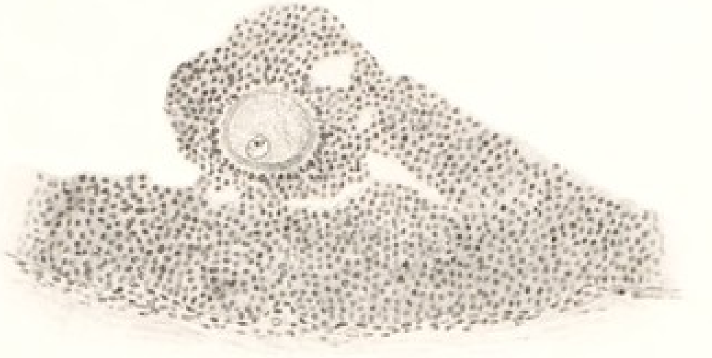


FIG. 10. Section of Ovary of Cow showing a Follicle of 2 mm., with ovum.

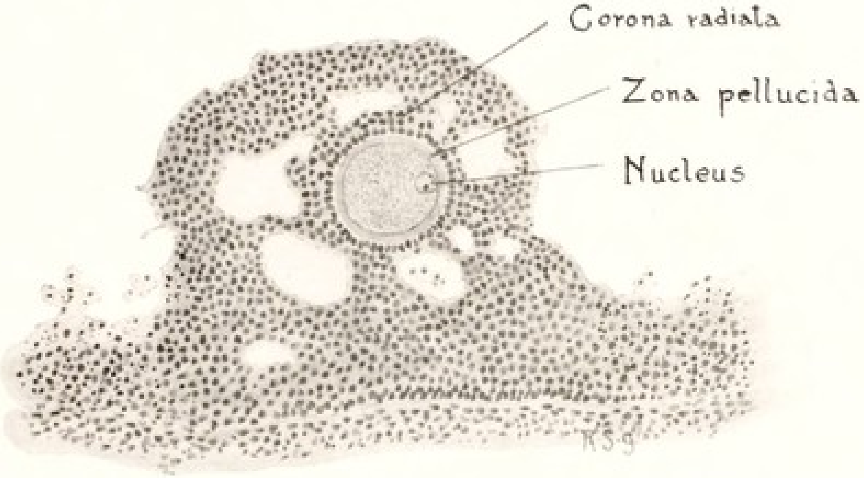


FIG. 11. Section of Ovary of Cow with a nearly ripe Ovum in an Ovisac 5 x 7 mm. showing Vacuoles in the Cumulus preparatory to Ovulation.

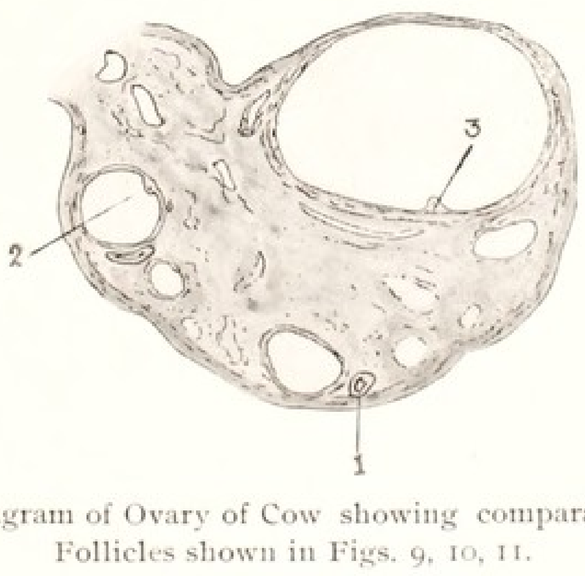


FIG. 12. Diagram of Ovary of Cow showing comparative sizes of Follicles shown in Figs. 9, 10, 11.

from the *primitive ova*, become much larger than the others, while the nucleus, or germinal vesicle, enlarges and its enveloping membrane becomes distinct. The contents of the nucleus become massed at one point and form a distinct reticulum, in which one or more nodal points enlarge to constitute the nucleolus, or *germinal spot*. The neighboring germinal cells become arranged about the ovum in such a manner as to enclose it completely in a follicle, which has at first a single layer of cells. Later a second layer of cells forms within the first, closely investing the ovum and continuous at one point with the cellular layer of the wall. This mass of cells, bearing within it the permanent ovum, constitutes the *discus proligerus*.

The cells of the follicular walls multiply rapidly. The external enveloping layer extends more rapidly than the inner *discus proligerus* causing a separation between the two, except at the point of attachment of the latter. A section through the discus proligerus and follicle reveals a crescent-shaped cavity filled with fluid. Fully developed, this constitutes the ovisac, which consists of the outer layer of follicular cells, or *tunica granulosa*, and the inner granular cells, the *discus proligerus*, embedded within which lies the ovum. The cavity of the follicle between the two masses of cells is occupied by the follicular fluid. The immature egg sac usually lies deep within the ovary. As it matures and the volume of follicular fluid increases, it approaches the surface of the ovary. In the cow, about one-half of the ovisac protrudes finally beyond the general ovarian surface as a hemisphere, while the other half remains below the general level of the gland. The ripe ovisac of the cow is about one-half to five-eighths of an inch in diameter. In the sow the ovisac grows completely beyond the ovarian surface and appears as a pedunculated cyst one-fourth inch in diameter. In pushing toward and beyond the ovarian surface, the tunica albuginea, or ovarian capsule, atrophies and disappears at the summit of the distended sac, and the peritoneum is pushed outward. The follicular wall becomes very thin. During rectal palpation in the cow, it often ruptures under very slight pressure. During the maturation of the ovisac, the ovum undergoes important changes. Before the ovisac ruptures, the nucleus of the ovum passes from the center of the egg toward its periphery ; a definite *vitelline* membrane is formed within the *zona radiata* immediately about the nucleus of the ovum; the nucleus becomes indistinct; and, while the yolk retracts slightly from the vitelline membrane at one point, the first polar body, a small mass apparently derived from an unequal division of the nucleus, is assumed to be extruded.

When the egg has fully ripened and the ovisac has completed its growth and is fully distended with fluid, estrum, or "heat", occurs.

2. Estrum

Preliminary to reproduction, an irresistible sexual desire occurs in both sexes, leading to coition.

In the female the condition, which is known as estrum, occurs immediately prior to ovulation. It finds expression in various ways in different species of animals. In general there is a nervous excitability, the external genitals are swollen and vascular, and there is an increased secretion of mucus from the vulva and the vagina. In the mare, when other horses—especially stallions—are present, there are frequent emissions of urine in small quantities, and the vulvar lips are frequently opened and the erected clitoris protruded. In ruminants and the sow, the female imitates the copulatory act of the male by mounting, or standing to be mounted by, other animals of its species. In certain pathologic cases (nymphomania) the cow especially does not confine her expressions of sexual desire to her own kind, but may attempt to mount other species of animals.

In all animals there is a tendency during estrum for the female to wander from home. This is most noticeable in the bitch and the cat, which, if not securely confined, disappear, tending to wander long distances and to remain away during a large part or all of the estrual period. The sexual wanderings of domestic animals constitute an interesting chapter in the dissemination of infectious diseases.

3. Copulation. Coition

The advent of puberty in the male awakens a sexual desire somewhat analogous to that of the female. The female exhibits sexual desire only for a comparatively brief time, while a ripe ovisac is present in the ovary. The estrual cycles are comparatively uniform in each species. Only at times of estrum is the female capable of conception. The male ordinarily exhibits little or no sexual desire except in the presence of a female in estrum, but the testes function constantly. The sexual desire may be activated at any time when a female in estrum approaches sufficiently near to be recognized, and copulation occurs when opportunity offers.

During the act of copulation, the semen from the male is injected into the vagina of the female, possibly in part into the cervical canal. Some think that most or all of the semen is ejaculated directly through the cervical canal into the body of the uterus and that the urethral opening of the male comes in direct contact with or enters the os uteri. Harms, quoting Duranton (Journal de Lyon, 1888) cites a case of alleged rupture in one uterine cornu of a cow during copulation, owing to the entrance of the penis of the bull through the cervical canal, but this must have been an error in clinical history. A study of the cervical canal of the cow, as delineated in figures 6, 7 and 8, pages 28, 29, suffices to refute any allegation of the entrance of the penis into the cervical canal. It is an anatomical impossibility. In the mare, with a far more dilatable cervical canal, copulatory injuries from an unusually long penis occur in the vagina—not in the uterus. Male animals, after the amputation of a considerable portion of the penis, are quite as fertile as before, although the stump of the organ can not reach the *os uteri*. Clinically, a large part of the semen is ejected from the vulva of the female immediately after copulation, and quantities of semen are readily obtained from the vagina at this time. The condition essential to fecundation, so far as the male is concerned, is that physiologically perfect spermatozoa shall gain the cervical canal, traverse the uterus and oviducts, and meet the ovum in the pavilion of the oviduct. Of the countless myriads of sperm cells in one discharge of semen, but one can take part in the fertilization of an ovum.

Ovulation

At about the close of estrum, in those animals where the phenomena have been studied, as in the cow, the distended ovisac ruptures as a result of the intra-follicular pressure. Prior to the rupture of the ovisac, preparation for the detachment of the ovum from the enveloping and supporting cells of the discus proligerus has been made by the formation of numerous vacuoles in the mound, as shown in Fig. 11. The attachment of the ovum is rendered exceedingly frail, subject to detachment upon the slightest disturbance. The ovum is apparently maintained in situ chiefly, if not wholly, by the sustaining pressure of the follicular liquid. The ovum, the follicular fluid, and some of the granular cells of the discus proligerus in which the ovum was embedded are then discharged into the pavilion of the oviduct, which is at this epoch erected and closely applied to the ovary at that point where the ovisac is about to rupture. Here, if successful copulation has occurred, spermatozoa meet the ovum and a single spermatozoon fuses with each ovum, to constitute fertilization.

The precise period at which ovulation occurs is not known for most domestic animals. In the rabbit which has given birth to young, copulation occurs immediately following parturition. Ovulation follows about twelve hours later—an interval sufficiently great for the migration of spermatozoa from the vagina to the ovary. In the cow, estrum persists ordinarily for but twelve to twenty-four hours, and ovulation occurs at about the close of this period. If copulation occurs early in estrum, better opportunity is afforded for the arrival of spermatozoa at the pavilion of the oviduct prior to the rupture of the ovisac and discharge of the ovum. In swine, carnivora, and to some degree in solipeds, the estrual period is prolonged, extending over several days. In these we have no accurate data of the epoch of ovulation. Probably ovulation occurs at a time corresponding to that observed in the cow—that is, at about the close of estrum.

The number of ovisacs rupturing at a given estrual period corresponds as a rule with the maximum number of possible fetuses. It is said that rarely two ova are contained in one ovisac. I have been unable to verify this statement, and have in all cases of twins in the cow observed two corpora lutea, sometimes both in one ovary but most frequently one in each. Sometimes a single fertilized ovum divides to constitute two embryos, which form identical twins, but this is not known to occur in domestic animals. In multipara, it is assumed that there are at least as many ova discharged, from as many ovisacs, as there are embryos formed.

Physiologically, estrum and ovulation are inhibited by pregnancy; abnormally, they occur while the animal is pregnant and the fetus alive and well.

Fertilization

Fertilization, fecundation, or conception follows when a healthy female copulates naturally with a healthy male. Since copulation precedes ovulation, spermatozoa have already migrated through the genital tube and have reached the pavilion of the oviduct, where they await the discharge of the ovum. One spermatozoon penetrates the egg and traverses the zona radiata to the nucleus. The nucleus of the spermatozoon fuses with that of the ovum. A beginning has been made for the development of a new individual. The animal has conceived.

Menstruation

If a heifer or a cow fails to conceive, when estrum, copulation, and ovulation have occurred, or if copulation has failed, she regularly menstruates. If she conceives, she does not as a rule menstruate. Evidently the engorgement of the uterus during estrum is designed to fit the genital tract for the protection and nutrition of the fertilized ovum. Should fertilization fail, capillary hemorrhage from the placental areas follows. The volume of hemorrhage is sufficient that the blood is expelled through the vagina and vulva to stain the exterior vulvar region and adjacent parts. Upon the killing floor of the abattoir, heifers or cows having in their ovaries ripe ovisacs have engorged uteri with special engorgement of the placental areas. If the ripe ovisac has ruptured, and presumably fertilization has failed, the placental areas are covered over with thin coagula of bright red blood. Later this is expelled, to constitute the menstrual fluid. The exact significance of menstruation is not fully determined. By my observations I have been led to the conclusion that menstruation constitutes reliable evidence of a failure to conceive, so far as the estrum just past is concerned. Apparently there are exceptions to the rule.

EMBRYOLOGY. TERATOLOGY

Embryology is a study of the orderly development of the fertilized egg through its various stages until it has acquired the anatomic structure and physiologic function of the adult animal.

Teratology is the consideration of the aberrant or disorderly development of the fertilized egg.

Each of these subjects is too extensive for any definite incorporation in a treatise upon obstetrics. It is desirable however to incorporate a brief outline of the orderly development of the mammalian embryo, as a basis for directing attention to a few of the more common aberrations. Sometimes they may compromise the life of the mother by inducing more or less serious dystokia. Far more frequently aberrations in the development of the fetus invite economic loss by imperilling the life of the young owing to vital defects in essential organs; by decreasing its efficiency or depreciating its appearance; by transmitting the defect to the progeny; or because the congenital defect tends to lead to serious disease in the young or adult animal.

The extent of deviation from the normal knows no bounds. There may be a barely perceptible departure from the normal. In fact, no exact line between embryologic and teratologic development can be drawn. Conversely, the departure from type may be so extreme that genus and species lose all traces of identity and the individual is represented by a shapeless mass in which only weird traces of organs may with difficulty be recognized, as in the amorphus, or acardia, of Figs. 19 and 20.

The veterinary obstetrist needs know, so far as possible, the embryologic foundation of certain defects and of diseases arising from them in domestic animals, because the intelligent handling of these must be based upon such an understanding.

There will be further occasion to refer to some forms of aberration in development when dealing with the subject of dystokia, since some of them lead to very great difficulty in parturition and tax to the utmost the resources of the obstetrist. It will be desirable also to mention some of the aberrations in development when dealing with the defects of the new-born animal.

It is worthy of remark that those arrests in the development which occur early in the life history of an embryo show a marked tendency to recur in the offspring of the defective individual, should it live to breeding age. This may readily occur in the milder forms of aberration in development, but it is only rarely that the more serious cases, commonly designated monstrosities, are capable of breeding, or even of surviving to adult life. The lesser aberrations in development, such as arrests in the descent of the testicle—cryptorchidy—and in the closure of the umbilic or inguinal ring, resulting in hernia, are extremely liable to become fixed and to be reproduced with disastrous frequency in the offspring.

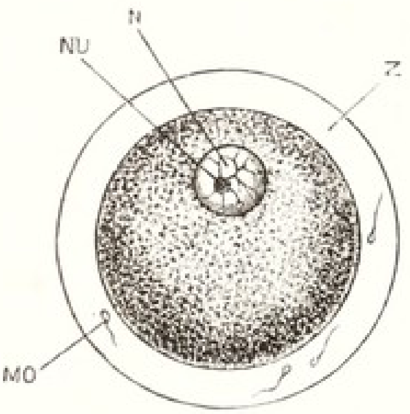


FIG. 13.

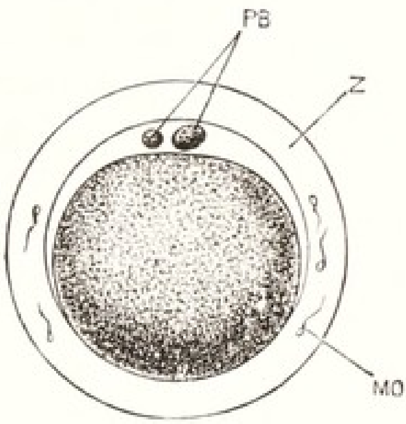


FIG. 14.

FIG. 13. A fully formed ovum of the rabbit shortly before its discharge from the ovary. (Marshall after Bischoff.)

FIG. 14. Ovum of rabbit from the upper end of the oviduct after extrusion of the two polar bodies. (Marshall after Bischoff.) MO, spermatozoon. N, nucleus, or germinal vesicle. NU, nucleolus, or germinal spot. PB, polar bodies. Z, zona pellucida.

Segmentation of the Egg. Immediately after the ovum has become fertilized through its fusion with a spermatozoon, the resulting cell undergoes a progressive division by the process of mitosis, which is termed segmentation. The observations upon the fertilization of the mammalian egg have been carried out largely upon the rabbit. Generally copulation ensues in the rabbit immediately after the doe has given birth to young. Eight to twelve hours later the ovisacs rupture. The spermatozoa have already passed through the uterus and the oviduct and have reached the ampulla of the tube, so they may at once meet the egg when it is discharged and fertilization follow immediately. The spermatozoa may even have reached the ovum while yet in the ruptured ovisac, before it has been discharged into the oviduct, as shown in Fig. 14.

In the typical fertilization of the rabbit ovum, where the spermatozoa have already reached the anterior end of the oviduct when the ovisac ruptures, and fertilization occurs at once, the fertilized ovum undergoes segmentation during its passage toward the uterus. According to Van Beneden, the segmentation of the ovum begins ten or twelve hours after fertilization, or eighteen to twenty-four hours after copulation, and continues for the next two days, or until about the end of the third day

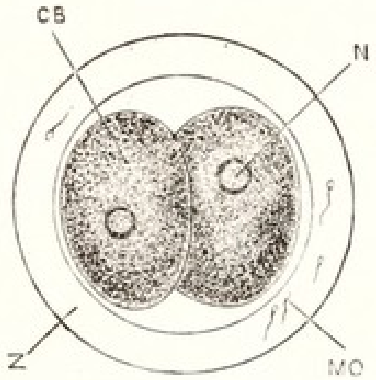


FIG. 15.

FIG. 15. A rabbit's ovum from the middle of the length of the oviduct, about 22 hours after copulation, showing division of the ovum into two cells. $\times$ 200. (Marshall after Bischoff.)

CB, blastomere, or segmentation cell. MO, spermatozoon embedded in the zona pellucida. N, nucleus. Z, zona pellucida.

after copulation, when the ovum reaches the uterus and its segmentation has been completed. So far as known, the ovum has no power in itself, like the spermatozoon, of migrating from the pavilion of the oviduct, through the duct, into the uterus, but is instead transported chiefly or wholly by the cilia of the columnar epithelium of the duct. At this time it is about the same size as the original ovum, or possibly somewhat smaller.

About ten to twelve hours after the fertilization of the egg of the rabbit, the ovum undergoes cleavage, by which there arise two spherical cells, which are essentially alike in all respects, except that some observers believe that one is slightly smaller than the other (See Fig. 15). Each of these two cells, after a brief pause of a few hours, divides again into two cells, forming a mass of four ovoid cells, which again subdivide to constitute a group of eight cells. Those derived from the supposedly larger of the two first cells are now more clearly larger than the others. The larger ones are grouped together centrally, and the smaller rest upon them as a cap. Later the segmentation of the small cells proceeds somewhat more rapidly than that of the larger, and the former tend to grow around and enclose the latter. According to Marshall, when the ovum of the rabbit has reached the 70th hour after fertilization, its segmentation has been completed and it passes from the oviduct into the uterus. At this time it is a

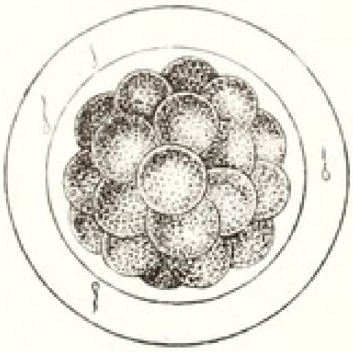


FIG. 16.

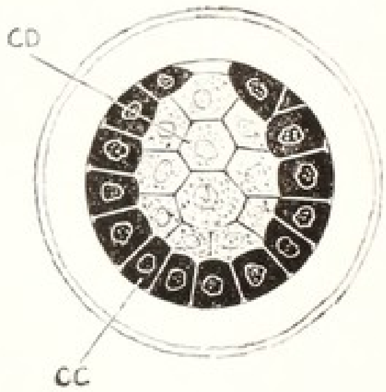


FIG. 17.

FIG. 16. A rabbit's ovum from the lower end of the oviduct, about the middle of the third day; showing the morula stage, shortly before the completion of segmentation. × 200. (Marshall after Bischoff.)

FIG. 17. A rabbit's ovum seventy hours after copulation, taken from the lower end of the oviduct just before entering the uterus and showing the condition at the close of segmentation. × 200. (Marshall after VanBeneden.) C D, internal mass of large cells. C C, external layer of small cells.

spherical mass consisting of an exterior layer of small, nearly spherical, transparent cells, enclosing almost completely the group of larger, more granular cells: it has reached what is known as the morula, or mulberry stage (See Figs. 16 and 17). At this stage the external layer of smaller cells and the internal mass of larger cells are firmly attached to each other at one point only. The segmented ovum is still surrounded by the zona pellucida.

Within a few hours after entering the uterus, the ovum becomes greatly enlarged, owing to the accumulation of a large volume of fluid between the external layer of small cells and the mass of larger inner cells, except at the point of attachment between the two. The inner mass now occupies a comparatively small area at the superior pole of the ovum. At this stage of development the ovum is known as the *blastodermic vesicle*. The mass of inner cells is flattened out in the form of a disc, consisting at the center of several layers of somewhat spherical cells, known as the embryonal or germinal area. At the periphery of this area there are but one or two layers of cells. As the vesicle increases rapidly in size, the zona pellucida disappears.

During this stage of development, which continues in the rabbit to about the seventh day, the ovum lies free within the uterine cavity. In multiparous animals the ova, which enter the uterus almost simultaneously, tend to become distributed at more or less uniform intervals throughout that horn of the uterus leading from the ovary from which the fertilized ova have come and assume the positions which they are to retain throughout their period of intra-uterine development. The location of each embryo is indicated early by a bulging of the uterine walls.

Toward the close of the development of the blastoderm, important changes take place, by which there are established three distinct germinal layers, each of which is destined to take a special part in the formation of certain tissues of the embryo. These changes affect chiefly the embryonal area at that point in the blastoderm at which the various layers are united and the large internal polygonal cells are massed.

The exact method of the formation of the germinal layers is not wholly determined. In the embryonal area, which is a circular or discoid patch, three layers of cells may be recognized : an upper or external layer of ephithelial cells, the ectoderm ; a middle layer of larger, cuboidal cells, the mesoderm ; an inner layer of epithelial cells, the entoderm. At the margin of the embryonal area, the walls of the blastodermic vesicle consist of two layers of cells representing the external and internal germinal layers ; passing slightly beyond this, the remainder of the blastodermic vesicle, constituting about three-quarters of its total surface, consists of a single layer of cells, the ectoderm. According to Rauber and Kölliker, the uppermost layer of the blastodermic vesicle—the primitive ectoderm—disappears from the embryonal area, to be succeeded by a new ectoderm arising from the inner mass of large cells, so that the entire embryonal area is ultimately derived from the inner mass, which, in the morula, consisted of the larger, granular, slowly multiplying cells. Late in the blastodermic stage, the embryonal area becomes pyriform, its greater diameter corresponding to the long axis of the blastodermic vesicle in the rabbit, which has now assumed the elliptical form. In other domestic animals the long axis of the embryonal area is transverse to that of the blastodermic vesicle. The broader end of the embryonal area is designated the anterior, or head end, and the narrower the posterior, or tail end.

The Primitive Streak and the Primitive Groove

As the blastodermic vesicle approaches the completion of its development, there appears the primitive streak, consisting of an axial thickening of the ectoderm at the posterior, or tail end

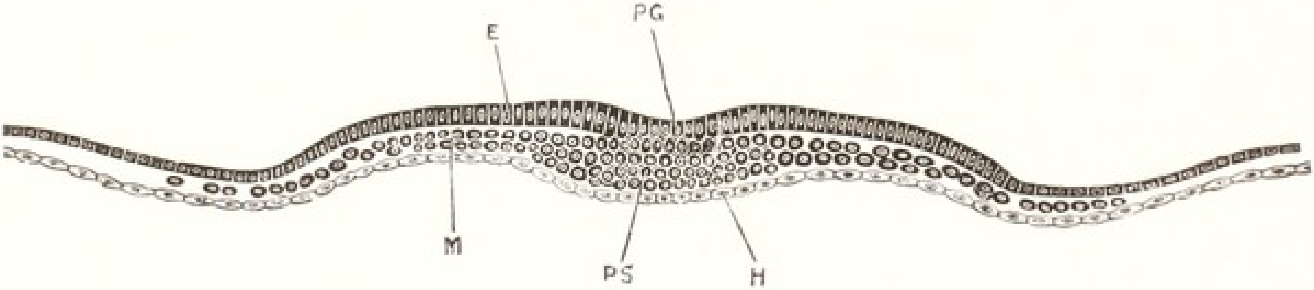


Fig. 18. A transverse section across the hinder part of the embryonal area of a rabbit embryo at the end of the seventh day, the section passing through the primitive streak. × 80. (Marshall after Kölliker.)
E, ectoderm. H, entoderm. M, mesoderm.
PG, primitive groove. PS, primitive streak.

of the embryonal area. This thickening, which extends longitudinally until it attains a length equal to about two-thirds of that of the embryonal area, has in its center a faint longitudinal depression, the primitive groove. A cross section of the primitive streak shows it to consist of a multiplication on the median line of the deeper cells of the permanent ectoderm. From the deeper layers of the thickened, dense, primitive streak, the cells grow out in lateral plates between the ectoderm and the entoderm, to constitute the permanent mesoderm (See Fig. 18).

In the median line a rod-shaped mass of mesodermic cells becomes closely packed together and somewhat clearly separated from the adjacent mesoderm, to constitute the notochord, about which the final axial skeleton is to form.

Formation of the Embryo

The embryo is formed in the embryonal, or germinal, area. A longitudinal depression, the neural groove, is formed immediately in front of the primitive streak. The long axes of the two structures are parallel. The neural groove is bordered on the sides by the neural folds. These grow upward from the ectoderm, approach each other, and become united above to form a tube, in the walls of which eventually forms the central nervous system. In the anterior, or head end of the neural groove the brain vesicles soon appear.

By an infolding of the walls of the blastodermic vesicle about the margins of the embryonic area, the latter becomes constricted off from the rest of the vesicle, which eventually becomes the vitelline or yolk sac. The yolk sac of the mammalian embryo is small and of little consequence, as it contains no appreciable amount of nutriment for the embryo, but simply a quantity of a presumably inert fluid. After this constriction forms, dividing the embryo from the yolk sac, the dorsal surface of the embryo grows much more rapidly than the ventral, causing it to bend ventralwards very rapidly, so that the head end is soon at right angles to the remainder of the embryo. The head of the embryo is bent downward into the yolk sac and pushes the walls of the latter before it. The different parts of the brain soon become recognizable, and later the beginnings of the nose, eyes, and ears. Upon the sides of the head and neck the visceral arches and imperfect clefts appear.

The Celom, or Body Cavity

On the eighth or ninth day after fertilization in small animals —perhaps somewhat later in the larger ones—there is a rearrangement of the cells of the mesoderm, by which the celom, or body cavity, is formed, radiating outwards from the region of the notochord, to pass beyond the embryo itself and extend outward in the walls of the blastoderm to near the margin of the mesodermic area. This change serves to divide the mesoderm into two layers, the external of which is closely adherent to the ectoderm. The two constitute the somatopleure. The inner mesodermic layer and the entoderm, with which it is intimately related, constitute the splanchnopleure.

From the ectoderm arise finally the epidermis, hair, nails, hoofs, horns, etc., and the cerebro-spinal nervous system. From the mesoderm of the somatopleure arise the striped, or voluntary muscles, bones, connective, and other skeletal tissues, and the deeper layers of the skin.

The mesoderm of the splanchnopleure gives origin to the heart and circulatory system and to the muscular portions of the digestive, respiratory, and urino-genital organs, and, in a general way, to the pale, or unstriped muscle fibers. The entoderm of the splanchnopleure forms the epithelium of the digestive and respiratory tracts. The origin of the various tissues from the three embryonic layers is of great interest in the study of disease and repair. A wound of the epithelium can be perfectly repaired by epithelial tissues only. Cells originating from the mesoderm have not the power to repair an ectodermic injury.

Ere the blastoderm can proceed far in its development, new provision must be made for its nutrition, which, in mammalia, must be derived from the mother through an intimate relation between her placental uterine mucosa and the special organs of the fetus—the fetal envelops—especially the fetal placenta. At a very early period, the nutritive relationship between the mother and the fertilized ovum is established by two outgrowths: one of the extra-embryonal somatopleure, to constitute the amnion and amniotic chorion (false amnion or prochorion); the other from the splanchnopleure, to constitute the allantois and allantois-chorion.

The Nervous System

The *neural groove* of the blastoderm marks the beginning, location, and form of the future cerebro-spinal nervous system. The neural folds, consisting of thickened ectoderm, increase in prominence, while the groove between them deepens and the summits of the folds approach each other, as segments of an arch, to meet finally and fuse above the groove, converting it into a closed tube which, lined with ciliated ectodermic cells and filled with fluid, is to persist throughout the life of the animal as the central canal of the spinal cord and as the ventricles of the brain. From the deeper ectodermic cells in the walls of the tube are to develop the nerve cells and fibres of the cerebro-spinal axis. Under normal conditions, the neural groove grows

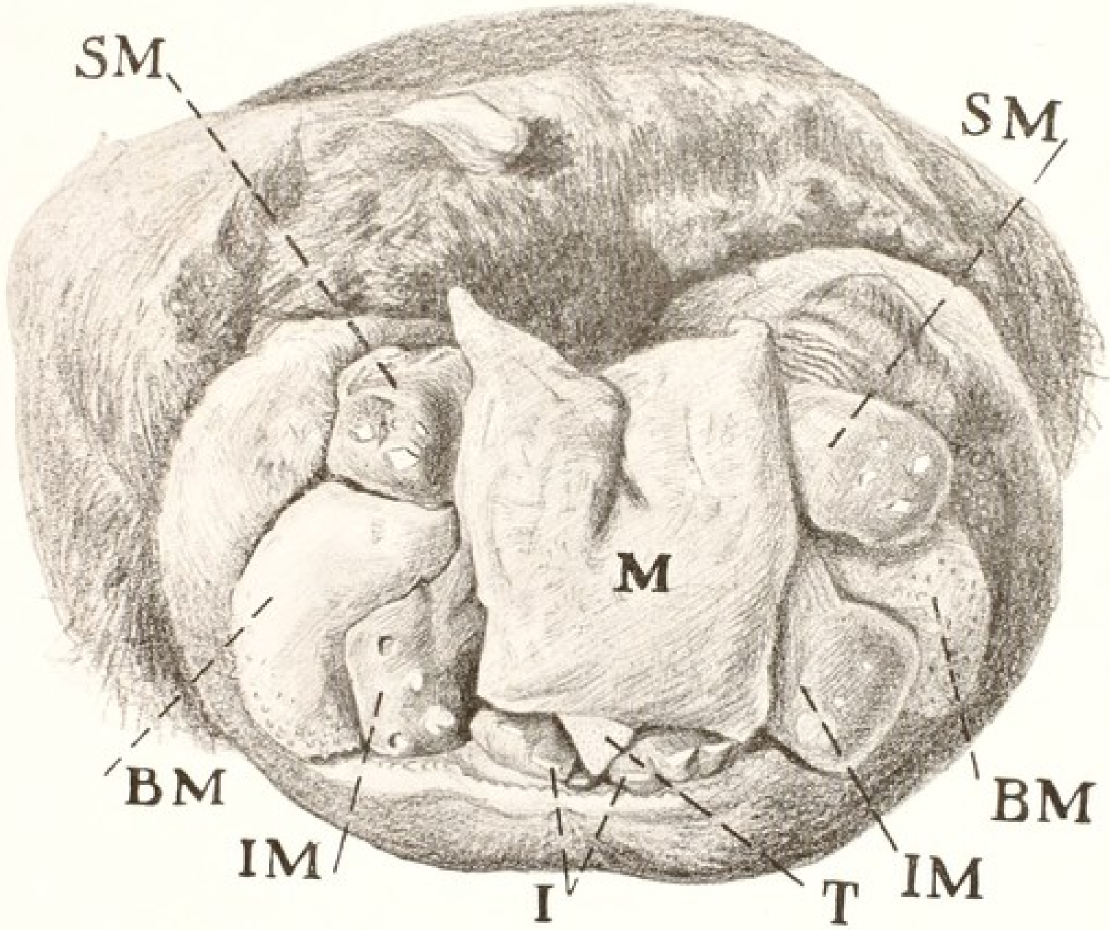


FIG. 19. AMORPHUS, OR ACARDIA. FROM COW. × ½.
(Museum New York State Veterinary College.)
M, muzzle. SM, SM, superior maxilla, showing white denticles, IM, IM, inferior maxilla showing denticular masses (grinders). BM, buccal mucosa showing papilla. T, tongue. I, incisors.

rapidly in length and depth. In the rabbit the lips of the neural folds have met and fused to constitute a complete tube by the end of the ninth day. At this time one can distinguish the spinal cord, the fore-brain, the mid-brain, and the hind-brain.

The cerebro-spinal nervous system of mammalia constitutes the central organ, about which the other portions of the embryo develop in more or less complete harmony. Any interruption in

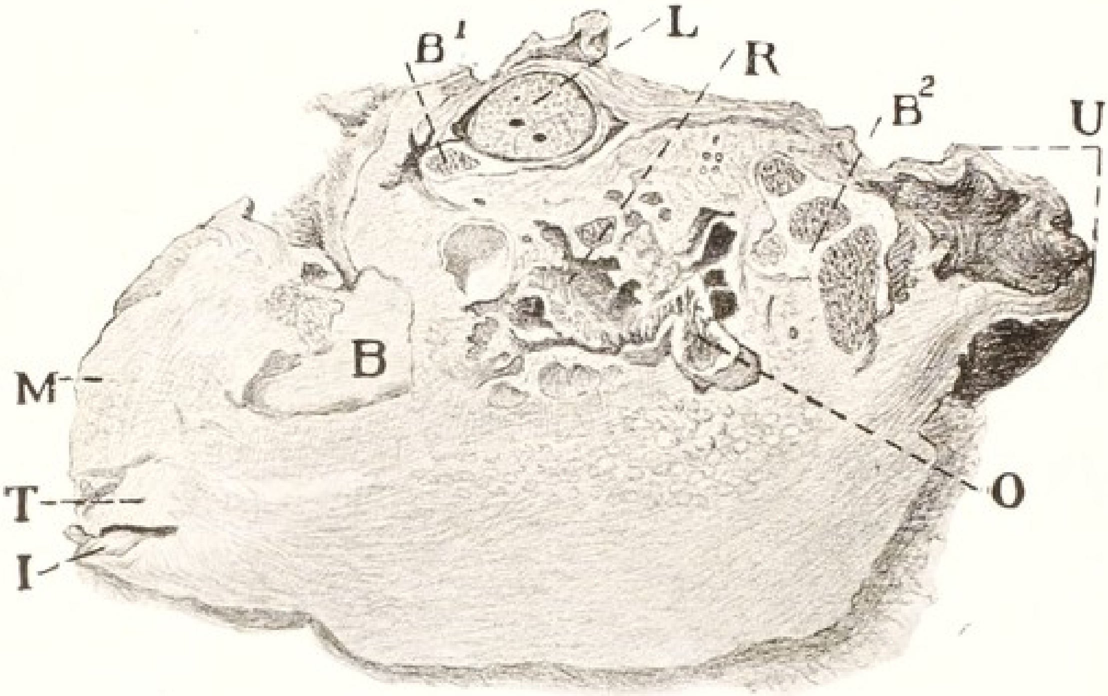


FIG. 20. SAGITTAL SECTION OF FIG. 19. × ½.

I, incisors. T, tongue. M, muzzle.

B, bone (skull). B¹, sternum. B², bone (pelvis?).

L, lung. R, rumen and recticulum.

U, umbilicus. O, omasum.

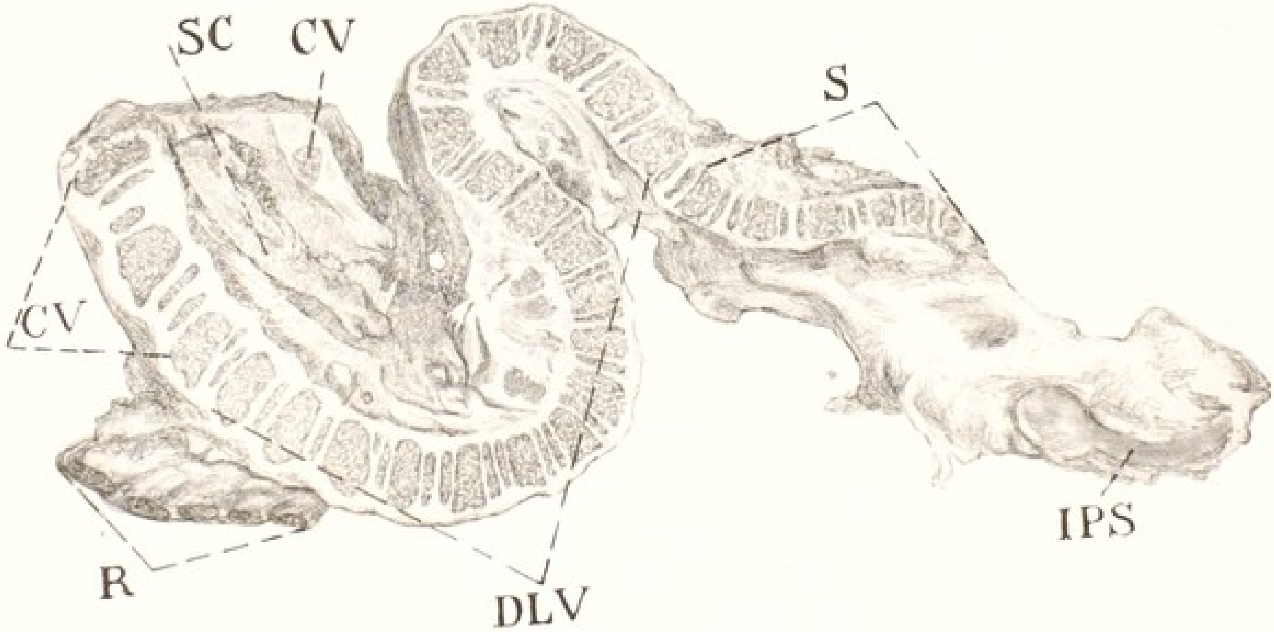


FIG. 21. SPINA BIFIDA WITH SPINAL FLEXURE.

(Museum New York State Veterinary College.)

CV, CV, cervical vertebra. R, ribs.

SC, spinal cord, ending in anterior dorsal region.

DLV, dorso-lumbar vertebra. S, sacrum.

IPS, ischio-pubic symphysis.

the normal development of the cerebro-spinal axis interrupts or vitiates the proper growth of other parts of the body. When the neural groove becomes branched and double at its anterior end, there forms in the embryo two heads instead of one, constituting a double-headed monster, or bicephalus. The fission may extend more posteriorly, to constitute a double neck or chest. When the posterior end of the neural groove undergoes division into two parts, the result is a monster in which the posterior parts of the body are double, while the anterior may remain single and normal. When two neural grooves form side by side and in intimate contact with each other, there may result a double monster, of two more or less separate bodies. Finally, the division between the two neural grooves may be complete, and two embryos may form which are wholly separate, but have common envelopes and umbilic cords. Sometimes one of two embryos resulting from fission is so aberrant in form as to constitute a well-nigh shapeless mass, like Figs. 19 and 20, designated *amorphus* or *acardia*. Such a body can live and grow only through a continuity of its nutritive system with that of a normal fetus, the heart of the normal fetus furnishing the circulatory force for the mass. When the heart of the normal fetus ceases to beat or the umbilic cord between the fetus and the acardia ruptures, the latter ceases to live.

The fusion of the lips of the neural canal may become interrupted at various points and the canal may remain open up to the time of birth, to constitute, according to location, cervical, dorsal, lumbar, or sacral spinal bifida (Fig. 21).

The Brain

The brain commences to form and is recognizable before the neural canal has been completed. It consists at first chiefly of a series of vesicles which are known as the fore-brain, mid-brain, and hind-brain. The cerebral hemispheres are developed first as a median prolongation at the anterior end of the fore-brain, which later becomes divided into the two hemispheres by its anterior wall growing back into it from the front. The two hemispheres appear first as large vesicles with very thin walls. These cavities persist throughout life as the two lateral ventricles of the brain, which communicate, through the foramina of Munro, with the third ventricle (See Figs. 36 and 57). The fore-brain gives rise early to the optic vesicles, as lateral outgrowths, which are ultimately converted into the essential parts of the eye. Normally, there are two of these outgrowths, one from each cerebral vesicle. Later there appear two additional outgrowths which become the cerebral hemispheres. The two optic vesicles sometimes fail to form and there develops instead

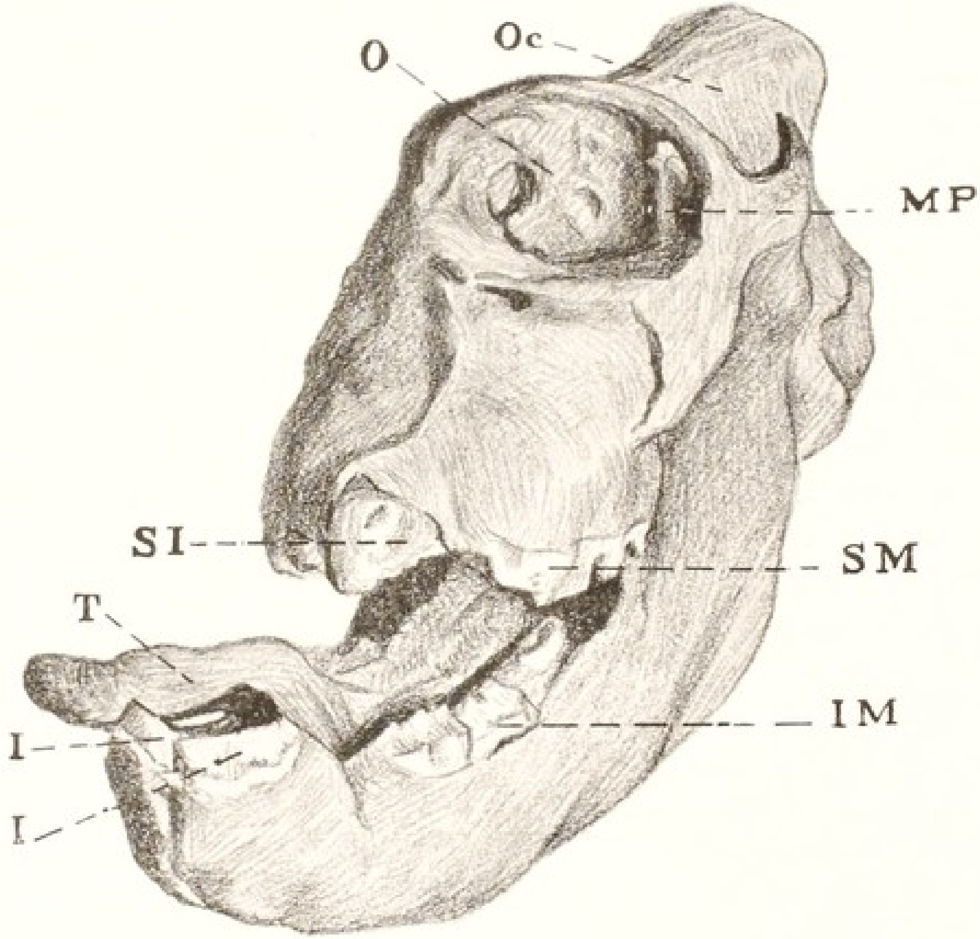


FIG. 22. SKULL OF CYCLOPS. FOAL.
(From the museum of the New York State Veterinary College.)

Oc, occiput. O, single orbital cavity. MP, coronoid process of inferior maxilla. SM, superior grinders. SI, superior incisors fused into a single organ. IM, inferior grinders. T, tongue. I, I, inferior incisors.

a single vesicle from the arrested fore-brain, which grows out as a single projection on the median line, to constitute the one-eyed monster, or cyclops.

In some cases the fluid in the lateral ventricles of the cerebral hemispheres becomes enormously increased, to constitute the fetal disease of hydrocephalus, as indicated in Fig. 25. In other instances the cerebral hemispheres grow rapidly and the walls of the skull fail to close over them, so that they protrude, to constitute hernia cerebri, as shown in Fig. 26. In the family of swine from which the specimen shown in Fig. 26 was obtained,

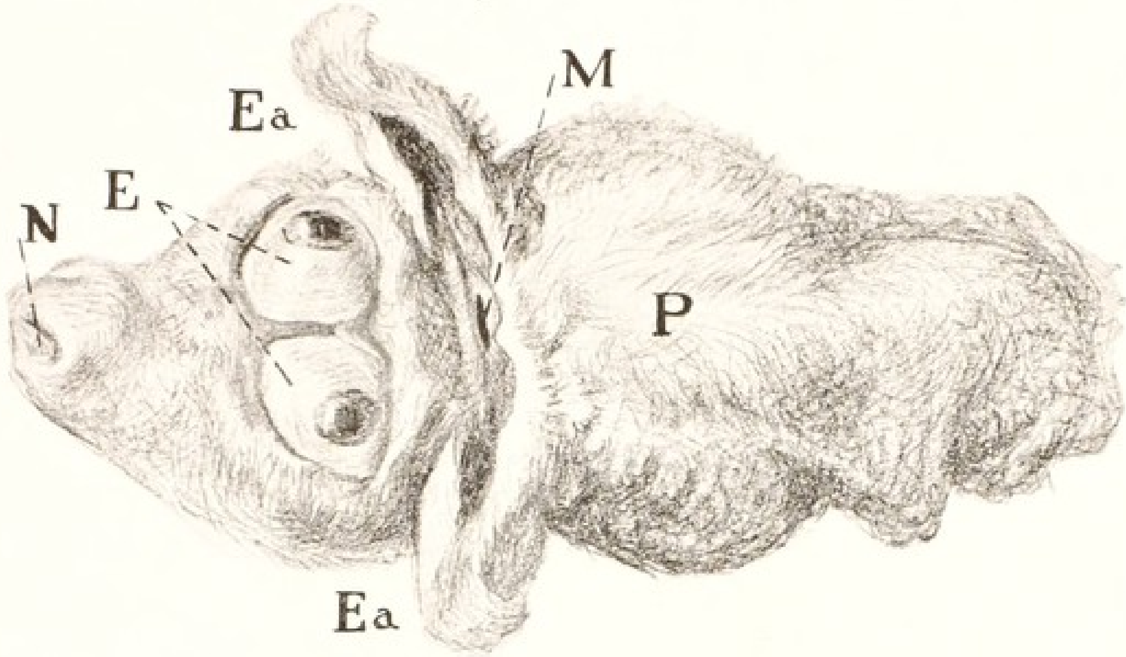


Fig. 23. CYCLOPS. LAMB. Head and neck, seen from below. (Museum New York State Veterinary College.)

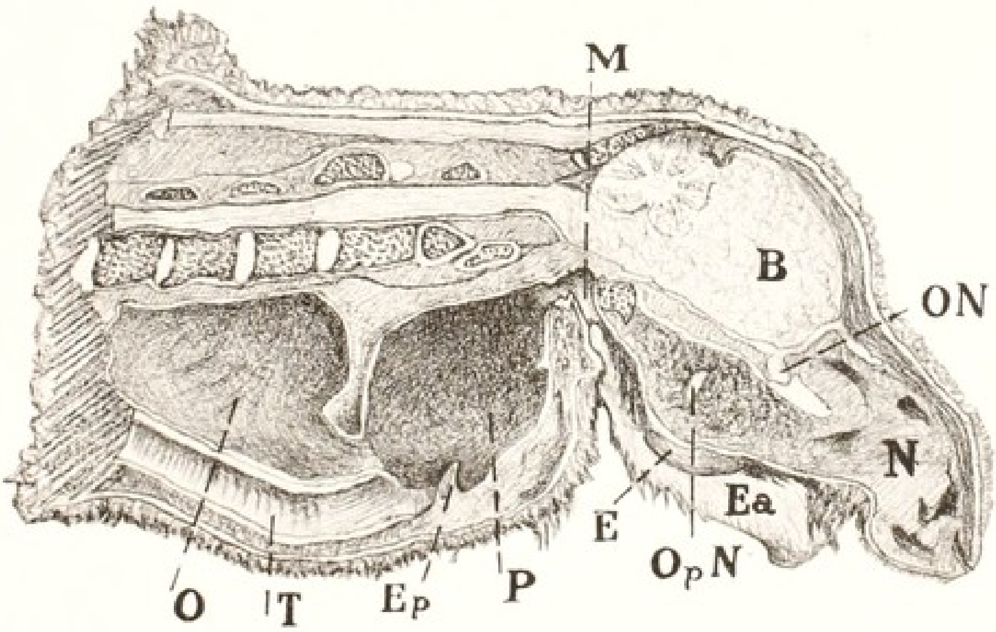


FIG. 24. Sagittal section of Fig. 23.

M, mouth. Ea, ear. B, brain. T, trachea. E, eye. N, nostril. P, dilated pharynx. ON, olfactory nerve. OpN, optic nerve. Ep, epiglottis. O, oesophagus.

the aberration became so fixed that a majority of the pigs were thus affected at birth, necessitating the slaughter of the entire family.

The olfactory vesicles grow out from the anterior ends of the cerebral hemispheres, to form later the olfactory lobes, from which the olfactory nerves pass to the nose. These sometimes fail to appear if the optic vesicles are represented by a single vesicle, and the young is born without a nose or the power of smell.

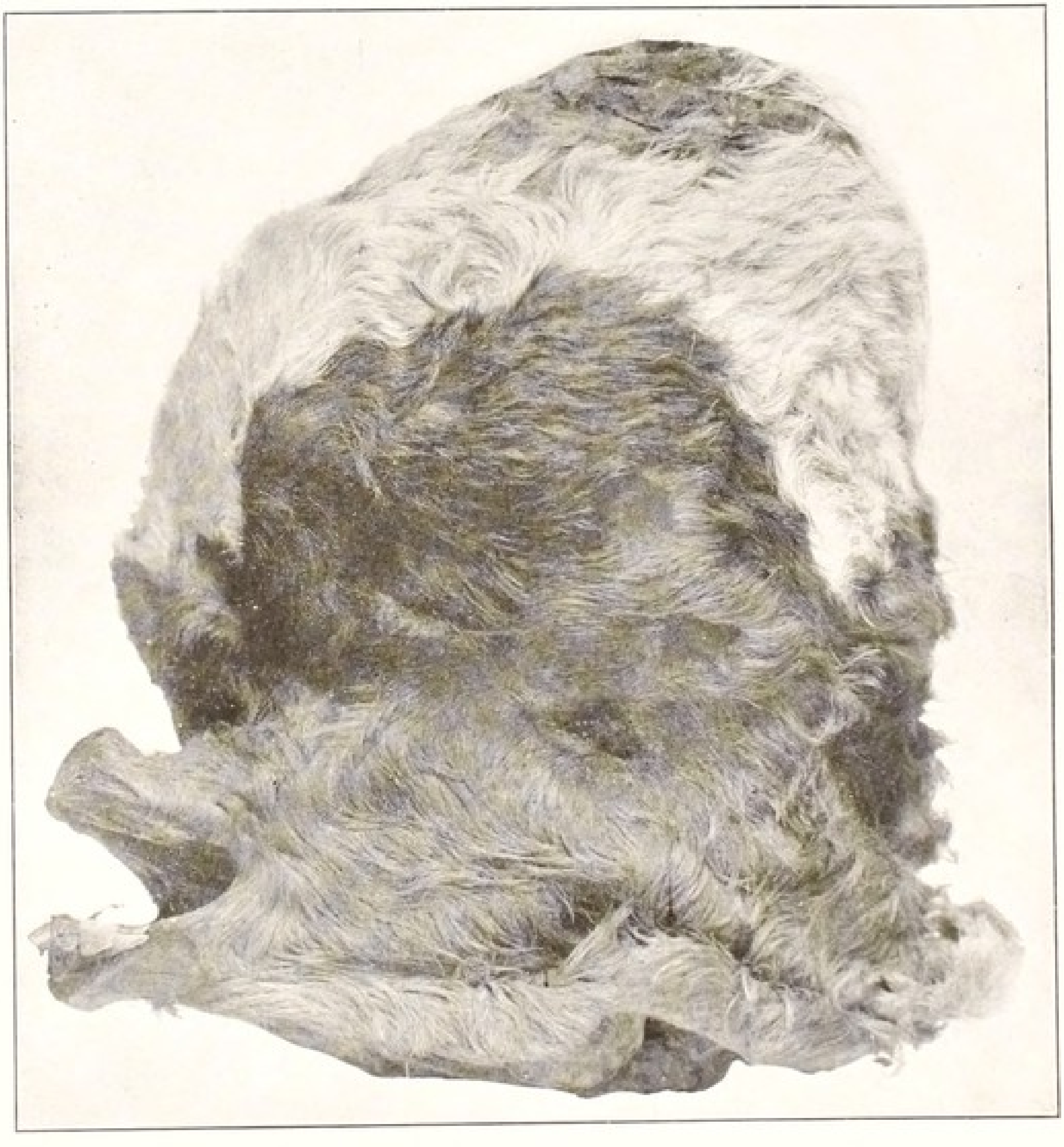


FIG. 25. HYDROCEPHALUS. CALF (After photograph).
(Museum New York State Veterinary College.)

THE SPINAL CORD

The essential parts of the spinal cord—the nerve cells and their axis cylinders—arise from the deeper layers of the columnar epithelial cells surrounding the central canal. The nerve cells, or neuroblasts, are at first spheroidal in form and show upon their surface one to several prolongations, which are later to constitute the polar elongations, or axis cylinders, of the nerves.

The sensory spinal nerves develop from the spinal ganglia, which appear in the neural folds. From the median sides of these there grow centralwards nerve fibres into the spinal cord, to constitute the superior, or dorsal roots. They become the cen-

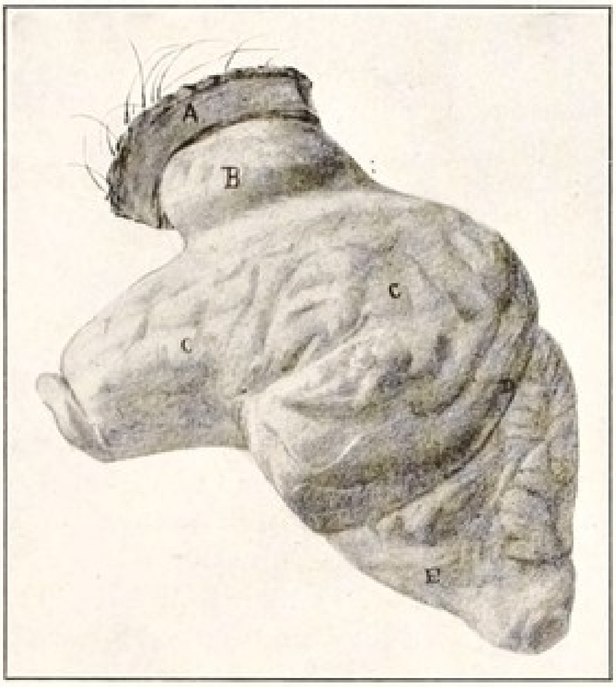


FIG. 26. HERNIA CEREBRI. PIG.

(From the museum of the New York State Veterinary College.)

Lateral view of brain, seen from the left.

A, segment of skin covering the herniated portion of the brain, B. CC, cerebrum. D, cerebellum. E, medulla oblongata.

tripetal, or sensory roots of the nerves. The ventral, or motor nerves arise as small outgrowths from the lower part of the sides of the spinal cord, in the position they occupy during adult life. The ventral roots grow outward to meet the dorsal roots just beyond the ganglia and fuse with them. Up to this point of fusion, the spinal nerves are pure—the superior one sensory, the inferior motor. Later they divide again into dorsal and ventral twigs, each of which is composed of mixed nerves containing both sensory and motor filaments.

DEVELOPMENT OF THE ORGANS OF SPECIAL SENSE

THE OLFACTORY ORGANS. THE NOSE

The olfactory organs appear early as thickened patches of ectoderm upon the antero-inferior part of the head. These soon sink inwards to constitute the olfactory pits, into the bottom of which the nerves of smell grow out from the olfactory bulbs of the brain.

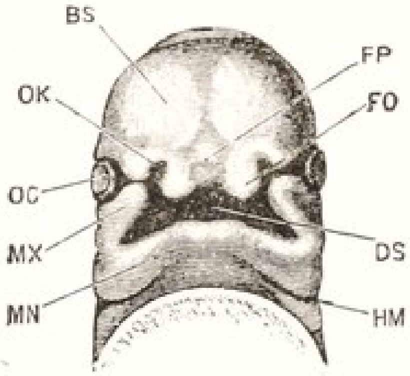


FIG. 27.

Fig. 27. The under surface of the head of a human embryo, lettered by Professor His, Hn, and estimated as about twenty-nine days old. ×7½. (From Marshall after His.)

BS, cerebral hemisphere. DS, stomodeum. FO, processus globularis, or lateral portion of fronto-nasal process. HM, hyomandibular cleft. MN, mandibular arch. MX, maxillary arch. OC, eye. OK, olfactory pit. FP, median portion of fronto-nasal process.

The olfactory pits are at first incomplete. Their lower borders, which are deeply notched, communicate with the stomodeum, somewhat as an extension of that cavity. The olfactory pits and the stomodeum are connected by a narrow isthmus, bordered inwardly by the *processus globulares* of the fronto-nasal process and externally by the maxillary processes of the maxillary arch. Soon the maxillary processes approach and fuse with the processus globulares, to complete the circumference of the olfactory pits and, by separating them from the mouth, to constitute the nostrils. As far as the incisive foramen of the adult, the processes globulares send projections inwards to constitute the anterior portion of the palate, while, behind the foramen, the maxillary processes send out shelf-like projections, which meet on the median line to constitute the posterior portion of the palate and, from their fusing borders, send projections upward which reach and fuse with the lower surface of the fronto-nasal process, to constitute the nasal septum, dividing the nasal chamber into two distinct cavities. The nasal passages are at first very short, but, as the nose elongates, the palatine processes from the maxillary arch grow backward and, fusing on the median line, separate completely the oral and nasal cavities, so that the latter finally open posteriorly, through the posterior nares, into the pharynx.

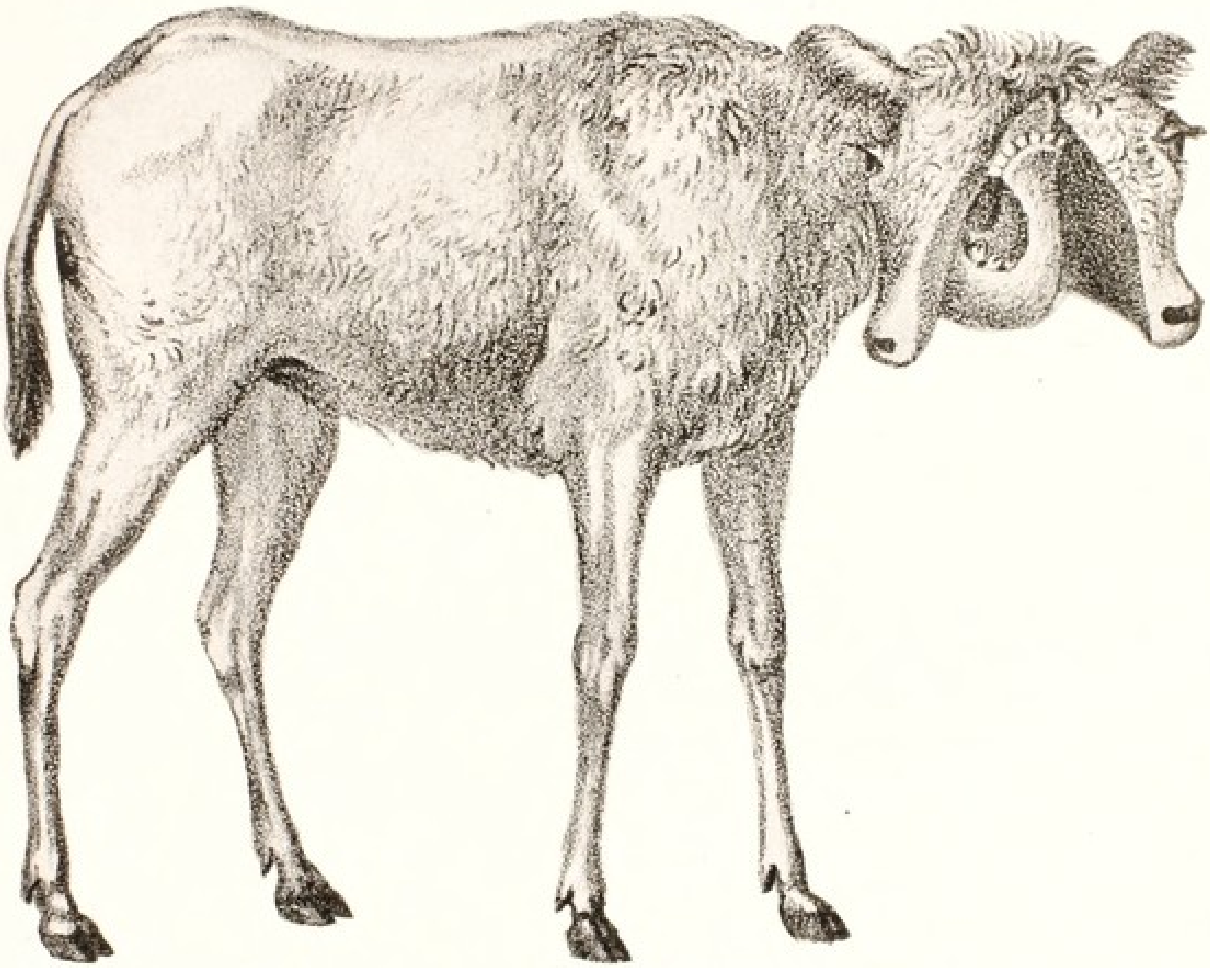


FIG. 28. SCHISTOCEPHALUS BIFIDUS. (Gurlt)

The upper lip is formed by a fusion of the fronto-nasal processes with the maxillary arch. Aberrations in the development of the anterior nares and upper lip are not rare, especially in bovidae, where in some instances the processes globulares fail to fuse with the maxillary processes, constituting hair lip (schistocephalus fissilabrus). In other instances, as in Fig. 28, fission occurs on the median line through the fronto-nasal process, so that the maxilla is divided, with the mandible curved upward between the two lateral halves, to constitute schistocephalus bifidus.

In dealing with diseases of the septum nasi, its origin should always be recalled and it should be remembered that, in some forms of disease, fluids may collect or new tissues may develop between the two laminae, from which the septum takes its origin.

In some cases the palatine processes fail to fuse, resulting in a cleft palate, as shown in Fig. 29. In other instances the fusion extends too far backward and, passing across the pharynx, completely separates the nasal chamber from the mouth and pharynx, constituting atresia of the posterior nares, by which arrest in development the animal, unable to breathe through the nostrils,

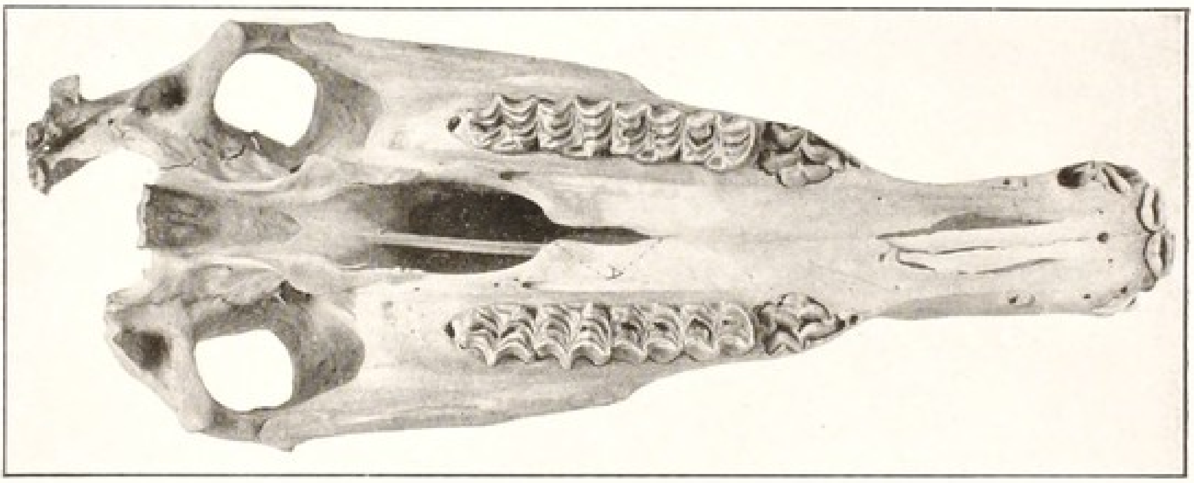


Fig. 29. Cleft Palate, Foal.

(Museum New York State Veterinary College.)

must respire entirely through the mouth. The horse, having a greatly elongated soft palate, which renders oral breathing extremely difficult, can not live if both posterior nares are closed; if the atresia affects but one nostril, the animal can breathe readily when not severely exerted, but if put to hard work shows extreme dyspnoea as a result of the restricted breathing room.

The Eyes

The eyes originate partly from the optic vesicles of the brain and partly from the optic pits in the ectoderm upon the sides of the head.

The optic nerves develop from the optic vesicles, which appear ten to twenty days after fertilization, varying apparently according to species, as lateral outgrowths of the fore-brain. The optic vesicles appear first as tubular outgrowths from the forebrain, but the distal end of each soon becomes enlarged, while the connecting stalk remains a narrow tube. Later, the anterior wall of the enlarged distal end becomes invaginated, to constitute the optic cup, the walls of which are later to form the retina, within the depression of which the vitreous body develops. The lens develops somewhat later, appearing first as a pit in the ectoderm upon the side of the head. The pit gradually sinks deeper and its mouth narrows, until it finally closes, to constitute the vesicle of the lens.

The vesicle sinks into the optic cup and the margins of the latter come in close contact with it except at one point on the ventral surface, where there is a distinct groove, the *choroidal fissure*. The vesicle becomes the *lens*.

The *vitreous body* is believed to arise from the retina as a secretion or outgrowth from its anterior surface.

As the lens becomes invaginated and separated from the external ectoderm, a layer of mesoderm extends across between the vesicle and the external ectoderm, constituting the *cornea*, the tissues of which become transparent. The choroid and sclerotic coats develop from the mesodermic tissues surrounding the optic cup; the iris is formed by a forward growth of the margins of the optic cup; and the anterior chamber appears somewhat later as an excavation between the cornea and lens. The eyelids, consisting of folds of the skin from above and below, are the last structures in connection with the eye to form. These extend over the eyeball, to meet finally and become completely fused without adhering to the surface of the cornea, so that they create between their internal surfaces and the cornea a closed cavity—the lacrymal sac. In the rabbit and carnivora, the eyelids remain closed for a short time after birth; in ruminants and solipeds the eyelids open somewhat prior to birth. The membrana nictatans, or third eyelid, which exists in all domestic mammals, is formed from a fold of skin in a manner similar to the two ordinary eyelids. The lacrymal duct is formed in the groove existing between the external nasal process and the maxillary arch.

In domestic animals there are occasional aberrations in the development of the eye. Sometimes the eyelids have become so intimately fused that they fail to open at the proper time, a condition which is not usually subject to remedy. Sometimes the cornea fails to undergo the normal transformation into a transparent body, and remains opaque. Sometimes long hairs, which may be subject to surgical removal, grow from the neighborhood of the lacrymal duct in the third eyelid, irritating the eye. Sometimes there is a contraction of the inner, or mucous layer of the eyelid or a comparative overgrowth of the external skin, which causes the eyelids to become inverted, producing entropium.

The Ear

The first traces of the ears consist of open pits opposite the hind-brain, usually when the embryo is about ten to fifteen days old. The pits sink in deeply, until they come into close contact with the hind-brain, and early acquire a communication with the auditory nerves. The mouths of the pits soon close, and the invaginated portion becomes separated from the external ectoderm, to constitute the auditory vesicles, in which the essential parts of the ear—the semicircular canals, vestibule, cochlea, etc.—are developed.

The Eustachian tube is formed from the hyomandibular pouch, which extends out from the pharynx as a diverticulum. At one time it pushes out against the ectoderm and is separated from the exterior by a very thin membrane consisting of ectoderm externally, in immediate contact with the inner layer of entoderm, with no mesoderm between. Later, a layer of mesoderm grows in between the ectoderm and entoderm ; the three constitute the tympanic membrane. This pouch does not normally reach the surface at any time during fetal life. Abnormally—though but rarely—the gill slits open upon the surface, as in fishes, and, persisting, constitute at birth gill-slit fistula. In the soliped, there is a large infundibulum formed in connection with the Eustachian tube, which is known as the guttural pouch, or air sac. It communicates with the Eustachian tube by an elongated slit which is sometimes abnormal in the new-born foal and causes air to become impacted in the sac (tympany of the guttural pouch), which may so press upon the larynx as to strangle the young animal.

The formation of the external ear, or pinna, has not been as well studied in domestic animals as in man. The conchal cartilage arises from the mandibular and hyoid arches, which bound on either side the hyomandibular cleft. As shown in Fig. 30, in the human ear the concha consists of a series of tubercles with deep fissures extending between them. We have no data to show that the early stages of development of the concha in domestic animals are precisely parallel, but they are presumably

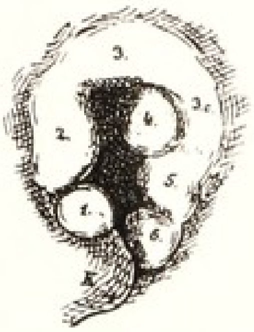


FIG. 30. The left ear of a human embryo, lettered by Professor His, Br. 2, and estimated as thirty-five days old. (From Marshall, after His.) $\times$ 20.

1, tuberculum tragicum. 2, tuberculum anterius helicis. 3, tuberculum intermedium helicis. 3 and 3c, cauda helicis. 4, tuberculum anthelicis. 5, tuberculum antitragicum. 6, tuberculum lobulare.

essentially so. By observing Fig. 30, it will be seen that between 1 and 2 there is a deep fissure which, in the ear of the horse, is apparently marked by an important ridge inside the concha. It is interesting, in connection with this fissure, to observe that foals are frequently born with a deep invagination of the ectoderm at this point, causing a long, narrow fistula which extends downwards between the exterior of the cartilage and the skin, from about the middle of the internal border of the concha to near its base. From this fistula there usually exudes a viscid mucus. In some cases the invagination extends more deeply and penetrates the squamous temporal bone. In the development of the osseous tissues, the distal end of the invaginated epithelium becomes cut off by the bone and a closed sac is formed, in which ordinarily one or more teeth (ear teeth) develop, which resemble closely the molars of the horse and may grow to almost any size, projecting far above the external surface or growing inward, causing an inward bulging of the skull into the cranial cavity (See Figs. 31 and 32). Some authors ascribe these formations to outgrowths from the buccal mucous

FIG. 31.

Ear teeth in ears of foal after the removal of the mucous fistula and the teeth.

A, level of tooth in left ear. F, mucous fistula leading down to T, the cavity from which the tooth has been removed.

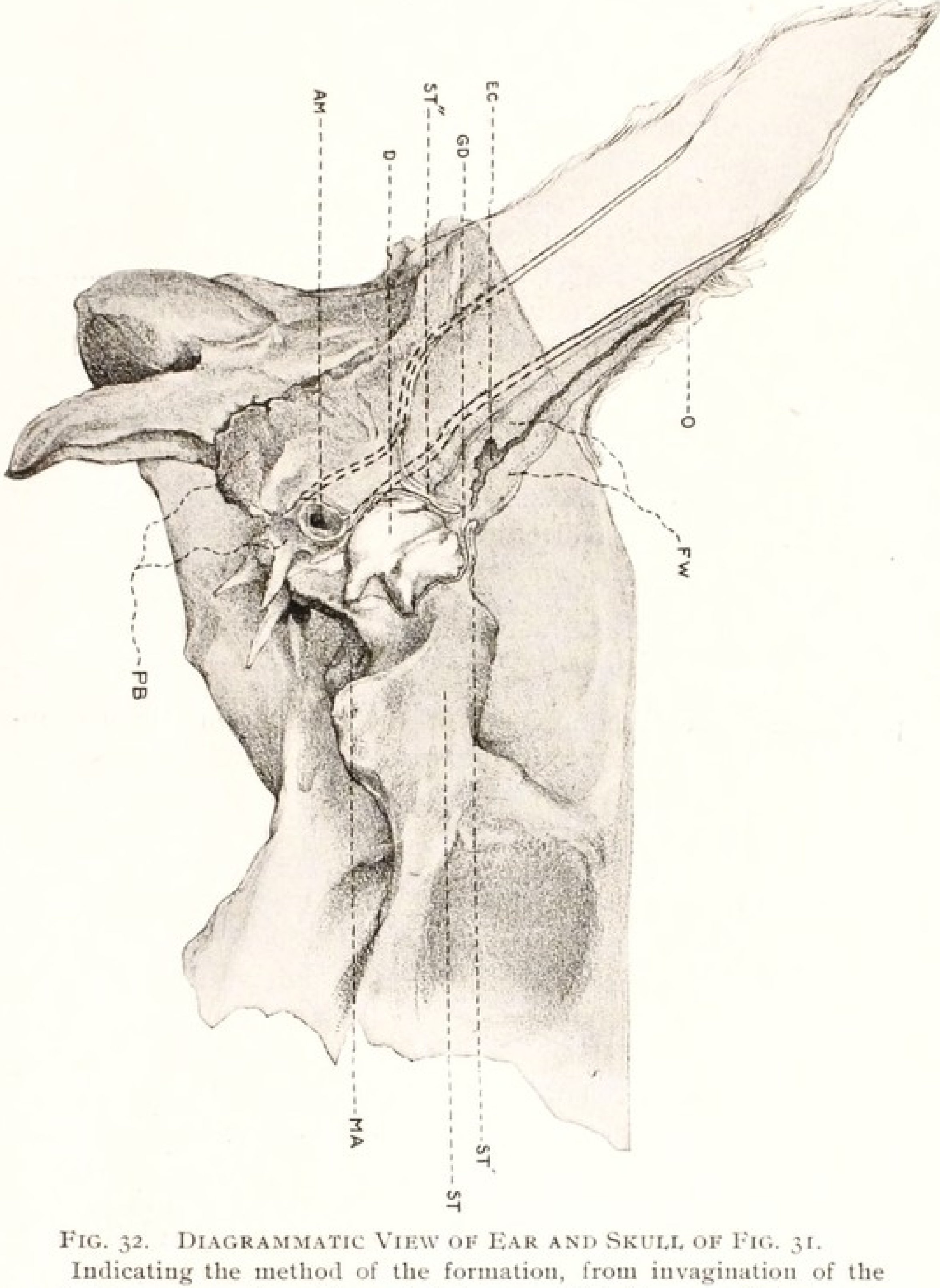


FIG. 32. DIAGRAMMATIC VIEW OF EAR AND SKULL OF FIG. 31.

Indicating the method of the formation, from invagination of the ectoderm. O, orifice of invaginated area. FW, fibrous wall of invaginated canal. EC, ectodermic cavity. D, tooth. ST, squamous temporal bone. ST′, ST″, incarcerating outgrowths of squamous bone tending to isolate EC from D. GD, persistent fibrous cord connecting EC with the capsule of D (the ectodermic canal in this cord has been obliterated). PB, petrous temporal, or ear bone, which constitutes a separate bone in the horse. AM, auditory meatus. MA, maxillo-mandibular articulation.

membrane. A glance at the figures, prepared from a clinical case, indicates, to the contrary, that they arise from the ectoderm of the conchal margin, in a manner parallel to the formation of the teeth within the mouth from the stomodeal ectoderm.

It is to be remembered also that the concha is formed by an evagination of the skeletal mesoderm. In such evagination there occurs a folding of the cartilage matrix so that the two laminae, continuous at the summit, come into immediate contact, blend intimately, and come to be regarded as a single layer of cartilage. Pathologic conditions arise however to remind one of the mode of origin when lymph accumulates between the two laminae to constitute otohematoma, or "blood ear," in dogs and horses. Forgetting this embryologic origin, the practitioner frequently errs in regarding the collection of lymph as beside the cartilage instead of between the two cartilaginous laminae.

Formation of the Digestive Apparatus

The alimentary canal of the embryo consists at first of that portion of the splanchnopleure of the blastoderm which is included within the embryo in the process of ventral infolding and finally becomes constricted off from the yolk sac. For a time the alimentary tract continues to communicate with the extra-embryonal portion of the blastoderm, or yolk sac, by means of the yolk-stalk, or vitelline duct. In some species of animals, traces of the tube may be found in the umbilic cord at the time of birth. It does not normally retain its relation with the intestine, and all traces of continuity between the gut and the vitelline duct are effaced.

The intestinal tract, during the early life of the embryo, is divided into three sections, known respectively as the fore-, mid-, and hind-gut. The first comprises that portion anterior to the communication with the yolk-sac; the second, the middle portion, including the yolk-stalk; and the third, or hind gut, that which projects from the yolk-stalk posteriorly. In the fore-gut there appear early two dilations—the pharynx and the stomach. The gut is at first closed at both its anterior and its posterior end; the communications with the exterior become established later. The anterior gut opens first. There appears, in that region of the embryo which is later to constitute the mouth, a depression known as the stomodeal pit, by which the ectoderm sinks inward towards the pharynx, until finally the two cavities are separated merely by a thin layer each of ectoderm and entoderm. The intervening mesodermic tissues have been absorbed. Eventually, the thin membrane gives way and the mouth communicates with the anterior end of the fore-gut, or pharynx.

The pharynx shows a marked dilation in comparison with the other parts of the digestive tube. In sagittal section, the internal surface shows the prominent visceral arches, between which extend the visceral pouches. Among these visceral pouches, the hyomandibular and first branchial are the most prominent. They have, on the outer surface, corresponding visceral grooves, which do not normally open upon the exterior, but the hyomandibular groove becomes very thin and ultimately forms the tympanum.

The embryonic line of demarcation between the stomodeum and fore-gut is not perfectly known in the adult, but is in the immediate vicinity of the soft palate. The buccal mucosa and the teeth are derived from the stomodeal ectoderm, and the tongue grows forward from the entoderm of the floor of the fore-gut.

Later in the life of the embryo, varying according to species, there appears, opposite the posterior end of the hind-gut, a distinct depression in the ectoderm—the proctodeal pit. The invagination of this pit is of a character similar to that of the stomodeum, and soon extends toward the hind gut sufficiently that only a thin membrane remains between them, consisting externally of a layer of ectoderm and internally of entoderm. Normally, this pit soon opens into the hind-gut. The alimentary canal then communicates with the exterior, both anteriorly and posteriorly.

Various aberrations occur in the development of these parts. The most common is an arrest in the development of the hind-gut. Sometimes a portion of it is wanting, it does not become connected with the proctodeal pit to open exteriorly, and the young animal is born without a rectum. Sometimes the membrane between the proctodeal pit and the hind-gut fails to disappear, and the young animal is born without an anus, as shown in Fig. 37. In still other instances, as recorded by Gurlt, the intestine ceases at the vitelline stalk, passing out through the umbilicus, where it ends blindly.

A highly interesting aberration, involving the digestive tract

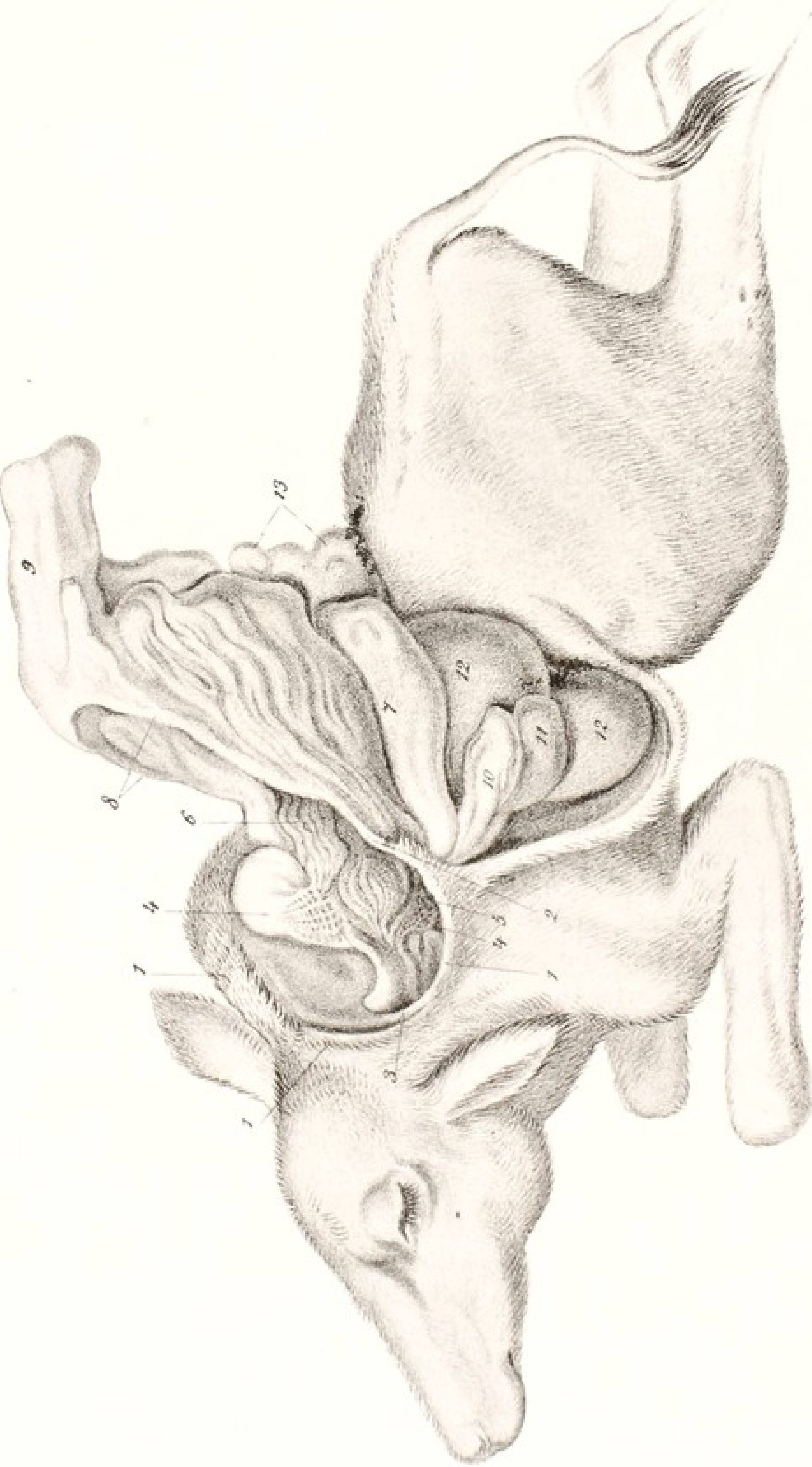


FIG. 33. SCHISTOCORMUS FISSIDORSUALIS SUBECOSTATUS. (Gurlt)

and spinal column, is that recorded by Gurlt (illustrated in Fig. 33) as schistocormus fissidorsualis subecostatus, described as a cleft in the dorsal wall of the body beneath the spinal column on the left side, through which the stomachs and other abdominal viscera prolapse. Gurlt remarks that the aberration is very rare and that he has known of but three instances—all in ruminants—one in the calf and two in lambs. I have observed a single case, resembling that of Gurlt in many respects but showing important differences. Figs. 34 and 35 delineate briefly its character. In this instance the omasum, *M*, and the spleen, *S*, are protruding from a crater-like opening in the head, through the occiput. The rumen and reticulum are wanting in the specimen : fragmentary shreds indicate that they had been torn away before the

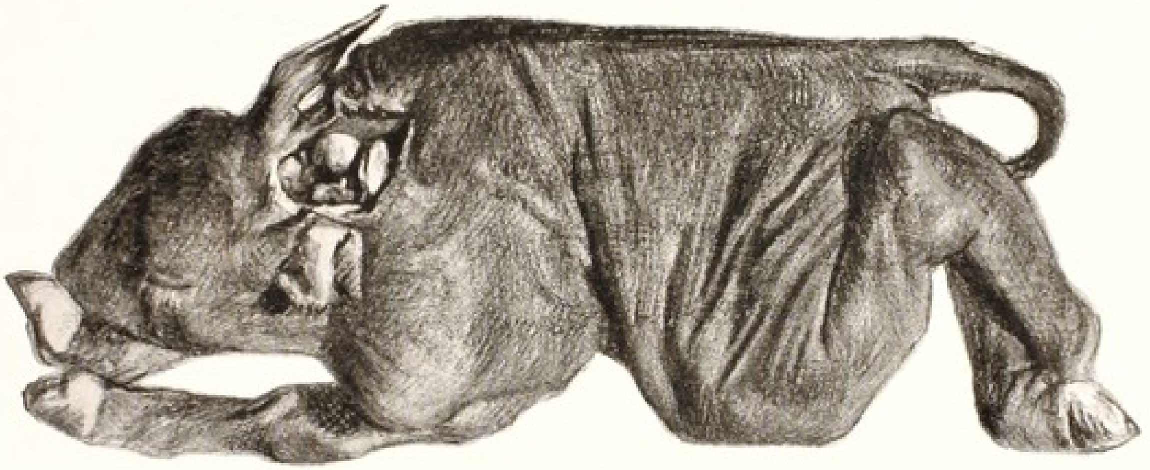


FIG. 34. SCHISTOCORMUS FISSIDORSUALIS.

Showing crater-like opening in the occipital region.
(Museum New York State Veterinary College.)

specimen came into my hands. In this case, the prolapse of the alimentary tract is not lateral, but dorsal, immediately upon the median line, obliterating for a distance the cerebro-spinal axis.

Since the notochord becomes established prior to the formation of the gut, it would seem that the prolapse, instead of occurring through the notochord, would pass in front of it. This is apparently what has occurred. It appears probable that the notochord had been arrested in its development anteriorly and permitted the evagination to occur in front of it. A study of Fig. 36, *IN* and *PT*, shows that, just anterior to the end of the notochord, there is an infundibulum growing down from the thalamencephalon and just opposite, growing upward from the

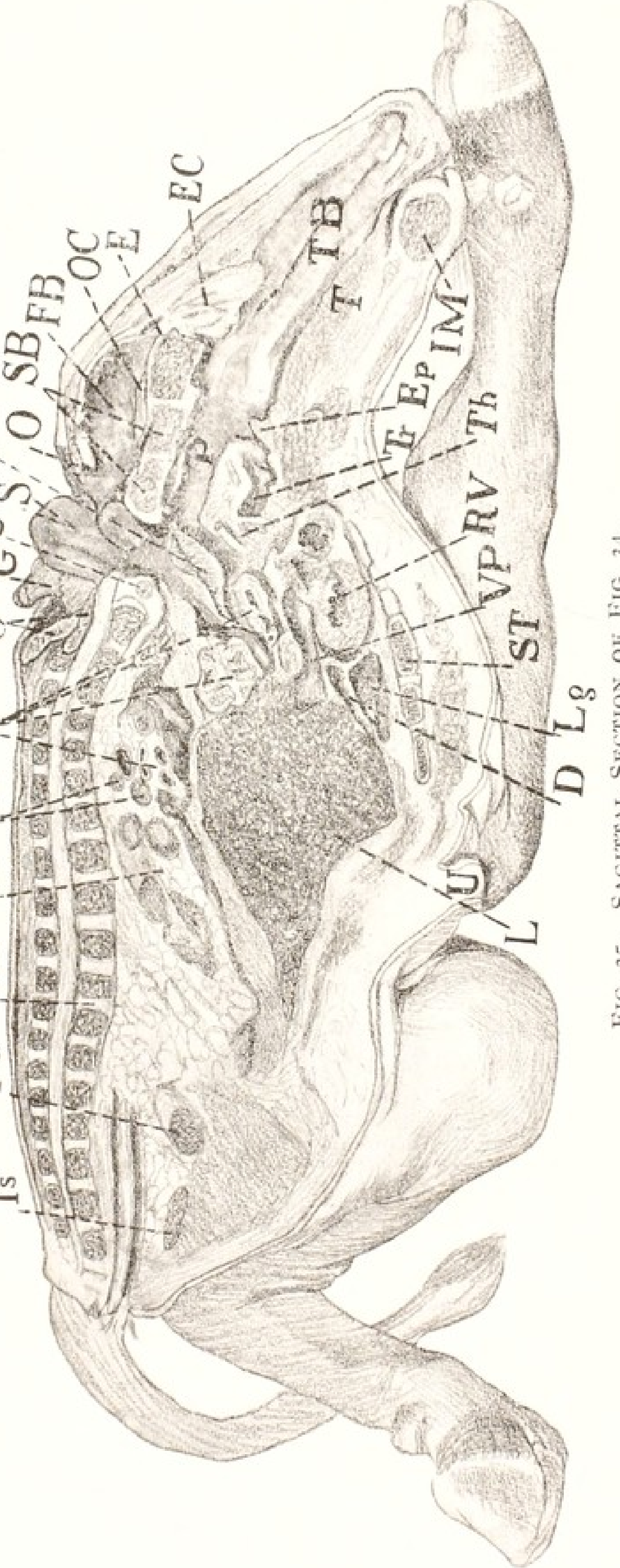


FIG. 35. SAGITTAL SECTION OF FIG. 34.

T, tongue.
IM, inferior maxilla.
TB, trubinated bones.
E, ethmoid bone.
EC, ethmoid cells.
FB, fore brain.
OC, optic commissure.
SB, sphenoid bone.

S, spleen.
G, gastro-splenic omentum.
M, third stomach.
C', first rib.
O, ant. end of occiput.
O', post. end of occiput.
Ep, epiglottis. The line crosses the thyroid gland.

P, pharynx.
Tr. trachea.
St, sternum.
RV, right ventricle.
VP, portal vein.
I, intestine.
K, kidney.
A, adrenal gland,

L, liver.
Th, thymus.
Lg, lungs.
U, umbilicus.
Pu, pubis.
Is, ischium.
LS, lumbo-sacral articulation.
D, diaphragm.

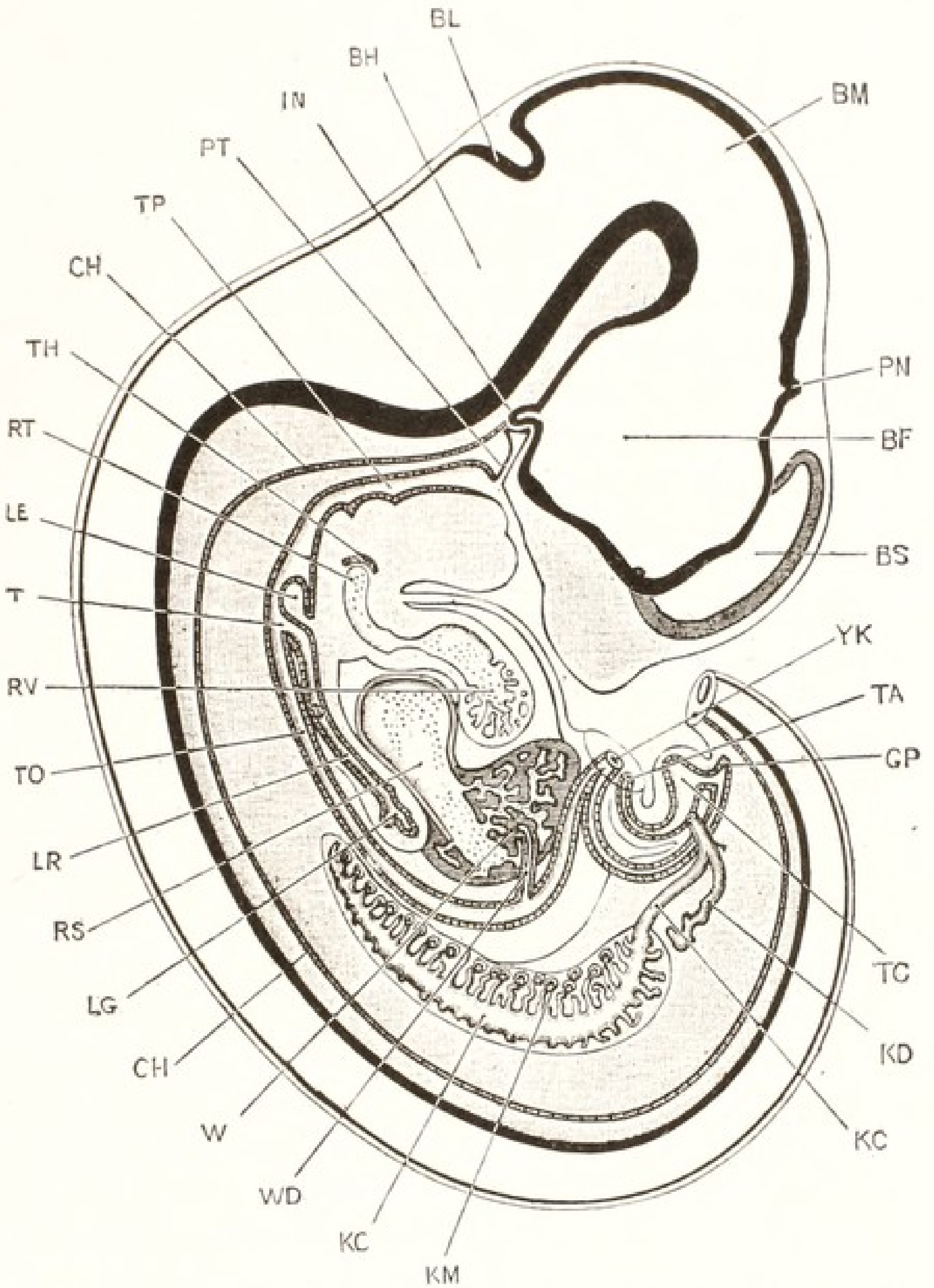


FIG. 36. A median longitudinal, or sagittal, section through a rabbit embryo, at the end of the twelfth day. The section is a strictly median one except in two respects: the cerebral hemisphere of the left side has been introduced in order to render the figure more complete; and the Wolffian body and ureter of the right side added. The terminal portion of the tail has been removed.

BF, cavity of fore-brain, or thalamencephalon.
BH, cavity of hind brain, or fourth ventricle. BL, cerebellum.
BM, cavity of mid-brain. BS, cavity of cerebral hemisphere, or lateral ventricle. CH, notochord. GP, post-anal gut.
IN, finger-like process of infundibulum. KC, Wolffian duct.
KD, ureter. KM, Wolffian body. LE, epiglottis.
LG, lung. LR, trachea. PN, pineal body. PT, pituitary body.
RS, sinus venosus. RT, truncus arteriosus.
RV, ventricle of heart. T, glottis. TA, stalk of allantois, cut short.
TC, cloaca. TH, thyroid body. TO, oesophagus. TP, pharynx.
W, liver. WD, bile duct. YK, yolk stalk, cut short.

(Marshall.)

posterior border of the stomodeum, the pituitary pouch, which later becomes the pituitary body. Eventually the two infundibuli come into immediate contact with each other. The fore-gut has pushed forward and upward, to escape through or near to this area of low resistance, upon the back of the head. The escape of the fore-gut, through this area, prevented the development of the neck, including the cervical portion of the spinal cord, and the sternum, *ST*, extends forward beneath the pharynx, *P*, and the basi-occipital bone, *BS*. The illustration from Gurlt indicates likewise a virtual absence of neck.

The alimentary canal forms immediately beneath the notochord,

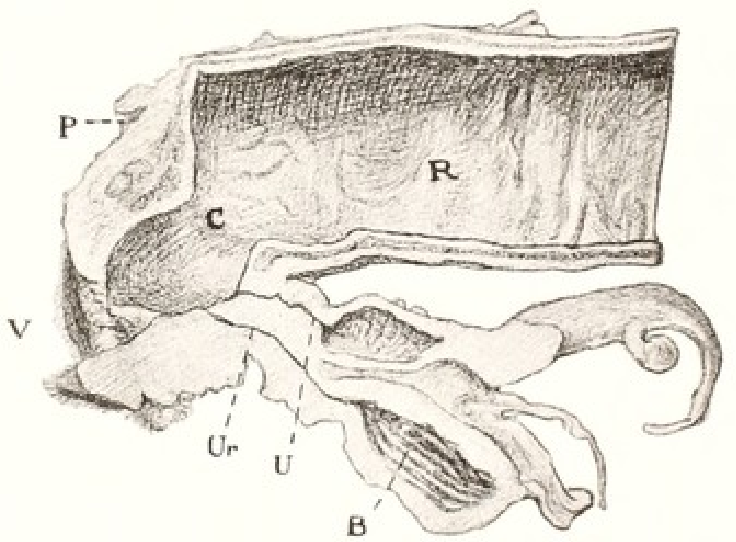


FIG. 37. ATRESIA ANI. LAMB.

R, rectum. P, closed proctodeal pit. C, cloaca. Ur, urethra. U, uterus. B, bladder. V, vagina.

and is at first of the same length as the body cavity, but later it increases in length far more rapidly than the body and drops away from the dorsal portion of the body cavity, to float freely, confined in position only by the mesentery, which it has derived from the peritoneum of the superior wall of the abdomen and carried with it in its descent.

At first the final portion of the posterior gut of the embryo, representing jointly the intestine and the genito-urinary passages, consists of a single dilated chamber, or cloaca, but later there grows back, from the angle between the stalk of the allantois and the hind gut, a partition which serves to separate the digestive tube from the genito-urinary tract. This partition is sometimes incomplete. If the proctodeal opening, in the female, fails in the upper, or intestinal portion and no anus develops, the feces from the intestine may drop into the vagina, to be expelled through the vulva, as indicated in Fig. 37. Sometimes the proctodeal membrane persists and the recto-vaginal septum is complete, so that the meconium, or fetal feces, is retained. Since the fetus normally does not defecate, this occasions no disturbance until some hours after birth, when the obstruction to defecation becomes notable and important.

The Lungs

The lungs, formed as an outgrowth from the floor of the pharynx in the region behind the branchial arches, begin as a longitudinal groove, which soon develops into a blind pouch. This evagination extends backward beneath the pharynx. At its distal end the pouch soon divides into right and left halves, to constitute the two lobes of the lungs. The growth continues backward beneath the oesophagus and above the heart. The distal ends of the two lobes become enlarged and commence dividing into small lobes. The lobes elongate greatly, giving rise to buds ending in somewhat enlarged ampullae. The ampullae continue to subdivide; the terminal infundibuli constitute the air cells. The smaller tubes leading from the air cells are the bronchioles, the larger ones the bronchii, the original tube leading from the floor of the pharynx the trachea, and the slit which first appeared in the bottom of the pharynx the glottis.

The Teeth

The teeth, which appear very early, originate from the ectoderm of the stomodeum in the form of a longitudinal invagination of thickened epithelium along the border of the jaw, which eventually sinks down into the substance of the jaw as a continuous ridge, known as the common enamel germ. Later, the ridges become enlarged at intervals, to constitute the individual enamel organs, while the portions between these enlargements tend to atrophy and finally disappear.

Each enamel organ soon consists of a flask-like vesicle of ectoderm with a narrow neck, which is still continuous with the epithelium of the mouth by a cord-like constriction, the gubernaculum dentis. The distal end, or fundus, of the flask is enlarged and spherical. Beneath the enamel organ, there soon forms from the mesodermic connective tissue the dental papilla, which pushes up into the sac, causing an invagination of its base. The enamel sac soon invests the top of the papilla as a cap and takes on the form of the future tooth. The enamel organ acquires the form of a flattened sac, the distal end of which is invaginated so that the two walls are brought into close proximity (See Fig. 38).

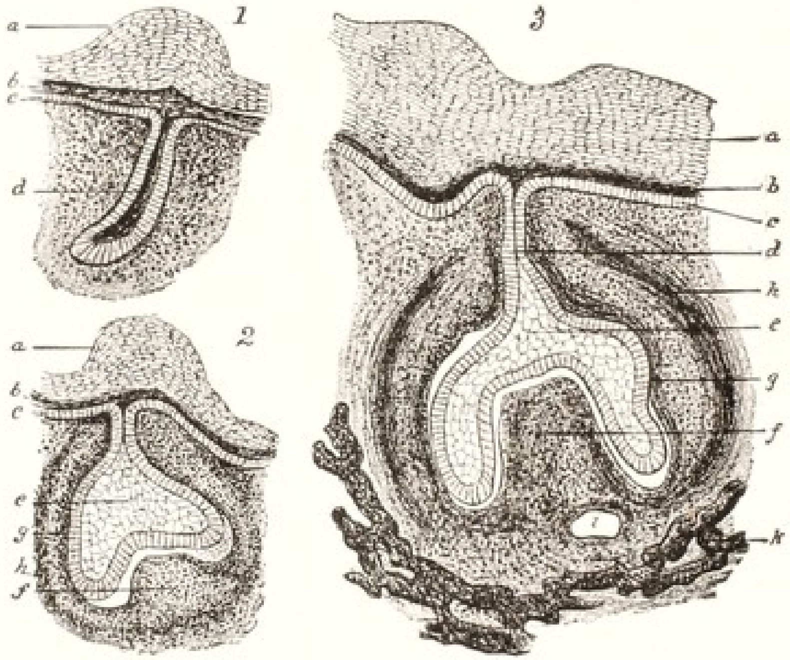


FIG. 38. Three successive stages in the development of a tooth germ of a pig embryo (after Frey and Thiersch): a, b, c, layers of thickened oral epithelium, showing dental groove on surface in 3; e, enamel organ; f, dental papilla; g, h, internal and external layers of follicle wall; i, blood-vessel; k, maxilla; d, epithelial ingrowth, the end of which expands into the enamel sac. (Heisler.)

Upon the external surface of the dental papilla, odontoblasts arise, from which the dentine of the tooth is formed. The enamel prisms are formed from the epithelium of that part of the walls of the enamel sac lying in immediate contact with the dental papilla. The superficial wall of the enamel sac—that portion continuous with the neck-like mass of epithelial cells still maintaining connection with the mouth cavity—disappears without taking any recognized part in the formation of the enamel tissue. The dentine, forming from the odontoblasts upon the apex and sides of the papilla, soon invests these portions in the hard ivory substance. The base and center of the dental papilla continue as the tooth pulp. The base of the papilla is at first wide open, but gradually contracts as the tooth develops, and finally there grow out in some teeth projections, or septa, of dentine, to constitute the roots, or fangs, which divide this cavity, according to the individual tooth, into two or more distinct openings, through which the blood vessels and nerves pass to the pulp of the tooth (See Fig. 39).

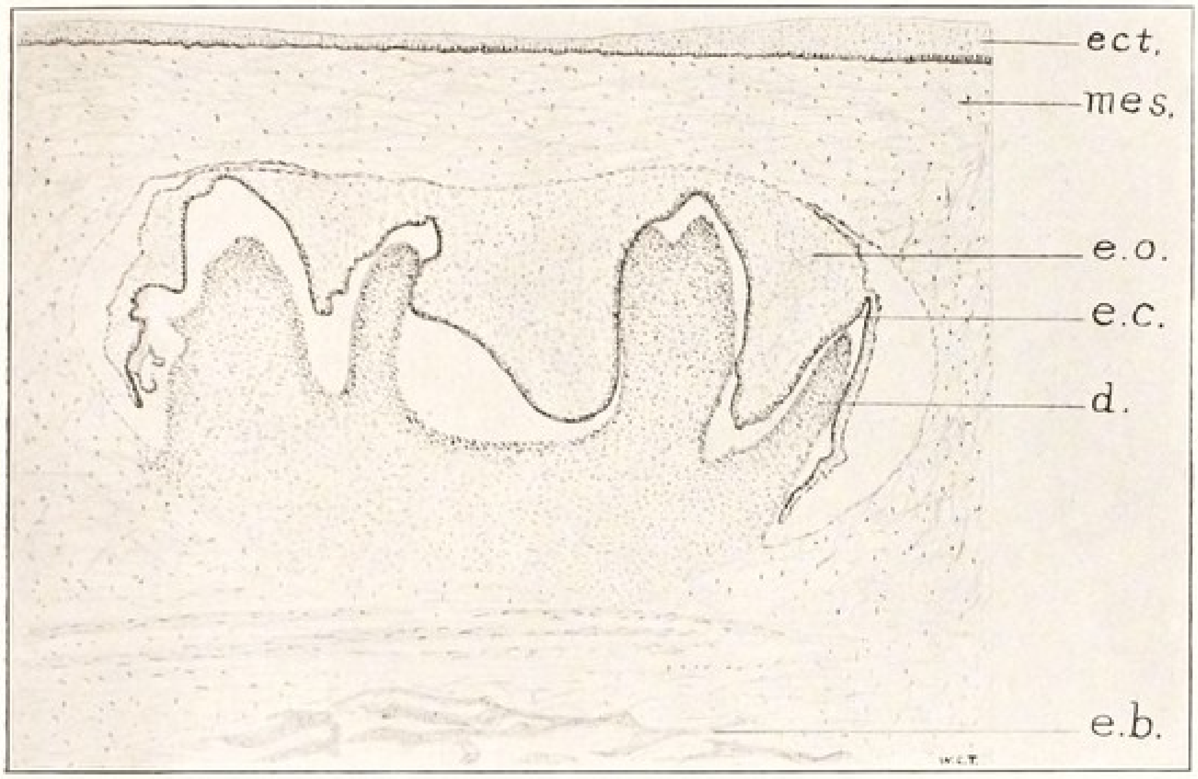


FIG. 39. Sagittal section through an inferior grinder of an equine embryo, 4 inches long. ect, ectoderm of mouth cavity; mes, mesoderm; eo, enamel organ; ec, enamel cells; d, dentine; eb, embryonic bone.

The enamel cap is at most points detached from the dentine papillae. The section through the tooth follicle is so made that the plicae of the enamel cap have split each of the dentine papillae so that there are four instead of two.

As the enamel organ sinks into the jaw, a condensation of the surrounding mesodermic connective tissue occurs, to constitute a capsule—the tooth follicle—which closely invests the enamel organ and papilla. When the bony tissue of the jaw forms, the follicle serves as periosteum for the tooth and alveolus, while from its inner layers the external tooth tissue—the cement—is developed. The origin of the dental tissues is, then: 1, the enamel from the invaginated ectodermic cells; 2, the papilla, vessels, nerves and dentinal tubules from the mesodermic connective tissue; and, 3, the cementum and the dental and alveolar periosteum from the mesodermic dental follicle.

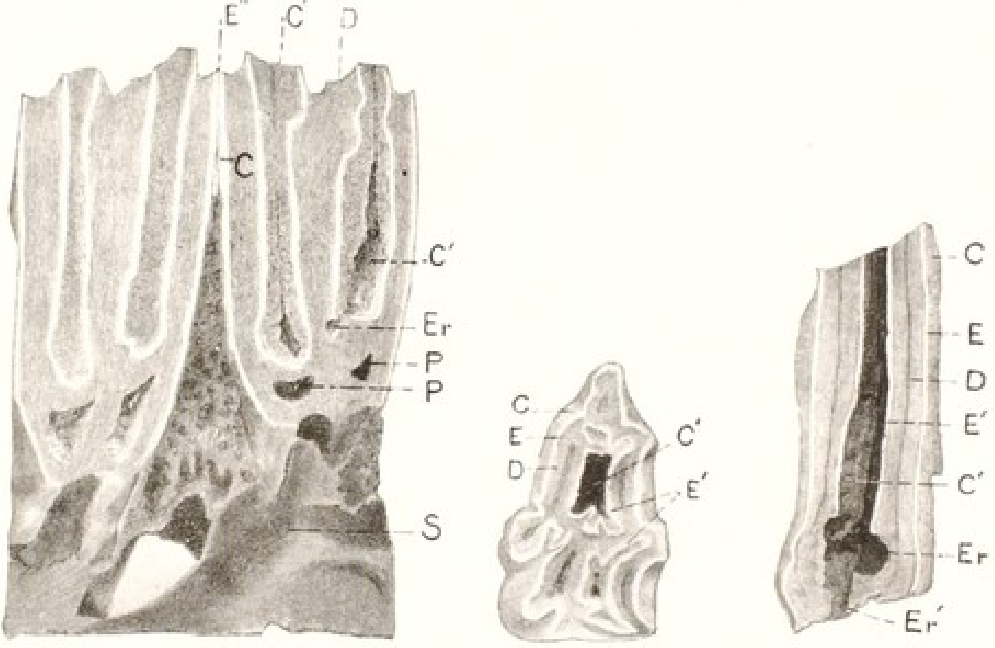


FIG. 40. FIG. 41. FIG. 42

FIG. 40. Sagittal section of superior molars of adult horse showing on the left normal development and on the right arrested development of the cement area.

FIG. 41, 42. Crown, and longitudinal cross section of a superior grinder of adult horse showing absence of cement in central infundibulum and erosion of the enamel and dentinal plates.

C, external cement. C′, central cement area.

E, external enamel layer. E′, central enamel. E″, external enamel at point of contact between adjacent molars. The adjacent enamel laminae project above the surrounding tissues, have no cement between them, and are so arranged as to prevent the impaction of food particles between.

D, dentine. Er, erosion area. Er′, erosion canal penetrating the tooth fang.

P, pulp cavity. S, superior maxilary bone.

When the bony jaws form, the teeth are at first in continuous grooves, but transverse osseous partitions later extend between the tooth germs, to constitute finally a separate compartment, or alveolus, for each. The permanent teeth are developed as outgrowths from dental ridges adjacent to the enamel organs of the temporary set in those cases where they are preceded by such; otherwise they are formed the same as the temporary teeth from a backward growth of the common enamel germ (dental ridge).

The teeth of domestic animals—especially of the horse—are subject to many aberrations in development. The mesodermic connective tissue follicle, under disturbances, may undergo serious aberration during its developmental stages. A large amount of fluid may be formed within the follicle, which may cause the destruction of the tooth germ and may become enormously increased, to the extent of one, two, or more pints of fluid, and, in the upper jaw, may cause serious distress to the animal by projecting into the sinuses and interfering with respiration. These aberrations we know as follicular cysts. In other cases, there is formed in the walls of the follicle an abnormal amount of cement, to constitute a cement tumor, or cementoma. Sometimes there is a distension of the follicle with fluid, accompanied by a growth of cement upon its inner surface, giving rise to compound follicular cysts. Sometimes the walls of the tooth follicle become greatly thickened by an abnormal growth of connective tissue, to constitute a fibrous odontome.

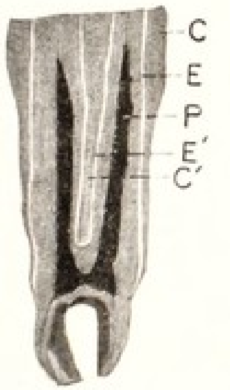


FIG. 43. Cross section of molar of adult horse.
C, external cement. C′, central cement. E, external enamel. E′, central enamel. P, pulp cavity surrounded by dentine.

In the horse, and to a less extent in other animals, where there are deep invaginations from the sides or upon the crown of the enamel organ into the dental papilla, there is normally formed in the grinders enough cement to close completely the spaces between the infolded layers of enamel. In some instances this formation of cement is incomplete and an opening is left through the central portion of this substance, from the grinding surface of the tooth down to the bottom of the infundibulum, in close contact with the enamel. Through this cleft, food particles pass and, becoming lodged in the deepest part, undergo bacterial decomposition, which causes a solution of the enamel and dentine and, finally, a perforation of the pulp cavity, leading to a purulent inflammation of the tooth pulp and a destruction of the life of the organ, with many complications of a highly important character. (See *C'*, Figs. 40, 41, and 42.)

The enamel organ is subject to aberrations in its development, by which a tumor is formed constituting a multilocular cyst which may prevent eruption of the tooth.

The dental papilla undergoes two important forms of fetal aberration, or arrest in development. First, there may be an excessive development of the dentinal substance to constitute an ivory tumor, or radicular odontome. Occasionally such tumors in the horse attain a weight of five pounds or more.

There is frequently an arrest in the development of dentine at the wearing surface of the tooth. In the grinder of the horse, where the enamel dips down into the body of the tooth from its grinding surface, two lamellae of dentinal substance are brought into close contact. The papilla, or radicle of the tooth, *d*, Fig. 39, splits up into several sharp elevations, which push their way up into the enamel organ. The dentine forms from the ondontoblasts upon the exterior of these projections. The soft tissues, or tooth pulp, occupy the interior of these elevations, so that at their apexes, before the tooth erupts and the crown is worn away, the inner, or pulp surfaces of the dentinal plates should come in immediate contact. Normally the opposing faces of these two plates should fuse at the grinding surface and hermetically seal the pulp cavity, as shown between *C* and *C'* in Fig. 43, and at *D* in Figs. 40 and 41. In some cases, as shown in Fig. 44, this fusion fails to occur, causing, when the dentinal summit is worn away, an opening into the pulp cavity, with food particles passing through between the unfused laminae into the pulp, leading to a purulent inflammation. Thus, in the early stages of embryonic life, aberrations in the formation of the tooth germs serve in a variety of ways to induce defects in the teeth which lead to their early disease and destruction, accompanied by an endless variety of complications of more or less serious importance for the well-being of the animal.

The enamel of the mammalian tooth, the hardest tissue in the body, is normally a product of ectodermal growth from the stomodeum, which has become invaginated into the bones of the maxilla and mandible, but teratologically tooth tissues are not confined to these parts. It has been related on page 67 that tooth tissue, histologically and anatomically, is also formed in the squamous portion of the temporal bone of the equine embryo, but here the conditions simulate closely those obtaining in the oral cavity it-

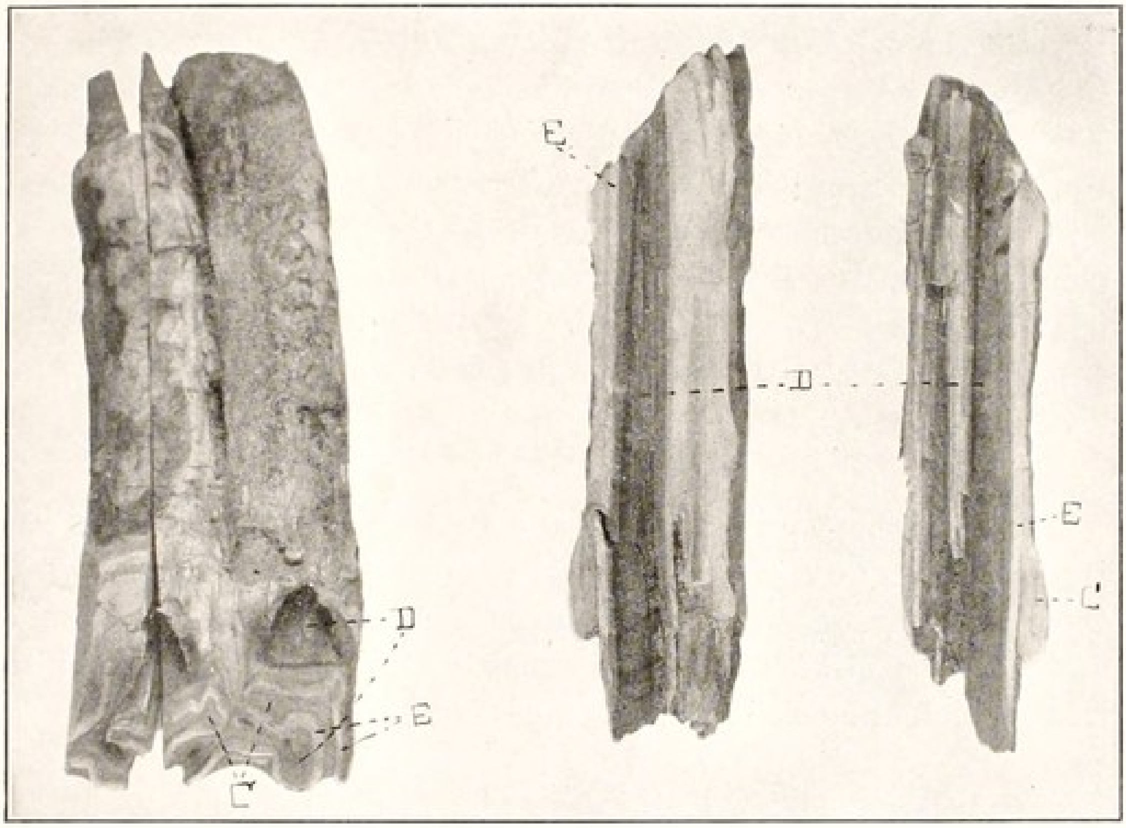


FIG. 44. Table surface and section of inferior molar of adult horse, showing non-fusion of dentinal lamellae, followed by infection and purulent pulpitis.

C, cement. E, enamel. D, open pulp cavity surrounded by dentine.

self. That is, ectodermal cells are invaginated into the deeper layers of mesoderm. From the mesodermal cells, the squamous temporal bone is formed, and from the incarcerated ectoderm, as in the jaws, the enamel tissue. Somewhat rarely in horses, and yet more rarely in other animals, there are observed dental tissues in the ovaries and testicles. Apparently they arise from the primitive genital cells of these glands.

Teeth, hair, or other ectodermic derivatives are liable to develop when limited sacs of ectoderm, invaginated into mesoderm, become incarcerated and separated from the general ectodermic layer, and the surrounding mesoderm is converted into bone or firm layers of unyielding connective or other dense tissues.

The Liver

The liver of the embryo appears about the end of the second week, as an outgrowth from the ventral wall of the intestine, just beyond the dilation which marks the future stomach. The formation of the liver resembles in many respects that of the lungs. The outgrowth becomes enlarged at its distal end, and the proximal portion becomes narrowed to constitute the bile duct. The liver, the most conspicuous of all the glands in the embryo, constitutes at the time of birth the largest and heaviest portion of the viscera. In volume and weight, it is equal to the entire intestinal tract, with the lungs and heart added.

The Pancreas

The pancreas forms at about the same time as the liver, as two infundibuli, one from the ventral and one from the dorsal wall of the duodenum, in the tissue of the mesentery between the intestine and dorsal wall. The gland quickly divides up into lobules, from which the acini and ducts are formed.

THE CIRCULATORY SYSTEM

The Heart

During the second week of embryonic life the heart is recognizable as two distinct, symmetrical, straight tubes, lying along the head-end of the embryo between the yolk-sac and the neural folds and connected at their posterior ends with the vitelline vessels. The two soon unite to form a single tube, which becomes twisted upon itself and forms a prominent swelling on the ventral surface of the embryo in the region of the pharynx. It is twisted in an S-shaped loop, free in its middle portion, with the ends attached anteriorly and posteriorly to the ventral surface of the fore-gut. The posterior, or dorsal, portion of the heart, representing the future auricles, is separated by a somewhat marked constriction from the ventral portion, which is to become the ventricles. The anterior end of the loop is somewhat enlarged, to constitute the *truncus arteriosus*, which is attached to the fore-gut in the vicinity of the mandibular arches.

The heart increases rapidly in size. Within a week from the first traces of its formation, the constriction between the auricular and ventricular portions has become very narrow, the auricles have assumed their ear-like form, and the ventricular portion lies transversely across the body, shaped somewhat like the simple adult stomach.

The Sinus Venosus. The Auricles and Ventricles

The blood is returned to the heart by three symmetrical pairs of veins: the Cuvierian vein from the body of the embryo, the vitelline vein from the yolk-sac, and the allantoic vein from the placenta. These three pairs unite to constitute the sinus venosus, lying transversely across the body and opening into the auricular portion of the heart. The *sinus venosus* ultimately becomes a part of the auricle and disappears.

The auricular chamber early becomes imperfectly divided into the two auricles by outgrowths from the walls, which finally separate completely the two chambers. The septum between the two auricles does not become complete during fetal life, but closes normally at the time of birth; abnormally, it may persist after birth, constituting the defect known as persistent foramen ovale and inducing cyanosis of the new-born, by which the arterial and venous blood remain mixed, giving a bluish color to the skin and mucous membranes, ending usually in the early death of the young animal. The constriction between the auricular and ventricular portions gradually develops to form the septum between these cavities and the auriculo-ventricular valves. Toward the close of the first month, the ventricular cavity becomes divided into two somewhat unequal halves. There forms also, in the truncus arteriosus, *ta*, Fig. 45, a median partition, which, growing backwards, divides the vessel into two parts, which are to represent in the future the common aorta and the pulmonary artery.

The Arteries

Early in the third week of embryonic life a series of aortic arches—one for each of the visceral arches, the more anterior appearing first (See between *va* and *da*, Fig. 45)—arises from the anterior extremity of the truncus arteriosus. At first there are two wholly separate dorsal aortae, which run parallel to each other throughout the length of the body just beneath the notochord, but they soon become fused posteriorly to constitute the single dorsal aorta, from which are given off the vitelline arteries to the vitelline sac. Further back the aorta divides into the two allantoic arteries, which carry the blood to the allantois. The aortic arches pass from the ventral aortae on the floor of the pharynx up through the visceral arches on either side and open into the dorsal aorta. They are soon complete: five—or, according to some authors six—pairs are present, one for each branchial arch, all connected above with the dorsal aorta.

The attachment of the truncus arteriosus begins to shift backward along the floor of the mouth. The vessel divides into two branches, the anterior of which maintains connection with the mandibular and hyoidean aortic arches, while the posterior is connected with the three—or four—remaining vessels.

The aortae continue forward beyond the aortic arches and run alongside the brain, to constitute the internal carotid arteries.

Changes now begin to appear, progressing toward the founda-

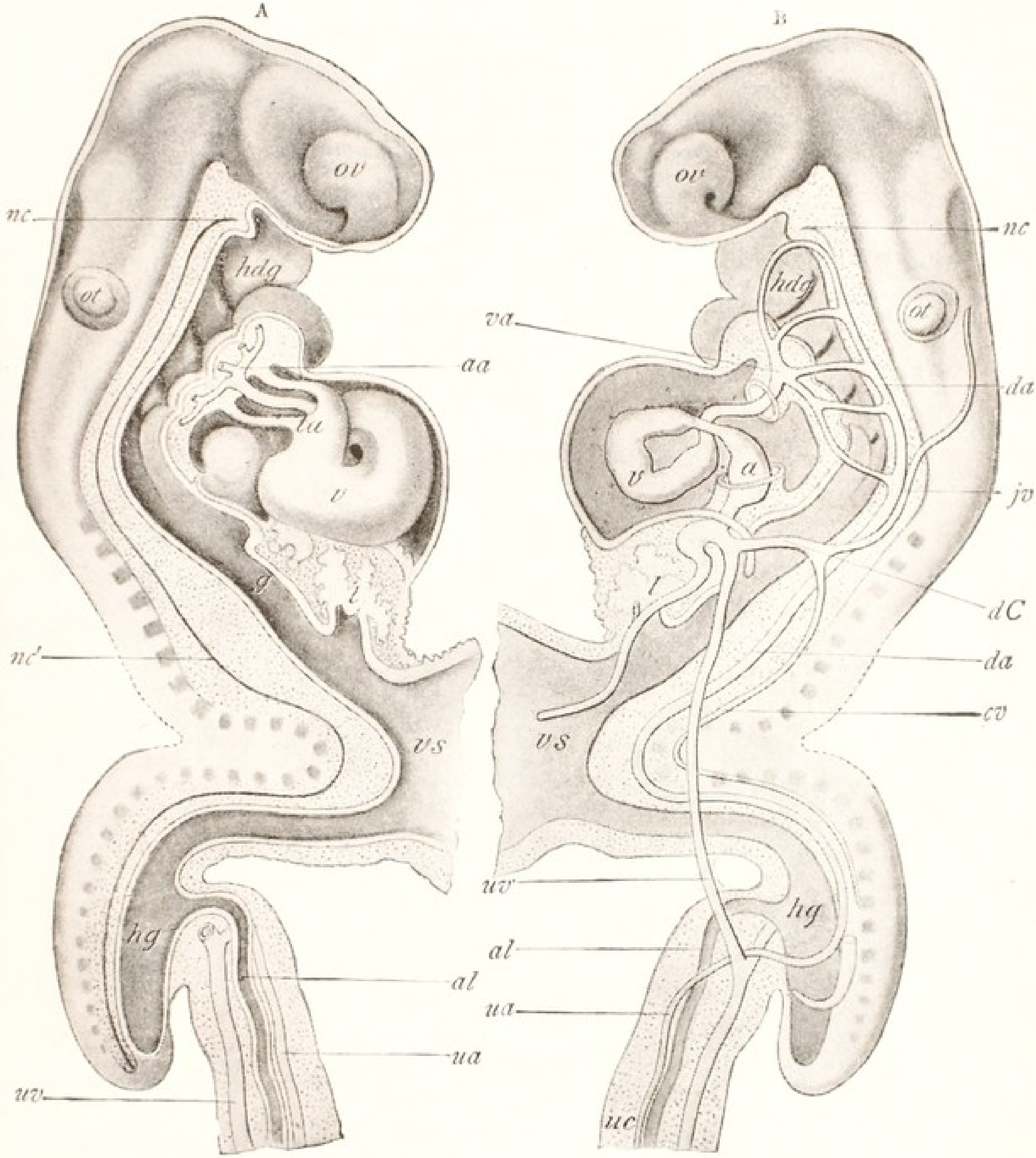


FIG. 45. Reconstruction of human embryo of about 17 days (His): ov, optic vesicle; ot, otic vesicle; nc, nc′, notochord; hdg, head gut; hg, hind gut; vs, vitelline sac; l, liver; v, ta, primitive ventricle and truncus arteriosus; va and da, ventral and dorsal aortæ; a, sinus venosus; aa, aortic arches; jv, primitive jugular vein; cv, cardinal vein; dC, duct of Cuvier; uv, ua, umbilical vein and artery; al, allantois; uc, umbilic cord. (Heisler).

tion of the adult plan of circulation. The middle portions of the aortic arches in the mandibular and hyoidean arches disappear, and the connection between the truncus arteriosus and the aortae, through these arches, ceases to exist. The proximal ends of these vessels remain as the external carotid arteries.

The third aortic arch retains its connection with the anterior portion of the aorta and its proximal end, or stem, constitutes the common carotid artery. The connection between the portion of the aorta posterior to the junction with the third aortic arch and anterior to the fourth disappears, thus separating the carotid system from the aortic vessels.

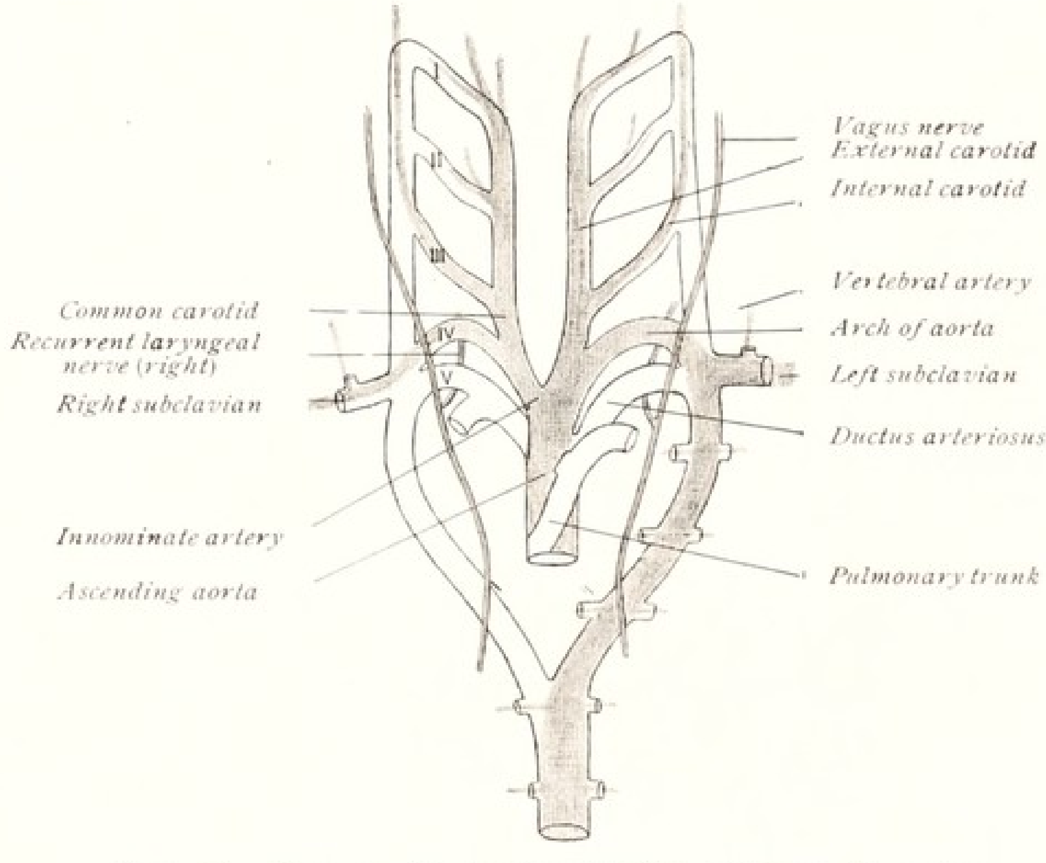


FIG. 46. Diagram illustrating the fate of the aortic arches. (Modified from Heisler.)
I, II, III, IV, V, the first to fifth aortic arches.

The left fourth aortic arch persists, to become eventually the aorta, while the sixth arch ultimately becomes the pulmonary artery. (See Figs. 45 and 46.)

At approximately the fifth or sixth week of embryonic life, the heart leaves the region of the pharynx and passes backward; the neck becomes elongated and the head extended forward, causing a great lengthening of the common carotid artery.

During the formation of the cranial nerves, the inferior laryngeal divisions of the pneumogastrics cross behind the sixth aortic arches between the aorta and truncus arteriosus, to reach their destination in the muscles of the larynx. As the heart recedes toward the chest and the head grows forward, the laryngeal nerves are necessarily dragged along with the aortae into the chest cavity, thus bringing about their recurrent course.

While the heart is moving backward, the right aortic, or systemic arch becomes smaller and finally disappears. As a result, the right laryngeal nerve is released from the dragging of the aorta, but still passes around the right subclavian artery. The persistence of the left arch, which becomes the common aorta,

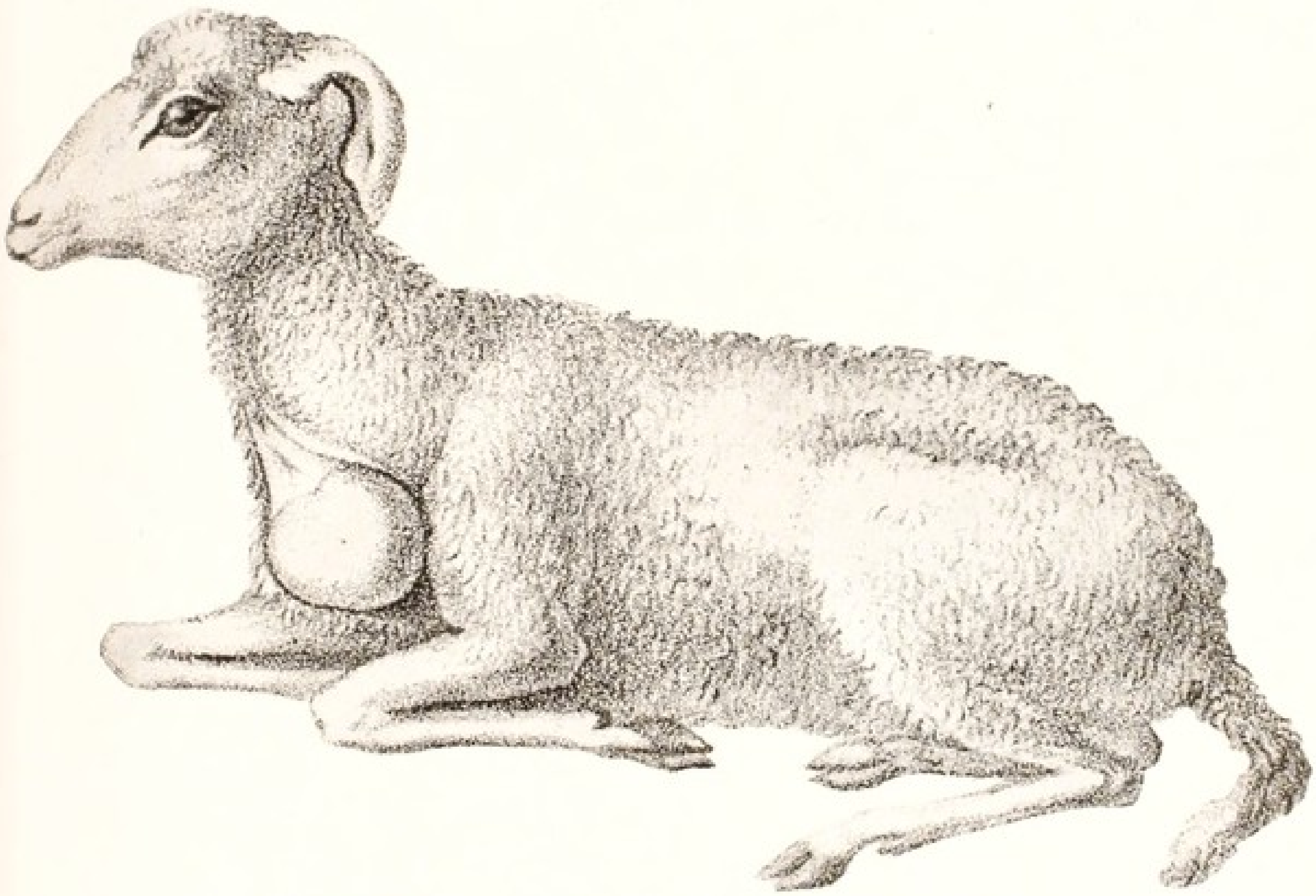


FIG. 47. FISSICOLLIS. CERVICAL ECTOPIA CORDIS.
(Gurlt.)

continues the dragging upon the left recurrent nerve, which, throughout the life of the animal, must pass into the chest, around the aorta, and retrace its way back to the larynx. This essential difference in the course of the two inferior laryngeal nerves is by some presumed to have a fundamental relation to the fact that, in the affection of "roaring" in horses, it is regularly the left nerve which becomes most degenerated, though no essential relation of this to the disease is known. There is no explanation why the recurrent character of the nerve should cause disease in the horse, and not in other animals.

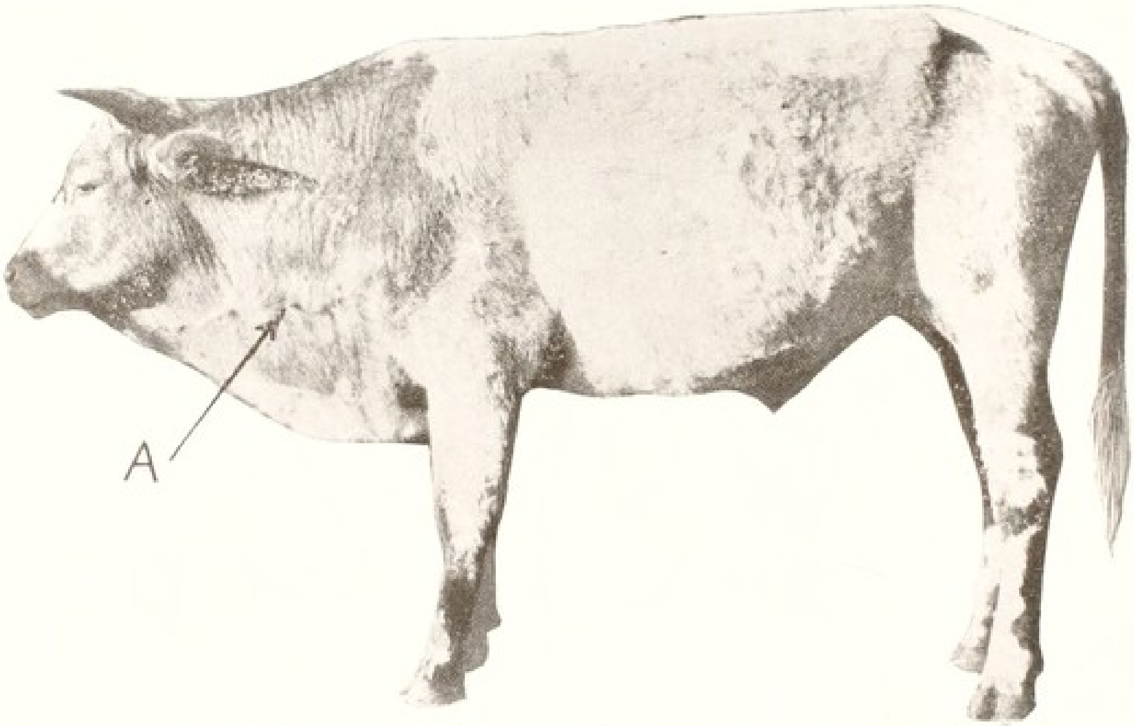


FIG. 48. CERVICAL ECTOPIA CORDIS IN AN ADULT STEER.
A, ectopic heart. (Kansas City Veterinary College.)

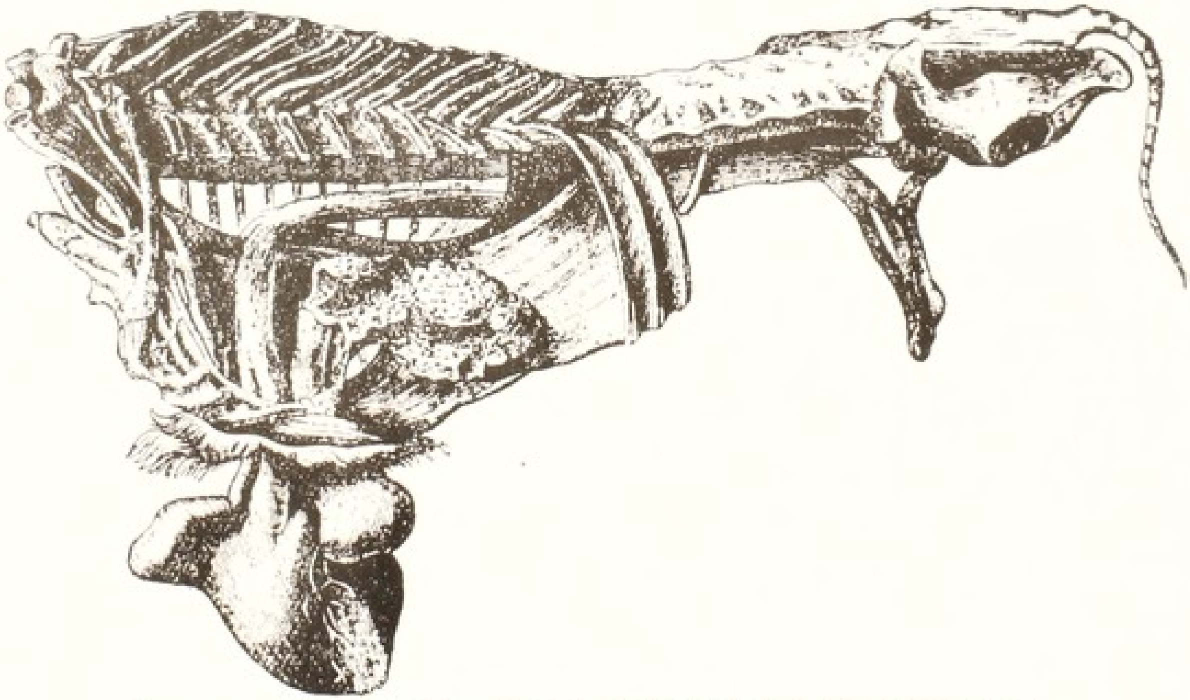


FIG. 49. ECTOPIA CORDIS; SCHISTOCORMUS FISSISTERNALIS.
(After Hering.)

Sometimes the heart, becoming arrested in its movement backward, remains in the cervical or pharyngeal region. Thus, especially in bovidae, the young may be born with the heart just beneath the pharynx or at any point between this and the first rib, as shown in Figs. 47 and 48, graphically reminding one of the normal shifting of the location of the heart in the embryo, from its first position along the floor of the pharynx, toward the posterior portion of the body, to become lodged within the chest cavity. In other cases, the aberration in the location of the heart may occur in connection with a fissure of the sternum, through which the heart becomes herniated, as in Fig. 49.

The sixth aortic arch gives off a branch, before joining the aorta, to go to the lungs and constitute the pulmonary artery. In the right vessel, the arch disappears between the pulmonary artery and the aortic arch; in the left, it continues, as the ductus arteriosus, which, up to the time of birth, maintains the indirect communication between the right ventricle and the posterior aorta, and persists throughout life as a fibrous cord, the ligamentum arteriosum.

The Veins

When the mammalian embryo is about three weeks old, there are three pairs of veins: the Cuvierian, the vitelline, and the allantoic. The first of these, formed by the union of the cardinal veins, return the blood from the embryo itself. The vitelline veins, formed in the walls of the yolk-sac, carry blood from it along the vitelline stalk to the heart. The third pair returns blood from the placenta along the stalk of the allantois. The vitelline veins of mammals are naturally small, since the vitellus, or yolk, containing essentially no nutriment, affords small opportunity for any important functions in these vessels. They are situated in the mesoderm of the splanchnopleure, enter the embryo at the umbilicus and, passing forward along the sides of the alimentary canal, empty into the sinus venosus.

In growing out from the intestine, the liver surrounds the vitelline veins before they empty into the sinus venosus. Here the veins break up into a series of capillaries, converging later to form the efferent hepatic vessels. In this way, the venous capillary system of the liver is formed. A vein divides up into capillaries in the same way as arteries regularly do, and these converge again to form a second venous trunk. At about the same period that the vitelline veins are breaking up to constitute the functional circulation of the liver, they become connected with each other just before their entrance into that gland, by three communicating branches, two of which pass beneath the duodenum and one over it, thus forming venous rings surrounding the intestine. From the anterior ring, there arise veins which carry the blood into the liver. The right and left vitelline veins soon unite to form a single trunk, which, a little later, is joined by veins returning blood from the intestine. After this, it is known as the hepatic portal vein. The veins which previously established the communication between the right and left vitelline veins disappear in part in such a way that the remaining portions, which constitute later the direct trunk, are twisted about the duodenum much the same as in adult life.

The allantoic veins are at first paired, and outside the fetus remain permanently separate. They arise in the placenta, pass along the sides of the allantoic stalk on either side of the urachus, enter the fetal body through the umbilicus, and eventually reach and empty into the sinus venosus. Later they lose their connection with the sinus venosus. The right vein becomes smaller and finally disappears; the left increases much in volume and, as it nears the liver, gives off some vessels which enter it directly, while the main portion of the vessel joins the hepatic portal vein prior to its entrance into that gland.

At a slightly later date, when both vitelline and allantoic vessels have ceased to empty into the *sinus venosus*, all the blood from these two vessels must pass through the capillaries of the liver before it can reach the heart. At this period, a communication, the ductus venosus, is established between the right hepatic and portal veins, by which the blood may pass from the vitelline and allantoic vessels across to the hepatic vein, without passing through the capillaries of the liver. In the foal the ductus venosus becomes obliterated some time prior to birth, so that all blood from the allantois must pass through the liver. The posterior vena cava does not acquire much size until the hind limbs begin to form and the iliac veins unite to constitute its principal branches.

It enters into the *ductus venosus* near its termination in the hepatic vein. The anterior and posterior cardinal veins unite to form the Cuvierian veins. The anterior cardinal vein persists in some adult domestic animals, such as the cow, as the internal jugular vein. The middle portion of the posterior cardinal vein disappears ; the posterior end becomes the internal iliac vein ; and the anterior portion of the right posterior cardinal vein persists as the vena azygos. The anterior vena cava represents the right anterior Cuvierian vein, and the left vein disappears completely, with the possible exception of the coronary sinus of the heart.

The Fetal Circulation

In the earlier stages of the fetal circulation, all the blood returned to the heart—whether from the embryo, the placenta, or the vitelline sac—is emptied into the sinus venosus, from which it passes into the cavity of the common auricle. In this way a complete mixture of the blood from all sources necessarily occurs. The mixed blood is then forced by the ventricle, through the truncus arteriosus, toward the head of the fetus.

The sinus venosus later becomes a part of the auricle, into which empty the Cuvierian veins and the posterior vena cava. Gradually the septum between the two auricles is formed, but there remains the foramen ovale, through which the blood can pass with more or less freedom. The posterior vena cava opens very near to the foramen ovale, where a small valve tends to cause the blood to flow from the posterior vena cava to the left auricle, by way of the foramen. In this way, considerable admixture of blood from the three different vessels still ensues. Later, as the left Cuvierian vein disappears, the blood from the head and anterior limbs is all returned through the right vein, or anterior vena cava, so that there are now only two vessels, both of which empty into the right auricle. At this period, the blood which enters the auricle from the anterior vena cava, coming from the head and both fore-limbs, is entirely venous in character, while that from the posterior vena cava is chiefly arterial, or red blood coming from the placenta, with a small portion of venous blood added from the posterior limbs and other parts of the body.

By an elaboration of the valve in the foramen ovale and a valvular fold at the opening of the posterior vena cava, the blood from this vein appears to be largely carried directly across the right auricle into the left auricular chamber.

The right auricle now receives blood from the anterior and posterior venae cavae and a small amount from the coronary sinus. The blood comes from the head and forelimbs, from the hinder part of the body, the placenta, the intestine and the liver, and from the walls of the heart itself. The blood entering the heart through the posterior vena cava deserves special consideration. The right allantoic vein disappears early, while the left persists and enters the body through the umbilicus, to pass forward to the posterior border of the liver, where it unites with the hepatic portal vein. The combined vessel now carries blood from the intestine, from the vitelline veins of the earlier period, and from the placenta.

The blood which is carried to the heart by the posterior vena cava is largely arterial in character—that is, it has given up its carbon dioxide and other waste material in the placenta and has derived from the blood of the mother oxygen and nutritive materials. Into the posterior vena cava enters also the blood which has been to some degree favorably modified by passing through the kidneys and the liver, in which glands certain deleterious substances have been removed. The waste materials extracted by the kidneys and thrown into the bladder may be discharged either into the amniotic sac through the urethra or the allantoic sac through the urachus. The liver excretions pass to the intestines, where they become desiccated and are stored up in the large intestine, to constitute the chief volume of the meconium.

The anterior vena cava carries only that blood which has been sent through the arteries to the head, neck, and anterior limbs after it has performed its nutritive office to those parts. Consequently it comes back charged with waste materials, without having received in its course any additional nutrient matter or having undergone any purification in passing through the tissues or organs. The blood passes into the right auricle and thence into the right ventricle, from which it is driven along the pulmonary artery. Since the lungs are not yet functioning, the blood passes through the ductus arteriosus to the dorsal, or posterior aorta. Entering the latter at an acute angle, the blood is directed backward toward the posterior part of the body, whence it passes largely to the placenta, through the umbilic arteries, where it is relieved of its waste matters and, in exchange, receives oxygen and nutrient material. The arterial blood returning through the umbilic veins, from the placental capillaries, with a small addition of wholly venous blood from the posterior limbs and some blood which has been modified by passing through the kidneys and liver, re-enters the right auricle, to pass at once into the left auricle and thence into the left ventricle. From this latter cavity, it is driven along the common aorta until it reaches the carotid and subclavian arteries, through which it is carried almost wholly to the head and anterior limbs.

Although the aorta is freely open from the heart along the posterior aorta toward the posterior portions of the body, it appears that very little of the blood from the left ventricle passes backward. This is largely because the blood from the right ventricle, which at this period is as strong as the left, has already filled with blood that portion of the posterior aorta posterior to the juncture of the ductus arteriosus with that vessel. Consequently, the blood pressure in the two portions of the vessel is approximately equal, so that there is as great a tendency for the blood from the right ventricle to pass forward from the ductus arteriosus as for that from the left to pass backward from the opening of the ductus arteriosus when propelled through the common aorta.

In some cases, it has been found that the aorta has become obliterated during embryonic life at a point just anterior to its juncture with the ductus arteriosus and posterior to the fourth aortic arch, so that all the blood to the posterior end of the fetus must pass through this vessel. The wholly independent anterior and posterior circulations do not interfere with the development of the fetus, but at the time of birth the circulation is at once blocked to all the posterior portions of the body, so that the newborn young must promptly perish.

The plan of the fetal circulation is in a measure the reverse of that after birth : the purified or red blood comes from the placenta along the posterior systemic veins to the right auricle, whence it passes largely to the head, neck and anterior limbs through the right ventricle, ductus arteriosus, carotid and subclavian arteries. Throughout fetal life, the blood of the entire body is of a mixed character. The red blood of the umbilic veins become somewhat mixed with venous blood before reaching the heart.

Prior to birth, the vitelline vessels have disappeared except in so far as they have persisted as portions of other vessels within the body. As soon as birth takes place and the umbilic cord is ruptured or the placenta detached from the uterus, the allantoic circulation must cease abruptly, while the pulmonary circulation must be promptly established because the respiratory functions have been shifted from the placenta to the lungs.

As soon as the animal begins to breathe, the functional circulation of the lungs must at once be established. While, prior to birth, no blood of any note has passed through the pulmonary arteries and capillaries, they must now promptly become active. In order that the blood from the right ventricle shall pass through the pulmonary arteries to the lungs, instead of through the ductus arteriosus into the aorta, it is essential that the latter become promptly obliterated.

The rupture of the umbilic cord finally interrupts the placental circulation and renders useless all those vessels within the fetal body whose sole office was the maintenance of the placental circulation. To this end, the intra-fetal portion of the umbilic vein, with the ductus venosus, needs to close and disappear. Vestiges of the umbilic vein persist, but its channel becomes occluded within a very few days after birth, unless interrupted by disease. The allantoic, or umbilic arteries must likewise undergo a partial degeneration and complete loss of function. When ruptured in the natural way, the umbilic arteries usually part just outside the abdomen, though some writers (Carsten-Harms), quite certainly erroneously, allege that they occasionally rupture within the abdominal cavity, especially in the cow. In the foal and the calf—probably in all animals—the arteries normally rupture one to three inches outside the abdomen, retract immediately, with the stump of the urachus, within the abdominal cavity for a distance of two or more inches, and, dragging with them the connective tissue surrounding their walls, retreat in such a manner as to preclude the possibility of hemorrhage and to diminish greatly any danger from infection in the ruptured vessels (See Fig. 53). Their ruptured ends come to rest at the anterior portion, or fundus, of the urinary bladder, whence they may be traced throughout life as connective tissue cords, passing from this point to the internal iliac arteries, to constitute the round ligaments of the bladder of the adult.

THE DEVELOPMENT OF THE URINO-GENITAL SYSTEM

The urinary and genital systems are closely allied in their origin. Both are preceded by the Wolffian bodies and ducts, which for a time perform the excretory office of the kidneys and finally take prominent parts in the origin of both the urinary and the genital organs.

The Wolffian Ducts and Wolffian Bodies

The Wolffian ducts are claimed by some embryologists to originate as a pair of longitudinal grooves in the ectoderm, on the lateral surface of the body, at about the level of the notochord or somewhat below. The invaginations of ectoderm continue to sink inward into the mesoderm of the somatopleure until they come in contact with the peritoneum. Other investigators hold that the Wolffian ducts are of mesodermic origin, though at first lying immediately against the ectoderm, as solid rods, which later become excavated in their center to constitute hollow tubes. For a time the Wolffian ducts end blindly behind, but later they open into the cloaca.

The Wolffian bodies—one on either side of the mesentery—are first recognizable during the third week of the embryo, as longitudinal thickenings in the dorsal surface of the body cavity. They develop rapidly and become greatly elongated so that they soon reach from the posterior portion of the cervical region back to the end of the lumbar region.

The essential tissues of the Wolffian bodies appear to develop, independently of the Wolffian ducts, from the mesoderm, in the form of cords of cells. The cords coil somewhat upon themselves, and become excavated to constitute tubes. One end of each tube grows toward the Wolffian duct, and empties into it; the other end becomes dilated, and then invaginated, to constitute the Malphigian bodies, or glomeruli. Into these glomeruli, branches of the aorta penetrate to furnish the functional blood supply. The veins from these glands empty into the posterior cardinal veins.

Later the Wolffian bodies commence to degenerate and

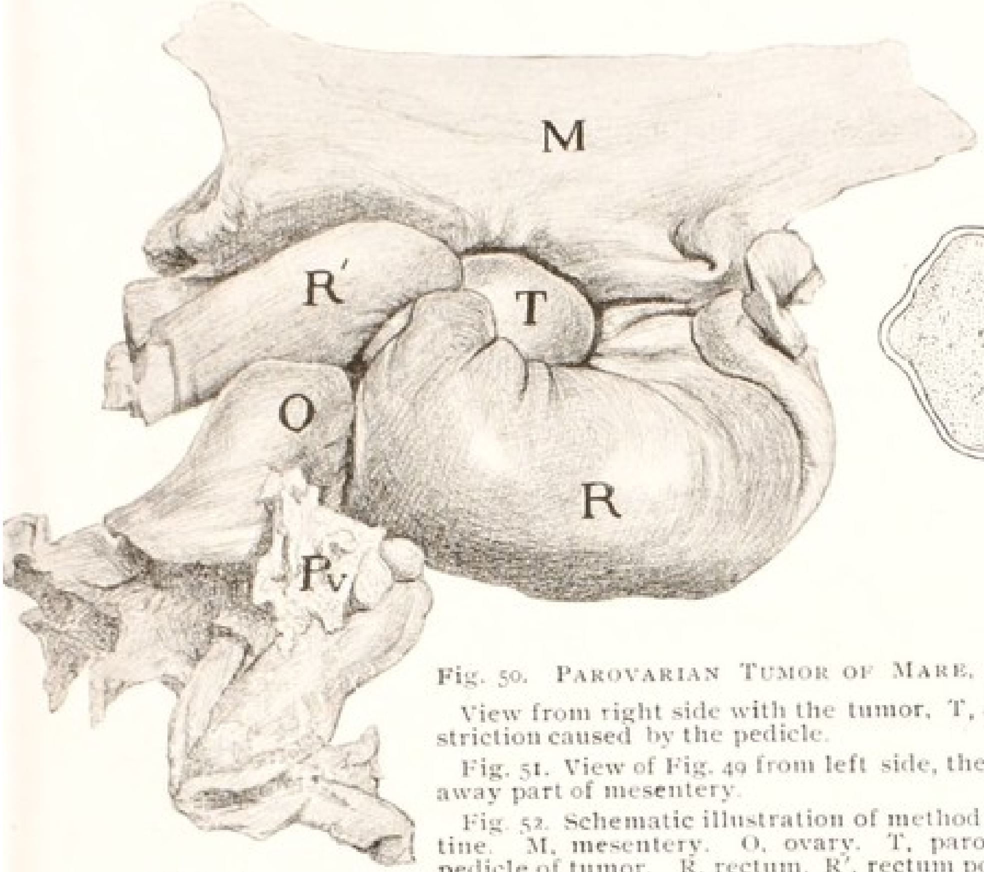


FIG. 50.

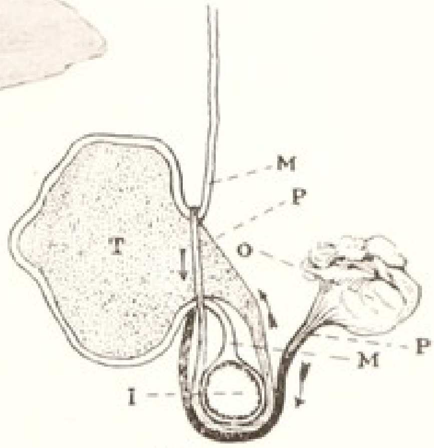


FIG. 52.

Fig. 50. PAROVARIAN TUMOR OF MARE, INCARCERATING RECTUM.

View from right side with the tumor, T, almost hidden by the constriction caused by the pedicle.

Fig. 51. View of Fig. 49 from left side, the tumor exposed by cutting away part of mesentery.

Fig. 52. Schematic illustration of method of incarceration. I, intestine. M, mesentery. O, ovary. T, parovarian tumor or cyst. P, pedicle of tumor. R, rectum. R′, rectum posterior to point of strangulation.

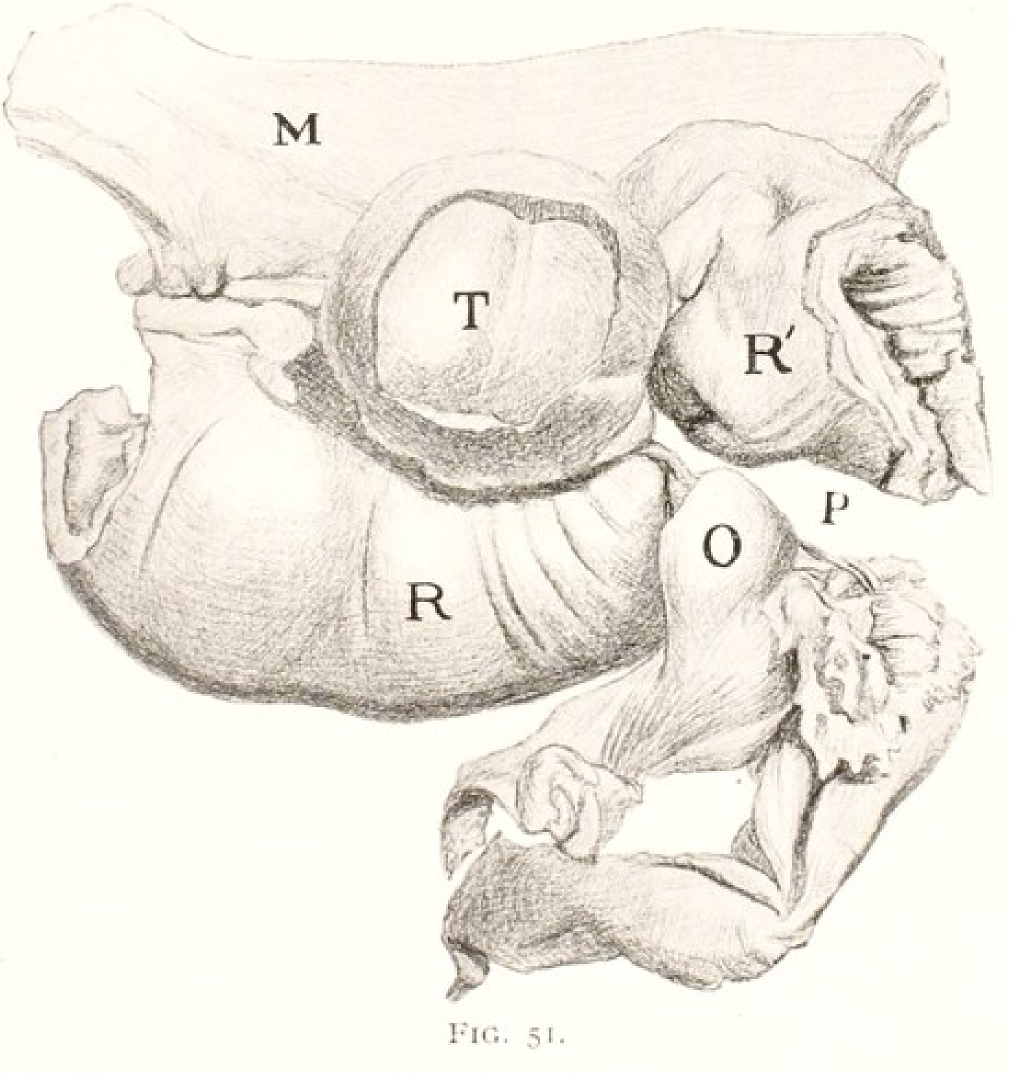


FIG. 51.

atrophy; finally the essential tissues of the organs almost wholly disappear and with their ducts become concerned in the origin of accessory portions of the reproductive apparatus. The Wolffian bodies play no important part in the formation of the ovaries, but they send some outgrowths into these glands, which persist for a time. Some remnants of the Wolffian bodies persist, however, as the parovarium, or organ of Rosenmueller, and from these vestigial portions some of the cystic tumors seen occasionally in the mare and the cow appear to arise. In rare cases pedunculated parovarian tumors become looped about the rectum, inducing fatal incarceration, as shown in Figs. 50-52.

In the female, some traces may remain of the anterior end of the Wolffian duct as a part of the parovarium. It is not rare to see in cows a cystic condition of the parovarium. The cystic tubular swelling attached to the anterior surface of the ovary feels, upon rectal palpation, much like a cystic oviduct. No remains of the posterior portion of this duct are observed in most animals. In the cow however they usually persist as Gaertner's canals. These sometimes become blocked at their mouths and cause retention cysts. These cysts appear as elongated sacs, arising close to the meatus urinarius on either side and extending upward and forward along the walls of the vagina. When they become very greatly distended, they may serve to interfere with copulation and, if very large, possibly with parturition.

In the male the Wolffian bodies largely disappear, but portions of them take a somewhat prominent part in the formation of the testicles and thus persist throughout life. Tubules grow out from the Wolffian tubules in the anterior part of the Wolffian bodies and finally enter the substance of the testicle, to constitute the vasa efferentia, which eventually become connected with the seminal tubes. The anterior Wolffian tubules form the coni vasculosi; the Wolffian duct, the duct of the epididymis and the vas deferens.

The Kidneys, Ureters, and Bladder

Before the disappearance of the Wolffian body, there appears toward the posterior end of the Wolffian duct an outgrowth, or diverticulum, which is later to constitute the ureter and which, shifting backward toward the cloaca, finally acquires an independent opening a little way behind that of the Wolffian duct.

At the anterior end, the infundibulum grows forward beneath the Wolffian body and dilates to form a sac which is to constitute the pelvis of the kidney. From the walls of the pelvis of the kidney a number of branching converging tubules, the secreting tubules, arise as rods of cells from the contiguous mesoderm ; the rods become hollowed out and at their ends enlarge to constitute the glomeruli of the kidney.

The urinary tract of the cloaca, posterior to the entrance of the ureter, becomes narrowed to form the urethra ; anterior to the point of entrance of the ureter, the urinary segment of the cloaca dilates to form the urinary bladder. From the anterior end, or fundus, of the bladder, the allantois arises, the first segment being constricted to form the urachus, which extends through the umbilicus and umbilic cord to the allantoic cavity. During the life of the fetus, the urine may pass either through the urachus into the allantoic sac or through the urethra into the amniotic cavity.

THE MALE REPRODUCTIVE ORGANS

The Testicles

The testes, like the ovaries, form in the genital ridges of the peritoneum. In the earliest stages the male and female glands can not be differentiated. In the indifferent gland the reproductive cells become grouped in cords containing small cells along with the larger and more important primitive sexual cells. The sexual cords are formed from the roundish masses of cells, separated from each other by connective tissue sheaths. Eventually they become elongated and hollowed out to constitute the seminiferous tubules.

The developing testicle shifts its location early from its primary lumbar position toward its final resting place in the scrotum. Formed in the peritoneum of the body wall in the sub-lumbar region, the gland is outside or behind the parietal peritoneum. As it shifts its position and descends into the cavity of the abdomen toward the internal abdominal ring, it necessarily carries with it a peritoneal covering and remains attached to its point of origin by a double peritoneal fold, the mesorchium, between which its vessels and nerves pass.

While the Wolffian body is being formed, the inguinal ligament, which arises from the fundus of the scrotum, passes up through the inguinal ring and acquires intimate connection with the gland. The cord persists and maintains a connection with the testicle, as the gubernaculum testis, or with the ovary, as the *round ligament*. The gubernaculum testis consists of connective tissue and unstriped muscle fibres, surrounded by peritoneal coverings. Since the testicle, the gubernaculum testis, and the vas deferens form outside of or behind the peritoneum, each of the three structures, as the organ descends, must drag with it a double peritoneal fold, so that finally there appear three peritoneal folds, as shown in Figs. 53 and 54—one for the testicle and its artery, *A* ; one for the vas deferens, *V*; and a third for the gubernaculum testis, *G*, *G'*, and *G''*—all of which are continuous. As the gland continues to descend toward the inguinal ring, the peritoneum of the abdominal floor, which stretches across the ring, evaginates through it as the processus vaginalis at *P*, in Figs. 53 and 54, into which pouch the epididymis, *E*, descends, followed later by the gland, *T*. Since the testis has been formed on the median side of the Wolffian duct, which later forms the epididymis, the two structures maintain their original relation throughout and, when the testicle comes to rest in the scrotum, the epididymis lies upon the supero-external face of the

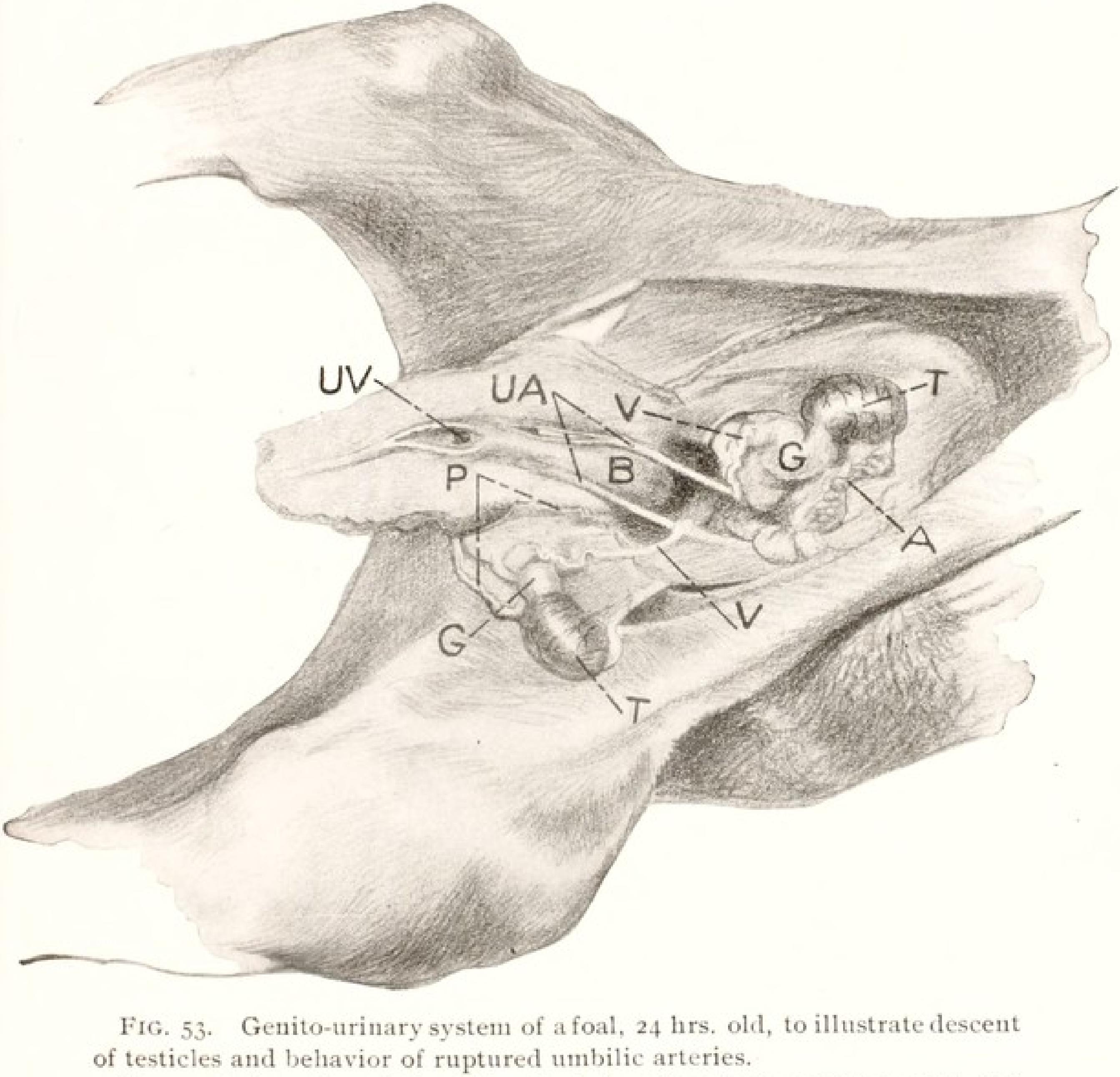


FIG. 53. Genito-urinary system of a foal, 24 hrs. old, to illustrate descent of testicles and behavior of ruptured umbilic arteries.

The central portion of the abdominal floor has been partly excised and laid back. Seen from below.

T, testicle. A, artery of testicle. G, gubernaculum testis. V, vas deferens. E, bladder. UA, ruptured ends of umbilic arteries retracted within abdomen. P, processus vaginalis. UV, umbilic vein.

gland. In the descent of the testicle and epididymis, their relations with each other become reversed. In the abdomen, processus vaginalis, and inguinal canal, the epididymis is *beneath* the testicle and precedes it in the descent. In the horse, however, when the testicle finally reaches the bottom of the scrotum it performs a partial revolution forwards on its short axis, reversing the relation and bringing the epididymis above the testicle. In ruminants this reversal of relation does not occur, as the long diameter remains perpendicular. The processus vaginalis remains normally open throughout life in domestic animals, but in the adult it is physiologically so narrow that abdominal viscera may not escape through it.

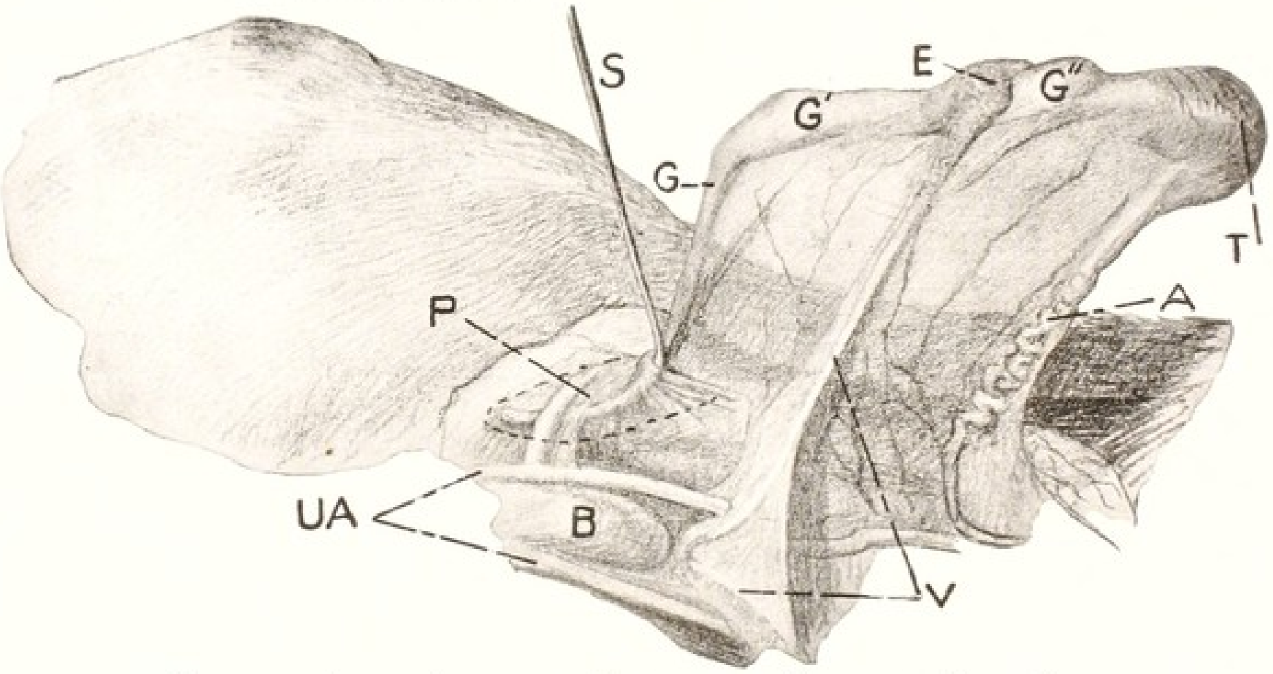


FIG. 54. RIGHT INGUINAL REGION OF FOAL, 24 HRS. OLD

Illustrating the descent of the testicle, viewed from below; the testicle is lifted upwards to reveal attachments.

P, processus vaginalis, surrounded by a dotted line and containing a curved sound, S. G, gubernaculum testis emerging from the internal inguinal ring and reaching to the larger portion, G′, which extends to the epididymis, E, and is succeeded by the final or third section of the gubernaculum, G″, reaching from E to the testicle, T.

A, artery of testicle. V, vas deferens. B, bladder. UA, umbilic arteries.

The testicle, when it has descended into the scrotum, is attached below and posteriorly to the fundus of the sac by the gubernaculum testis and upwards along the posterior wall of the scrotum and inguinal canal by the frenum, or mesorchium, consisting of the peritoneal duplicature between *V* and *C* in Fig. 54; above, it is attached by means of the testicular, or spermatic cord, consisting of the vas deferens, arteries, veins, and lymphatics, covered by peritoneum. In the foal, pig, and more rarely in other species, at the time of birth, there is frequently present a hernia (congenital scrotal hernia) of intestines or omentum through an abnormally large processus vaginalis, alongside the spermatic cord.

In some instances, the epididymis, *E*, Fig. 54, descends into the scrotal sac, while the gland remains in the abdomen or incarcerated in the internal ring. Far more frequently, both gland and epididymis are retained within the peritoneal cavity, to constitute cryptorchidy. The successful castration of cryptorchid animals depends fundamentally upon the possession by the veterinarian of a practical knowledge of the track and mode of descent of the testicle, and of its attachments, through the medium of the gubernaculum testis, vas deferens, and testicular artery.

The Wolffian ducts open early, at their posterior ends, into the urinary tract, which is later to constitute, in front of the urethral opening, the urinary bladder and, posterior to it, the urethra. The penis of the male and the clitoris of the female arise as outgrowths from the ischial arch; in the female it stops short in its growth as a non-essential erectile organ, while in the male it becomes greatly elongated and, curving downwards and then forwards, passes between the thighs to end in a special sheath and prepuce. The urethra extends throughout the entire length of the penis, to open at its extremity.

Arrests or aberrations in the development of the penis occur, consisting usually of an abbreviation in its length, suggesting a graduation in development between a normal penis and a clitoris. Sometimes the defective penis is directed more or less backwards, leading to a backward direction of the urinary stream. In other instances, the formation of the urethra is aberrant and it opens at the ischial arch or lower down along the penis, to constitute hypospadias or epispadias.

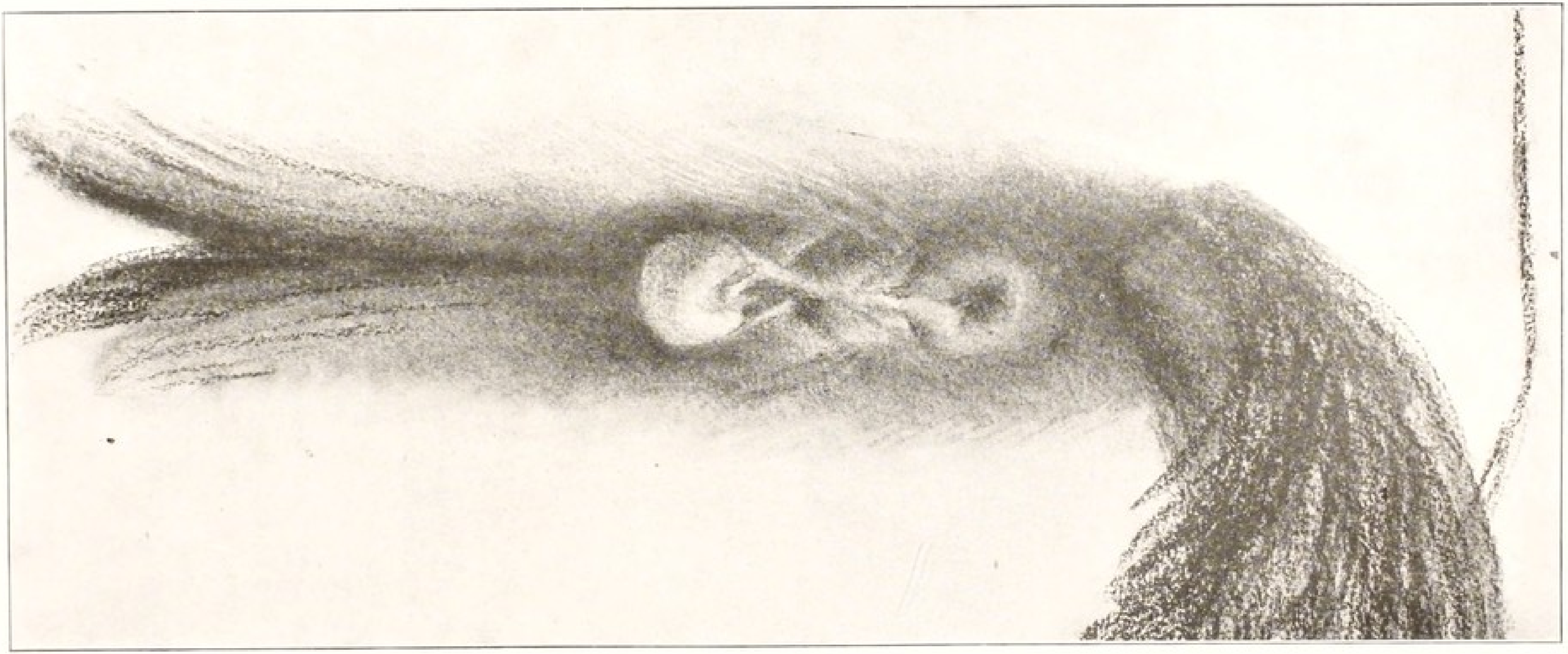


Fig. 55. Pseudo-hermaphroditism of Horse, showing Rudimentary Penis

Defects in the development of the penis and the clitoris are largely associated with aberrations in the essential genital organs themselves, of a more or less hermaphroditic or bisexual character. Hermaphroditism varies greatly in character and extent and tends largely to follow certain types for each species of animals. In the horse it is not rare to meet with an animal having a well developed vulva, vagina, and uterus, the vulva and vagina functioning as in a normal mare. No ovaries are present, but instead typical cryptorchid testicles producing the ordinary cryptorchid sexual reflexes—a male voice, form, and behavior. An animal may have one male and one female genital gland.

The Limbs

In a rabbit embryo of about the tenth day, the mesoblastic cells on either side of the notochord become grouped into cuboidal masses, divided by transverse lines into somites or primitive segments. The first pair appears in the cervical region prior to the closure of the neural tube. Additional somites appear,

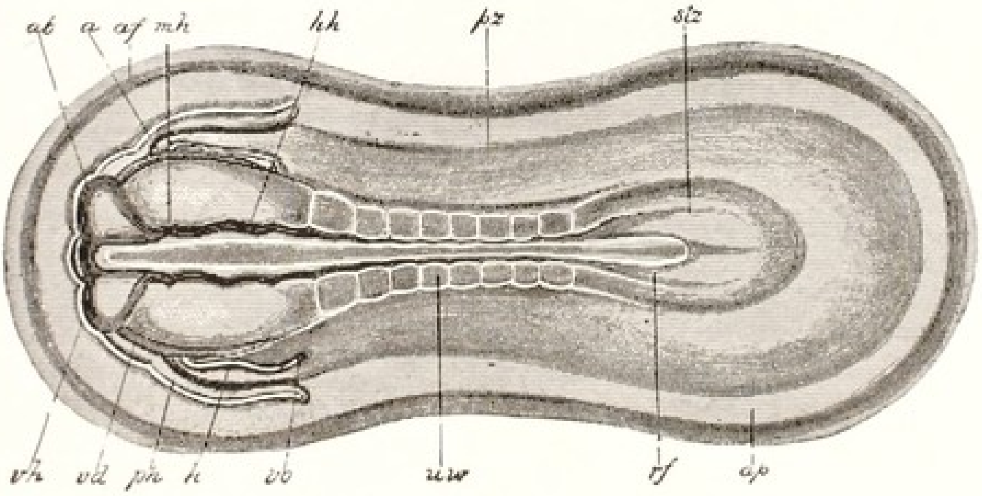


Fig. 56. Rabbit embryo of the ninth day, seen from the dorsal side. (after Kölliker.) × 21.

stz, stem zone. pz, parietal zone. In the stem zone 8 pairs of somites appear on either side of the chorda dorsalis and neural tube.

ap, area pellucida. rf, medullary groove. vh, fore-brain.
ab, eye vesicle. mh, mid-brain. hb, hind-brain.
uw, primitive segment. h, heart.
ph, pericardial portion of body cavity.
vd, margin of entrance to foregut. af, amniotic fold.
vo, vena omphalo-mesenterica. (Heisler.)

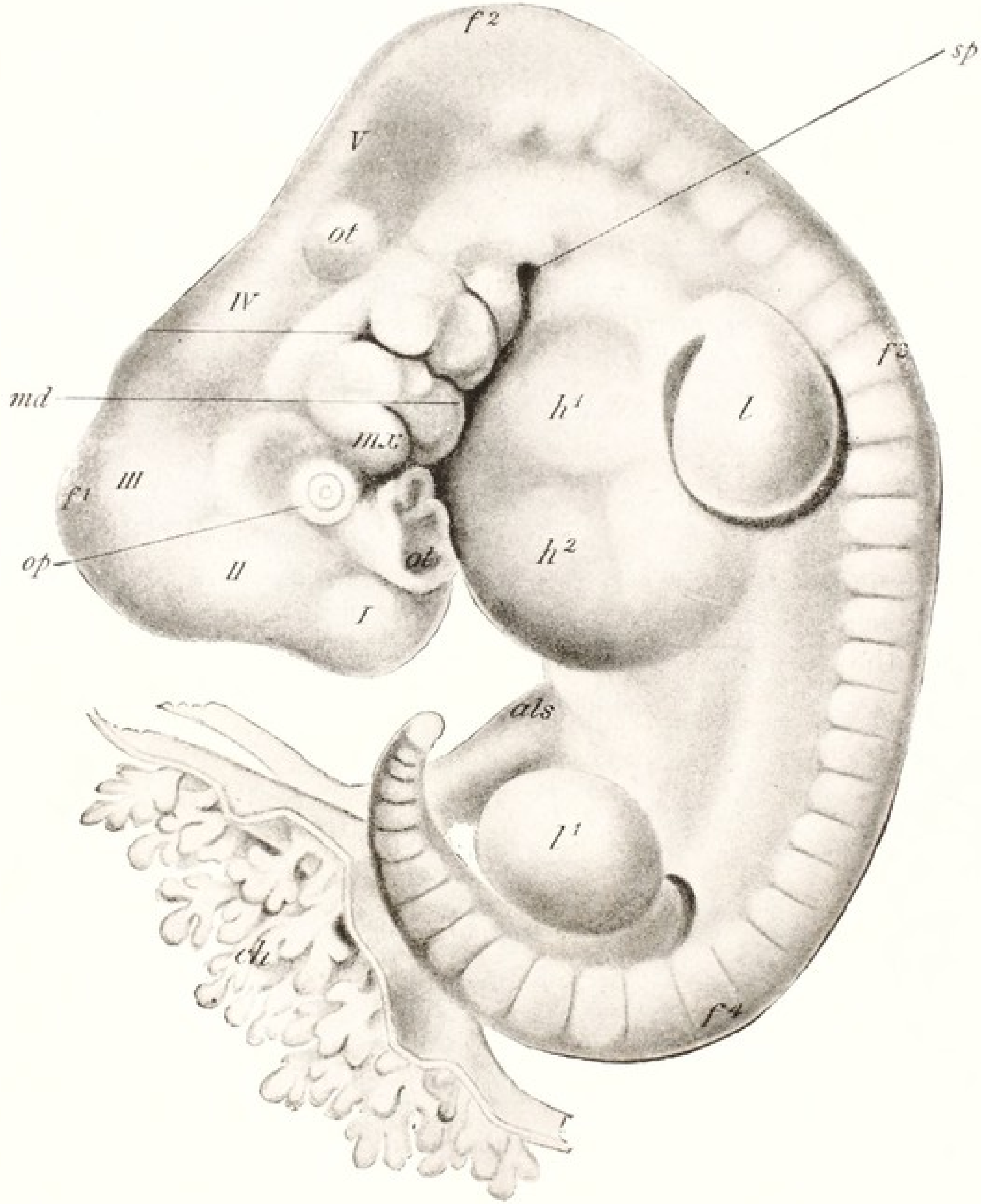


FIG. 57. HUMAN EMBRYO OF ABOUT 28 DAYS, SHOWING LIMB BUDS. (His.)

I to V, brain vesicles. f^1, f^2, f^3, f^4, cephalic, cervical, dorsal and lumbar flexures. op, eye. ot, otic vesicle. ol, olfactory pit. mx, md, maxillary and mandibular processes of first visceral arch. sp, sinus precervicalis. h^1, h^2, heart. l, l^1, limbs. als, allantoic stalk. ch, villous chorion. (Heisler.)

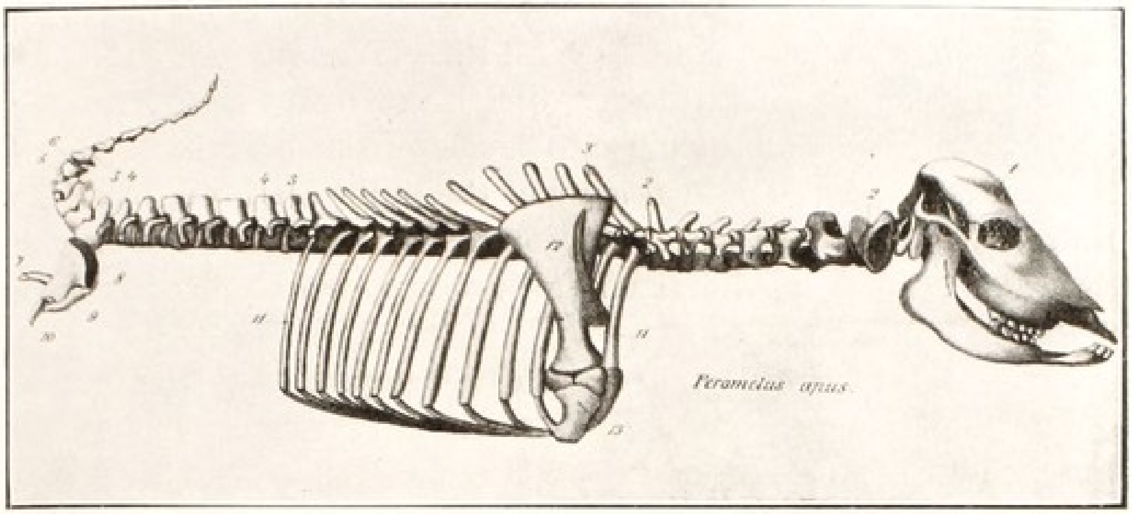


FIG. 58. PEROMELUS APUS. (Gurlt.)

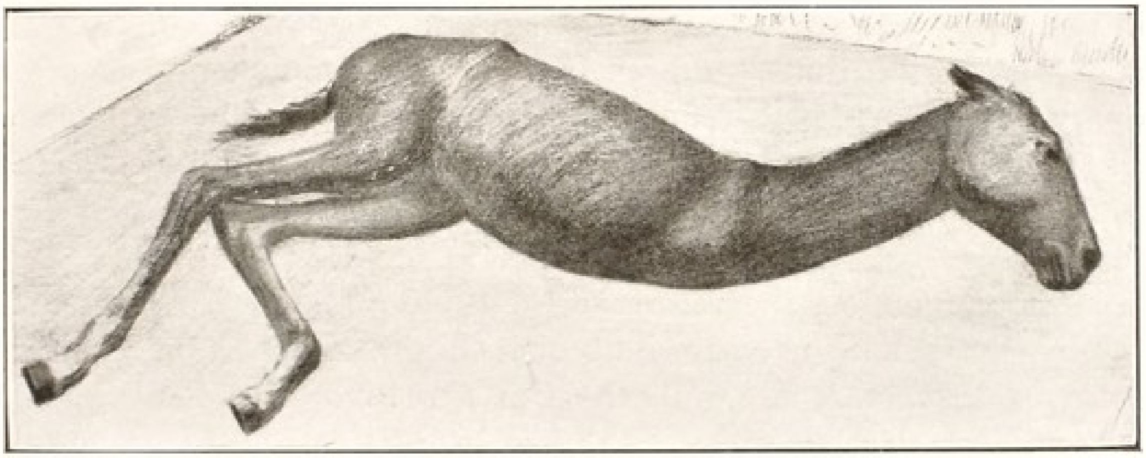


FIG. 59. PEROMELUS ACHIRUS, FOAL.
(Museum N. Y. State Veterinary College.)

extending forward toward the head end and backward toward the tail. From these somites arise the vertebral column ; the skeletal muscles, tendons, and ligaments ; and the corium, or deeper layer of the skin.

The limbs begin as small buds, or outgrowths, arising from the mesoderm opposite the ventral margins of the mesodermic somites soon after the third week in the human embryo, earlier in the rabbit, and probably in most domestic mammals. Each vertebra represents a somite. Each limb bud occupies an area corresponding to that of several mesodermic somites, as indicated by the fact that the nerves passing to each limb are formed by the union of branches from several intervertebral nerves. The buds lengthen to constitute the limbs, the bones arise from the connective tissue, and the muscles develop from the muscle plates of the mesoderm. The segments of the limbs are brought about by transverse grooves where the joints are later to form and the digitations begin as longitudinal grooves, which deepen into clefts.

Various aberrations occur in the development of the limbs. The buds may appear and, within them, rudimentary bones representing the scapula, pelvis, humerus, or femur, but the other parts may fail of development. Any one, or all of the limbs may be wanting. Fig. 58 represents the skeleton of a bovine fetus without limbs (peromelus apus). Fig 59 represents a foal in which the two anterior limbs are wanting (peromelus achirus). Such defects are due to arrests in the development of the limb buds during the first stages of pregnancy. Between such absence of limbs and their normal development, occurs every gradation of arrest, such as peromelus micromelus or dwarf limbs. By becoming involved in a loop of the umbilic cord, a limb may undergo amputation during its early stages of development.

A more common aberration in the limbs and feet is abnormal fission, by which the entire limb or its digitations become multiplied. Most commonly, only the digits are involved, resulting in one or more extra members, as shown in Figs. 60 and 61. Sometimes a greater part of the limb is involved in the abnormal fission. Rarely, in those animals naturally provided with two or more digits, normal fission fails, or, after their more or less complete fission, fusion occurs between them and the animal is born with less toes than normal. The failure of the fission to occur in animals normally having cleft feet may readily become fixed as a family trait, as observed in mule-footed swine.

Sometimes in the development of the limbs a tendency is shown toward the addition of an element not normally present in the genus, but occurring regularly in other genera, as illustrated in well developed clavicles in the pig, shown in Figure 62.

FIG. 60. MEGALOMELUS PERISSODACTYLUS. PIG.

FIG. 61. MEGALOMELUS PERISSODACTYLUS. FOAL.

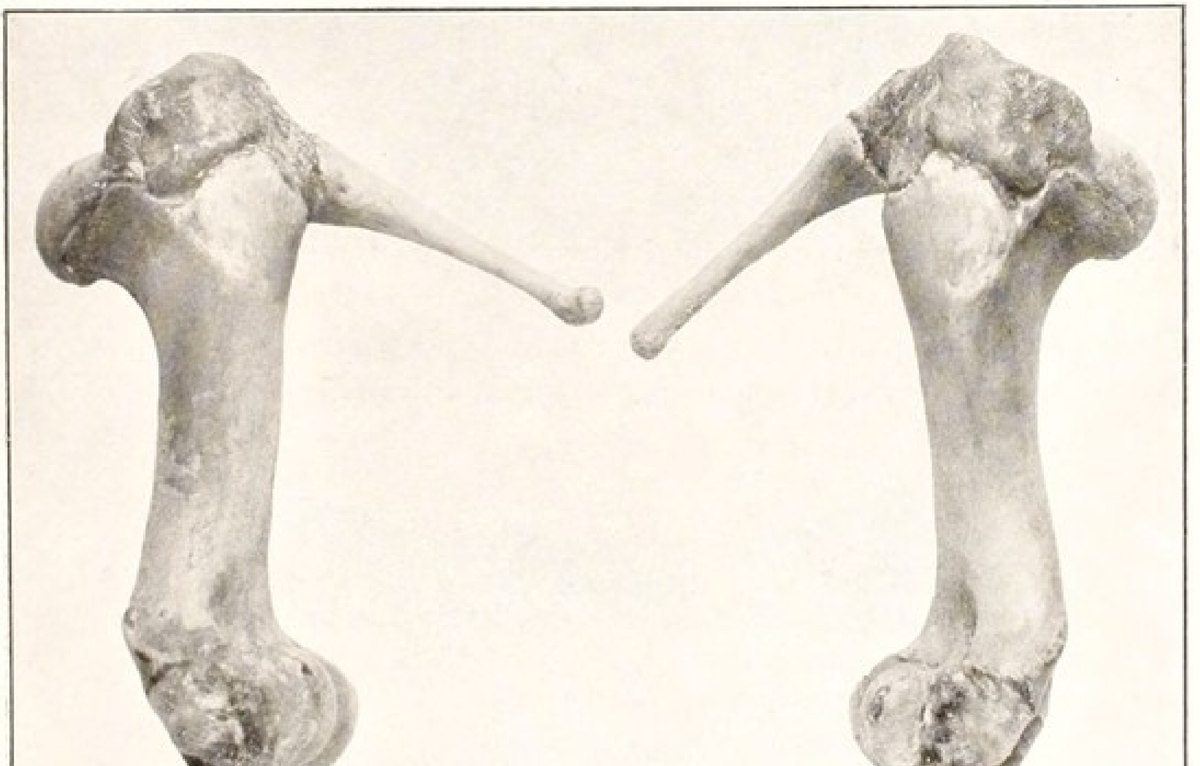


FIG. 62. HUMERI OF PIG, WITH CLAVICLE-LIKE OUTGROWTHS.

FIG 63.
Foal with bent anterior metacarpal bones, showing extreme dorsal flexion of metacarpo-phalangeal articulations.

FIG. 64. Bent metacarpi, from A.

The limbs are furthermore subject to a variety of deformities due to contractions of the articulations or to a bend in the bone itself, as shown in Figs. 63, 64, and 65.

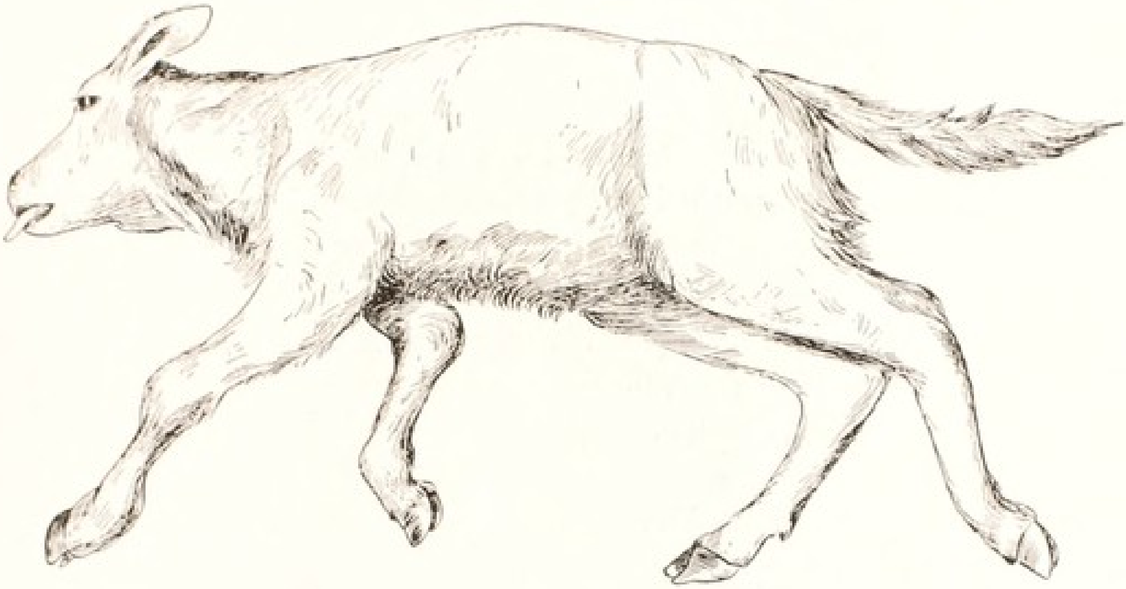


FIG. 65. CONTRACTIONS OF NECK AND LIMBS OF CALF.

THE FETAL MEMBRANES AND THE PLACENTA

The maintenance of the intra-uterine life of the fetus and its development to that degree which will enable it to maintain a more or less independent existence after birth require that effective means be established for the exchange of nutritive and waste materials between the fetus and its mother. The embryo must be fixed at a given point in the uterus, where its position can be maintained throughout the duration of pregnancy, in such a manner as best to protect and insure its life and normal growth. To this end there are formed three structures from the blastodermic vesicle, which undergo changes to constitute finally the fetal membranes and placenta.

1. The Vitelline, or Yolk Sac

When the embryo commences to develop, the embryonic area folds downward and inward at its borders, leading to a constriction between this area and that part of the blastodermic vesicle which lies beyond and constitutes the vitelline sac. The embryonic area and the vitelline sac finally become separated by a narrow neck, the vitelline duct. The yolk plays but a minor part in the development of the embryo. The yolk sac disappears completely in most species, though in some it persists as an embryonal vestige to the time of birth. In the mare the yolk sac is very inconspicuous early in fetal life and disappears almost completely at a very early stage. Fig. 73 outlines the general plan of the sac at the twenty-eighth day of pregnancy. Fig. 74 indicates that at five months the vitelline sac has well-nigh disappeared.

In the sheep, as shown in Fig. 75, the blastodermic vesicle assumes a wholly different form and undergoes great elongation. In other domestic animals there are variations in the form of the sac, but in each alike the vitelline sac is of little importance except during the very earliest stages of embryonic life. Prior to the formation of the amnion, the surface of the blastoderm, and later the vitelline sac, must perform in a primitive way the placental functions, affording means for the limited exchange of nutriment and excrement necessary for the development of the ovum.

2. The Amnion

The amnion commences to form soon after segmentation has been completed and the ovum, after passing through the oviduct, has reached the uterus. In the embryo of the sheep, the amnion

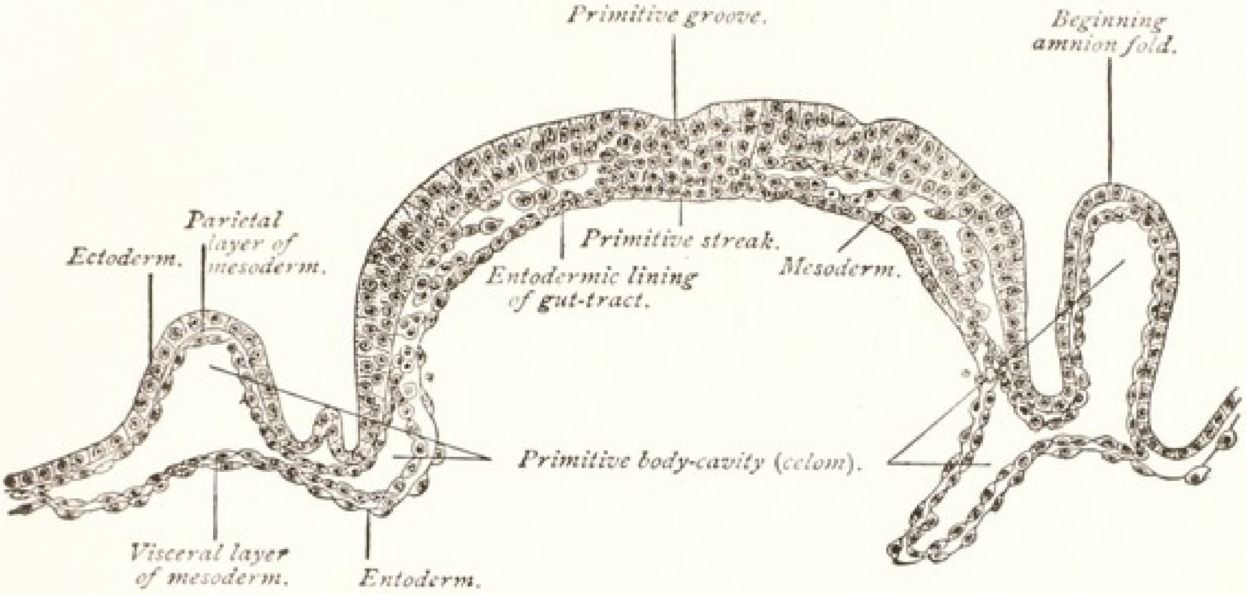


FIG. 66. Transverse section of the embryonic area of a fourteen-and-a-half-day ovum of sheep. (Heisler, after Bonnet.)

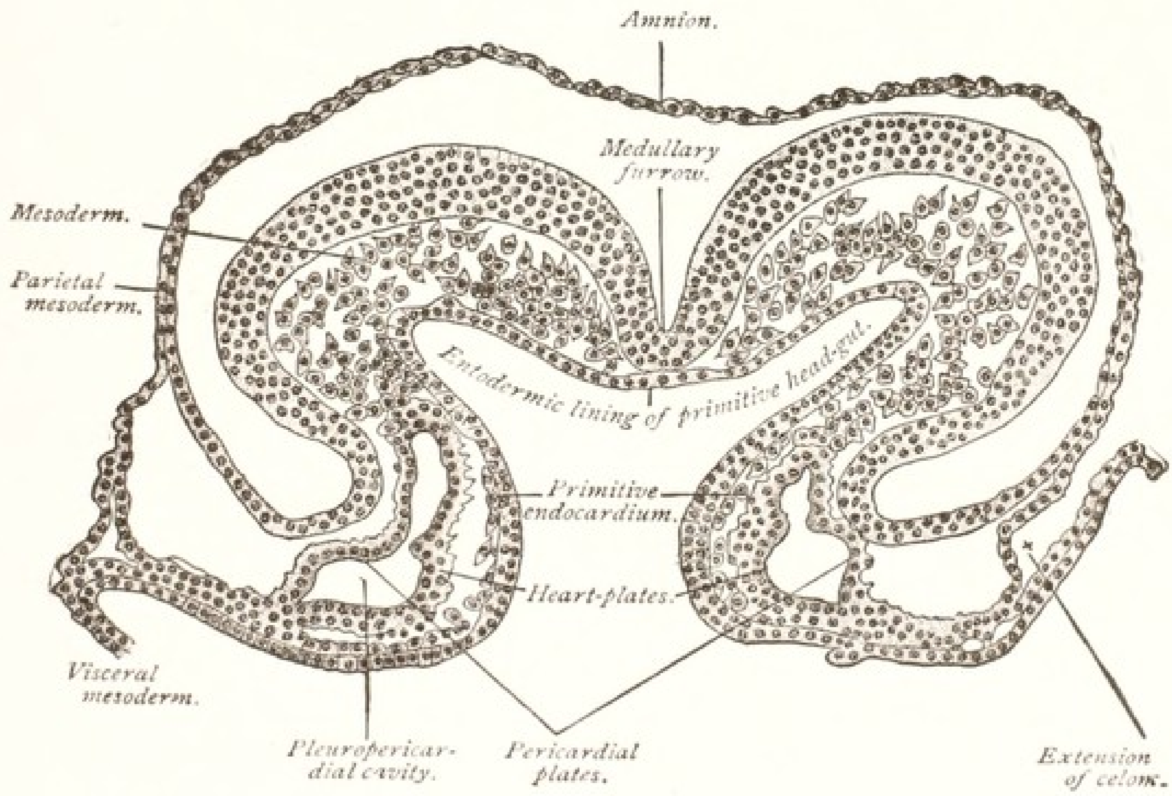


FIG. 67. Transverse section of a sixteen-and-a-half-day sheep embryo. (Heisler, after Bonnet.)

forms at about the thirteenth or fourteenth day of gestation, and is soon complete. The date of the formation of the amnion in other domestic animals is approximately the same.

The amnion arises from the extra-fetal portion of the somatopleure, which folds upward around the margin of the embryonic area. It forms a double membrane which, by continuing to grow upward and converge, finally meets above the dorsal surface of the embryo and fuses. By the fusion there is formed a double sac which envelops the fetus completely except at its point of origin at the ventral surface, where it takes part in the formation of the umbilicus. The inner of these two membranes constitutes the true amnion; the external one forms the external (false) amnion, or primitive chorion. Later, the allantois grows out and blends with it to contribute to the formation of the permanent, or allantois-chorion.

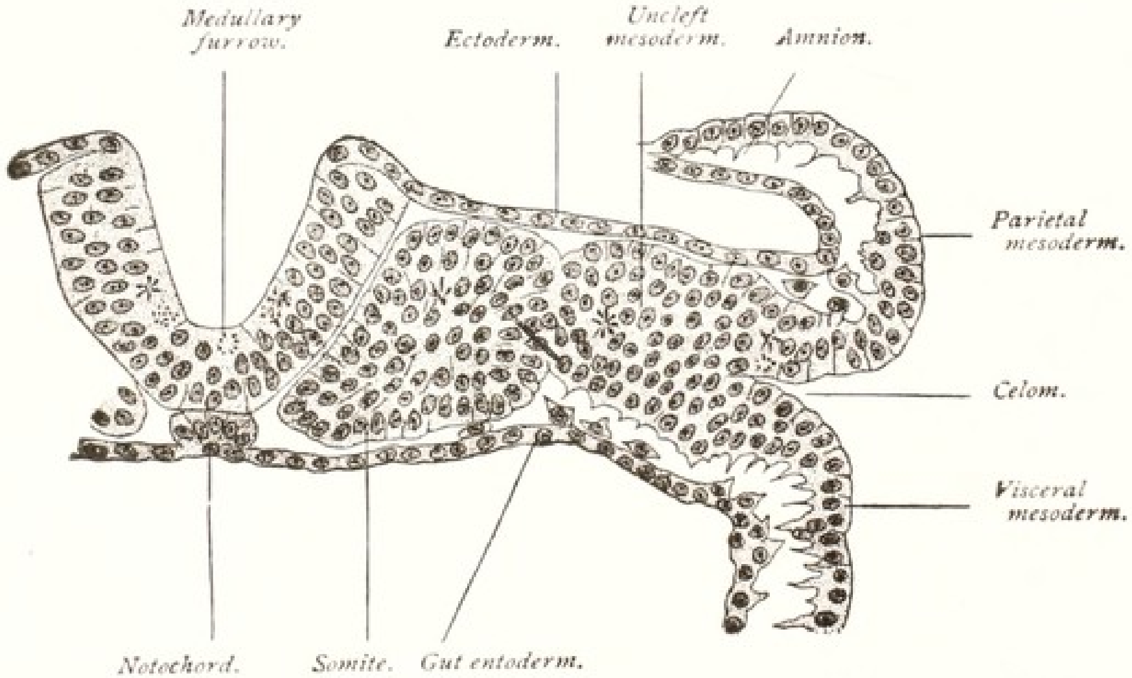


FIG. 68. Transverse section of a sixteen-and-a-half-day sheep embryo with six somites. (Heisler, after Bonnet.)

The outer, or false amnion is merely a portion of the external wall of the blastodermic vesicle, without its relations having been changed exteriorly. Between the ammion and the fetus is the amniotic cavity, filled with the ammiotic fluid.

When the amniotic cavity becomes distended with fluid, the amnion closely invests the vitelline stalk and the allantoic vessel. The amount of liquor amnii varies greatly in different animals and at different periods of pregnancy, but it is generally most abundant at about the middle of gestation. In the cow and the mare, the amount of amniotic liquid varies from 5 to 8

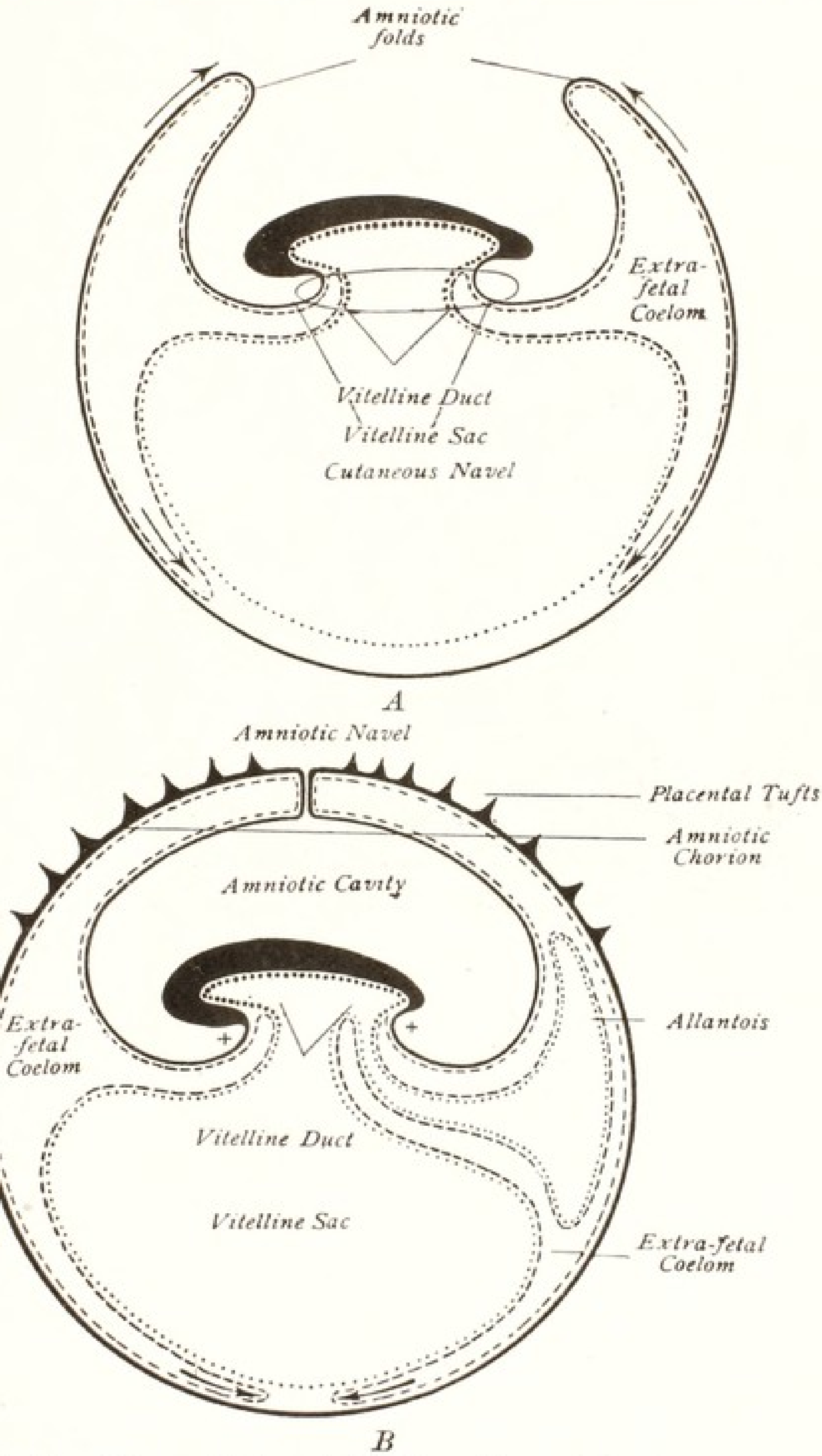


FIG. 69. Schematic longitudinal sections of fetal annexes of mammalia. At the points indicated by + the skin is continuous with the amnion. (Bonnet.)

liters ; in the sheep, according to St. Cyr and Violet, it varies between 100 and 500 grammes ; in woman, the amount is said to be about 1½ liters.

A pathologic increase of this fluid constitutes dropsy of the amnion. The amount of the dropsical fluid in the cow may reach twenty or more gallons and prove so burdensome as to prevent the patient from arising when down, because of the great weight of the accumulated fluid (See Dropsy of the Amnion).

In some cases, especially in the embryo of the cow, the amnion is believed to become contracted during the early stages of its formation and cause an eversion of the somatopleuric portion of the embryo, producing the distortion known as schistocormus reflexus. In this aberration, the body cavity is not completed and the internal viscera, derived from the splanchnopleure, lie free within the chorion. In other words, the constriction and infolding of the splanchnopleure, to constitute the intestine, proceeds. The constriction which should externally mark the division between the fetal and the vitelline portions of the somatopleure, to constitute the umbilicus, fails to develop ; the amnion contracts ; the spinal column of the embryo bends ventralwards and passes out through the non-constricted umbilic area ; and the embryo turns inside out. The spinal axis of the fetus becomes sharply doubled dorsally and the somatopleuric portions lie as a partially everted sac with its pleuro-peritoneal surface presenting externally (See Figs. 71 and 72). It is said that the amnion sometimes adheres to the ectoderm of the fetus, usually upon the head, and causes an important or serious obstacle to parturition.

The liquor amnii contains albumin, sugar, urea, and other elements of urine, and, abnormally, in some cases meconium. The source of the amniotic fluid has not been fully shown. Some hold that the fluid transudes into the cavity from the amnion, coming from the blood of the fetus. Urine may be expelled readily and freely into the amniotic cavity through the urethra.

The amnion consists, on the fetal side, of a thin layer of ectoderm ; on the outer side it is formed from the somatopleuric mesoderm. The external surface of the amnion is in contact with and adherent to the inner wall of the allantois.

FIG. 70. SCHISTOCORMUS REFLEXUS. (Gurlt.)

FIG. 71. Schistocormus reflexus, after partial embryotomy to overcome dystokia.

E, left ear, above which is seen the radial portion of the left carpus.

F, right anterior foot. R, ribs. S, sternum.

Pl, lacerated area where posterior limbs have been torn away.

3. The Allantois.

The allantois arises as an evagination from the hind gut, just posterior to the vitelline duct, and grows outward and backward between the amnion and the primitive chorion (false amnion), as two separate layers. In the mare and carnivora, the allantoic sac finally envelops the amniotic sac completely, so that in these animals there occur two complete hollow fetal envelopes, the cavity of each filled with fluid (See Figs. 73, 74). The allantois consists of two distinct walls, of which the inner is in contact with the amnion and the outer fuses with the primitive chorion (false amnion), to form the permanent allantois-chorion. Each of the allantoic walls consists of two layers—entoderm and mesoderm. The sac is lined with entoderm, outside of which is a layer of mesoderm. On the inner, or amniotic side, the mesoderm of the allantois is in immediate contact with the mesoderm of the amnion and the two become intimately adherent, though separable. The allantoic mesoderm of the outer wall is in contact with the mesodermic layer of the primitive chorion and fuses with it. Tracing the allantois-urinary tract from behind forward, there is found the constricted urethra and the dilated urinary bladder from the urinary segment of the cloaca. From the allantois, beginning at the anterior end of the urinary bladder, there is an elongated, narrow tube—the urachus—which extends from the fundus of the urinary bladder, through the umbilicus and the umbilic cord, across the amniotic cavity, where it dilates to form the allantoic sac.

In domestic animals the allantois forms a great sac filled with the allantoic fluid. This consists largely of the secretions from the kidneys, augmented possibly by transudation from the blood vessels of the walls of the sac itself. Since it contains albumen, grape sugar, and urea, it is similar in character to the amniotic fluid, except that no meconium can reach this cavity, since only the urinary tract communicates with it.

In the fetus the urinary secretions may pass from the urinary bladder, either backward through the urethra into the amniotic cavity or forward through the urachus into the allantoic cavity. Consequently, through this tract the two cavities communicate throughout intra-uterine existence. In the human embryo there

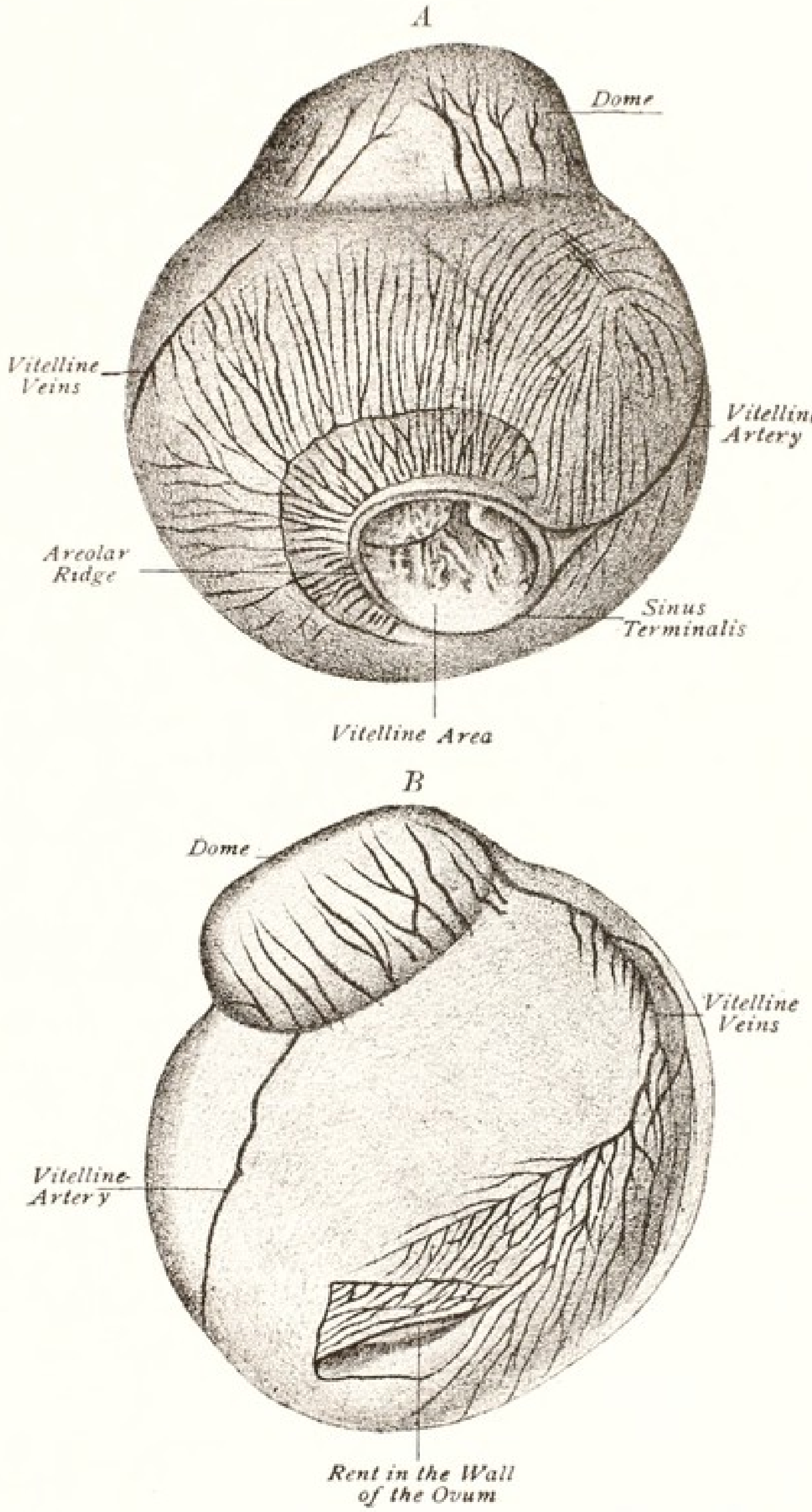


FIG. 72. A, embryo of the horse in its membranes. 4.2 cm. in its greatest diameter. Twenty-eight days after fecundation.
B, the same seen from the other side. (Bonnet.)

is virtually no allantoic sac: the allantois is a simple tubule, the cavity of which quickly becomes obliterated.

Collectively, these membranes, with the addition of the vestigial remains of the vitelline sac, constitute the fetal membranes, or afterbirth.

The Chorion

The external, or vascular layer of the allantois, with vestiges of the external, or false amnion, constitutes the permanent, or allantoic chorion. In the brief interval elapsing between the formation of the amnion and the allantois, the external, or false amnion performs temporarily the functions of the placenta by throwing out placental tufts, which acquire intimate contact with the mucosa of the uterus, maintain the attachment and fixation of the embryonic sac in its position, and provide for nutrition and excretion. Later, when the vascular layer of the allantois spreads over the inner surface of the false amnion and fuses with it, the allantoic tufts push out into the existing amniotic structures, acquire intimate relations with the uterine mucosa, and bring about finally the effacement of the amniotic chorion as a recognizable structure.

The form, extent, and relations of the allantois in different animals present great variations. In the mare, as indicated in Figs. 73 and 74, the allantoic sac completely surrounds the amnion, forming a second complete double envelope, except for the area occupied by the vestigial yolk sac. Thus, it separates completely the true from the false amnion, or amniotic chorion. A study of Fig. 74 shows that the somatopleuric mesoderm, or outer layer of the true amnion, is in contact with the splanchnopleuric mesoderm of the allantois. The two membranes are separable by exercising great care, but are so intimately blended that ordinarily the two, taken together, are regarded as the amnion, though actually distinct. Similarly, the external wall of the allantois presses against the mesoblastic layer of the amniotic chorion, or false amnion, fuses with it, and constitutes the allantois-chorion.

The blastoderm of the horse is spheroidal or globular, as indicated in Figs. 73 and 74. In ruminants and swine, as shown in Figs. 75 and 76, the sac becomes very greatly elongated, much

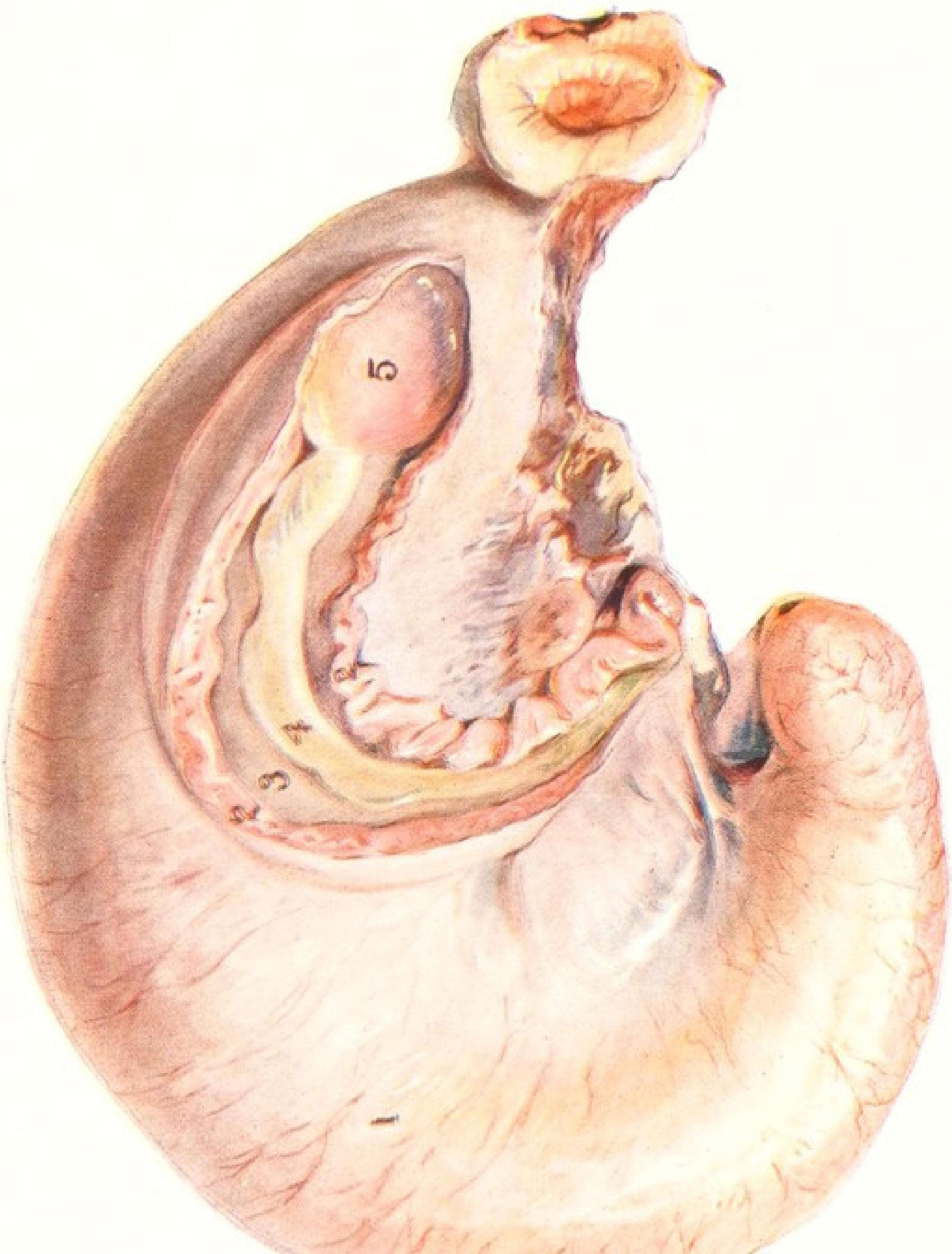

5
4
3
2
1

Plate III.

Gravid Uterus of Cow at about four months, showing Abortion Exudate in the Non-gravid Horn.

1. Right (gravid) horn. 2, 2. Cut margins of non-gravid horn. 3. Cavity of non-gravid horn, the mucosa covered with the exudate of contagious abortion. 4. Necrotic chorion of non-gravid horn covered over with brownish-yellow exudate of contagious abortion. 5. Healthy base of the fetal sac of the non-gravid horn, continuous with the healthy fetal sac of gravid horn.

longer than the uterine cavity. This elongated sac does not persist, but atrophies and almost wholly vanishes long before birth. In swine the apices of the allantoic sac are destitute of placental tufts, as shown in Fig. 76. In ruminants (Fig. 79) and in swine, the allantoic sac becomes much elongated and its cornual apices, along with the amniotic chorion, finally undergo necrosis, as is shown on the right of the figure, or the apices of the

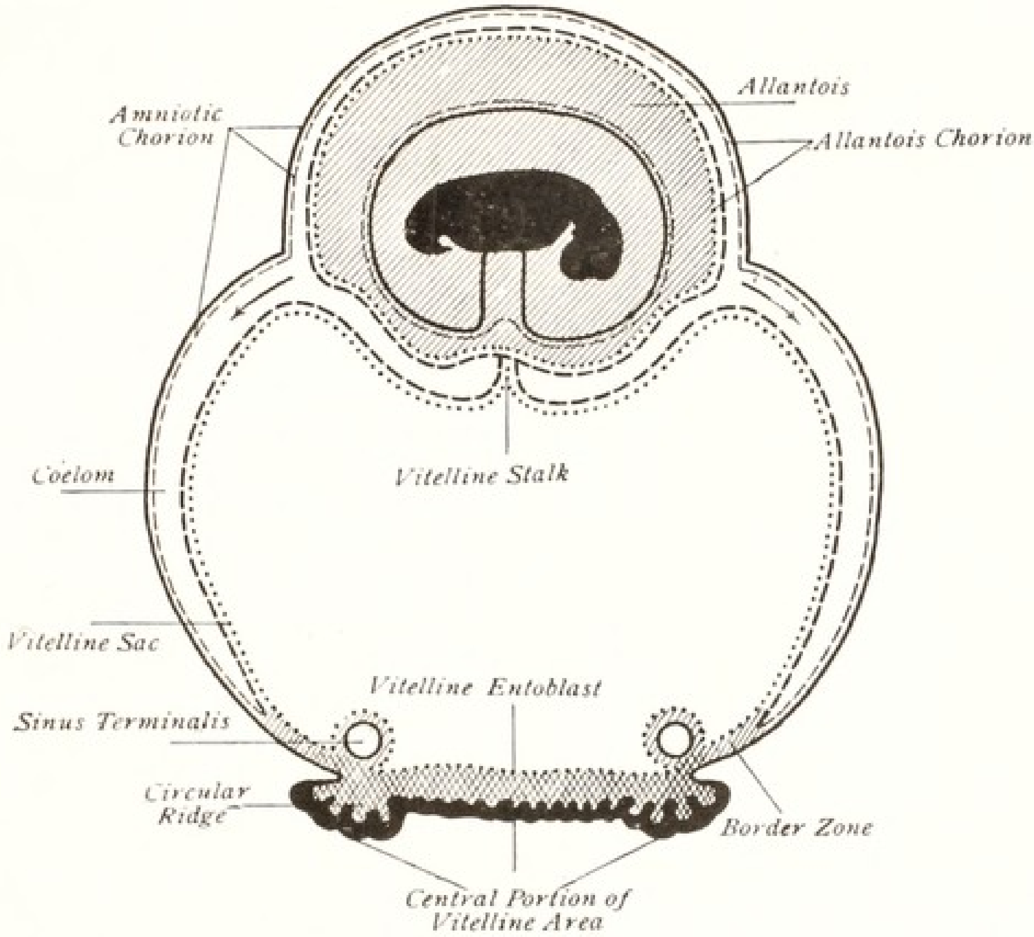


FIG. 73. Schematic illustration of fetal annexes of the embryo of the horse, 28 days after fecundation, as in Fig. 72. Perpendicular section through the embryo and its envelopes.
The embryo in black. —Ectoderm. . . . . Vitelline layer.
– – – Parietal mesoderm. — — — Visceral mesoderm. (Bonnet.)

amniotic chorion alone become necrotic without the allantois having penetrated them, as shown at the left. According to Bonnet, this is caused by pressure due to the excessive length of the fetal sac.

The actual cause and significance of the necrotic tip of the fetal sac is unknown. Macroscopically, it appears pathologic. In some cases it is unquestionably pathologic. Where the boundary line lies between physiology and pathology, is not known. The degree of necrosis is almost never the same at each apex, but is as a rule far greater in that of the non-gravid horn. Sometimes the necrotic tip is not recognizable; sometimes the entire non-gravid horn is necrotic.

In single pregnancy the allantoic sac of the ruminant occupies both cornua, though in varying degrees of inequality. The ar-

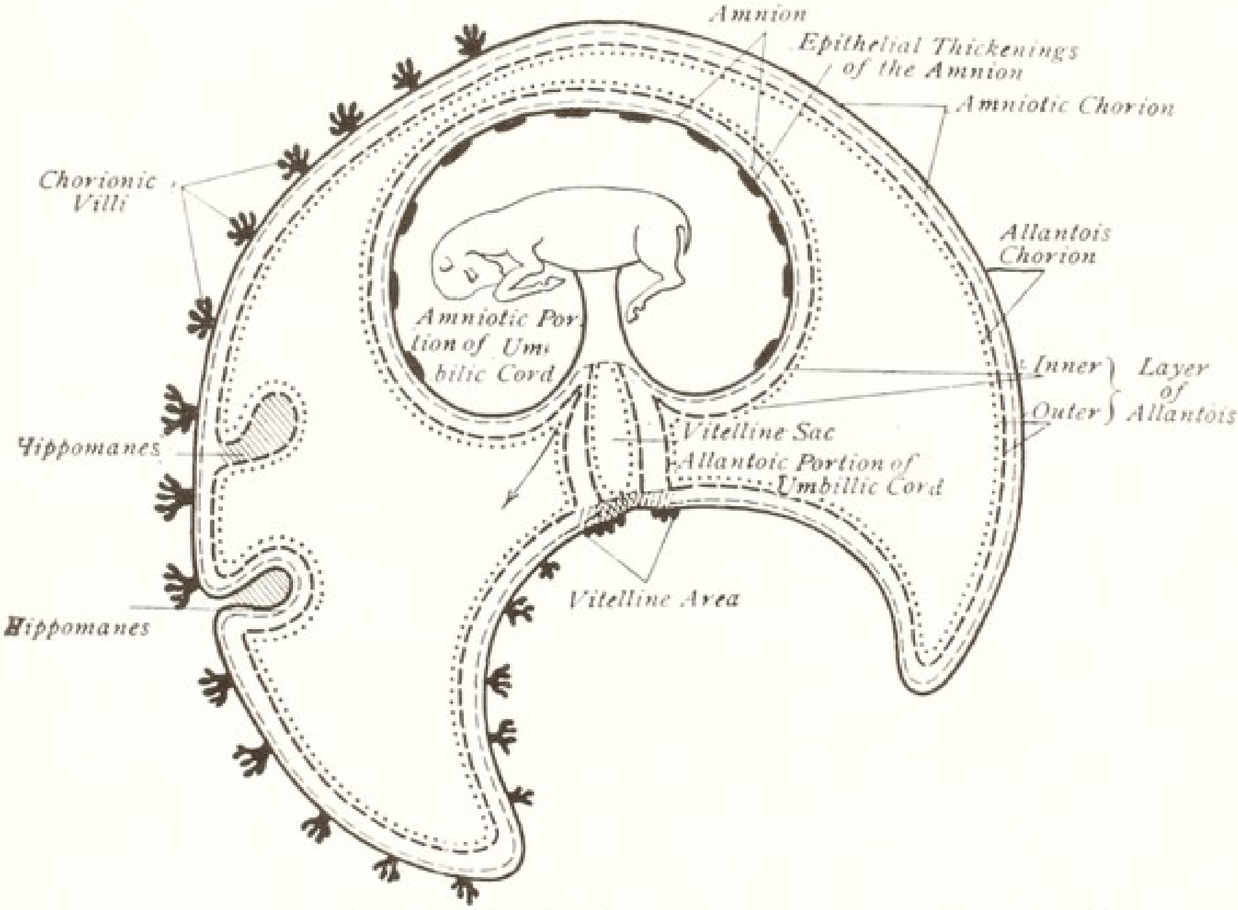


FIG. 74. Schematic longitudinal section of a horse embryo in its annexes, at about five months gestation. Reduced to about 1/6. (Bonnet.)

rangement of the allantois in ruminants differs greatly from that in the horse. At first the allantoic sac of ruminants completely surrounds the amniotic sac, somewhat similarly to that of the mare, as indicated in Plate II, but as pregnancy advances the allantoic sac retracts ventralwards alongside the amniotic sac, as indicated in Plate I (frontispiece). The allantoic sac then appears as a greatly elongated cavity along the ventral and lateral portions of the amnion and, extending far beyond the amnion anteriorly and posteriorly, reaches the apices of both horns. This

PLATE II.

FETAL SAC OF COW AT ABOUT 100 DAYS.

A Amnion.
Al. Allantois.
1. Necrotic tip of non-gravid horn.
2. Necrotic isthmus between gravid and non-gravid horn.

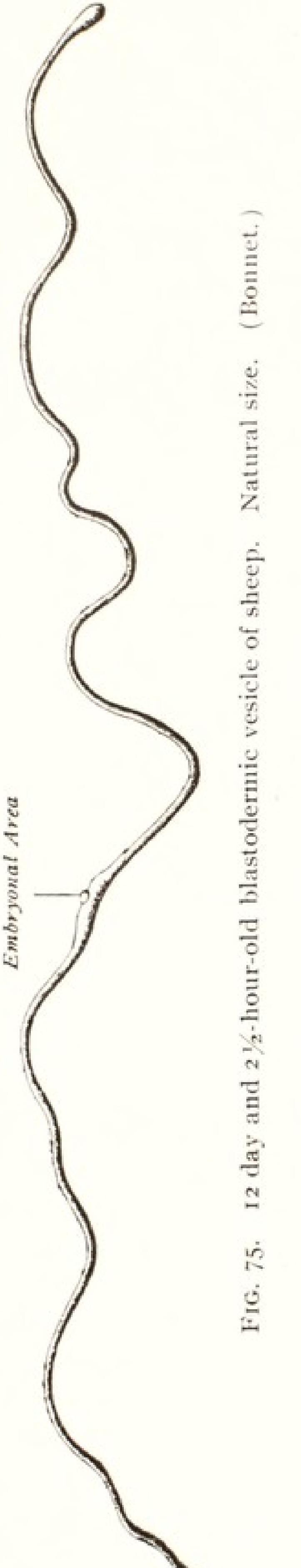


FIG. 75. 12 day and $2\frac{1}{2}$-hour-old blastodermic vesicle of sheep. Natural size. (Bonnet.)

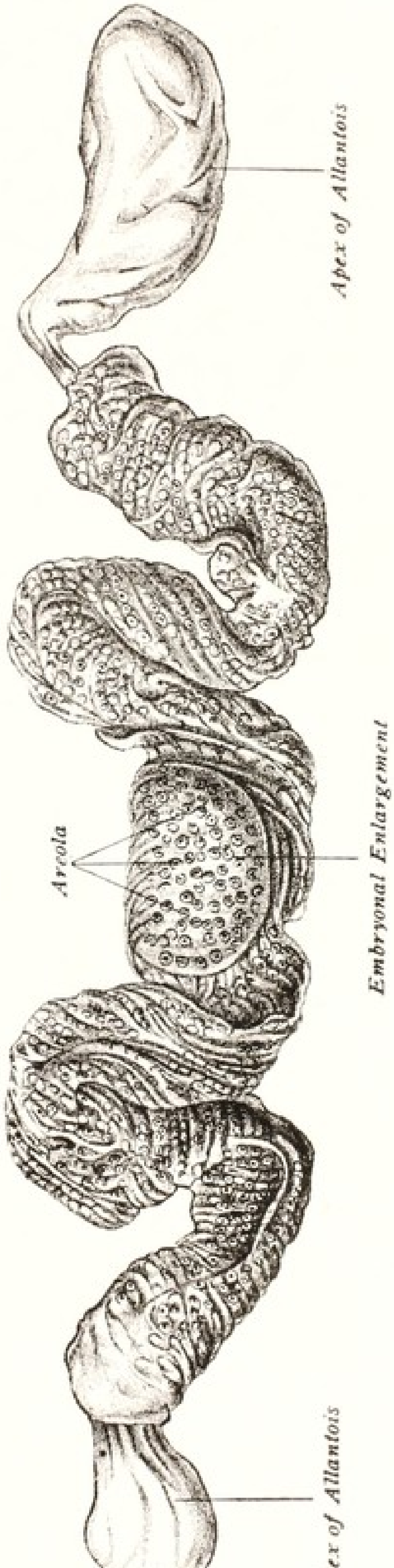


FIG. 76. Swine embryo and its membranes. 48 cm. long. Reduced to about $\frac{1}{2}$ size. (Bonnet.)

applies however only to the inner, or entodermic layer of the allantois, which constitutes the lining of the allantoic sac. The vascular, or mesoblastic layer persists completely around the fetus and its amnion, but, over that portion of the amnion where the allantoic sac does not extend, the amnion and the vascular layer of the allantois are unseparated by any intervening fetal fluids. As mesoderm is everywhere contiguous to mesoderm, and entoderm to entoderm, the two allantoic layers and the amnion become adherent to each other over a large area, to such a degree as to make their separation difficult.

The difference in the character and extent of the allantoic sac establishes a marked difference in the phenomena of parturition. In the mare, where the allantois constitutes a complete enveloping sac filled with fluid, the fetus may be born more or less completely enclosed within the amniotic sac and the adherent inner or amniotic layer of the allantois; in ruminants, the extensive area of the amnion not covered by the allantoic sac causes the former to remain adherent to the chorion and the fetus to be born naked.

The Placenta

The placentae are those portions of the fetal membranes, or annexes, and of the uterus which serve to bring about an intimate contact between the circulatory systems of the mother and the fetus. Since there is virtually no nutrient reserve in the vitellus, the development of the mammalian embryo can proceed independently for but a brief period, and its further growth must depend upon nutritive substances obtained from the uterus of the mother.

When the morula reaches the uterine cavity at the eighth to tenth day, the primitive chorion throws out tufts, the primordial chorion, which enter into somewhat intimate relations with the uterine mucosa. This zone soon becomes attenuated, and disappears, as the blastoderm rapidly enlarges within it. This primitive chorion, or prochorion, must be replaced by a more permanent and efficient structure for the nutrition of the fetus.

When the amnion develops, the external, or false amnion is but a continuation of the somatopleuric wall of the yolk sac, which completely invests the embryo. Over the entire surface of this embryonic sac, villi grow out to establish relations between the embryo and uterus, to constitute the amniotic chorion, or placenta. These structures—like the preceding, primitive and temporary in character—soon become lost, as unimportant parts of the more permanent structure to follow, or they atrophy and disappear.

When the vascular layer of the allantois develops, it grows out and fuses with the amniotic chorion, which largely disappears or becomes lost as a separate membrane, while the blood vessels

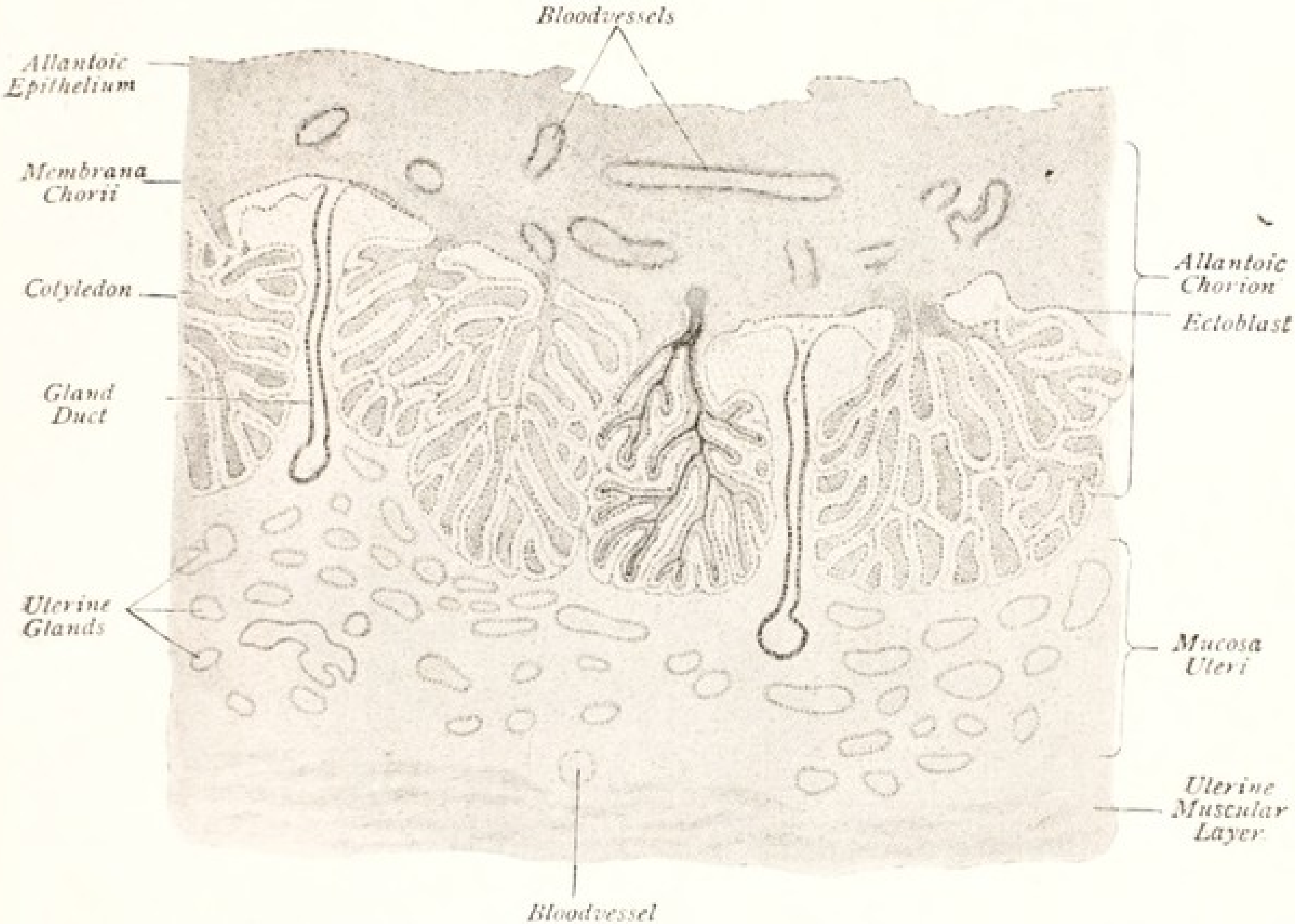


FIG. 77. Section through the chorion and uterine mucosa of the horse, at 9½ months. Enlarged about 45-1. (Bonnet.)

from the allantois grow out through it to constitute new tufts, which soon attain an intimate relation with the blood vessels of the uterus.

The blood vessels of the fetus and those of the mother do not become continuous, but are constantly separated by the endothelial layers of both the maternal and the fetal capillaries. The capillaries of the allantois become greatly branched and grow out as villi, which, sinking into the mucous membrane of the uterus, come into immediate contact with corresponding capillary loops from the uterine vessels and become closely applied to each other, with extremely thin walls, through which there is a free interchange of nutritive and waste products, but not of cellular elements.

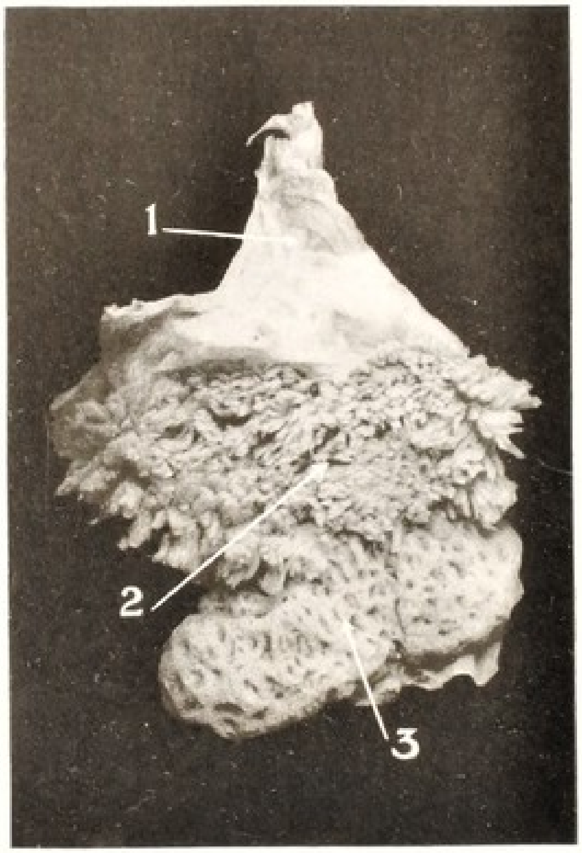


Fig. 78. Cotyledon of Cow, from photograph.

1, chorion. 2, chorionic tufts. 3, cotyledon of uterus, showing placental crypts.

The separation of the fetal from the maternal circulation is so complete that most micro-organisms of disease do not ordinarily pass through, and consequently where the mother is affected with a contagious disease the fetus does not ordinarily contract it through the blood stream. For example, in tuberculosis the fetus is almost never infected during its intra-uterine existence, but is born free from the malady, however badly the mother has been affected during the period of pregnancy. In those rare cases of fetal tuberculosis which are recorded, the infection is

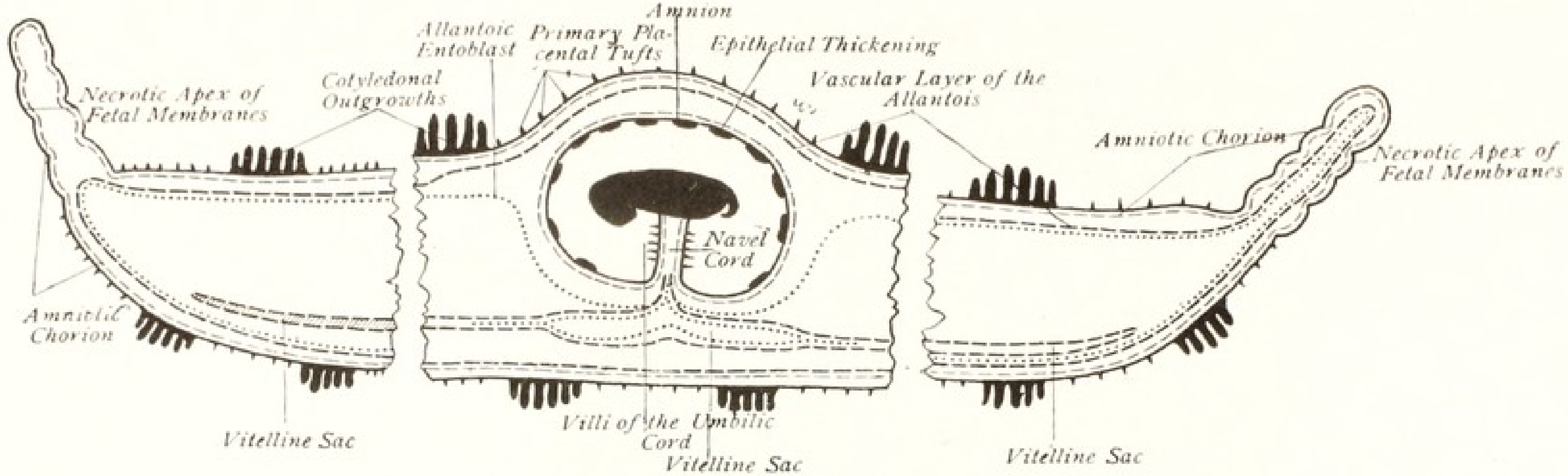


FIG. 79. Schematic sagittal section through the fetal annexes of ruminants. The parts between the two end portions and the central piece are represented as having been excised. (Bonnet.)

usually attributed, not to the passage of the tubercle bacillus through the undamaged placental filter, but to placental tuberculosis, in which the tuberculous lesions grow through the placental filter and invade the fetal tissues.

The area—or areas—in the mucosa of the uterus at which elaborate changes take place for the attachment and nutrition of the fetus, is known as the maternal placenta. The corresponding portion—or portions—of the chorion, which sends capillary tufts into the placental crypts of the uterus, constitutes the fetal placenta.

Among domestic animals there are great variations in the placentae. In some species the relations existing between the fetal villi and the capillaries of the uterus are said to be so intimate that, when the fetal placenta is removed, a portion of the mucous membrane of the uterus is carried with it; in other animals the placental villi of the fetus pull out of the maternal crypts and leave the capillary walls intact. Owing to this difference in the mode of separation or dehiscence of the fetal membranes, mammalia are divided into two groups: the deciduata, in which the maternal mucosa is presumed to come away with the fetal membranes; and the indeciduata, in which the separation between the fetal membranes and the uterus occurs between the tufts of the chorion and the maternal vessels. In the indeciduate group are horses, swine, and ruminants—except the camel; in the deciduous group elephants, carnivora, rodents, and monkeys.

Placenta (a flat cake) signified originally the cake-shaped vascular structures forming the physiologic bond of contact between the uterus and the chorion in woman. Regardless of their form or distribution, the term has come to signify the analogous structures in all higher mammalia.

The form and extent of the placenta in the different species vary greatly. In equidae the placentae, or chorionic villae, are diffused over the entire surface of the chorion, as small elongated tufts, which we know as diffuse placentae. In swine the placental tufts are distributed over the chorion much as in the mare, but the ends of fetal sacs, abutting against each other, naturally prevent the placental formations at these points of contact. In ruminants, the villi are restricted to about one hundred comparatively small areas, which are known as placentules, or cotyledons. Between the cotyledons, the chorion is free from the uterus. In the non-gravid uterus of the ruminant there exist numerous elevations upon the surface of the mucosa, which constitute the quiescent cotyledons.

When impregnation takes place, the cotyledons become highly vascular and their mucous membrane undergoes marked development, while from the chorion there grow out, at points corresponding to these eminences, numerous branched tufts, which ultimately sink deeply into the mucosa of the cotyledons, or placentules. This condition is designated as multiple placenta (See Figs. 78 and 79). In carnivora the placentae are zonular. The chorionic villi are restricted to the zone of the chorion encircling the embryonic sac, in contact with the uterine walls. At the anterior and posterior poles of the fetal sac, as in swine, where they come in contact with adjacent fetal sacs, the chorion is devoid of villi. The contiguous choria must not fuse nor bear tufts, lest the fetal membranes of one fetus bar the way to the egress of the succeeding young during parturition.

The Umbilic Cord

The umbilic cord serves as a bond of communication between the embryo and its placenta. It is formed by the allantoic stalk, surrounded by the amnion, and includes the vestiges of the vitelline duct. In the mare and carnivora it is divided into the amniotic and allantoic portions. The amniotic portion, or the umbilic cord proper, extends from the umbilicus of the embryo, through the amniotic cavity, to the allantois. The allantoic section of the umbilic cord extends across the allantoic sac, from the amnion to the allantois-chorion. A cross section of the umbilic cord in the amniotic portion reveals the following structures: the amnion, serving as a thin, dense, investing membrane; the two umbilic arteries; the pair of umbilic veins, sometimes fused to constitute a single vessel; the urachus; and the vestiges of the vitelline duct. Around these vessels, filling out the amniotic sheath and investing the urachus and vessels within to constitute a more or less even cord, is the Whartonian jelly embedded in a network of delicate connective tissue.

The allantoic portion of the umbilic cord consists essentially of the mass of umbilic vessels, which have now become more or less branched. Partially surrounded by, and adherent to these vessels, may exist more or less evident remnants of the vitelline duct and sac, prominent in the very early stages of fetal life, rapidly disappearing later. The urachus expands into a funnel-shaped dilation just beyond the amniotic sac, to constitute the allantoic sac.

During the earlier stages of gestation in the cat, and occasionally in other animals, there projects into the umbilic cord, in front of the allantoic stalk, one or more loops of intestine, and in some cases portions of the liver or of other viscera. The protruding intestinal loop escapes through the umbilic ring of the somatopleure, beside the allantoic stalk, inside the skin and amniotic sheath. Apparently the primary protrusion of viscera through the umbilicus occurs because the abdominal cavity has not developed with sufficient rapidity to accommodate the rapidly growing visceral mass. Consequently, portions of viscera are crowded out through the umbilic opening alongside the vessels and remain outside the abdominal cavity until the contraction of the umbilicus gradually forces them back into the now more capacious abdomen, where they remain permanently. Sometimes the umbilic ring does not normally contract : it remains open, the intestinal loop fails to return within the abdominal cavity, and the fetus is born with umbilic hernia.

The vessels of the umbilic cord are disposed spirally from left to right—a condition sometimes suspected to be due to a revolution of the fetus upon its short axis, but apparently more properly referable to a fundamental plan in development uninfluenced by fetal movements. The spiral arrangement of the cord adds to its compactness and strength and aids in the maintenance of the vessels in regular order.

The length of the umbilic cord varies widely with species and individuals. In the foal, where it is from 35 to 40 inches long, the amniotic portion represents about one-third of the total length. The cord is sufficiently long that, when the foal is normally born and the dam is in the recumbent position, it remains intact and may even persist after the mare has risen to her feet, but ruptures when she turns her head to the foal, to lick it, or starts to move away from it. Sometimes the foal, by its struggles, ruptures the cord ; sometimes the cord remains intact, the chorion is completely expelled, still attached to the foal, and the rupture of the cord takes place after the foal rises to its feet.

The normal point of rupture of the navel cord of the foal is about 1½ to 2 inches from the umbilicus, at a well marked constriction. This delimits the cord proper from what may be called the *umbilic base*, or cutaneous navel—a hairless, cylindrical, firm segment 1 to 1½ inches long. At the termination of this portion, a softer and more fragile cord begins with a somewhat constricted neck. Within the fragile area of the cord at a point one-half inch or more from the base, the rupture of the cord generally occurs.

The navel cord of the calf, consisting of an amniotic portion only, is less than half as long as that of the foal: it ranges between 11 and 16 inches—one-fourth to one-fifth the length of the fetus. This difference leads regularly to rupture during the expulsion of the fetus and only rarely permits the birth of the calf with the cord intact. Hence, in the cow and other ruminants, not only is the fetus born naked, as already related, but during its expulsion the rupture of the cord usually frees it completely from all fetal annexes.

In the pig the umbilic cord is wholly amniotic and very long—as long as the fetus; in carnivora the cord is short and very resistant, so that eventually it is usually bitten in two by the mother.

PREGNANCY, OR GESTATION

Pregnancy, or gestation, is that period during which the young is undergoing development in the uterus of the mother, a period extending from the time of the fertilization of the ovum until birth. The modifications which necessarily take place during this period are of a very profound character and exert an important influence upon the life and the nutritive powers of the mother.

The volume of the uterus becomes very greatly increased. The walls of the non-gravid organ are contracted and firm and the uterine cavity is insignificant. The mucous membrane of the uterine walls is in contact. As soon as impregnation occurs, the uterus must become very greatly increased in volume in order to accommodate the fetus, the fetal fluids, and the fetal membranes. Prior to impregnation, during estrum, the uterus has undergone some degree of enlargement and intensified function preparatory to the reception and nutrition of the fertilized ovum. Consequently, impregnation in a way continues and accelerates the increase in the volume of the uterus until it reaches its maximum just prior to parturition.

The first notable change in the uterus, which has already been anticipated during estrum, is greatly increased vascularity, both of the muscular walls and of the mucosa. The mucous membrane becomes especially vascular, as is shown by its deeper color and its great increase in thickness, as well as by a softening of the membrane. The increased function in the mucosa is not equally apparent in all parts, but is most pronounced in those regions where the attachment of the fetal placenta is to occur. Thus, in the ruminant the principal increase in activity and growth of the mucosa is at those points which are to constitute the cotyledons of the gravid horn. In the mare, with diffuse placenta, the vascularization takes place uniformly over the entire organ. In the bitch and cat, it is largely concentrated in that part which is to enter into relations with the placental zone of the fetus.

In multiparous animals such as the bitch, cat and sow, the uterine cornua become enlarged and bulged at the points where the impregnated ova have lodged and are later to become attached to develop into embryos This arrangement results in a nodular form. The nodes in the elongated organ are usually quite equally distributed throughout the entire length of the tube. In uniparous animals, in which the fetus, as a rule, is lodged partly in one cornu and partly in the body of the uterus, the gravid cornu and body increase far more rapidly in size and undergo greater changes in structure than the non-gravid or vacant cornu.

When pregnancy occurs, the arteries and veins of the uterus enlarge very rapidly and increase to many times their former volume, so that any injury or wound of these vessels tends to cause more or less serious hemorrhage. The ready availability of the uterine arteries in cows and mares by rectal palpation supplies valuable guidance in the diagnosis of pregnancy.

The tension of the non-gravid organ serves to differentiate it from the intestines and other abdominal viscera, because of its firmness upon palpation. During pregnancy the tension decreases somewhat, but in most animals the organ remains more tense than the contiguous viscera. In the pregnant bitch the tension of the organ decreases to such a degree that it closely resembles the intestine and occasionally embarrasses the operator when spaying a bitch unexpectedly pregnant. The decrease in the tension of the organ is attributable partly to the thickening and softening of the highly active mucous membrane, partly to the enormous increase in the number and volume of the arteries and veins in the uterine walls, and partly to a relative decrease in the thickness of the muscular walls and to the distension of the uterine cavity with the fetal fluids. In the non-gravid uterus there is present in the contracted organ a reserve of tissue, which must later undergo very rapid development. The wall of the non-gravid is usually fifty to one hundred per cent. thicker than that of the gravid cornu.

The glands in the uterine mucosa become rapidly elaborated: the utricular glands become enlarged, they increase in length and width, and their secretions become augmented. In the ruminant, the uterine cotyledons develop rapidly. Some have believed that new ones appear. Rainard could distinguish but thirty to forty cotyledons in the uteri of heifers or lambs, but after parturition found one hundred or more. This conclusion is most certainly erroneous, and probably due to the inconspicuousness of the cotyledons in females which have not been in estrum. If placental areas develop after the birth of the animal, they would be expected to be irregular in number and arrangement, but this is not true. The cotyledons are quite regularly disposed as shown in Plate I (Frontispiece), but after the cotyledons have been destroyed by disease the new adventitious cotyledons follow no law in number, disposition, size, or form. In that part of the mucous membrane of the uterus where placental structures are to form, crypts develop at an early period of pregnancy, into which the villi of the fetal chorion grow and acquire intimate contact. The crypts are the counterparts of the villi of the chorion and vary in their form and complexity according to the species of animal. They are lined with a thin layer of epithelium, immediately beneath which are the placental capillaries, in a rich net-work. In the mare, the crypts are distributed over the entire uterine surface, in harmony with the distribution of the villi of the chorion; in the cow they are limited to the cotyledons and constitute essentially the mass of these organs during pregnancy. In those animals having zonular placentae, they are confined to the placental zone. Between the mouths of the crypts, utricular glands open upon the surface of the mucous membrane and pour out their secretions, the uterine milk (See Fig. 77).

During pregnancy the muscle fibres of the uterus become increased in size and apparently multiplied in numbers, leading some to believe that the increased volume of the organ is not wholly dependent upon increased function in some of the muscle cells, but partly upon a multiplication of the muscle fibres. The lymphatics and nerves also increase in extent and volume during pregnancy.

The broad ligaments of the uterus become increased in their length and thickness, and their muscle fibres in volume. It has been asserted that the muscle fibres of the uterine ligaments are increased in order to give them sufficient strength to sustain the weight of the greatly enlarged uterus and its contents. This can not be correct, because the gravid uterus lies upon the floor of the abdomen and does not swing in the ligaments. The broad ligaments provide continuous sheets which prevent entanglements with other vicera and afford a safe route of communication for the uterine vessels. The increase in the extent and strength of the broad ligaments should be attributed rather to the necessity for their maintaining their relations with the uterus in its changed position and for preventing their rupture during movements of the organ. In themselves, the ligaments would not suffice to sustain the weight of the gravid uterus, but they perform an important office in tending to keep the uterus in its normal direction along the abdominal floor. It should be constantly borne in mind however that the parietal attachments of the broad ligaments do not change their location during pregnancy. It is also to be noted that the gravid uterus grows forward constantly and advances beyond the anterior attachments of the broad ligaments to the abdominal walls, and that it is because of this that torsion of the uterus can occur.

The sensibility of the uterus is increased. Upon opening the bodies of pregnant animals under anaesthesia or immediately after death, the uterine walls undergo very marked contractions, which resemble closely the peristalsis of the intestines. The uterine contractions, or peristalsis, are especially marked in the pregnant bitch or cat, where there are alternate constrictions and dilations due to alternating contraction and relaxation of circular fibres, while the part taken by the logitudinal muscle fibres is shown by an alternating increase and decrease in the length of the uterus.

The sympathy between the uterus and the other parts of the genital apparatus is shown in a variety of ways. It has been generally believed that copulation, in case of the pregnant female, tends to produce reflex contraction of the uterus, with an expulsion of its contents, or abortion. In manipulations of of the pregnant uterus per rectum, it has been insisted, apparently upon insufficient ground, that the operator should be very gentle and careful, lest uterine contractions be induced which will end in the death and expulsion of the fetus. Hess has asserted that abortion is readily and uniformly induced by the dislodgment of the yellow bodies from the ovaries by manual compression per rectum, but in my clinical experience abortion does not always follow. It is a common experience that the removal of the ovaries from the pregnant female—castration—tends to induce abortion, but this rule is not without exception. The uterine contractions are important for the maintenance of the physiologic power in the uterine walls. Although the uterus during the non-gravid period is in a large measure dormant, its physiologic life, like that of other hollow organs with muscular walls, is dependent upon a certain degree of rhythmic muscular contractions. The efficiency of these contractions is finally very necessary at the time of parturition, because it is largely through these that the os uteri is dilated and the fetus is expelled. It is notable that in multipara, where the uterus is long and tubular, the uterine contractions play the most conspicuous part in the expulsion of the fetuses. In unipara the uterus needs propel the single fetus but a short distance until it enters the pelvis and is then subject to the forces of the contractions of the abdominal walls. In multipara, this is only partly true for the fetuses lodged in the posterior, or basal ends of the cornua. The fetuses located at or near the apices of the horns must be propelled a long distance through the tubular uterus before they reach the pelvis and vagina, where the force of the abdominal walls may be brought into play. In the mare and the cow, the final expulsive powers at the time of parturition reside to a larger degree in the abdominal walls and the uterus performs a less conspicuous part in the act of birth.

After the expulsion of the young from the uterus, it is still highly important that there should be a vigorous contractile power in the organ, in order that the fetal membranes, blood clots, epithelium, and other debris may be expelled. The uterine walls should contract vigorously also, in order to decrease the volume of blood passing to the organ and to close any capillaries in the placental mucosa which may have been wounded during the process of the separation of the fetal membranes from the uterus. Vigorous uterine contractions after parturition obliterate the uterine cavity promptly and bring its epithelium everywhere in contact. The vigorous uterine contractions exert indirectly a disinfecting or bactericidal power, tending to prevent the entrance of infection, or to overcome any infection which may have gained entrance into the cavity during or immediately after the expulsion of the fetus.

THE FORM OF THE PREGNANT UTERUS

The gravid uterus undergoes important changes in its form, since it must adapt itself to the form, volume, and position of the fetus or fetuses, and especially to the membranes which surround them. In multiparous animals, the fetuses are distributed approximately equidistant from each other throughout the length of the cornua. At the points where the fetuses develop, the uterus becomes enlarged and between them is constricted, giving to the organ a nodular appearance. In animals which usually produce but one young at a time, as the mare and the cow, the uterus assumes a somewhat oblong or globular form. In uniparous animals, since the fetus is usually contained jointly in the uterine body and one horn, the principal changes take place in these parts, leaving the non-gravid cornu but slightly increased in size or changed in form, so that it appears frequently as a mere appendage upon the side of the enlarged cavity which contains the fetus. In the multiparous animal, whether there be several fetuses or only one, the development of the young occurs in the cornu or cornua and the so-called uterine body regularly remains empty, serving merely as a passage for the fetus at the time of parturition. In rare cases in multiparous animals, not infrequently in the mare, a fetus may develop more or less equally in the two cornua—bicornual pregnancy—and at the time of parturition offer serious or insurmountable obstacles to birth (See Transverse or Bicornual Pregnancy). Usually in multiparous animals the number of fetuses is approximately equal in the two horns. This is dependent, however, upon the functional activity of the ovaries. If one ovary is incapable of ovulation, an oviduct is impassable, or a cornu is so diseased that an embryo may not live therein, the pregnancy is unilateral. Each fetus lies in that cornu corresponding to the ovary from which the fertilized ovum originated.

The cervix undergoes well-marked changes during pregnancy. The cervical canal is firmly closed by the constriction of the circular muscle fibres of its walls and the occlusion is rendered additionally secure by means of an elaborate gelatinous seal, which is quite thick and firm. The cervix is at first quite firmly contracted, so that it is exceedingly difficult in the cow to force a passage through the canal into the uterus. In the pregnant, as in the non-pregnant mare, the cervical canal is very easily dilated and one or more fingers or the entire hand may be inserted.

As parturition approaches, the os uteri normally becomes somewhat dilated and the uterine seal enlarged in similar degree, insuring the continuance of the sealing of the uterine cavity. The walls of the cervix become softer and more distensible and the longitudinal folds of mucous membrane begin to disappear. Finally, when parturition begins, the cervical canal, under normal conditions, is dilated until it is of the same dimensions as the vagina and uterus, so that each segment of the birth canal now becomes continuous, with no distinct line of demarcation between them. After parturition, the cervix normally resumes its previous condition very promply, so that with in a few days it is approximately the same as before impregnation.

The situation of the uterus is modified by the changes taking place in its volume. At the same time, its growth must alter in some degree the situation of other viscera. The gravid uterus possesses high specific gravity, as compared with other abdominal organs. As a consequence, in quadrupedal animals it soon descends to and rests upon the abdominal floor. Its position upon the abdominal floor is slightly modified in some cases by neighboring organs, when they are sufficiently voluminous and possess a high specific gravity, like the rumen of ruminants and the colon of solipeds. In the mare the pelvic flexure of the colon is displaced somewhat to the right and the uterus passes along beneath it to the left of the median line. In ruminants, the uterus becomes slightly displaced to the right by the enormous rumen. The urinary bladder of the non-gravid ruminant lies virtually upon the median line of the pelvic floor, so long as it contains little urine. When it becomes distended with urine, the influence of the rumen causes the uterus to become displaced to the right. This, in turn, tends to push the bladder to the left. When the uterus is gravid, the displacement is accentuated. If the biadder is distended the tensely stretched vagina lies along the right side of the bladder, against the ilium. In multiparous animals, none of which have any very voluminous floating viscera, the gravid uterus becomes the most important abdominal organ and takes first place along the median line of the abdominal floor, displacing the other viscera to either side or upward.

These changes come about somewhat slowly. At first the gravid uterus rests partly within the pelvis, well suspended by the broad ligaments in the sublumbar region, but as soon as the fetus has acquired any great volume it bears the uterus at once downward and forward onto the abdominal floor, and finally pushes its way, on this inclined plane, until it reaches the diaphragm, where the most anterior extremity of the gravid uterus lies in close relation with the stomach, liver, and diaphragm.

During this change in the position of the uterus, the os uteri is for a time dragged forward so that it is farther from the vulva than in the non-pregnant animal, but later, in unipara, when the fetus has come to rest against the diaphragm and has acquired a longitudinal diameter which equals or exceeds that of the abdominal cavity of the mother, the more posteriorly situated end of the fetus, with its membranes, pushes up into the pelvis against the os uteri internum, and in the cow passes above the cervix and comes to rest above the anterior end of the vagina. The gravid uterus of ruminants assumes a wholly different form to that generally described. The distinctively vascular portion of the gravid uterus of the ruminant is the lesser curvature, along which the uterine vessels reach the organ. The axial line of the vagina and cervix does not constitute the axial line of the uterus, but, when continued forward from the os uteri internum, passes immediately along the uterine floor. The axial line of the uterus is parallel to the vagino-cervical axis, but lies above it to the extent of one-half the diameter of the uterus. This is best seen in Plate I (Frontispiece). The vaginal portion of the cervix may be pushed back toward the vulva, and in some cases, when parturition is near, especially in the cow and the ewe, it becomes displaced backward to such a degree that it may even appear between the lips of the vulva when the animal is lying down. This prolapse of the vagina and cervix in pregnant ruminants sometimes requires the attendance of the obstetrist (See Ante-Partum Prolapse of the Vagina).

In some animals with exceedingly pendulous abdomens, or in that pathologic condition where rupture of the abdominal floor has occurred so that the fetus passes through the muscular floor of the abdomen to rest against the skin, the uterus is dragged abnormally downward and forward so that the vulva and anus are drawn inward and present a concavity.

In multiparous animals the uterus lies folded upon itself very much the same as the intestine. It has been said that in the pig each cornu of the uterus lies above the corresponding row of mammae. This however is impossible, since when there are six or seven fetuses in one cornu their combined length is at least double the distance from the pubis to the diaphragm. Consequently they can not be arranged in a straight line, but the cornu must be thrown into folds to accommodate the fetuses contained within it. In the cow, also, the gravid uterus must sometimes be completely doubled upon itself. When twin fetuses are the result of two ova from one ovary, the two fetuses lie in one horn, end to end. When well matured, they may each measure forty-eight inches from the nose to the root of the tail, necessitating a cornual length of more than eight feet, fully double the greatest diameter of the abdomen. The uterus must then be doubled upon itself.

The direction of the uterus in domestic animals is very simple. Its weight and the horizontal position of the body tend constantly to keep its long axis in an antero-posterior direction, in a general line with the long axis of the body, modified only in those cases in which the cornua are too long to lie in a direct line and in the larger herbivora, in which the uterus may be slightly displaced to the right or left by great viscera.

In the cow and the mare, in which the abdomen may be very pendulous, there may be a somewhat marked deviation of the uterus downward, which may cause the os uteri to present somewhat upward, but is not of such a character as to be termed abnormal or to constitute an impediment to parturition. In other cases the uterus becomes displaced on account of the ruptured prepubian tendon (which see) or it may become rotated upon its long axis, inducing torsion of the uterus.

The influence of the gravid uterus upon neighboring organs is comparatively unimportant except in a purely mechanical way. It does not interfere materially with any of the abdominal viscera. When the fetus attains considerable size and rests against the diaphragm, it may mechanically impede respiration to a slight degree.

The influence of the gravid uterus upon the circulation of the pelvic region has been claimed by some writers to be quite important. Some obstetrists state that, in the cow and mare, the gravid uterus exerts an unfavorable compression upon the blood vessels of the hind limbs, vulva, and rectum and causes engorgement of the veins and lymphatics in these parts. In this way they account for the edema of these parts so often observed in the later stages of gestation in the mare. They contend that this edema is referable to some extent, in the mare and cow, to pressure upon the saphena and mammary veins. It would be exceedingly difficult to demonstrate this hypothesis upon anatomical grounds. The upright position of woman, with the head of the fetus normally resting in the pelvic inlet and the entire weight of the fetus bearing upon these parts, might be expected to interfere with the return of blood from her inferior extremities. This is clinically true. In domestic animals, the quadrupedal position prevents this. In dropsy of the amnion of the cow (which see) there is such a great collection of amniotic or allantoic fluid that the patient is borne down by the immense weight and cannot rise to her feet. Still, in these cases dropsy of the limbs is never seen, but they are on the contrary very clean and free from any edema whatever. Both from an anatomical and a clinical standpoint, the allegation that compression by the gravid uterus causes edema of the posterior limbs and abdominal floor is unsupported by evidence. The edema should be referred to other than mechanical influences. In pregnancy of woman the pressure of the fetal cranium in the maternal pelvis tends to cause compression of the urinary bladder, resulting in frequent urination. In quadrupeds the tense vagina is deflected to one side by the distended urinary bladder and does not interfere materially with the complete distension of the viscus.

The changes in volume, weight, and position of the gravid uterus, while they bring about some alterations in the position of other viscera, do not interfere materially with their functions. The modifications in position necessitated by the growth of the uterus come about gradually, so that the other organs readily adapt themselves to the change without inconvenience.

The increased weight of the body contents resulting from pregnancy necessarily hampers somewhat the movements of the mother, so that she is slower and less agile.

Very early in pregnancy, important psychic changes occur. In the mare, especially, it is noted that there is greater docility and that the animal seems somewhat more sluggish. Both the mare and the cow, toward the latter part of pregnancy, show some arousing of the maternal instinct and are more ready to defend themselves in event of danger. This is especially noted in the cow upon the approach of carnivorous animals, which in the natural state constitute her enemies.

In domestic animals those disturbances in the digestive and nervous systems which are seen at the commencement of pregnancy in woman are not observed. As a general rule, the pregnant female is more quiet and contented than the non-pregnant and, during the first half of pregnancy, takes on flesh rapidly upon a comparatively light diet, but later in gestation may show a tendency to lose flesh, because of the great drain upon the maternal system due to the rapid growth of the fetus. The tendency to fatten during the early stages of pregnancy is used by stock-feeders to hasten the fattening process of animals intended for slaughter. The volume of blood in the body of the pregnant female is said to be positively increased, but its corpuscles and solid constituents relatively decreased.

THE POSITION OF THE FETUS IN THE UTERUS

The position of the fetus or fetuses in the uterine cavity is largely determined by the form and direction of the uterus and the form and specific gravity of the fetus. Since these factors are reasonably constant in each species, it follows that the position of the young in the uterine cavity is also quite uniform.

It is not always easy to determine by post mortem examination precisely the position of the fetus in the uterus, because the fetus and uterus may change their positions somewhat according to that of the maternal body. The gravid uterus possesses the highest specific gravity of any of the abdominal viscera and the fetus offers the highest specific gravity among the uterine contents. This being true, it follows that the position of the fetus should always be stable, independent of its umbilic attachments. Should the position of the mother or of the uterus change, the fetus needs follow and promptly come to rest in a stable position.

In the development of the embryo, the head end grows much more rapidly during the first stages than the posterior portions. The circulation of the fetus is so distributed that more arterial blood reaches the anterior than the posterior end of the embryo, especially during the early stages of fetal life. The brain grows very rapidly. The dorsal surface of the body outgrows the ventral, so that the embryo is soon arciform. The great development of the head end of the embryo, as compared to the posterior, causes the anterior portion to possess greater weight, which would suggest that the embryo, if suspended, would come to rest with its head end lower than the posterior part of the body. The arciform character of the fetus continues throughout intrauterine life and from the beginning affects the stability of the position of the fetus.

The fact that the uterine cavity of each of the domestic animals is more or less tubular in form renders it essential that the long axis of the fetus should correspond to the long axis of the uterine cavity, so that regularly the fetus is found resting in this position. Exceptions to this rule occur in the cruciform uterus of the mare. This permits the fetus to assume a transverse position in relation to the long axis of the body of the mother and of the body of the uterus. The anterior end of the fetus develops in one horn and the posterior in the other; thus the two horns constitute a direct tube from apex to apex. The question of the development of the fetus in the two horns is discussed under "Bi-Cornual Pregnancy".

The presentation of the anterior or posterior end of the fetus toward the vulva is not subject to any known law. This may be largely determined by the inclination of the uterus and the comparative specific gravity of the head and tail ends of the embryo. Early in embryonic life, the fetus floats free in the amniotic sac and may turn upon its short axis, so that either the head or the tail may present toward the os uteri. Turning upon the short axis must necessarily cease as soon as the long axis of the fetus exceeds the transverse diameter of the uterine cavity. The fetus then becomes fixed, so far as the relations between the long axis of fetus and uterus are concerned, for the remainder of its intra-uterine life.

In uniparous and biparous animals, the bases of the uterine cornua slope more or less backward and downward from their anterior attachments toward the os uteri and maintain this position until the weight of the fetus and its membranes, with that of the contained fluids, bears the organ down to the abdominal floor. During this period, prior to the descent of the uterus upon the abdominal floor, the head end of the fetus is much the heavier, and consequently tends to become directed toward the os uteri. A further influence in reference to the position of the fetus is the question of the form of the uterine tube itself. This tube is not uniform in its transverse diameter, but is conical, with the apex of the cone toward the oviduct. The tendency would be for the larger, or head end of the fetus to occupy the larger end of the cornu—that is, for the head end to be directed toward the vulva.

In multiparous animals, in which the uterus lies upon the abdominal floor at a very early period in pregnancy, the question of the inclination of the uterus can have less influence upon the direction in which the head end shall present than in the unipara. They present somewhat indifferently, though the tendency for the head end of the fetus to present toward the vulva is still well marked.

Late in gestation, the hinder parts of the fetus become more developed, so that in the larger herbivora these equal or exceed in bulk and weight the anterior portions of the body. By this time the uterus is lying upon the abdominal floor and the posterior part of the fetus occupies the lowest point of the abdomen in the neighborhood of the diaphragm. In addition to this, the fetus has acquired a longitudinal diameter which is in excess of the transverse diameter of the uterine cavity, and the relationship between the long axis of the fetus and that of the uterine cavity becomes fixed and permanent.

In the vast majority of cases in larger domestic animals, the fetuses regularly present anteriorly at the time of birth. In multiparous animals, the fetuses present somewhat indifferently—usually anteriorly, frequently posteriorly.

When twin pregnancy occurs in the cow (perhaps also in the mare) the positions of the two fetuses are usually alternated. One presents with its head to the vulva ; the other with its tail. Generally one fetus occupies each horn—that is, each ovary has extruded an ovum, which has been fertilized. Then the head end of one fetus is in the uterine body cavity and beside it is the tail end of the other. When the two ova come from two ovisacs in one ovary, the fetuses lie end to end in the corresponding horn, either head to head or tail to tail. The relationship between the transverse axis of the fetus and that of the maternal body is largely determined by the form of the fetus itself and of the surface upon which it rests. The fetus early assumes the form of an arc, which is maintained throughout its intra-uterine life. The fetus bends ventralwards ; this inhibits any marked dorsal flexion. During the early stages of gestation, the uterus of the mare is suspended by its ligaments in the pelvic or abdominal cavity and its cornua are curved downward at the posterior end. In ruminants the gravid cornu or cornua retain for a time their non-gravid spiral form, curving downward, backward, and then upward. An arciform fetus would normally assume the most stable position, with its convex or dorsal surface applied to the convex dorsal side of the uterus and its concave, or ventral surface toward the concave uterine floor.

As the weight of the fetus increases and bears the uterus downward to the abdominal floor, the position of the arciform fetus becomes unstable because it tends to come to rest lying upon its concave ventral surface, on the essentially plane or somewhat concave abdominal floor.

In ruminants, in addition to the form of the fetus, the downward, forward, and finally backward curvature of the uterine cornua contributes to instability of its position. As the distended gravid horn acquires weight and descends to the abdominal floor, it must assume a stable attitude and, instead of resting upon its concave border, must revolve slightly upon its long axis and come to rest upon the abdominal floor.

The attitude of the fetus is determined largely by its form and the available space for its accommodation. In the cow and the mare, since near the close of pregnancy the abdominal cavity is not sufficiently long to accommodate the fetus in an extended position, it must be folded in a way to occupy a minimum amount of space antero-posteriorly. This condition is most completely fulfilled by the head and neck bending ventralwards so that the chin approaches the sternum ; the anterior limbs, becoming somewhat flexed at the elbow and carpus so that the feet rest beneath the head ; and the posterior limbs, flexed at the stifle and tarsus, becoming folded beneath the body in approximately the same position as is observed in sternal recumbency of the adult animal.

The fetuses of multiparous animals rest in a more direct line, since there is much less curvature in the long axis, especially toward the termination of pregnancy. The limbs, being shorter and less conspicuous than in the larger animals, are more frequently extended. The neck, being very short, is not curved.

When parturition approaches in the uniparous animal and the fetus has outgrown in length the antero-posterior diameter of the abdominal cavity, the presenting end of the fetus pushes up and into the pelvic cavity and is readily felt by manual exploration per vaginam or per rectum. In the cow, since the fetus has a comparatively short neck, the head is regularly extended, and a few weeks before parturition pushes up into the pelvic cavity and into the supra-cervical cul-de-sac of the uterus above the vagina. Sometimes it appears to the inexperienced veterinarian that the fetus is outside the uterus, although the position is perfectly normal, as indicated in Plate I. Along with the head, there regularly present the two anterior feet, extended.

At the termination of pregnancy the position of the fetus is altered by the uterine contractions, which force it backwards toward the pelvic inlet and vagina. The fetus normally revolves slightly upon its long axis and, changing from oblique sternal recumbency, presents with its dorsum toward the sacrum of the mother and its ventral surface toward her pelvic floor. This is essential because of the resistance offered to the passage of the fetus through the pelvic canal. Whenever it presents otherwise than with the dorsal surface corresponding to the spinal column of the mother, it causes great or insuperable difficulty in expulsion, calling for a rotation of the fetus upon its long axis before delivery can readily occur. This difficulty arises from the fact already related, that the fetus maintains the form of an arc, the ventral surface being concave. The roof of the passage through the pelvis is somewhat concave. The combined base line of the abdominal and pelvic floors presents a very definite convexity, so that the arciform fetus can readily pass only in the one position.

THE DIAGNOSIS OF PREGNANCY

It is of great importance in many cases to determine the existence or non-existence of pregnancy. In the examination of mares and cows for sale, it becomes highly important that the veterinarian should be able to determine definitely whether the animal be pregnant. If desired for breeding purposes, the best proof that can be established of the breeding power of a female animal is the fact that she is pregnant. When a mare is being purchased wholly for work, it is important to determine in advance whether she is pregnant, since pregnancy may interfere seriously with her usefulness. It is essential that cows which are used for dairying or breeding purposes be capable of breeding. It is very important that the owner be able to determine whether a cow shall be retained or sold to the butcher as sterile. This can be decided only by an intelligent investigation by the veterinarian or by awaiting the time for parturition to occur. The latter method may occasion a very considerable loss to the owner because of the delay.

In all animals, it is important that we should be able to differentiate between pregnancy and certain diseases which may more or less closely simulate it.

There are many signs of pregnancy which have more or less value, but the vast majority of them are somewhat erratic and liable to mislead. Not infrequently, an animal is regarded as pregnant for a long time and presents the general appearance of that condition, but finally fails to bring forth young; in other cases, which may be even more deceptive, there are but slight external appearances of pregnancy and the owner is surprised when parturition unexpectedly occurs.

The veterinarian should consequently be able to speak positively regarding the question of pregnancy in a domestic animal. In order to do so, he needs to know and consider all symptoms or signs which have any relation to the question.

The diagnosis of pregnancy during its early stages is difficult, and during the very earliest period is impossible. The symptoms of pregnancy are divided into three principal groups: the subjective, or physiologic signs; the objective signs; and the positive, or direct signs, which are observed by examination of the parts in a way to determine definitely the presence of the fetus, of the fetal sac, or of some other structure indicative of the presence of a fetus.

Menstruation. Within twenty-four to forty-eight hours after a cow has been bred, she may menstruate. The sanious discharge emanating from the vulva may adhere to that organ, the tail, and adjacent parts. If the cow has been bred and conceived, it is doubtful if there will be menstruation following. If she fails to conceive, menstruation is quite certain to occur. In many cases of serious sterility the volume of menstrual blood is very great. Fertilization appears to inhibit menstruation. It is quite possible that when copulation takes place late in estrum menstruation may occur in spite of conception.

The absence or presence of menstruation must not be accepted as final proof of conception or non-conception. It is, however, a valuable sign, and should always place the breeder and veterinarian on guard, with a rather definite expectation that the animal which has menstruated after breeding will again be in estrum in due course of time. It is of importance to note this carefully, because it places a breeder upon his guard at the next estrual period. Menstruation is not regularly observed in other domestic animals than the cow.

Cessation of Estrum. When an animal has been regularly in estrum and after copulation estrum does not recur, it is generally and properly accepted by the breeder as conclusive evidence of conception. The behavior of estrum in relation to pregnancy is subject to various limitations. The cessation of estrum as a sign of pregnancy is most reliable in those animals in which estrum has been regular and normal.

Estrum may occur regularly or irregularly in cows and mares which are pregnant, most commonly in early pregnancy, but not rarely after mid-term, so that the veterinarian must be constantly on his guard in examining such animals and must rely upon other signs to arrive at a safe conclusion.

Estrum is frequently absent in non-pregnant females. As a rule the reasons for this omission of estrum are recognizable upon examination. The persistence of the corpus luteum, sometimes of a former pregnancy, may inhibit estrum for months. It is only rarely, if ever, that estrum occurs when a large corpus luteum exists.

Pyometra also prevents estrum. At times the presence of a very small amount of pus in the uterine cavity may prevent estrum for months or years. In such cases the yellow body sinks deeply into the center of the ovary, the ovarian tissues draw over it, and it remains as a persistent structure, which by failing to atrophy prevents the occurrence of estrum. The presence of a macerating or a desiccating fetus in utero ordinarily inhibits estrum for months or years.

The Uterine Seal. When a cow or heifer conceives, there is at once a profound change in the character of the secretions from the vaginal and cervical mucosa. In the non-pregnant animal there is a normal secretion of lubricant mucus in small amounts. When estrum occurs, the volume of mucus becomes enormously increased and it flows from the vulva. When pregnancy occurs, the mucus of the vagina is decreased in amount, ceases to be lubricant, and becomes adhesive. A new type of secretion takes place in the cervical canal, having the character of tough gelatin rather than mucus. This fills all the depressions in the very irregular cervical canal and becomes massed in a firm body from one end of the cervical canal to the other, completely filling it and projecting forward into the uterine cavity and backward into the vagina. This uterine seal, which is highly adhesive, brings about a most thorough and efficient sealing of the canal. As a general rule the seal can be palpated at the external os uteri of the mare or cow with the finger-tip within thirty to sixty days after conception. The finger-tip is to be pressed carefully and gently against the external os uteri and then cautiously withdrawn; if the seal is present it is readily revealed by its adhesiveness.

Sometimes in the cow the vaginal end of the seal is inconspicuous, while deeply within the canal it may be well developed. In these cases the operator may decide the question by drawing the cervix back into the vagina and carefully sounding the cervical canal with a suitable instrument. The adhesiveness of the seal renders its identification comparatively easy.

As with other signs of pregnancy, the uterine seal is subject to limitations. Very rarely this seal, or a substance closely resembling it, is found in the cervical canal of the non-pregnant animal and may mislead the observer. Sometimes when the animal is pregnant, the seal is partly or wholly absent. Such is the case in purulent inflammation of the cervical canal. In some animals which are to abort as a result of cervicitis the seal is not formed, or the formation is very imperfect. Consequently the presence of the typical seal not only gives reliable evidence of pregnancy, but adds to that a certain feeling of security, suggesting that the animal not only is pregnant, but perhaps is safely pregnant. In spite of the limitations of this sign of pregnancy, it is one of the most valuable which we possess.

Palpation of the Uterus per Rectum. The digital palpation of the uterus of the cow and mare per rectum affords the most valuable means of diagnosis which we possess. After conception the uterus undergoes prompt and marked changes in volume, form, consistence, and location. When estrum occurs there is a marked engorgement and elongation of the uterus—an essentially erectile organ. The elongation is so sudden that the broad ligaments do not yield and the uterus is thrown into undulating folds. The organ is hard, tense, and smooth. The condition is most notable in heifers. If conception occurs, the engorged, undulatory character continues for two or three weeks, but the organ in heifers remains almost static in size for fifteen to twenty days, after which it gradually enlarges. In cows which have previously calved, these symptoms do not become so apparent and the enlargement is not pronounced until forty to sixty days. Then the uterus becomes larger, most markedly in the gravid horn. The same general conditions obtain in the mare.

Owing to the great variations of the size of the uterus in adult cows, due partly to individual peculiarities and partly to the health or disease of the organ, one has to await a quite definite increase in volume before this becomes of distinct value in determining pregnancy. The same may be true of heifers which have been sterile for a long period and in which the uterus has undergone enlargement because of chronic endometritis.

As a general rule, however, heifers which have conceived at all promptly show distinct and characteristic enlargement of the uterus within twenty to thirty days after conception, and cows at any time from thirty to sixty or seventy days. The enlargement of the uterus as a result of conception is really very characteristic. The organ may be enlarged from a great variety of causes, but the enlargement due to other influences than pregnancy differs materially and clearly in almost every case. In pregnancy the uterus is smooth and even in outline, firm, tense, and fluctuating. Except in case of twin pregnancy, the pregnant horn is much larger than the other, and corresponds with the corpus luteum of pregnancy. In the mare, owing to her crucial uterus, the embryo may develop transversely in both horns, resulting in equal volume. At the region of the internal os uteri the superior uterine wall rises up suddenly like a terrace, instead of sloping forward gradually as is observed in cases of pus or lymph distending the organ. The firmness of the uterine wall is in marked contrast also to the character of the walls when the organ is distended with pus or lymph. In pregnancy the uterus is distinctly firm. It exhibits to the touch a sense of vigor and life. When lymph distends the uterus, the walls may be thin as in pregnancy, but they are soft and flaccid and the horns are probably equally filled. When the organ is distended with pus, the contents do not move as freely as the fetal liquids. The uterine walls are soft and flabby with a moderate amount of thickening, or they are tense and at some place an abscess of the uterus may point, or the organ is very dense, with thick, hard walls.

As pregnancy advances, additional evidences appear. The organ becomes very greatly enlarged, the walls are tense, and the fetal fluids are quite readily recognized as such. Later, cotyledons are palpable through the uterine wall of the cow and when pregnancy has reached four to five months one will occasionally recognize the fetus itself floating in its fluids. The fetus becomes increasingly easy of recognition as pregnancy advances. In some cases, however, both fetus and uterus fall forward into the abdomen and may be beyond the reach of the examiner. In such cases there is still good evidence of pregnancy. The vagina is drawn far forward, the cervix has been dragged anterior to the pubis, and the posterior end of the uterus constitutes a large, thick, firmly stretched band passing downward and forward beyond the examiner's reach. This of itself does not indicate pregnancy with absolute certainty, because the same displacement of the uterus might occur from the presence of large uterine tumors or from other pathologic conditions which would cause an increased weight of the organ, possibly dragging it downward and forward. In this emergency, however, other signs appear to aid the examiner in making his diagnosis. As a general rule in such cases, the diagnosis can be verified by abdominal ballottement, and also by palpation of the enormously enlarged uterine arteries.

The Corpus Luteum of Pregnancy. Physiologically, a corpus luteum develops after each estrum, and is of the same form, size, and consistency, whether the animal be pregnant or not. In sterility, however, the corpus luteum is one of the most common sufferers from pathologic changes. The bovine corpus luteum of pregnancy is normally five-eighths to three-quarters of an inch in diameter, somewhat oval in form, usually even in contour, and firm in consistency. Forming, as it does, within the crater left behind when the ovisac ruptures, it is at first naked. That is, it is not covered over by epithelium and it protrudes somewhat beyond the surface of the ovary. If the animal conceives, the tunic of the ovary soon draws over the surface of the yellow body and leaves it smooth and firm. The wound is healed. Sometimes a considerable projection remains, even though the peritoneum has drawn over the yellow body. In sterility, however, the wound in the ovisac frequently fails to heal and the yellow body remains for a long period of time protruding and naked. The protruding dome feels soft upon palpation, like the exuberant granulation of an unhealthy ulcer. As time goes on, the corpus luteum of sterility frequently undergoes cystic degeneration in its center. It becomes soft and more or less fluctuant, according to the degree of degeneration. Finally, as the degeneration extends, the lutein tissue disappears and a cyst remains. When one can recognize these conditions in the ovary, he can with very rare exceptions rest assured that pregnancy has not occurred through fertilization of the ovum which was discharged from the ovisac in which the diseased yellow body develops. He must not be deceived, however, because of the presence of a cyst or cysts in an ovary. The typical corpus luteum of pregnancy must virtually always exist in a pregnant animal, but cysts may co-exist. Accordingly, while the absence of a corpus luteum of a normal type is fairly conclusive evidence that the animal is not pregnant, the co-existence of a cyst in the same or other ovary is not final proof, though it is strong evidence that the animal is non-pregnant. When a typical corpus luteum of pregnancy is present and other findings are in accord, the evidence afforded by the corpus luteum is of the greatest possible value. Amongst thousands of ovaries which I have examined, I have seen but one corpus luteum of pregnancy which departed markedly in volume from the normal. The one exception was more than one inch in diameter. In cows which, though pregnant, nevertheless show estrum, the corpus luteum disappears, at least sometimes. Hence a cow may be pregnant and no corpus luteum present. The corpus luteum of the mare, being located in the hilus of the ovary, is not palpable.

The corpus luteum of estrum, when normal, differs but little from the corpus luteum of pregnancy in form, volume, and consistency, but, while the corpus luteum of pregnancy persists throughout pregnancy and for thirty to sixty days thereafter, the corpus luteum of estrum is a temporary structure, which disappears very largely at about eighteen days after estrum, so that at the average period of twenty-one days it has become so far resorbed that it no longer inhibits the maturing of a fresh ovisac.

It is at this period that the corpus luteum becomes of the greatest significance in the diagnosis of pregnancy. If estrum has been regular and the animal is not pregnant, it is very certain that at about twenty-one days the animal will again be in estrum and that the corpus luteum of the previous estrum will have disappeared or have decreased to a very small size. At the same time, if estrum is near, the uterus is engorged, the cervical canal is dilated, and the vagina contains the lubricant mucus of estrum. Hence, if the practitioner examines a cow at about eighteen to twenty-one days after breeding, if she is pregnant there is present a typical corpus luteum of pregnancy, and if she is not pregnant no corpus luteum is present. This consequently offers the most valuable period for making an accurate diagnosis of early pregnancy. It is the most secure time that we have for making a diagnosis and it is the most important time, because if the animal is non-pregnant we may immediately institute measures, such as disinfecting the uterine cavity, preparatory to breeding when the approaching estrum has become established.

The Uterine Arteries. The uterine arteries afford definite evidence of pregnancy. Normally, the middle uterine artery and the posterior uterine or vaginal artery are barely, though clearly, palpable in non-pregnant cows. As soon as pregnancy occurs, these arteries very rapidly take on renewed activity and increase rapidly in volume. The middle uterine artery is recognizable, leaving the internal iliac artery at almost right angles to the arterial trunk, from the region of the anterior border of the shaft of the ilium. It curves backwards, medianwards, and finally, in the form of an arc, forwards, to disappear in the uterine walls. The posterior uterine or vaginal artery, smaller than the other, emerges from the hemorrhoidal artery approximately opposite the os uteri externum, and pursues a course analogous to that of the artery described above. Each of them is readily picked up and palpated. In pregnancy they become elongated, seem coiled, are greatly distended with blood, and throb like an artery which passes to an acutely inflamed area. When pregnancy is well advanced, the middle uterine artery grows to one-half inch in diameter and the blood is forced through it under very high pressure, giving an impact which differs from that observed in any other artery with which the practitioner is familiar.

Palpation of the Fetus per Vaginam or per Rectum. When pregnancy is well advanced, the fetus of the cow or the mare may usually be felt upon rectal palpation, though not always in early pregnancy. Up to the fourth month, the fetus ordinarily lies upon the floor of the uterus and cannot, without undue violence, be palpated through its surrounding fluids. Even at the fifth or sixth month, or later, the fetus may have dropped so far forward and downward in the abdominal cavity that it cannot be palpated from the rectum. Later however the fetus becomes so large that a portion of it necessarily projects up near or into the pelvis, where it is readily felt. Palpation of the fetus per vaginam has a very limited application. It generally succeeds during the last months of pregnancy. At this time in many cases, some portions of the fetal body, usually the head and the two anterior feet, rest upon the vagina posterior to the os uteri externum, occasionally giving the inexperienced examiner the impression of extra-uterine pregnancy.

Abdominal Ballottement. After the sixth month of pregnancy, the buttocks or other portions of the fetus usually lie in close contact with the abdominal floor of the lower right flank region. If the hand is placed firmly against the abdominal wall, a somewhat vigorous thrust made upward, and then suddenly the force released, but the hand kept in contact with the abdominal wall, the adjacent portion of the fetus is pushed away upward in its fluids, floats for a moment, and then drops back against the examiner's hand with a recognizable impact. This is a good sign of pregnancy, but not always reliable. In many cases, no portion of the fetus chances to lie in sufficiently close contact with the abdominal wall to render the test efficient. On the other hand, a tumor or a very large and heavy calculus might mislead the examiner when the animal is really sterile.

Auscultation of the Fetal Heart. In the advanced stages of pregnancy it is frequently possible, by careful auscultation of the abdominal walls over the region of the fetus, to detect the beat of the fetal heart, which is usually at least twice as rapid as the beat of the maternal heart.

The abdominal ballottement and the auscultation of the fetal heart are of minor value, because when these can be successfully applied the other signs which have been enumerated above should already have decided the question long before these signs, however good they may be, can come into play.

Much has been said recently regarding the value of the Abderhalden test for pregnancy. The claims made for it have been largely based upon the hypothesis that we do not possess other accurate methods for making a diagnosis. It is claimed that, by dialysis, pregnancy may be diagnosed with reasonable accuracy at a very early date. Some writers claim that the test may be successfully applied at ten or fifteen days, though most of them claim that it does not become accurate until about sixty days, at which time ordinarily an accurate diagnosis may be made by physical examination. Dr. Moriz Kahn, in a recent contribution, makes two basic errors in relation to physical diagnosis, in an effort to build an important place for the Abderhalden test. He states erroneously that pregnancy can not be diagnosed by physical examination until mid-term has been reached, and that after mid-term has been reached the physical diagnosis of pregnancy always constitutes a menace to the life of the fetus. As a matter of fact, however, the physical diagnosis of pregnancy in cows is just as accurate at sixty days as is claimed by the most enthusiastic investigator for the Abderhalden test. The danger from the physical diagnosis of pregnancy has been entirely overdrawn. I have not observed a case, after thousands of examinations, where any menace to the life of the fetus could possibly be attributed to the examination. Abortions have occurred after physical examination, as a matter of course, but there has been no possible connection between the two phenomena so far as I have been able to observe.

Kahn admits also that in many cases errors arise which invalidate the Abderhalden test. In the cases reported by Kahn himself, approximately forty per cent. of his tests were invalidated by some error in technic, so that a second test was necessary in order to make an accurate diagnosis. It is claimed that the test is highly valuable in cases of sale and warranty, but at the same time it is admitted that the blood of a cow which has recently calved, and presumably also of one which has recently aborted, gives a positive reaction for a somewhat indefinite period. Accordingly, even though a test is positive and no error in technic has been made, the Abderhalden test can at best show only an alternative result—that is, the animal either is or has recently been pregnant. Just how recently, we do not know. In this respect it is inferior to physical diagnosis, because the latter shows that the animal is actually pregnant at the time of examination and in many cases also may give valuable information as to the safety of the pregnancy which exists.

In another direction the Abderhalden test is very defective. In examining cows for sterility, the examiner must decide upon the spot whether a cow is pregnant. In many cases the whole value of his work in relation to sterility depends upon a prompt and accurate diagnosis without resort to the delays and difficulties of laboratory methods. For example, when called to examine a cow which has proven sterile, at about the time for a return of the estrual period, the practitioner needs to make a prompt and accurate diagnosis and apply the proper handling immediately.

If he cannot make his diagnosis and take prompt action, in case the cow is sterile, he must lose one estrual period without having made any material progress.

The physical diagnosis of pregnancy is not dependent upon any one sign, but rather upon a summary of all signs, all of which are in close accord and are available to the careful examiner. We have dealt with these individually. They should always be considered individually, and later collectively. For example, if an animal has been bred for thirty days, if estrum has not recurred, if the uterine seal is present and definite, if one of the horns is larger than the other, and on the same side with the enlarged horn there is a typical corpus luteum of pregnancy, the cow is pregnant, and the diagnosis is as accurate and secure as any diagnosis which we can well make in our work. Other signs exist which may aid us and add to the security when any one of these fundamental signs is absent or in some manner clouded. With experience and care, any veterinarian can learn to make a safe and accurate diagnosis of pregnancy by physical examination.

Certain other signs of pregnancy frequently relied upon have a minor value. One of the commonest physical signs of pregnancy is a change in the volume and form of the abdomen.

The development of the fetus, its membranes, and the contained fluids, and the increased volume of the uterus itself, necessarily cause a corresponding increase in the size of the abdomen. Naturally this increase occurs chiefly during the later stages of pregnancy, although it begins very early in gestation. During the earlier months, the apparent increase in the volume of the abdomen must be due to an increased volume of fat or of intestinal contents, since the actual increase in the size of the gravid uterus is not sufficient to bring about any visible changes. Later, this change in volume becomes more marked and there ensues also some degree of change in form, which helps to distinguish the enlargement of pregnancy from other abdominal enlargement.

The pregnant uterus, having a very high specific gravity, drops directly upon the abdominal floor and bears it down, causing the abdomen to enlarge chiefly in the lower part, while the upper portion apparently sinks somewhat. While this symptom is important as an indication of pregnancy, it is not reliable. Frequently the enlargement is not prominent, so that in some cases there may be so little increase in the size of the abdomen as to deceive the owner until near the time of parturition. A heifer in first pregnancy and in advanced tuberculosis was so gaunt that the owner believed her non-pregnant. The attending veterinarian made a physical examination and pronounced her non-pregnant. I pronounced her pregnant—probably with twins. A few weeks later she gave birth to well matured twins. A small abdomen is not proof of non-pregnancy, nor is a large abdomen proof of pregnancy.

Various diseased conditions may give rise to an enlargement of the abdomen which may closely simulate pregnancy, such as ovarian and uterine tumors, hydrometra or pyometra, ascites—especially in the bitch—and dropsy of the kidney (hydronephrosis)—especially in the sow. Even in health, some females, especially the large herbivora, acquire a very voluminous abdomen from feeding heavily on hay or grass, and the condition at times simulates pregnancy so closely as to lead to error. Therefore the enlargement of the abdomen, as a sign of pregnancy, becomes valuable only in connection with other signs, and should not be depended upon alone.

The enlargement of the mammae and the secretion of milk have some, though not much value in the diagnosis of pregnancy. The enlargement of the mammae normally begins quite early during pregnancy in primipara ; in animals which have produced young several times the glands do not ordinarily show signs of enlargement until toward the close of gestation. In the cow or goat used for dairying purposes, the milk flow may be perpetual and, there may be no notable enlargement of the udder just before parturition. In poor milkers there is usually a tendency for the flow of milk to decrease soon after conception, and in many cases it is impossible to keep the cow milking up to the time of parturition, or even to mid-term. In other cases, however, the animal continues to secrete milk throughout gestation, and toward the time of parturition, when the mammae would ordinaily enlarge as a result of pregnancy, there is increased secretion of milk.

The enlargement of the mammae is not, however, a trustworthy sign of pregnancy. In some animals the glands fail to enlarge to any appreciable degree and, after parturition, fail to furnish milk for the nutrition of the young. This is especially observed in old mares which have been bred for the first time. On the other hand, the mammae become enlarged in the absence of impregnation. Fleming states that the milk glands may be aroused to activity in the young animal when but a few days old, owing to suction upon the teats, as is habitually observed when a number of young calves, kept together, form the habit of sucking each other repeatedly. While this rarely excites the glands to function, it is claimed that sometimes it does. It is far more liable to lead to abscessation of the milk cistern, with tumefaction of the gland. In other cases it is repeatedly noted that animals which are in estrum show functional activity of the milk glands. The bitch, while in estrum, is said to show very frequently enlargement and some functional activity of the mammae. I have observed a mare mule which, though presumably incapable of breeding, constantly soiled her hind legs badly while in estrum owing to a profuse flow of milk from the greatly enlarged udder. This is not uncommon in the mule. I have also observed sterile heifers, which had never been pregnant, yield as high as twenty pounds of milk a day.

It has been claimed that toward the close of gestation there are alterations in the composition of the urine of the pregnant animal, consisting chiefly in a decrease in the salts of lime, but the data upon this point are not sufficient to warrant any definite conclusion.

Some have proposed weighing animals suspected of being pregnant, but the weight of animals varies so greatly, as a result of the character of food, work, or health, that no deductions can safely be drawn in this way.

The movements of the fetus constitute clear evidence of pregnancy and of the fact that the fetus is alive. Since we have no reliable and safe methods for inducing movements of the young, this evidence is procurable only by chance or at considerable risk.

The differentiation of pregnancy from various diseases of the uterus or abdominal organs sometimes causes difficulty. The uterus itself is subject to a variety of diseases which cause its enlargement, simulating the pregnant condition. In very rare cases, usually in the cow, there occurs a dropsical condition of the uterine walls or a vast accumulation of lymph in the uterine cavity, which causes the organ to become enormously enlarged and leads sometimes to the supposition that the animal is pregnant.

Extensive abscess of the uterus, or pyometra, might be mistaken for pregnancy. In the case of pyometra, there is usually some abnormality of the cervix and a more or less constant purulent discharge from the vulva. The uterus is very flaccid and the two horns are usually distended alike, with no fetus recognizable in either.

A uterine tumor may be mistaken for a fetus, but should be distinguishable by the fact that it does not move in the uterus, but only with the uterus or its walls: that is, the tumor may be pushed back and forth only to the same degree as the uterus itself moves with it, while the fetus may move freely within the cavity of the organ, except in cases of mummification.

Tumors of the ovaries, whether cystic or solid, rarely attain sufficient size to be mistaken for pregnancy, though in one case I observed in a sow an ovarian tumor weighing twenty-eight pounds. These tumors are to be differentiated from pregnancy, or at least from normal uterine pregnancy, by the fact that the uterus itself is normal, empty, and in its proper location, except as it may be displaced by the weight of the tumor.

Hydronephrosis, or cystic kidney, is occasionally observed in domestic animals, usually in the sow, and may simulate pregnancy to the extent of causing a very great increase in the size of the abdomen. A sow in our clinic, which would normally weigh about three hundred pounds, had a cyst of the kidney which occupied almost the entire abdominal cavity and caused a very great enlargement of it. The weight of the cyst finally became so great that the animal could not rise when down. The cyst contained about eighty pounds of fluid. In such an animal, it is not easy, for a time, to differentiate between this condition and pregnancy. In the cystic kidney, however, the cyst augments continually and more or less rapidly, giving the body a general fullness, which is not at all confined to the lower flank region as in pregnancy. The abdomen becomes very tense.

Moreover, there is likely to be increased thirst, along with some depression and greater difficulty in moving than if the animal were pregnant. There is usually some history of the date of breeding; the enlargement of the abdomen soon shows a want of harmony with the period of possible impregnation. If the normal duration of pregnancy has been exceeded and the distension is very great, these facts become highly suggestive. If great distension of the abdomen occurs prior to the time at which pregnancy should normally cause enlargement, this is obviously due to some other cause.

Ascites, or dropsy of the abdomen, may also become confused with pregnancy, especially in the bitch, where it is comparatively common. Differentiation would depend largely upon the same considerations as in cystic kidney; between the two conditions there is little difference in the symptoms in the living animal.

THE DURATION OF PREGNANCY.

The duration of pregnancy varies greatly in the different species, in individuals of the same species, and in the same individual during different pregnancies. In domestic animals the regular extremes of variation are observed in the rabbit, where the young are carried for 28 to 30 days, and the elephant, where the duration is 1¾ years, or about 21 months. The duration of pregnancy is not definite in the individuals of any species; the limits of variation increase as the average duration for the species increases. In those animals having a short period of gestation, like the rabbit, the variation is very slight, scarcely exceeding two days, while in the mare, with an average duration of more than eleven months, the variability is increased to nearly two months. The variations in the duration of normal pregnancy in the mare exceed the total normal duration of pregnancy in the rabbit.

The duration of pregnancy bears a somewhat constant ratio to the size of the animal, as measured by the average size of the members of the genus. As a general rule, the larger the animal the greater the duration of pregnancy, but in a given species or genus where there are great variations in size, as in the dog, there is no consequent variation in the duration of pregnancy. The mastiff has no greater gestation period than the toy terrier. In those species or genera which hybridize, such as the horse and the ass, the duration of pregnancy is naturally nearly the same.

The duration of pregnancy is somewhat dependent also upon the state of development in which the young are born. In carnivora there is a duration of eight or nine weeks; in sheep the duration is twenty weeks. However, the lamb when born is far more mature than the puppy.

Statistics apparently show that a male fetus is carried a trifle longer than a female in those animals where generally but a single young is born at a time, but if any difference exists it is quite unimportant obstetrically.

It may be that some of the variation in the duration of pregnancy can be accounted for by the time during estrum at which copulation takes place or the time elapsing between copulation and fertilization. This can scarcely apply to the cow, in which the estrual period is ordinarily less than twenty-four hours, while the variation in the duration of pregnancy is twenty to thirty days. It has not been determined how long a time is required for fertilization to take place after impregnation, but it may generally be assumed that ovulation occurs soon after copulation and that fertilization follows promptly.

According to Bonnet, the ova of the ewe, sow, and bitch have undergone segmentation and passed through the oviducts to the uterus eight to ten days after coition, which would intimate that the fertilization had occurred within a few hours after ovulation and impregnation, and segmentation had promptly begun. Thus, the time elapsing between coition and fertilization must be inconsequential, as related to the span of gestation.

The chief cause of variation in the span of gestation does not rest upon these considerations. To some extent it may be explained by the fact that the fetus may be expelled in a state of relative immaturity, almost a premature birth ; it may reach that average stage of development which we would designate as normal ; or it may remain more or less quiescent in the uterus for a period after the attainment of this normal degree of intra-uterine development. It is reasonable also to conclude that the rate of development of the young will vary according to the individual character of the mother and may be dependent, in a degree, upon her state of nutrition.

Duration of Pregnancy in the Mare. In discussing the duration of pregnancy, it is designated as normal or abnormal. A normal duration of pregnancy does not necessarily indicate that the mother, the fetus, or the parturition is actually healthy. The duration may be normal, but the fetus sick or dead ; the duration of pregnancy may be quite abnormal, and the fetus and dam healthy. The normal duration of pregnancy is the duration of time usually observed between conception and birth : outside these limits the duration is abnormal. As a general rule, the duration of pregnancy in the mare is about 12 lunar, or a trifle over 11 calendar months, or about 330 to 340 days. Bonnet gives 11½ to 12 lunar months (322–336 days) as the normal. Dietrichs, among 500 observations, found that 80 per cent. of mares foaled between 331 and 350 days. Count Lehndorff, in his text-book on horse breeding, gives a table of more than 8,300 records, in which the average duration of pregnancy was 11 months and 3 days. Statistics show that, in various studs, the male foals were carried from ½ to 6 or 8 days longer than the female. There are great variations of opinion by different writers in reference to the normal duration of pregnancy. Some consider normal a birth which occurs at from 300 days, or 10 calendar months, to 365 or more days and some even extend the limit to 394 or even to 420 days, as in a case given by Baumeister and Rueff.

Saint-Cyr concludes that the normal duration of gestation in the mare is 340 to 350 days. Some may be born alive, and continue to live, from the 300th day onward. It is not rare for foals to be born up to nearly 365 days. Rarely, normal gestation may be prolonged to 400 days, or over 13 months. It would seem, therefore, that there may be a variation in the period of gestation in the mare of about 100 days, or more than 3 months, and that we apparently have no means for determining in advance at what time a mare will foal, except that, in a general way, we may expect the vast majority of births to take place between 11 and 11½ calendar months.

It has been alleged that breed has a certain degree of influence upon the span of pregnancy and statistics of Count Lehndorff seem to indicate that, in different studs, there are more or less marked differences in the duration. Fleming is of the opinion that thoroughbred mares have a longer duration of pregnancy than those of the common breeds. A client, engaged in breeding pedigreed French draft horses, found that, in 55 mares, the average duration of pregnancy was 336 days. Among the 13 pregnancies in one year, the average was 333 days—the longest 364 days, a mare foal, and the shortest 318 days, a horse foal. The shortest duration recorded by him was 298 days, a mare foal.

It is very evident that in speaking of the normal duration of pregnancy one must constantly have in mind the definition of *normal* as used by the speaker or writer. If *normal* is to be regarded as synonymous with *usual* or *general*, it is evidently wrong to speak of three hundred days or four hundred days as the normal duration of pregnancy in a mare, because such a duration is exceedingly rare.

Duration of Pregnancy in the Ass. Carsten-Harms gives the duration of pregnancy in the ass as 348 to 377 days—greater than the average duration in the mare—but the observations which have been made are not sufficient in number to be very reliable. Various writers claim that the period of gestation of mule foals is greater than that of horse foals.

Duration of Pregnancy in the Cow. The duration of gestation in the cow is usually 270 to 290 days. In 1062 cases quoted by Fleming, 15 were pregnant less than 241 days; 52 from 241 to 270 days; 119 from 271 to 280 days; 544 from 271 to 300 days; 230 from 282 to 290 days; 70 from 290 to 300 days; and 32 beyond 301 days. Fleming gives the average duration as about 283 days; Colin as 280 to 285 days. Pregnancy in the cow lasting less than 270 days or more than 295 days should be regarded as abnormal. Not rarely, the records upon which the computations of duration are based are open to serious question. At less than 270 days, most parturitions are pathologic. In many cases the cow has had several services and has calved from an earlier service than that upon which the computation of time is based. When pregnancy extends over 295 days, one may well suspect error in records, or pathologic retardation or other interferences.

As in the mare, it has been claimed that breed exerts some influence upon the duration of pregnancy. Wilhelms has asserted that the Hungarian cow goes some 10 days longer than the Dutch cow.

Duration of Pregnancy in the Sheep and the Goat. The duration of pregnancy in the sheep and the goat is about five months, with variations of about twelve days. Some observers have found the duration of gestation longer in case of female than of male lambs. There is an impression, apparently supported by statistics, that twins are born somewhat earlier than single fetuses, but the difference, if any exists, is very slight.

Duration of Pregnancy in the Sow. The duration of pregnancy in the sow is a trifle short of 4 calendar months, or about 115 to 120 days. The variation is not very great, although some authors give, as extremes, about 104 to 127 days, with most births occurring between 115 and 125 days.

Duration of Pregnancy in Carnivora. The bitch is pregnant from 58 to 65 days, but usually about 9 weeks, or 63 days. The duration of pregnancy in the cat is 3 or 4 days less, or about 8 weeks, with a variation of 3 or 4 days.

Duration of Pregnancy in Wild Animals. In wild ruminants, the duration of pregnancy varies from 34 to 40 weeks. Harms notes the peculiar fact that in the deer there is a period of 40 weeks between fertilization and the birth of the young, but that this time does not represent the period of development of the fetus as we understand it in most animals. The ovum of the deer undergoes segmentation and then lies in the uterus for 4 months in an essentially dormant state. About December the distinctive embryonic development begins, and birth follows in May or June—about 5 months later. If this time of 5 months, during which the active development of the fetus has taken place, is compared with the duration of gestation in the sheep, the two become virtually identical. It is suggested that this delay in the development of the young is a provision by which it may be born at a favorable season of the year. The phenomenon reminds one of the dormancy of the bird's egg, which, though fertilized, does not undergo segmentation until incubation begins.

THE NUMBER OF FETUSES.

In domestic animals wide variations exist in the number of fetuses ordinarily brought forth at a given birth. In this respect the animals are separated into two or three classes: the unipara, chiefly the mare and the cow, which ordinarily give birth to but one young at a time; the bipara, or twin-bearing animals, among which the goat and the larger breeds of sheep are most prominent; and the multipara—the carnivora and the sow. In all animals, however, there are occasional departures from the rule. Thus, in unipara twins are born, and sometimes in multipara only one or two young are born at a time.

TWIN PREGNANCY.

Among domestic animals, twins are rarest in the mare, although every veterinarian of experience in a horse-breeding district has observed equine twins. In the cow, twins are not at all rare; they are commonest in Holsteins and rarest in Jerseys.

The origin of twin pregnancy varies. Fundamentally, the number of fetuses must correspond with the number of ova which have been discharged during a given estrual period. It is claimed that in some cases two or more eggs are formed in one ovisac, each of which, when discharged and fertilized, may develop into a fetus. In such case, but one yellow body forms in the ovary to represent the two fetuses. Usually twins proceed from the simultaneous rupture of two ripe ovisacs, each of which contains a single ovum which is discharged and subsequently fertilized. In the cow the two ova generally originate one in each ovary, but at times the two ova originate from two ovisacs in the same ovary and are succeeded by two yellow bodies. In other cases, twin pregnancy may be caused by complete equal division of the ovum or blastoderm, to form two separate embryos which may become identical twins, of the same sex, enclosed in a common chorion, each having a separate amnion. In the examination of the pregnant uteri of more than two thousand cattle, I have failed to find twins without two corpora lutea.

In domestic animals I have been unable to recognize identical twins. The college museum contains fission monsters, where apparently only the completion of the fission is wanting to produce indentical twins. The question is best studied in spotted cattle. In Fig. 80, the fission has extended through the head and neck, and into the chest. As far as the fission extends, the markings are inversely identical. The proximal sides of the divided parts are marked inversely alike, and the distal sides follow the same rule. Had the fission been completed and the plan of marking persisted, the color markings, when the calves were standing side by side or head to tail, would have been unlike, but, when standing head to head or tail to tail, would have been inversely identical. That is, a photographic negative of either side of one calf, turned end for end, would be the negative of the opposite side of the other calf.

A B C

FIG. 80. FISSION MONSTER (tetrachirus choristocephalus) CALF.

Showing essential identity of color markings as far as fission extends. A, right side of right head and neck. B, anterior view showing left side of right division and right side of left division. C, left side of left head and neck.

(Museum New York State Veterinary College.)

In numerous cases it is found, when twin fetuses are expelled, that one is much more developed than the other, suggesting that the less developed one has been dead in the uterus for a considerable period of time, without having undergone decomposition. In the mare, abortion occurs in probably 90% of the cases of twin pregnancy. Among those which are born alive, not infrequently one of the pair is Lilliputian.

Rueff records one case of twin gestation in the mare in each 250 pregnancies. While I have observed several instances where twins have been born alive, they are usually more or less imperfect and tend to perish soon after birth. Sometimes they are quite normal and vigorous, and very much alike in form and size. Triplets and quadruplets have been recorded very rarely in the mare. As in twins, abortion usually brings the pregnancy to a premature close ; if born alive, the foals are generally weak and tend to perish. Saint-Cyr cites one case in which a mare, from a single stallion service, aborted two fetuses in one chorion and, some months later, gave birth to a living and vigorous foal.

A similar tendency to twin abortion, already mentioned in the mare, is well marked in the cow. Abortion is probably three to four times more frequent in twin than in single pregnancy. Regularly abortion is most common in first and second pregnancies, where twins are most rare. In adult cows, where abortion is less frequent and twins more common, the frequency of abortion, premature birth, and retained afterbirth in twin pregnancy becomes notable. The abortion of cows in twin pregnancy is not accidental or essentially what might be termed "twin abortion," but is simply contagious abortion.

There is a tendency in certain cows to produce twins year after year. Fleming quotes one case in which a cow, during an interval of seven years, produced twenty-five calves—an average of more than three young per annum. She gave birth to a single calf the first time, and thereafter produced two to six calves at a birth. In the one instance of six young, all died. One of the most notable cases of excessive number of young is that given in the Magazin of Gurlt and Hertwig, Vol. 23, page 125. A cow which had given birth to one vigorous calf was butchered, and fifteen fetuses were found in the uterus. Other instances of from three to six or more calves at a birth are recorded. They are of little interest except from the standpoint of curiosity. When a cow is attended during parturition, a search of the uterus should always be made, after the removal of a fetus, to determine that no additional young are present.

In the ewe twins are very common. In some of the large mutton breeds, except in yearling ewes, twin pregnancy becomes the rule and single births the exception. In some well-fed bands of ewes, an average of two lambs per ewe for the entire number is reached. In one flock of 26 Cotswold ewes, there were 52 lambs: there had been a sufficient number of triplets to bring the average up to two lambs for each ewe. In the smaller breeds of sheep, like the Merino, twins are less frequent. In the goat the general rule is twins or triplets.

In the cow there frequently occur what are known as free-martins: twins are born, one of which is a bull and the other, arrested in its sexual development, remains a neuter.

The Diagnosis of Multiple Pregnancy in uniparous animals is seldom demanded except in cases of difficult parturition. Even then, as a rule, the twin pregnancy is not suspected except in those cases where the difficult parturition is produced by the simultaneous presentation of parts of the two fetuses. Sometimes twin pregnancy may be suspected on account of the very great size of the abdomen of the mother. It may be diagnosed by manual exploration through the rectum, if portions of each fetus are in reach. When two young present simultaneously at the pelvic inlet and cause dystokia, the condition can usually be readily diagnosed by tracing the presenting parts—limbs or head—to the separate bodies of the fetuses. The only difficulty encountered in diagnosis, as a rule, is when a single fetus undergoes such deformity as campylorrhachis or schistocormus reflexus (Figs. 70 and 71), in which case the spine of the fetus is abruptly bent upon itself, so that the head and all four feet present simultaneously at the pelvic inlet, thus closely simulating twins. These abnormalities are to be differentiated from twins by the fact that, when one portion of the aberrant fetus is repelled or advanced, the other part moves in harmony with it. This is not true of twin pregnancy, in which one fetus can be repelled while the other advances.

Arrangement of the Fetuses in Twin Pregnancy. In twin pregnancy, each fetus occupies the uterine horn corresponding to the ovary from which the ovum producing the fetus emanated. In a minority of cases, the two fetuses arise from the ova of two ovisacs rupturing simultaneously in one ovary. The two fetuses then develop in the one horn on the side of the functioning ovary.

The ordinary non-identical twins of the cow commonly lie in reversed positions, one presenting anteriorly and the other posteriorly. If emanating one from each ovary, the two lie side by side in the two horns, which are essentially equal in volume and alike in form. When the two fetuses emanate from two ovisacs in one ovary, they both lie in one horn, in reversed position, end to end, not side by side. They follow the rule of multiple pregnancy : each fetus lies longitudinally in the horn, the membranes of each fetus in contact with the entire circumference of the uterine mucosa within the area occupied. In all cases I have observed in the abattoir, the fetuses due to two ova from one ovary lay head to head, resulting in the posterior fetus presenting its posterior end to the cervical canal and the anterior fetus presenting its head. When such fetuses are at full term, an elongation of the uterine body and gravid horn to at least eight feet is necessary, compelling a folding of the uterus upon itself, as in multipara.

The membranes of twin fetuses vary in arrangement. In the cow I have constantly observed a continuous chorion due to the fusing of the two membranes in their vascular layer. The two allantoic sacs, the entodermic portion of the allantois, are sometimes fused, but generally distinct. The amniotic sacs are distinct. Clinical records of one of a pair of twins having been born at one time and the other a day or more later would indicate that sometimes there are two wholly distinct choria, permitting one fetus to be expelled without disturbing the integrity of the annexes of the other. This would appear most probable in twins, following the rupture of two ovisacs in one ovary, where the fetuses are arranged end to end in the gravid horn.

Occasional instances are recorded where an animal has aborted one fetus at a comparatively early period in gestation and later, after the normal duration of pregnancy, has given birth to a living twin. Quite commonly, in the mare, one of a pair of twins perishes and remains in the uterus for a considerable time, while the other continues to live and develop. Finally both are aborted, or the one is born alive, and there is observed a great variation in the degree of development of the two, which sometimes leads to the belief that they represent impregnations at widely separated times.

Occasionally in twin pregnancy one twin is more or less enclosed within the body of the other. Presumably this results from unequal fission of an ovum, by which two embryos result. For some reason one of the embryos is much larger than the other and, remaining intimately connected, grows around and includes the other more or less completely.

ANOMALIES IN FECUNDATION

Superfecundation

Superfecundation is the fertilization of two or more ova, one after another, during one estrual period. When two or more ova are discharged during a given estrual period, one or more of them may be fertilized as the result of one copulation, and another ovum as the result of a subsequent copulation. If the two or more copulations are made by the same male, the evidence of superfecundation is wanting. When two or more males of different types, breeds, or species copulate with the female and each fertilizes certain ova, the evidence of superfecundation becomes marked. The phenomenon may occur in any female in which two or more ova are discharged during a given estrum.

Superfecundation is most common in neglected mongrel bitches, in which there is a prolonged estrum and very commonly repeated copulations with nondescript dogs. As a result, it is not rare to find the puppies of a given litter showing unmistakable evidence of varying male parentage.

In biparous animals, as the sheep and goat, such results are always possible, but the opportunity for copulation by males of different breeds is not usually offered.

In the mare, in which twins are rare, there are records, especially by Saint-Cyr, of a few cases in which a mule and a horse foal have been born at one time, the results of closely succeeding copulations of a stallion and an ass. The two services may be separated by several days, but must occur prior to the formation of the uterine seal. Lanzillotti-Buosanti records a case where an interval of eight days elapsed between the services by the stallion and the ass.

Superfétation

Superfetation differs from superfecundation in that a second ovulation occurs in an animal already pregnant and the second ovum is fertilized by a second copulation. In order that superfetation may occur, there must be a departure from the physiologic rule that pregnancy inhibits ovulation and estrum. Pregnant cows occasionally show estrum and copulate quite naturally as a result of the atrophy of the corpus luteum of pregnancy, but a second fertilization can not occur if the uterine seal has formed. This occurs ordinarily during the normal estrual cycle of twenty-one days. Regular estrum may appear for two, three, or more periods after fecundation, copulation follow, and finally a calf may be born normally from the first copulation. Ovulation occurs in such cows, but never, to my knowledge, fertilization, since the passage of the spermatozoa is barred by the uterine seal.

In bicornual uteri, in which the fetuses are usually limited in their location to the cornua, and the uterine body is vacant, the fetuses of the primary fertilization may be confined to one of the cornua if the ova were all from one ovary. An open avenue may exist through the entire length of the other cornu, so that a second fecundation may occur at a more or less remote period. De Bruin (Geburtshilfe b. d. kleineren Haustieren) quoting Kroon, relates that a goat was bred September 14, 1897, and estrum and copulation recurred on November 5th, or 52 days later. On February 13, 1898, 152 days after the first breeding, and at the completion of the normal duration of pregnancy, she expelled two living and one dead, fully developed young. On the following day, when the membranes were expelled, there were discovered three more fetuses, perfectly formed, but not fully developed. These Kroon regarded as certainly the result of the second copulation.

Tapken, also quoted by De Bruin, observed superfetation in sows. In one instance the sow was first bred on February 22, 1890, and again 17 days later. On June 21, 120 days from first breeding, she gave birth to 7 live pigs and, 14 days later, to 9 live and 3 dead pigs.

The Wandering of Genital Cells

Schmalz (Carsten-Harms) claims that the spermatozoa may pass through one of the oviducts into the peritoneal cavity, and cross over to the opposite ovary. It has also been claimed, that experimentally, in rare cases an ovum which has escaped from one ovary, but failed to enter the corresponding oviduct, has passed across to the other ovary and enter its oviduct. It has been alleged that an egg which has emanated from one ovary may become fertilized, pass through the corresponding oviduct and cornu to the uterine body and thence upward into the opposite cornu, to become attached and develop into an embryo. The evidence of such occurrence is found in the fact that a fetus sometimes develops in one uterine cornu, while the yellow body from which the ovum apparently emanated is located in the opposite ovary. The phenomenon is misleading. While such migration may be possible, the finding of the corpus luteum in one ovary and the fetus in the opposite horn does not prove the allegation. Recently I have made definite observations where a pregnant cow came in estrum because of the disapearance of a corpus luteum; quite naturally a new one would form following the estrum. In the ordinary course of events, after the corpus luteum of pregnancy has disappeared, the new ovisac would ripen in the opposite ovary and the resultant yellow body would be on the side of the non-gravid horn. The corpus luteum of pregnancy is not always the corpus luteum which formed in the crater of the ovisac from which the fertilized egg emanated.

Polyspermia

Some authors believe that an ovum may be overfertilized: that is, instead of one spermatozoon penetrating an ovum, two or more gain admission to it. In such case the development may be abnormal and lead to the formation of some of the double or triple monstrosities.

THE HYGIENE OF PREGNANT ANIMALS

Little can be said in reference to the general hygiene of a pregnant female which would not apply equally to the same when non-pregnant. It has been held by many that the pregnant female requires different general care from others, but there is no scientific reason why this should be so, nor are there any observations in clinical experience to justify such a contention. Certain special care is essential for the well-being of the pregnant female and the young within her uterus. The weight of the fetus tends to render the animal somewhat less capable of performing certain kinds of labor. The contact of the fetal placenta with the uterus is such that any very violent movements may cause some disturbance of the placental relations. Consequently, in animals in an advanced state of pregnancy, more care should be used to avoid violent exertion. This is seen to some extent in all animals, but especially in the larger herbivora, where the single, very large fetus may cause some disturbance of the placental attachments, should any sudden movement of the mother occur. In a general way however, we should not care to submit a non-pregnant animal to such abuse as would imperil the safety of a pregnant female.

The well-being of the pregnant female is best conserved by the same diet which would maintain the non-pregnant animal in the best state of health. In relation to exercise, the same conditions hold true. Those pregnant females which are allowed their freedom, and consequently get natural exercise without any serious disturbance, are those which most regularly pass through the pregnant state without serious inconvenience or danger. Next to these, the safest pregnancy in the mare is that accompanied by regular daily labor of a gentle character.

Violent movements in any pregnant female are, of course, to be obviated as far as practicable. Some physical insult may cause rupture of the uterus, abortion, or other disaster. It is important that the pregnant mare which is worked should not be roughly jostled by the pole of a vehicle or otherwise. Where abortion follows an injury, the life of the mother is endangered. The high intra-abdominal tension of violent exertion may also imperil the integrity of the uterine seal. Any form of violence which might bring about a sudden and severe impact upon the uterus should be avoided. Mares used for draft work should be carefully guarded against violent pulling, because this tends constantly to increase the intra-abdominal pressure, to interfere with the circulation in the uterus, and to disturb the placental attachments of the fetus. Similar dangers are observed when the animal is free in the pasture and becomes mired in deep mud. Pregnant animals which are used for labor may continue at quiet work to the end of pregnancy ; if the labor is strenuous, it is best to omit it early. A brood mare put to gentle farm work or other labor of a similar character may continue to work without disadvantage—and in many cases rather with advantage—up to the time of parturition. It is not at all rare in agricultural communities to have a mare stop in the plow or upon the road and give birth abruptly and successfully to a foal. Sometimes the mare drops, and before she can be unharnessed the foal is expelled. No untoward effect upon either the mother or the fetus is usually observed from such an occurrence.

When pregnant animals are free in the pasture, they usually guard against excesses and move with care, at a comparatively slow pace, thus avoiding the dangers which may be thrust upon them by injudicious handling while at work.

The shipment of pregnant animals in railway cars is in itself not essentially dangerous under proper conditions, but the unsteady movements of the car and the fright of the animal cause it to be thrown about more or less violently. If these violences can be avoided, the dangers from railway travel are reduced to a minimum and rendered comparatively unimportant.

Some writers advise that the pregnant female should not be allowed near the male, but there is no clinical evidence in support of such a contention. It is quite true that in exceptional cases a pregnant female will show signs of estrum and copulate with the male, but it has not been shown that this is extremely serious. Instances have been observed where abortion has quickly followed copulation, though it seems more probable that the death of the fetus caused the appearance of estrum, leading to coition, than that coition caused abortion. At best, it may be said that injury from coition during pregnacy is very rare. It is to be remembered however that pregnant females will only rarely copulate. Estrum is usually accepted as conclusive evidence of non-pregnancy, and the animal is bred, incurring all the risk possible were the male habitually free with the female. The risk is even greater. Some pregnant females which appear to be in estrum will not permit the male to copulate, but if the owner believes one of these to be in estrum she is frequently held while the male copulates with her. Abortion is less common amongst animals where males and females consort throughout the year. Wider acquaintance with abortion has shown that it is essentially an infectious disease and that physical injuries play a very unimportant role in its occurrence. In the smaller domestic animals though males habitually consort with pregnant females, abortion is far more rare than in the larger animals. The clinical evidence therefore would indicate that it is not harmful to pregnant animals to permit the male to consort with them regularly. Admittedly, however, it is dangerous to allow a male to be abruptly turned loose among pregnant females, where he may greatly annoy them and possibly cause serious injury.

The quality of food to be recommended for a pregnant animal does not differ essentially from that for the non-pregnant. There are foods which are unsafe for the non-pregnant animal and are equally unsafe for the pregnant female. Pregnant herbivorous animals are healthiest if allowed to graze in pastures, under the most natural conditions possible. It is not highly essential that they should be protected from inclement weather any more than if they were not pregnant. Rain, snow, cold, or heat is no more prejudicial to the well-being of a pregnant animal than to that of a non-pregnant one.

Some writers have insisted that certain forms of food, notably those which have been attacked by rust, fungi, or molds, are especially dangerous for pregnant animals. This, however, has not been demonstrated clinically. It is quite true that abortion is more common at times among animals which are fed upon a very poor quality of food ; if we observe non-pregnant animals which are compelled to subsist upon the same diet, we find that they suffer in a similar way in all respects save the one question of the well-being of the fetus. Both pregnant and non-pregnant animals become emaciated and weak or show other constitutional disturbance as a result of being compelled to live upon such food.

Occasionally abortion is apparently an additional symptom of the injudicious feeding. However, this is probably only apparently or indirectly true. If the uterus of a pregnant female contains organisms capable of inducing abortion, bad foods, by lowering the vigor of the animal, may give freer rein to the infection present, thus increasing its virulence to such a degree as to precipitate a disaster otherwise improbable. Sometimes special emphasis has been placed upon foods affected with smut or ergot, which are blamed for producing wide-spread abortion. The presence of smut or ergot upon fodder is seized upon merely as an explanation for the occurrence of infectious abortion. The damaged food, by lowering the vitality of the animal, increases the virulence of the infection.

If contagious abortion breaks out in a harem of mares which are running upon corn stalks during the autumn or early winter, after the corn has been gathered, it is not difficult for the owner or veterinarian to find stalks affected by smut and, believing that this causes abortion, to make it serve as a scapegoat for the infectious disease which is destroying the foal crop. At another season of the year, if the mares are grazing upon bluegrass and abortion breaks out, the searcher after ergot may find a few traces upon the grass and explain thereby the presence of the contagious disease. If the mares are grazing upon red clover, which admittedly has a tendency to induce tympany and other serious diseases in case of overfeeding, the character of the food is again drawn upon to explain the presence of the disease. In general it should be stated that the food should be of good quality, just as it should be for a non-pregnant animal, and that the amount should be essentially the same as that allowed to non-pregnant animals.

In reference to water for pregnant females, there is again no essential danger which does not apply equally to the non-pregnant animal. Some hold that pregnant animals should not be allowed to drink very cold water. This is not clinically true. Pregnant animals are constantly observed drinking cold water at will, without any ill effects. Throughout the western parts of the United States, and even in the Mississippi Valley, pregnant animals habitually have cold water during the winter season. Upon the great plains of the Rocky Mountains, pregnant animals very largely eat snow in winter instead of drinking water, without harm; when they do drink water from a stream, it is generally barely above the freezing point. Throughout the Mississippi Valley, it is not at all rare in winter for the farmer daily to break or cut the ice so that pregnant animals may drink.

If a pregnant animal which has been made very warm by fatiguing labor is allowed to become extremely thirsty and to drink an inordinate amount of ice-cold water, it may have a very deleterious influence upon the fetus. However, such an allowance of cold water would be equally improper for a non-pregnant animal. In those pregnant animals which are much out of doors during cold weather and which go to water at will, there seems to be no danger whatever from drinking the cold water, because it is taken very slowly, and usually in small volume, so that the shock is not great. It is common to note that these animals, after drinking ice-cold water, shiver somewhat, but this does not seem to have any special danger for the life of the fetus.

Some writers speak very unfavorably of allowing pregnant animals to eat frozen food, or herbage which is covered with frost. This notion also seems to be quite erroneous. Upon the western plains the animals which are left on the range during the entire winter, whether pregnant or not, must habitually paw or dig the snow from the scanty herbage in order to procure food, and consequently eat with the grass a considerable amount of snow, which may be at a temperature as low as—40° or—50° F. Yet, pregnant animals do not suffer from this cause. In the Mississippi Valley, during the earlier periods in the settlement of the country, since almost all pregnant animals were fed out of doors in the winter, the food had to be taken from the ground, which was largely covered with snow and frequently at quite a low temperature. Yet, these pregnant animals almost never aborted. It must be admitted however, as in the drinking of cold water, that some foods may be so damaged by cold as to make them indigestible and injurious, for pregnant and non-pregnant animals alike. Succulent foods, such as roots, clover, or green vegetables, which are normally killed by a moderately low temperature, may be so frozen as to be quite injurious. Naturally, they should not be allowed to pregnant animals, nor to those which are non-pregnant.

The housing of pregnant animals should not differ materially from that of the non-pregnant. The same rules as to light, air, ventilation, and the amount of cubic space per animal apply to all alike, whether pregnant or not. A stall that is good for a non-pregnant animal is good for a pregnant one. It is of course desirable that the stall floor for pregnant animals should not slope very greatly, either backward or forward. The same rule applies to the non-pregnant animal. Pregnancy intensifies the backward pressure of the abdominal viscera, when the stall floor slopes very greatly, and may possibly tend to cause prolapse of the vagina.

When the time for parturition draws near, it is generally advisable that mares kept in single stalls and cows kept in stanchions should be removed from these and given some degree of freedom. Most writers advise that the mare should be given a roomy box stall, in the belief that she can foal better in such a place. This may be generally true, although accidents have occurred owing to the very fact that the animal was loose in a box stall, since a mare sometimes lies down with her buttocks immediately against the side wall so that there is not room for the expulsion of the foal. Instead, the foal is jammed against the side of the stall, its expulsion delayed and its life endangered. Sometimes the mare turns around somewhat violently in a box stall and the head of the protruding fetus is seriously injured by being pressed against the wall. If a mare is to foal in a box stall, it should be ample in size and give every possible opportunity for parturition to progress without danger of accident from contact with the side walls. Some breeders arrange a special stall for foaling mares. A false wall is added, beginning at the base, three or four feet inwards from the main wall, and sloping upward and outward at an angle of 45°, joining the main wall at the height of three or four feet. This slanting wall prevents the foaling mare from becoming cast and the protruding foal from being jammed against the walls.

The pregnant animal, like any other, should be allowed to lead a tranquil existence, free from cruel handling and from great fear. If a pregnant animal is chased—for instance, if a ewe is annoyed by dogs—there is naturally danger to the lives of both mother and fetus, but so far as known this of itself can not and does not cause abortion. It may cause a rupture of the uterus, or torsion of that organ, with death of both mother and fetus, but in neither case does or can the ewe abort. If an infection exists in the uterine cavity, the mauling may precipitate an abortion, the foundation for which has already been securely laid. Such injuries to pregnant animals have been greatly over-strained in order to account for abortion.

It has been suggested that pregnant animals of different species should not be allowed in the same field or pasture, but this is only partially correct and depends rather upon the character of the individual animals than upon the difference in species. It is not rare in many localities to observe pregnant mares, cows, sheep, and pigs in the same enclosure, without any special danger to any from the presence of the others.

At the time of parturition of ruminants, it is unsafe to permit swine in the same enclosure. Swine, being omnivorous, greedily devour the new-born young of ruminants. Should the mother be exhausted or otherwise unable to defend herself, she too may succumb to the rapacity of the swine. This is especially true in cases of dystokia, and still more when prolapse of the uterus occurs. Fleming relates a case of prolapse of the uterus in a cow, in which swine devoured the prolapsed organ, but amputated it so well that the animal recovered.

It is a well-known fact that some animals take it upon themselves to annoy others, and even compromise their lives, whenever opportunity offers. This is especially true of mules, which sometimes have so meddlesome a disposition that they constantly harry any animal which cannot resist them, simply as a pastime: to a less degree the same applies to colts. Sometimes we observe that a pregnant mare or cow is exceedingly irritable toward her companions. Consequently it is somewhat unwise to permit a particularly ill-natured pregnant mare to consort with other pregnant mares, because of the injuries which she may inflict upon them by kicking or other violence.

Since surgical operations and medication sometimes offer dangers to the pregnant animal, they should be undertaken prudently. Serious surgical operations which are not urgent should be delayed until after parturition, especially if they involve the confinement of the pregnant animal. But this caution should not carry us too far. Serious operations, with rigid confinement, pain, fear, chloroform anaesthesia, loss of blood, subsequent infection and fever, are repeatedly performed upon pregnant animals without untoward results. While suggesting caution, pregnancy should not be regarded as a bar to major operations upon pregnant animals. Much will depend in these cases upon the temperament of the individual animal. Operations upon pregnant animals may be imprudent because the owner thinks the operation dangerous to the fetus. In one instance I dehorned a timid Jersey heifer, which was in an advanced stage of pregnancy. Abortion promptly followed, in a manner which suggested to the owner, who had inquired concerning the possible danger, that the abortion was due to the fright and pain of the surgical operation, or possibly to a considerable hemorrhage which followed the removal of the horns.

Any drug which causes more or less serious poisoning of the mother may naturally imperil the life of the fetus. Chief among the drugs which have a bad repute are aloes and other drastic purgatives. Usually purgatives, such as bland oils and moderate doses of eserine and arecoline, may be given without inducing abortion, and with essentially the same safety as though the animal were not pregnant.

Consequently, in dealing with pregnant animals, one should constantly bear in mind the possibilities of abortion or other injury to the fetus, and not cause unnecessary interference which may imperil the life of the fetus. From a politic standpoint, the owner of the animal should always be advised of the possible danger to the fetus from medication or surgical operation. In all cases the casting and other manipulations connected with disease or operation should be as gently and judiciously carried out as is possible.

DISEASES OF PREGNANCY

The diseases of pregnancy resolve themselves into three primary groups:

1. Diseases of the pregnant animal due to or intensified by the pregnant state.

2. Primary diseases of the fetus.

3. Infectious diseases of the mother transmissible to the fetus in utero. These affections, consisting chiefly of the sterility-abortion-calf scours group, work a large part of their destruction during pregnancy, but prevail so destructively throughout the entire life cycle of the animal that it is impossible to give the subject proper consideration in this chapter or elsewhere in a volume on obstetrics. The consideration of this group is made the foundation for a companion volume devoted to the diseases of the genital organs.

Diseases of the Pregnant Animal

Special diseases of pregnant animals are comparatively rare. Most pregnant animals are kept in a reasonably natural state and, consequently, do not suffer greatly as a result of gestation. Pregnancy confers no immunity against the ordinary diseases. There are some serious diseases during gestation, which are referable to the pregnant state and which require attention. In pregnant animals the tendency to disease is in harmony with the environment, the degree of domestication, and the care given the animal. Those animals which are most closely confined and housed are most subject to diseases during the pregnant state; but this is also in harmony with the prevalence of the diseases of non-pregnant animals.

The influence of gestation upon the course of the ordinary diseases of animals is not well marked and apparently makes very little difference, except that, when a pregnant animal becomes so seriously diseased that her life is threatened, the fetus tends, in some cases, to perish and become expelled prior to the death of the mother. Hence, any serious disease of the pregnant female may acquire additional gravity because of the possibility of abortion, which would complicate the malady. The fetus constitutes a burden upon the maternal system. When serious disease arises, the demand upon the nutritive supply of the mother for the maintenance of the life of the fetus may influence unfavorably the prognosis of the malady. Advanced pregnancy may greatly modify the prognosis of fractures, strains, and other more or less disabling injuries: the extra weight of the gravid uterus adds to the difficulty of getting up and down and interferes with locomotion in a manner which may jeopardize the life of the mother, the young, or both.

All those infectious diseases which are frequently accompanied by abortion, such as contagious pleuro-pneumonia of cattle, sheep-pox, contagious cellulitis or pink eye of horses, hog cholera, and foot and mouth disease, are constantly more dangerous for the pregnant female than for other animals, because of the danger which they possess for the life of the fetus, and the extra hazard to the mother through its death and expulsion. Even here the influence is indirect. In each species of domestic animal there is a form of contagious abortion. An infection is present in the genital tract, which under the most favorable conditions may cause no disaster and go unrecognized, but under the influence of concurrent disease or of bad food or feeding is intensified and given exalted power to induce disaster.

Some veterinary obstetrists claim that pregnant animals suffer especially from numerous affections which are seen less frequently in the non-pregnant, and, according to this view, should be in some cases referred to the pregnant condition. Among these are mentioned the cramps of the muscles of the hind limbs, which simulate closely the dislocation of the patella in non-pregnant animals. The difference between the two affections is not pointed out. Since the actual character of the so-called upward dislocation of the patella in the horse is in controversy, it is not necessary to discuss the question of the differential diagnosis, but merely to state that the occurrence of this cramp is not extremely rare in the mare and that it may readily be overcome, as in the so-called dislocation, by causing the animal to move the affected limb and then looking after the exercise and general care of the patient.

Some writers also refer to *pica*, or morbid appetite in pregnant animals, although no evidence is adduced that this is any more common in the pregnant than in the non-pregnant state, or that gestation has anything whatever to do with its occurrence. It requires no special notice in reference to handling, but should be dealt with as in the non-pregnant animal.

The same may be said of the question of constipation in pregnant domestic animals. The annoyance from this trouble in pregnant women is well known, but apparently it is not present to any marked degree in animals. It is caused usually by too close housing and injudicious feeding. It should be corrected simply by removing the causes and giving the animal proper attention.

Among the diseases of pregnancy, edema of the feet and limbs of the mare is described, which is compared to the edema of the feet observed in woman. It is a well known fact that this is a common malady in the horse, without any reference whatever to pregnancy, and it is only natural that in the pregnant state, while the animal is more quiet than usual, such an edema may become emphasized. Beginning, as is usual, in the lower parts of the limbs or feet, it reveals itself as an infiltration of the connective tissue beneath the skin, which is painless and tends to pit under pressure. The edema may gradually extend upward toward the body. It has little real significance, so far as the well-being of the mare or foal is concerned, and tends to disappear shortly after parturition. It may be largely avoided, during the period of pregnancy, by careful attention to the diet and the allowance of regular exercise. Usually it is not seen in those mares which are kept at moderate work, regularly run at pasture, or are otherwise kept constantly out of doors where they may take natural exercise. This condition should not be confounded with rupture of the prepubian tendon or the infiltration of the abdominal floor leading thereto.

Osteomalacie

Osteomalacie is described by numerous European writers as a common disease of pregnant animals. Apparently it does not differ from the osteomalacie of non-pregnant animals, but is believed to be more common and severe in the pregnant animal. Its chief interest to the obstetrist is the greater susceptibility to the malady. In some instances, epizoötics of osteomalacie have been recorded in pregnant cows and other pregnant animals.

Saint-Cyr attributes the malady to three chief causes: 1, deficient quantity and quality of food; 2, the parturient state; 3, prolonged lactation.

The first, in conjunction with bad housing, is generally invoked to explain the occurrence of osteomalacie in non-pregnant, as well as in pregnant animals. The second reason assigned, the pregnant state, is generally recognized as a cause of osteomalacie. The third cause is presumed to act merely by lowering the vitality of the animal, and thereby increasing its susceptibility.

The beginning of the malady is obscure. The pregnant cow moves carefully, maintains the recumbent position more than usual, and exhibits rheumatic symptoms. The appetite remains good. There is no fever. Then follow fractures of a more or less spontaneous character: a slight misstep, a slip, or even an effort to rise, serves as a sufficient cause. The pelvis suffers most frequently; in many cases it is comminuted. Other bones—scapula, sternum and long bones—are less commonly broken.

M. Germain reports the symptoms in the goat as consisting primarily of paraplegia, followed by swelling of the jaws and loosening of the teeth in the alveoli, with difficult mastication.

In solipeds, fracture of the vertebral column is not rare.

The diagnosis of the malady is not easy, as there occur no very definite symptoms, except those of general ill-health, until perhaps a fracture occurs, which is often referred to accident. When a fracture occurs in a pregnant animal, without sufficient known accident, the fact may well arouse suspicion of osteomalacie.

The prognosis, once the disease is well established, is very grave. When the malady becomes enzoötic, and as a consequence its nature is recognized early, much may be accomplished by improved hygienic conditions, especially by a liberal supply of nutritious food of proper quality. With these improvements, further benefit may be derived from the administration of nux vomica and iodide of potash. Some recommend phosphoric acid or calcium phosphate, internally.

Dropsy of the Uterine Walls. Parietal Hydrometra

Edema of the gravid uterus is extremely rare in domestic animals. One case is recorded by Harms, in a cow far advanced in pregnancy. The patient showed symptoms of abdominal pain and died within an hour. Post mortem examination revealed a great infiltration of the walls of the uterus, so that they had attained a thickness of 8 to 10 cm. Upon incision, the infiltrated fluid escaped.

Dropsy of the Utero-Chorionic Space. Visceral Hydrometra

An accumulation of fluid between the chorion and uterine walls is exceedingly rare. The few cases which are related are not perfectly clear, but suggest that in some of them the writer may have been dealing with hydramnios or hydrallantois. It appears, however, that such a condition does rarely occur.

Schutt (Gurlt und Hertwig, Vol. 9, page 199) relates a case in which the animal was very feeble and recumbent much of the time, but could get up with help. She groaned and was restless, respiration was somewhat labored, her coat was rough, and her appetite poor. The abdomen was greatly enlarged. The motions of the fetus could be distingished ; it could also be felt by ballottement. Finally the animal could not get up, and perished. Post-mortem examination revealed a greatly distended uterus, with normal walls, fetus, and membranes. Between the chorion and uterus there were 30 quarts of clear, odorless fluid.

Paraplegia

In the cow, and rarely in other ruminants, there occurs during pregnancy a form of paralysis of the hind limbs, the nature of which has not been fully determined. During one winter, in the area contributory to our college clinic, there was widespread complaint by dairymen of paraplegia in pregnant cows. It appeared in numerous dairies scattered over a large area and involved, in some herds, as many as ten to fifteen per cent. of the cows.

In these cases, the disease appeared more or less suddenly and the animal would be found lying down unable to rise. Perhaps at first she would be able to stand, upon being assisted to her feet. This condition might continue for days or weeks, until finally she would go down and be unable to rise, even with assistance. The disease generally appeared two or more weeks prior to the average end of gestation and continued until after parturition, unless the animal were previously destroyed or succumbed to the affection or to some intercurrent complication. The animal was bright, lay upon the sternum with the head erect, and appeared at first quite normal. The temperature was normal, the muzzle moist, the pulse and respiration unchanged. The bowels were normal, or possibly suffered some degree of torpidity, as would be naturally expected in an animal in the recumbent position. The appetite was good. The fetus was alive and apparently normal.

The occurrence of this malady could not be traced to any definite cause. The cows which were affected were in the stable, since the disease occurred during the latter half of the winter. As the food upon which they subsisted varied in the different dairies, nothing definite as to cause could be determined in this way. The grain upon which the animals were fed, mostly imported from the western states, consisted largely of bran, corn meal, and brewers' grains. The hay, grown locally by the farmers, had been generally damaged during the haying season because of wet weather, so that most of it was of an inferior quality and more or less discolored and mouldy, but it was not pre-eminently bad. The cows were not in good condition. They were not extremely emaciated and had not been starved so far as quantity of food was concerned, but had been fed rather liberally. Yet they were thin in flesh and seemed to be weak and wanting in vigor. This condition applied alike to the pregnant and the non-pregnant animals. The damaged hay seemed the most probable cause of the disease.

Saint-Cyr records similar occurrences. Though he thinks it would be improper to speak of them as epizoötic, yet they occurred quite frequently during certain years and in given herds.

The disease usually persists, should the animal survive, until parturition, after which it generally disappears. The tendency for it to disappear after parturition seems to be due largely to the decreased load which the animal has to bear because of the expulsion of the fetus and its annexes and the decreased drain upon the maternal system when freed from the nutritive demands of the fetus.

In the diagnosis of paraplegia, it must be carefully distinguished from other conditions causing recumbency. Inability to rise may be due to some accident, such as a strain or other injury to the limbs or spine. In pregnant cows, one of the commonest causes of inability to rise is dislocation of the head of the femur (See Coxo-Femoral Dislocation). Dislocation of the femoro-tibial articulation also occurs. The possibility or probability of such injury should be excluded. Osteomalacie, which may induce paraplegia, is not readily differentiated clinically from the affection under consideration.

One should carefully differentiate paraplegia from dropsy of the amnion, which see, in which the collection of the fetal fluids may be so great that the animal is unable to rise when down simply because of the enormous weight.

Paraplegia is also to be distinguished from parturient paresis, or "milk fever," which in rare cases appears during pregnancy, instead of after parturition. The differentiation of the two is not very easy, since in a mild form of parturient paresis the animal may look bright. Parturient paresis, however, occurs chiefly in those rare cases in which it is seen during pregnancy, only a few days prior to the end of gestation, and is usually accompanied by a sub-normal temperature, as in the ordinary paresis after calving. This will be more fully dealt with under "Parturient Paresis." Parturient paresis occurs solely in vigorous, well fed cows; paraplegia not due to accident may be seen in improperly nourished, anaemic cows.

There may be difficulty in differentiating between overfeeding and paraplegia. It is a well known fact that in the cow paraplegia is a common symptom of serious digestive disorders and that there may occur more or less complete paraplegia, paralysis, and coma following overeating and the decomposition of food in the rumen. The history of the overfeeding should of itself serve usually to distinguish between the two maladies.

The prognosis is uncertain. In the enzoötic outbreaks of paraplegia which I have observed, the treatment has not proven satisfactory. The forced decubitis was not readily overcome during pregnancy. The long wait until the advent of parturition led too often to fatal results. The mortality was high, perhaps largely because the patients were too distant and the handling consequently wanting in proper oversight.

Parturition, by removing the mechanical weight of the fetus and its annexes, exerts a favorable influence upon the course of the disease. Parturition also favors recovery by relieving the mother from the nutritive demands of the fetus. The earlier parturition occurs after the advent of the disease, the more favorable the outlook for the patient.

The treatment of paraplegia of pregnancy should be directed toward the securing of the best possible environment for the patient and providing abundant nutritious food. The animal should be given a comfortable, well bedded, dry stall where it can not slip when attempting to rise.

In all cases, an intelligent effort is to be made to relieve the patient of superfluous weight. Bulky innutritious food should be withdrawn and the alimentary tract relieved of any existing overload. This may be partly accomplished by means of laxative foods, such as roots and bran with an extra allowance of salt. But in decubitis there is a constant tendency to digestive torpidity, which should be combatted. Small doses of strychnine, given hypodermically, may aid materially. Not only does the strychnine overcome the intestinal torpidity, but at the same time it affords a most effective tonic. It may with great advantage be combined with small doses of eserine or arecoline until the alimentary tract has been satisfactorily unloaded. This is preferable to alkaline purgatives and oils, since it is safer to administer, more prompt and efficient in action, and probably less dangerous to the life of the fetus.

Enemas, so often advised, are of little use in ruminants. The principal area of resistance is the gastric apparatus, with one hundred or more feet of intestine intervening between the point of the administration of the enema and the obstacle to be overcome. The influence of the existing pregnancy is to be carefully considered. The presence of the fetus, fetal fluids, and membranes intensifies the malady by the mechanical weight. The nutritive demands of the fetus upon the mother add to the gravity of the case, especially when the digestive and nutritive powers of the animal are much depressed by the recumbency.

The methods of handling must be based upon the conditions presented in the individual case. It is best to await parturition, if this course appears at all safe. The hastening of parturition in a cow is very difficult and perilous for both mother and young. If the corpus luteum could be dislodged from the ovary, that would tend to incite uterine contractions and expulsion of the fetus, but in advanced pregnancy the ovary can not be easily reached. Breaking down the uterine seal and puncturing the fetal membranes may cause the expulsion of the uterine contents and is very likely to cause metritis. The cervix of the cow is so rigid that mechanical dilation followed by removal of the fetus is exceedingly laborious. When the fetus is of extraordinary value, is alive, and apparently vigorous, and the outlook for natural parturition is very unfavorable, the dilation of the cervical canal, followed immediately by the mechanical removal of the fetus is advisable, or the removal of the fetus by gastro-hysterotomy may be employed.

Having determined upon the premature evacuation of the uterus, the obstetrist, under all due aseptic precautions, is to dilate carefully and gradually the cervical canal sufficiently to permit the introduction of the hand into the uterus, rupture the fetal membranes, cause the fetal fluids to escape, secure the fetus, arrange the presenting parts in the proper position, and, by exerting sufficient traction, gradually cause the needed additional dilation of the cervical canal and complete the extraction of the fetus. The process should not be hastened, but accomplished as gently as is possible. The operation in the cow requires for its proper performance at least three to five hours. When begun, the delivery should be completed without any intermission. Should the operation be suspended after the cervix has been dilated and the membranes ruptured, in the weakened condition of the uterus, infection of the membranes, death and decomposition of the fetus, metritis and sepsis are well-nigh inevitable.

If possible, the fetal membranes are to be removed immediately; otherwise, one-half to one ounce of iodoform may be introduced into the fetal sac to minimize putrefaction and the animal should be examined at frequent intervals until the membranes are detachable. If the membranes are inseparable except by lacerating the maternal placenta, their removal should under no conditions be hurried.

Amaurosis.

Riss (Recueil de Med. Veterinaire, 1831) observed late in gestation two cases of amaurosis in pregnant mares, which disappeared promptly after parturition. The relation of the pregnancy to the amaurosis was not made clear.

Rupture of the Prepubian Tendon

Edema of the Abdominal Floor

Writers on veterinary surgery and obstetrics generally include rupture of the prepubian tendon among the ventral herniae, without directing special attention to this characteristic and very serious lesion with its premonitory symptoms. The eventual lesion consists of a transverse rupture of the prepubian tendon immediately in front of the pubis, between the two abdominal rings. The rupture is usually complete and obliterates all tissues between the two openings. The disease, or accident, is generally confined to the mare. Rarely it occurs in the cow. The rupture takes place only, or practically only, in advanced pregnancy, rarely prior to the close of the tenth, usually during or after the completion of the eleventh month.

The causes, so far as determined, are:

1. The increased strain upon the abdominal floor caused by the presence of the gravid uterus, which represents at the close of pregnancy probably 30 to 40 per cent. of the total weight of the abdominal contents.

2. Degenerative changes in the tissues of the abdominal floor, including the prepubian tendon, closely associated with profuse edema of this region.

3. Very rarely there is a definite history of violence. In one instance observed by the author, a mare, becoming mired in deep mud with her hind feet, over-exerted herself in gaining the bank of the stream, thus pulling the hind limbs forcibly backwards, and with them the pubis, causing its chief anterior stay, the prepubian tendon, to give way. No edema or other evidence of disease preceded the accident.

Almost always there can be no reasonable presumption of accident. The rupture may generally be designated as spontaneous.

Usually it takes place gradually, frequently preceded for days or weeks by premonitory warnings.

The disease is apparently more common in draft mares than in those of lighter breed, but as my experience has been largely with the former class the grounds for comparison are not ample. The lesion is observed most frequently in idle mares which are well fed.

The first symptom noticed is an extensive edema of the abdominal floor, beginning just in front of the mammary gland and extending thence forward and backward until it reaches from the anterior pectoral region to the perineum, covering the entire floor of the body for a depth of 2 to 4 inches. The edema presents the usual clinical characters, except that it is possibly somewhat firmer than generally seen and somewhat more inclined to be painful to the touch. The exact relationship of the edema to the rupture of the tendon is undetermined. Apparently the edema is an expression of serious degenerative changes which are taking place in the deeper parts. The edema seems to involve the tendon itself from the first and diminishes its resisting powers by forcing the fibres apart, as well as weakening them directly.

The movements of the patient soon become restricted to such locomotion as is essential, marked by care and deliberation. The restriction of movement may be due partly to the mechanical impediment of the edema, but it appears rather to result from pain. This restriction of motion generally precedes the rupture of the tendon and is increased as the rupture extends.

Should the tendon remain intact until relieved of its excessive load through parturition the edema quickly disappears and the parts become normal, but in many cases the tendon gives way before the foal is born. The mare then succumbs or, surviving, is ruined. The foal generally perishes.

When the tendon begins to part between the two abdominal rings, characteristic symptoms arise which serve to distinguish it from other lesions. The spinal column of the horse forms an arch from the first dorsal vertebra to the sacrum. This arch is chiefly maintained by the linea alba, originating from the sternum in front and ending behind on the pubis, as the prepubian tendon, thus acting as a powerful tie. If the prepubian tendon parts at the abdominal rings, the arch of the spine can no longer be completely maintained: the back drops downwards, as is shown in Fig. 81, producing lordosis, or "sway back," and the pubis becomes displaced backwards. This causes the external ilial tuberosity to descend and the ischial tuberosity to become displaced upwards, decreasing the slant of the hip.

The rupture of the tissues between the abdominal rings obliterates these and relaxes the fixation of the mammae in them. The abdominal tunic also becomes ruptured on the same level, the skin becomes greatly stretched, the milk glands are displaced downwards and forwards, as indicated by the position of the teat in Figs. 81, 82, 83, and 84, and the glands become less conspicuous because of the compression from the stretching of their capsule, derived from the ruptured abdominal tunic. In Figs. 81-83, the displacement is comparatively mild. In some cases it is much greater, as shown in Fig 84. No other form of rupture could cause such displacement of the mammary gland, as it is firmly fixed to the abdominal ring so long as that remains intact.

The umbilicus is necessarily displaced forwards and downwards, as shown at *U* in Figs. 82 and 83. The rupture having involved the entire prepubian tendon, and the abdominal tunic having given way, the rent may extend on either side outwardly from the external side of the abdominal ring until it includes the entire abdominal floor. Through this great rent, the gravid uterus and other viscera drop down upon the skin and skin muscles and, pushing the abdominal tunic and musculo-tendinous portions of the abdominal floor forwards, bear the skin and skin muscle downward until the hernial sac may reach the level of the tarsus, or even drop lower. Early in the progress of the lesion, firm upward pressure with the hand, in the pre-mammary region, discloses a tense hernial touch without a distinct boundary. As the rupture progresses, the hernial touch becomes more pronounced.

The downward displacement of the abdominal viscera, with the backward displacement of the pubis, causes the flanks to sink in and greatly reduces the transverse diameter of the body at this point.

The skin and skin muscle tend, by their elasticity, to check or stop the progress of the rupture. They are aided somewhat by the resistance of the uterine ligaments and the mesentery, which help to support the visceral weight when the organs have become displaced downwards. In some cases the skin and its muscle do not suffice to stay the progress of the rupture, but give way, causing eventration, necessitating immediate destruction of the patient.

FIG. 81. RUPTURE OF PREPUBIAN TENDON IN MARE IN ADVANCED PREGNANCY.

The udder and one teat are shown displaced forwards. There is slight lordosis and marked depression of the supero-external angle of the ilium and elevation of the tuberosity of the ischium and of the caudal end of the sacrum.

In those very rare instances where violence has played an essential part in causing the rupture, there need be no premonitory edema. The symptoms appear very suddenly; the tumor is large, the pain intense, the expression anxious, the body bedewed with cold sweat, respiration hurried, the pulse rapid and weak. The patient tends to collapse quickly from shock or hemorrhage.

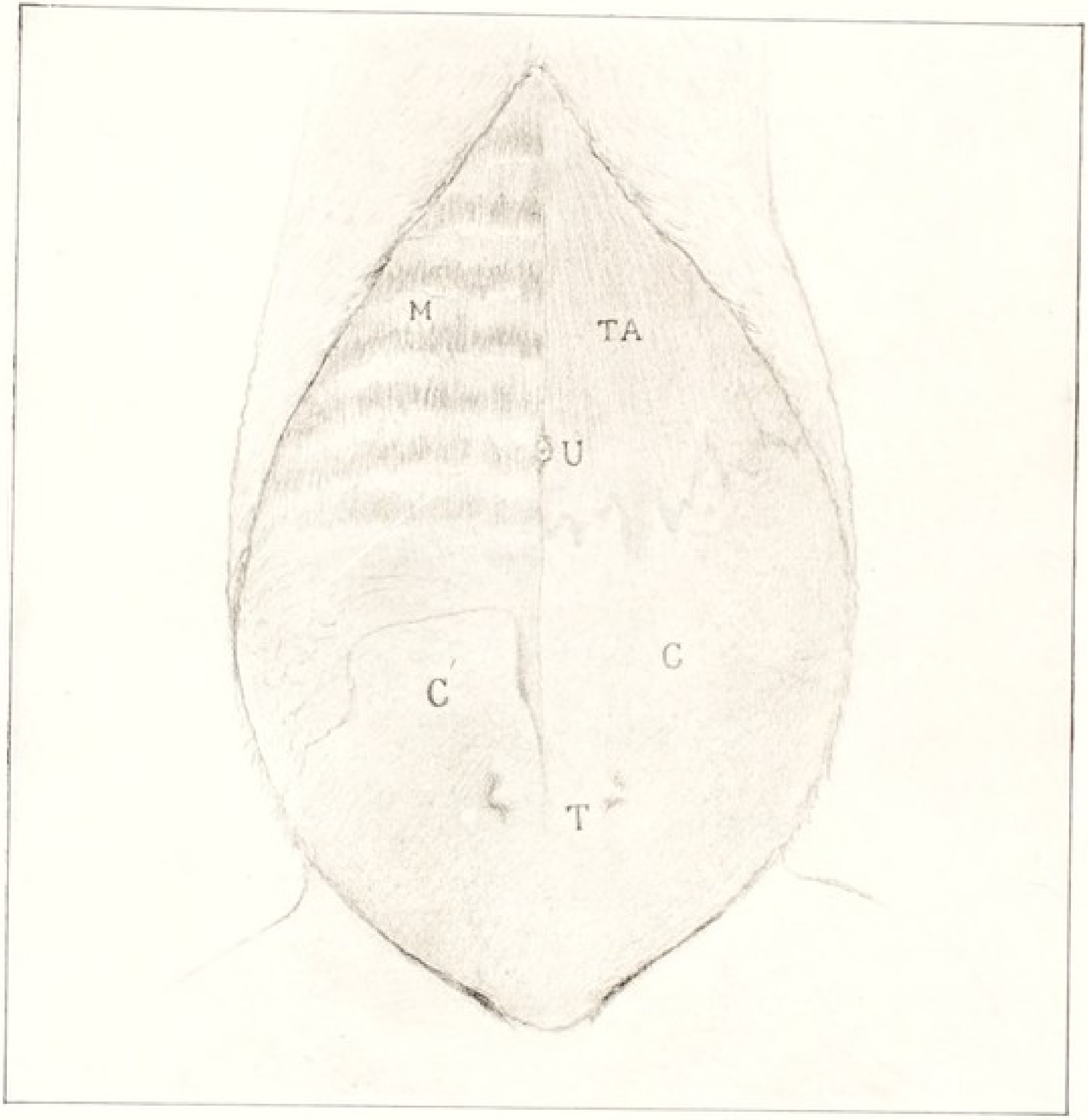


FIG. 82. RUPTURE OF THE PREPUBIAN TENDON IN THE PREGNANT MARE.
Dissected abdominal floor.

TA, abdominal tunic, showing ruptured margin displaced forwards.

M, transversalis muscle, the abdominal tunic removed, showing posteriorly the ragged margin at point of rupture.

C,C′, sclerotic connective or cicatricial tissue constituting, with the skin, the posterior portion of the floor of the hernial sac.

T, teats displaced forwards. U, umbilicus.

The character and extent of the lesions, with the reparative efforts in a surviving case, are well shown in Figs. 82 and 83, in which it is seen that the peritoneum, prepubian tendon, and abdominal tunic have all parted just anterior to the pubis and passed forward about halfway to the sternum, dragging with

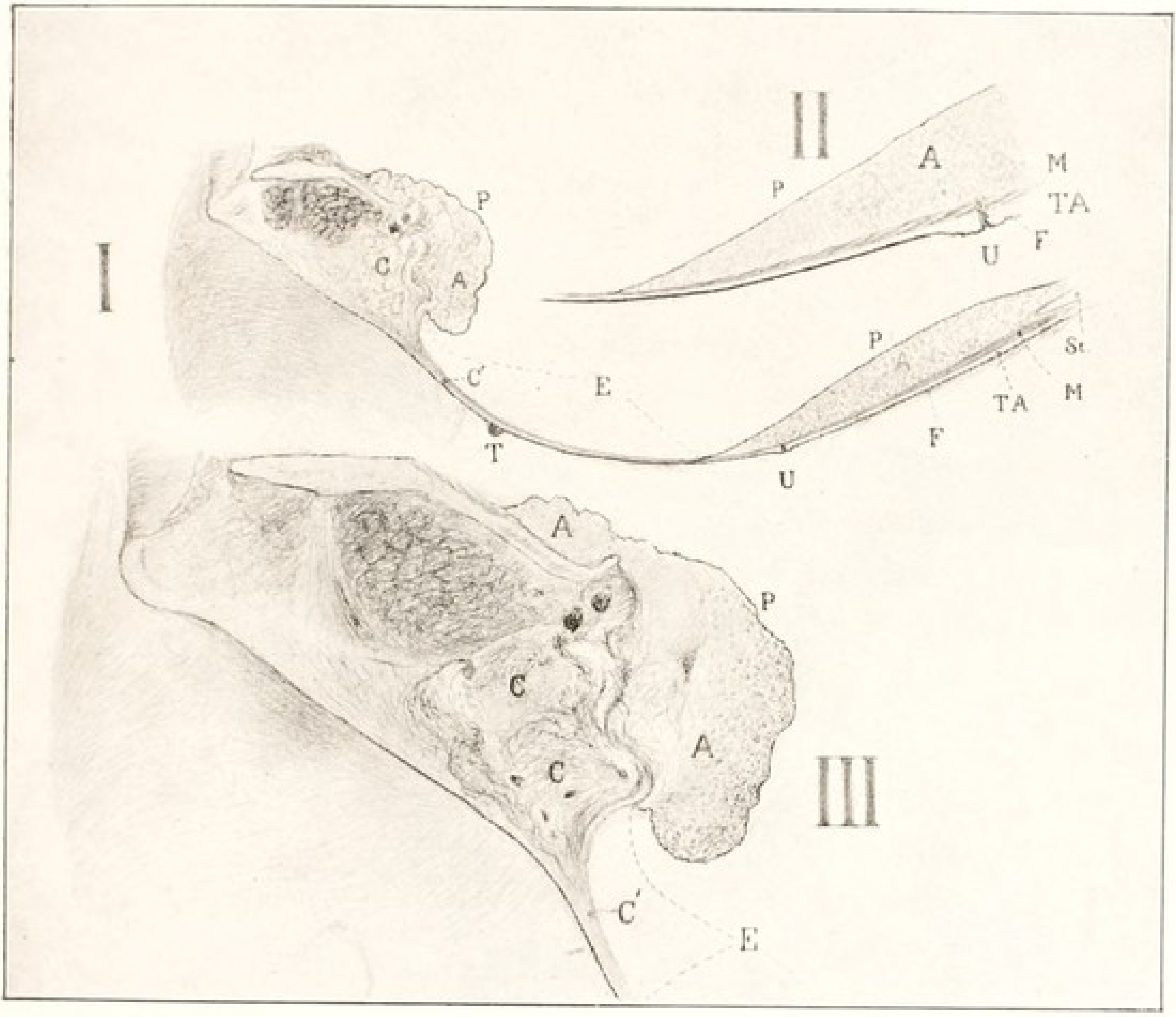


FIG. 83. RUPTURE OF THE PREPUBIAN TENDON IN THE PREGNANT MARE. Sagittal or median section of abdominal floor.

I, section extending through pelvis and sternum. II, detail of anterior portion. III, detail of posterior portion.

P,P, peritoneum. E, extent of rupture in the abdominal floor. A,A, subperitoneal fat, occupying entire area except that comprised in E, where peritoneum is absent as a result of the rupture. C, curled connective tissue, the pelvic remnants of the prepubian tendon, posterior to the point of rupture. C′, cicatricial tissue occupying the space between the ruptured ends of the prepubian tendon, devoid of peritoneum and adipose tissue. T, displaced teat. U, umbilicus, displaced forwards. F, skin and skin muscle. TA, abdominal tunic. M, transversalis muscle. St, sternum.

them, for a part of the way, the teats. Posterior to the teats, occupying the area previously filled by them, is an expansion of dense connective tissues, *C*, which has assumed the functions of the ruptured parts.

In Fig. 83 it is shown that the sub-peritoneal fat, *A*, does not invade the ruptured area, *E*: that is, the formation of the fat depends upon the presence of the peritoneum.

The prognosis of complete rupture of the prepubian tendon is very grave, since most mares, along with their foals, perish before the conclusion of the pregnancy during which the rupture occurs.

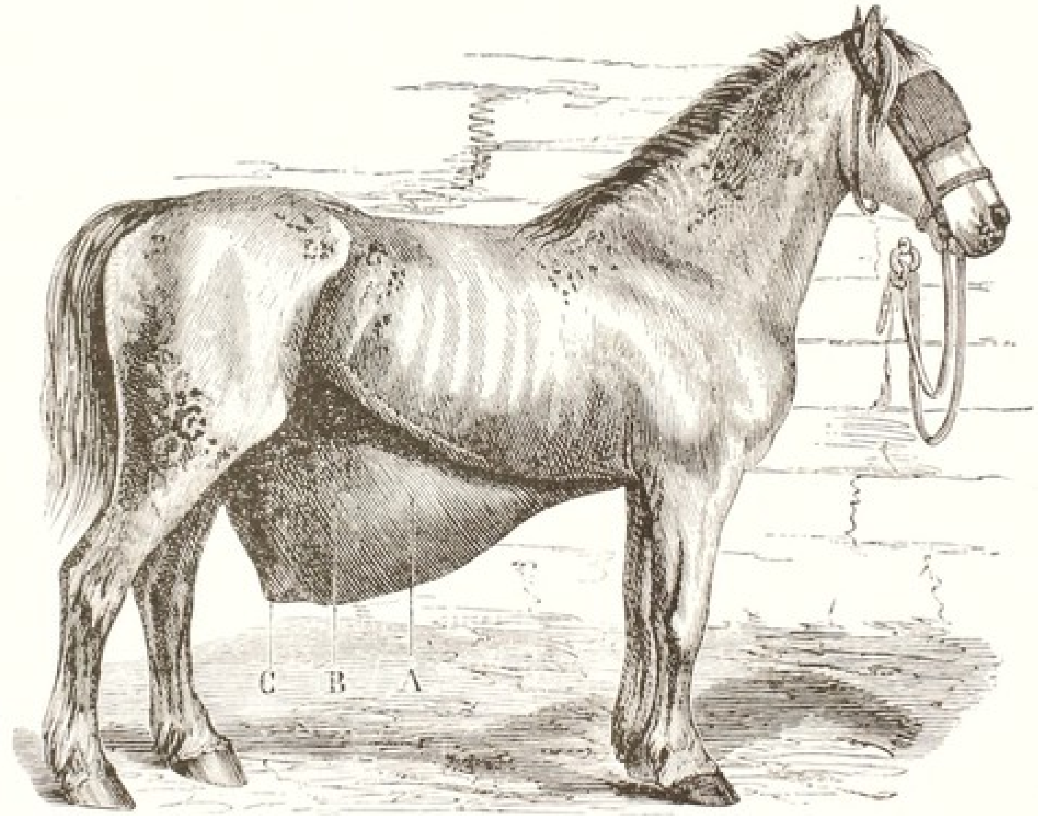


FIG. 84. RUPTURE OF PREPUBIAN TENDON. MARE.
After the uterine contents have been expelled.
A, B, hernial sac. C, teat, displaced downward and forward. (Saint-Cyr.)

If the pregnancy existing at the time of the accident is safely terminated, the animal may thereafter breed without danger or difficulty, but is so unsightly that her value for this purpose is seriously diminished. She may do ordinary slow work, but here the unsightliness becomes even more serious and few persons are willing to use such an animal.

When a threatened or beginning rupture is promptly recognized, and appropriate measures for prevention or relief applied, the prognosis is highly favorable.

The opinion of some obstetrists, that extensive edema of the abdominal floor in pregnant mares is unimportant and may be safely ignored, and that the disease will quickly disappear after parturition with little or no attention, leads to serious disaster. **Edema of the abdominal floor in advanced pregnancy in the mare is a serious condition, which calls for prompt and energetic handling.** It should always be regarded as a precursor of rupture of the prepubian tendon. If left without attention, many of the mares will succumb from rupture; if proper attention is rendered, the danger will be almost wholly averted.

Treatment. In the handling of threatened rupture of the prepubian tendon, mechanical support of the greatly overloaded and weakened abdominal floor should receive prompt consideration. Whenever extensive edema occurs along the floor of the abdomen in a mare far advanced in pregnancy, unless the condition is clearly referable to unimportant causes, the immediate application of an abdominal bandage of canvas or other strong material is urgently advised. The bandage should be constructed with 8 to 10 strong buckles and billets and fitted to the oval form of the abdomen by means of a gore placed in the center of the canvas. One does not at all times have the time required for properly constructing the bandage. In order to avert immediately threatening disaster, a many-tailed emergency bandage should be quickly applied. In order to adapt this to the oval form of the abdomen, the tails should be crossed so that the most posterior of one group of tails shall be tied to one of the most anterior of the other end, and the remaining tails united upon a similar plan. The spine and the point where the ends of the bandages are tied should be amply padded to avoid pressure necrosis of the skin. The bandage should be carefully readjusted daily, or as often as conditions may dictate.

In applying the emergency bandage to cases where the tendon has already parted or its rupture seems imminent, it must be quite tight. In order to facilitate this, it is best to tie a solid loop in each upper tail—that is, in each tail of the bandage which passes over the back of the patient—through which each lower tail may run as through a pulley. The bandage cannot be properly tightened at the first effort. One after another of the tails is to be tightened as well as convenient at the first tying. As soon as all are fastened, the obstetrist should go back to the first ones and tie them over again ; this process should be continued until the desired support is secured and the great weight of the viscera lifted from the abdominal floor and largely transferred to the spine through the bandage.

A decrease in the weight of the abdominal viscera is also of very great importance. The practitioner should lessen the weight of the digestive viscera by replacing all bulky food with limited quantities of concentrated aliment. The unloading of intestinal tract may be hastened by the aid of small doses of eserine sulphate or arecoline, such as one-half grain every half hour, until the desired effect has been attained.

If the tendon has parted, the induction of premature labor should receive careful consideration. As a rule, the foal perishes unless aid is given. Even under close watching, the uterine contractions go on unobserved and cause the death of the foal through separation of the placenta. The displaced uterus has largely lost its expulsive power and the rupture of the abdominal floor destroys completely the expulsive powers of the abdominal walls. Therefore it seems desirable to anticipate this danger to the fetus by bringing about artificial delivery early in the eleventh month, in a way best to safeguard the life of the fetus. Premature delivery is best effected by carefully dilating the cervical canal with the hand ; grasping, and if necessary cording, the fetal parts presenting ; and applying moderate traction to compensate for the lost expulsive power of the abdominal muscles. It is best to have the patient in lateral recumbency during delivery, since this raises the fetus approximately to a level with the pelvic inlet. When the mare is in the standing position, the fetus drops down below the pelvis, through the immense rupture, and rests upon inert parts. If premature delivery is not decided upon, the mare should be closely watched and prompt aid given at the first signs of parturition.

If the tendon has not ruptured, the bandage may be removed immediately after delivery and the case dismissed ; if it has ruptured, the bandage should be readjusted and retained until such time as the ruptured tissues have healed and the weakened abdominal floor has been reenforced by the formation of connective tissue, as indicated at *C'*, in Fig. 83.

The mare may be retained until the foal is ready to wean, and then destroyed ; she may be kept permanently as a brood mare, with reasonable assurance that thereafter she will foal unaided ; or she may be used at moderate work without discomfort.

In the very severe cases, where the skin and skin muscles are giving way so that eventration is imminent, or where accompanied by shock and serious internal hemorrhage, the mare should be promptly destroyed, after performing gastro-hysterotomy if it is desired to save the foal.

Hernia of the Uterus, or Hysterocele

While most veterinary obstetrists include the preceding rupture of the prepubian tendon under uterine hernia, it has been deemed preferable to discuss that condition separately and to include under the present title any other accident, defect, or disease by which a portion or all of the gravid uterus escapes through the muscular walls of the abdomen and comes to rest at or near to the skin. Such a hernia may occur in any domestic animal and at any point of the abdominal floor. Since any existing ventral hernia may become occupied by a portion of the gravid uterus in any animal where the non-gravid organ is of sufficient length to drop through the opening, impregnation may occur in the herniated organ. The hernia may also occur later, when the gravid organ is borne down into the hernial sac by the weight of its contents. If the hernial ring is sufficiently large to allow the escape of a fetus or fetuses through it, the gravid uterus drops into the hernial sac. The causes are the same as those of other herniae, and have a special relation to obstetrics only because the fetus passes through the hernial ring, becomes developed within the hernial sac, and offers obstacles to birth.

The hernia may be due to traumatism at any part of the abdominal wall, or to a congenital defect in the abdominal wall, either at the umbilicus or the inguinal ring. Sometimes, in the development of the fetus, the umbilic ring remains so large that the abdominal viscera permanently protrude through it, against the skin. When grown, if permitted to become pregnant, such an animal, if the hernial ring is very large, is liable to uterine hernia, and the fetus or fetuses may develop in the hernial sac. Herniae of such dimensions are rare in large domestic animals, but in the mare umbilic hernia is occasionally met with, of such size that, were she allowed to go without treatment and be bred, a uterine hernia might result.

In some animals, especially in the bitch and sow, the ovary and uterine cornua pass from their ordinary position through the inguinal ring and reach the location of the testicle in the adult male, in the perineal region. As a consequence, the young may develop in the herniated portion of the uterus, outside the abdominal cavity.

The diagnosis of uterine hernia is comparatively easy. The fetus or fetuses are so superficially situated that they may be recognized by palpation. Sometimes the tumor is not reducible, because the fetus has become larger than the hernial ring and consequently cannot be returned into the abdomen by pressure.

The significance of the hernia will vary greatly according to conditions. If occurring as the result of a recent accident, when no hernial ring or sac has become established, the hernia tends to enlarge rapidly because of the presence in it of the gravid uterus and other viscera. In any hernia with a well established ring and sac, into which the gravid uterus enters, the tendency is for the sac to continue to grow, but for the ring to remain undisturbed. The displacement has little risk generally for the life of the mother until parturition comes on, when it may become a serious menace to the lives of both mother and fetus. If the fetus be of too great size to pass readily through the hernial ring or if there be an extensive hernia of recent date, which has destroyed the expulsive powers of the abdominal walls, active obstetric interference may be demanded in order to save the lives of parent and offspring.

It is inadvisable, as a rule, to attempt to breed animals which have herniae in which it is probable that a fetus or fetuses may find lodgment. When a ventral hernia occurs during pregnancy, the parts should immediately be carefully supported by a wide bandage, to prevent the extension of the newly formed rupture. Females having congenital herniae at the umbilicus or inguinal ring should not be bred, for zoötechnic reasons, as well as because of the probability of obstetric difficulty. When such animals have been bred however, and the question of the preservation of the life of the mother or the fetus arises, artificial abortion may be induced in behalf of the life of the mother or hysterotomy may be performed with a view to saving the life of the fetus and perchance of the mother also.

Rupture of the Gravid Uterus

Rupture of the gravid uterus is not common in domestic animals, though doubtless it occurs more frequently than recognized. It may occur from a great variety of causes, may be of any degree, and may be accompanied or followed by various symptoms.

Those cases of rupture of the gravid uterus in which the fetus has escaped more or less completely from the uterine body without causing fatal lesions and the fetus and its membranes have not undergone decomposition, but remained indefinitely as an inert body, to constitute a form of extra-uterine pregnancy, are discussed on page 91.

Under *Torsion of the Uterus*, there will be occasion to speak of a transverse rupture of the uterus or vagina as a consequence of the revolving of the gravid organ upon its long axis to such an extent as to cause its tissues to part, leading to complications of a very grave character.

Rupture of the gravid uterus may occur as a result of emphysema of the fetus, which will be considered later.

When dealing with dystokia, it will be necessary to discuss the not infrequent uterine ruptures due sometimes to mal-position of the fetus and far more frequently to errors on the part of incompetent persons while attempting to overcome difficult parturition. Such ruptures are sufficiently considered in their proper places. It is desirable here to mention those instances of rupture of the gravid uterus not included in the other classes. Such ruptures are rare and their causes variable. Generally, so far as known, they are the result of impacts of blunt bodies against the abdominal floor, such as the kick of a horse, the impact of a wagon pole, falling upon projecting stones, etc. In other cases, no explanation for the disaster is recognizable; presumably an unseen accident has occurred.

The symptoms are not at all uniform, but dependent upon the extent of the rupture and other conditions.

The rupture may be incomplete: the mechanical insult or other cause serves merely to induce a more or less serious strain or partial rupture of the muscular walls of the organ. Such a lesion may result in appearances of ill-health. Possibly slight colic or other symptoms lead to the belief that some digestive disturbance exists. Later the weakened uterine walls may give way either as a result of the weight of the fetus or from other causes. Then follow rapidly symptoms of great depression—weak pulse, accelerated breathing, and cold body surface with probably cold sweats—followed in a few hours by death.

If the fetus, fetal membranes, and liquids are aseptic, the symptoms induced are chiefly those of shock and internal hemorrhage. If the uterine contents are infected and escape suddenly into the peritoneal cavity, there follows promptly the very grave depression of acute sepsis.

Exploration per vaginam reveals no data of value except the cervix be dilated so that the hand may be passed into the uterus. The absence of the fetus from the uterine cavity then becomes evident. The membranes have more or less completely escaped and the rent in the uterus is easily recognizable.

If the cervix is closed, the hand introduced into the rectum may yield all needed data for a positive diagnosis. The uterine body, somewhat retracted and without fetal contents, is recognizable. Outside the uterus, lying more or less free in the peritoneal cavity, the fetus may be detected.

The treatment of rupture of the gravid uterus in domestic animals has not yet been made practical. In most cases the patient dies without a positive diagnosis having been reached, and the actual nature of the accident is revealed post mortem. If recognized during the life of the patient, there is scant basis for hope of overcoming it by surgical means. Technically, laparotomy should be considered, but in the mare and the cow, where a correct diagnosis is most probable, there is virtually no hope for either dam or offspring. The fetus is ordinarily dead when the diagnosis is made, and there is little hope for the successful removal of the fetal cadaver, membranes, and fluids, the control of hemorrhage, and efficient closing of the rupture.

Extra-Uterine Pregnancy

Extra-uterine pregnancy is the existence of an embryo or fetus in the abdomen outside the uterine cavity. The precise nature of extra-uterine pregnancy in animals has not been definitely ascertained ; before arriving at any final conclusion, the subject needs much investigation. Not infrequently fetuses are found outside the uterus in the abdominal cavities of animals, but it has not been clearly shown how they attained this position. Their anatomical relations with the uterus are not recorded.

Several forms of extra-uterine pregnancy occur :

1. Ovarian pregnancy has been recorded and verified in woman. In these cases it appears that the ovisac ruptures, but the ovum does not escape from it, and spermatozoa, passing up through the oviduct and pavilion of the tube, reach the ovum and bring about its fertilization. The ovum may then undergo a development analogous to that observed in the uterus, either enclosed within the ovary or attached to it by the fetal membranes. The records of ovarian pregnancy in woman are exceedingly rare. In domestic animals there are no known symptoms which would lead to a diagnosis of the condition during the life of the mother. Ovarian pregnancy is liable at any time to cause the sudden death of the mother, owing to a rupture of the ovary when the fetus has developed within it or a violent detachment of the placenta, by either of which accidents fatal hemorrhage is highly probable.

2. Tubal pregnancy, apparently the commonest type of extra-uterine gestation, in all probability accounts for the majority of cases of this character in animals. Tubal gestation is more readily understood than other forms. Any defect in the tube which might cause the arrest of the fertilized ovum during its passage through it would naturally result in the attachment and development of the embryo at that point. In multiparous animals, if one of the first of the series of ova should become arrested during its descent, all those on the ovarian side of it would alike become halted in their migration. Consequently, a series of tubal embryos might be formed. Apparently this occurs sometimes in domestic animals, especially in the sow, and

leads eventually to the existence of a group of two or more extra-uterine fetuses, as shown in Fig. 85.

The cause of arrest in the migration of the ovum may be a folding in the tube or disease or injury of the mucous membrane. The tendency in tubal pregnancy in animals is for the development to go forward, in a quasi-normal manner, up to that period when the volume of the fetus and its membranes becomes so

FIG. 85. Extra-uterine pregnancy. Swine. Showing 2 fetuses closely adherent to each other and intimately invested by membranes.

(Museum New York State Veterinary College.)

great that the tube is no longer capable of accommodating them. Then the thin walls of the tube rupture and the fetus or fetuses, with part or all of the membranes, pass out into the peritoneal cavity. This rupture and the detachment of the fetal membranes may cause fatal hemorrhage. If fatal hemorrhage does not follow, and the fetal membranes have not been wholly detached from the maternal placenta in the oviduct, the fetus may become attached to or imbedded in the peritoneal surface, and continue to develop. If its placental attachments in the oviduct have become wholly separated, the fetus necessarily perishes at once and may undergo partial desiccation and remain in the peritoneal cavity without injury or inconvenience to the mother throughout her normal span of life.

In other instances of tubal pregnancy, the developing fetus, escaping through the pavilion of the tube, gains the peritoneal cavity. It may retain its attachment, through its membranes, with the tube, become adherent to the peritoneal walls, and continue until the normal duration of pregnancy has been completed and the usual size of the fetus is reached, when it perishes and probably partially desiccates.

We do not ordinarily discover tubal pregnancy during the life of the mother, but only upon post-mortem examination, usually when the animal is slaughtered for food.

3. Rupture of the gravid uterus may occur at almost any stage of pregnancy. The possibility of such an accident increases as the close of the normal period of pregnancy approaches. Rupture of the uniparous uterus most readily occurs in its body or the gravid cornu, and the adjacent fetus tends to drop at once through the rent into the peritoneal cavity. In the biparous uterus, the rupture may occur at such a point as to interfere with but one twin, unless the twins have a common chorion, when each must be affected similarly. In a multiparous uterus, the rupture may occur at any part of the gravid organ and one, two, or more adjacent fetuses escape through the opening.

The accident probably causes fatal shock or hemorrhage of the mother in most cases. Otherwise, the fetus may perish at once, and infection of its body and membranes follow through the os uteri, leading quickly to fatal sepsis of the mother.

Escaping these immediate dangers, should the chorion remain partially attached to the uterus, the fetus may continue to live up to the normal period of birth or may perish immediately. If the os uteri remains sealed or infection otherwise avoided, the fetus remains as an inert body for an indefinite period, to constitute a variety of extra-uterine pregnancy.

4. Some writers claim that a primary abdominal impregnation may take place—that is, an ovum may drop into the peritoneal cavity and there become impregnated by a spermatozoön, which, traversing the uterus, cornu, and oviduct, has escaped through

the pavilion into the peritoneal cavity. The embryo becomes attached to the peritoneal surface and develops in a more or less normal way. No unquestioned case of primary abdominal pregnancy has yet been seen. The possibility of such an occurrence has not been disproven. The cases thus far cited to prove the actual occurrence have been faulty in some particular, which serves to throw a doubt upon the correctness of the alleged occurrence.

The course of abdominal pregnancy in animals, so far as has been observed and recorded, is that the fetus or fetuses acquire a more or less rigid attachment to the abdominal walls or some of the viscera, and the fetal membranes closely invest the fetal body in such a way as to compress it into the smallest possible space. In the cases ordinarily observed, the fetus or fetuses are closely enveloped in firm membranes without any intervening liquids, so that the covering, which may be regarded as the amnion, is in direct contact with the hair of the fetus and cannot readily be stripped away from it. This is well shown in Fig. 85.

The fetus usually seems to have been normal originally, but to have undergone later a process of desiccation and remained an inert body for an indefinite period. There are virtually no records of how long a fetus may thus remain as an inert body in domestic animals, because as a rule it is only discovered upon slaughter and the time at which it developed has not been determined. In woman, where the observations have been more accurate, there are cases recorded where an abdominal fetus has remained inert, without inconvenience to the mother, during a period of more than fifty years.

The degree of desiccation in extra-uterine pregnancy is not equal to that observed in intra-uterine mummification. Extra-uterine fetuses are comparatively plump, usually normal in size and development, and closely invested by tough, adherent membranes. Intra-uterine mummified fetuses are free from membranous attachments, greatly shrivelled, discolored, and gnarled.

No cases are recorded in which extra-uterine pregnancy has caused any recognized disease or discomfort in animals. Fleming cites a number of cases in which the fetus has undergone putrid decomposition, with the formation of an abscess, which has ruptured into the intestines or other viscera or, more frequently, externally through the abdominal wall. He classes these as extra-uterine pregnancy, but submits no evidence to show that the fetus was not in the uterus until it decomposed and finally escaped therefrom as a part of the contents of an abscess within the uterine cavity.

The diagnosis of extra-uterine pregnancy is difficult in the living animal. Ordinarily no diagnosis is demanded. In carnivora the fetus may possibly be recognized and its location outside the uterus determined by extra-abdominal manipulation. This is difficult, however, as one can not readily trace the non-gravid uterus by this means. Even though a fetus may be felt through the abdominal walls, one can not be sure that it is not in the uterus. It may be attached firmly to the abdominal floor, which would constitute presumptive evidence that it is extra-uterine, but the proof is not final, since one of the uterine cornua, with a fetus included, may be firmly adherent to the abdominal wall and thus nullify the diagnosis. In large domestic animals, an exploration of the uterus may show that it contains no fetus. If a fetus can then be recognized, by rectal palpation, it becomes clear that extra-uterine pregnancy exists.

Fleming[1] quotes S. Della-Rovere as having attended a case of extra-uterine pregnancy in a cow, in which he removed a living calf through an incision in the wall of the vagina. The citation fails wholly to show that the fetus was not in the uterus. No record is made as to the condition of the uterus itself, and it is almost certain from Fleming's quotation that extra-uterine pregnancy did not exist at all.

It is not at all rare to meet with cases of uterine pregnancy which closely simulate extra-uterine gestation. It has been stated previously, while describing the position of the bovine fetus during gestation, that the fetus regularly pushes its way up into the pelvis above the vagina, where it can be clearly felt. The position is normal and has no danger for the life of either mother or fetus. A still more puzzling condition is one type of the bi-cornual or transverse pregnancy of the mare, in which the fetus lies beneath the vaginal floor in a transverse position, in such a way as to lead the inexperienced to believe that extra-uterine pregnancy exists.

[1] Text Book of Veterinary Obstetrics, 1st ed., p. 159.

In order definitely to recognize and verify extra-uterine pregnancy in the living animal, the following factors are essential: first, one must recognize the presence of a fetus; second, it must be proved not to be in the uterus, which can be done, in case of a uniparous animal, only by determining clearly that the uterine cavity is vacant. Generally one can determine clearly extra-uterine pregnancy only by a post-mortem examination.

The treatment of extra-uterine gestation is rarely necessary. If diagnosed, and it seems to threaten the life or health of an animal, the removal of the fetus may be considered. In animals which are used for meat purposes, the patient should be sent to the butcher at the earliest convenience, providing the meat has not been injured by decomposition of the fetus or by some disease of the dam induced by its presence. In carnivora, the fetus may be removed by laparotomy.

TORSION OF THE UTERUS

Torsion of the gravid uterus, or revolving of the organ upon its long axis, is an accident which belongs to quadrupedal animals. The displacement occurs most frequently in uniparous animals, especially in ruminants. It is most frequently diagnosed in the cow. It is common in the ewe. In the cow it occurs chiefly in dairying districts where the animals are kept confined in stanchions and where, as a consequence, they are subjected to certain violent movements, especially slipping in getting up on a wet floor or making a misstep into a deep gutter. It is comparatively rare in the mare, and even more so in the small, multiparous domestic animals. Historically, the accident has been recognized for more than a century, and has been well known and studied in every country where much attention is paid to dairying and the breeding of cattle.

The anatomical relations of the uterus largely determine the probability of torsion. The ovaries are formed near the Wolffian bodies, and the broad ligaments extend from these backward to, and including, the vagina, maintaining the genital tube in its position in the abdominal cavity. In all animals the ovaries drop more or less into the abdominal cavity, and tend to move backward toward the inguinal ring. As the ovaries retreat backward, the broad ligaments tend to follow them, so that their most anterior attachments pass back toward the inguinal ring. Consequently, the fixation of the uterus becomes more and more posterior as the ovary moves backward.

The backward migration of the ovary, and the consequent moving backward of the broad ligament, is most marked in the ruminant. Consequently when a ruminant becomes pregnant the gravid uterus soon projects far anterior to its ligamentous attachments to the abdominal walls. There is little to prevent the projecting portion of the gravid uterus from revolving upon its long axis, and once it has thus become displaced there are virtually no natural means for its replacement.

A highly important contributing cause of torsion of the uterus in the cow is that the cornua curve downward, backward, and then upward, instead of upward and forward as in the mare and most other animals.

A study of Fig. 4, page 23, shows that the non-gravid recurved ruminant uterus largely projects anteriorly beyond its broad ligaments. The ligaments are entirely posterior to the ovary (3) and the pavilion of the oviduct (5) and a large part of the uterine mass lies anterior to the attachment of the ligaments to the abdominal wall. The uterine horn is thrown into a loop; the apex and base are in close proximity. This is in sharp contrast to the uterus of the mare, as shown in Fig. 3 on page 22. Immediately when the uterus becomes gravid the projection of the uterus anterior to its ligamentous attachments becomes rapidly accentuated. As pregnancy advances, the uterus projects more and more anterior to its ligamentous attachments in the mare and ruminants. At the same time, the apices of the cornua are detained posteriorly, accentuating the looped form. With the middle of the gravid horn near to or against the diaphragm, its apex is not dragged far forward. In the pregnant cow, the ovary of the non-gravid horn remains readily palpable per rectum throughout pregnancy. The ovary of pregnancy can be palpated per rectum at six to seven months or later, while the anteriorly directed end of the fetus is in contact with the diaphragm.

In the mare and ruminants, the accident consists of the revolution of the gravid uterine loop upon its base, or stem, and the apex of its gravid horn, in which process its broad ligaments must become involved. The torsion occurs chiefly in the cervix and vagina. Rarely, when occurring early in pregnancy, the torsion takes place in the body of the uterus. This can occur only when the chief volume of the fetal sac lies far toward the apex of the horn and the uterine body is not tensely filled. Later, when the uterine body is fully distended, the torsion must occur more posteriorly. The rigidity of the cervix tends to prevent torsion in that area and causes it to occur chiefly in the empty, pliable vagina. When the uterus revolves, the broad ligaments are necessarily involved and take an important part in the incarceration of the organ, as tense cords wound spirally about it.

In the smaller multiparous animals, torsion usually involves one cornu only, or merely a segment of one horn with one or more fetuses.

The gravid uterus in torsion behaves very much the same as a stout bag filled with fluid contents. If such a bag is tied shut and attached at its mouth, and an attempt is made to revolve the free extremity upon its long axis, the spiral constriction will occur, not in its middle, but at the end where it is attached and constricted by its mouth being tied shut. In the distended uterus, when it revolves upon its long axis, the actual twist or spiral occurs ordinarily, not in the uterine body or in the cornua, but in the constricted neck or in the empty vagina just beyond. The method by which this torsion is brought about is well demonstrated in Figs. 86–88. If the upper portion of the uterus turns to the right, while the floor passes to the left, it is known as right torsion; if in the opposite direction, it is known as left torsion. The torsion may occur to the right or to the left, though usually to the right because the uterus is already inclined to the right.

The torsion may be of any degree compatible with the integrity of the organ. As a general rule, it is scarcely recognizable unless the revolution has reached the quadrant of a circle, 90°, or quarter torsion. The looped form of the twisted organ renders a quarter torsion stable, as the uterine loop then rests upon its side when the animal is standing or is in sternal recumbency. Should the torsion advance beyond that point, the organ becomes unstable until it reaches a three-quarters revolution when the loop again comes to rest lying flat upon the abdominal floor. If the torsion continues until the uterus has made a complete revolution upon its long axis, it is known as complete torsion. Some writers would have us believe that the uterus may make three or four complete revolutions. This assumption is open to serious question. The torsion can not well go very far beyond a complete revolution, until the strain upon the organ becomes too great, it ruptures transversely through the vagina and drops, an inert bag, almost detached, into the abdominal cavity.

The causes of torsion have not been fully determined. Anything which may violently disturb the uterus may cause it to turn upon its long axis. We have noted the peculiar anatomical relations of the uterus of the cow. Another peculiarity is that when she gets up she rises first upon her hind feet, which causes the gravid uterus to hang half suspended from the vagina in the abdominal cavity. When a cow lies down she does so first in front, and again the gravid uterus becomes suspended from its vaginal end. When thus partially suspended, a slip upon a wet floor may cause such a disturbance of the semi-pendulous organ as to cause it to revolve more or less completely upon its long axis.

Any movement of the animal which might cause a sudden im-

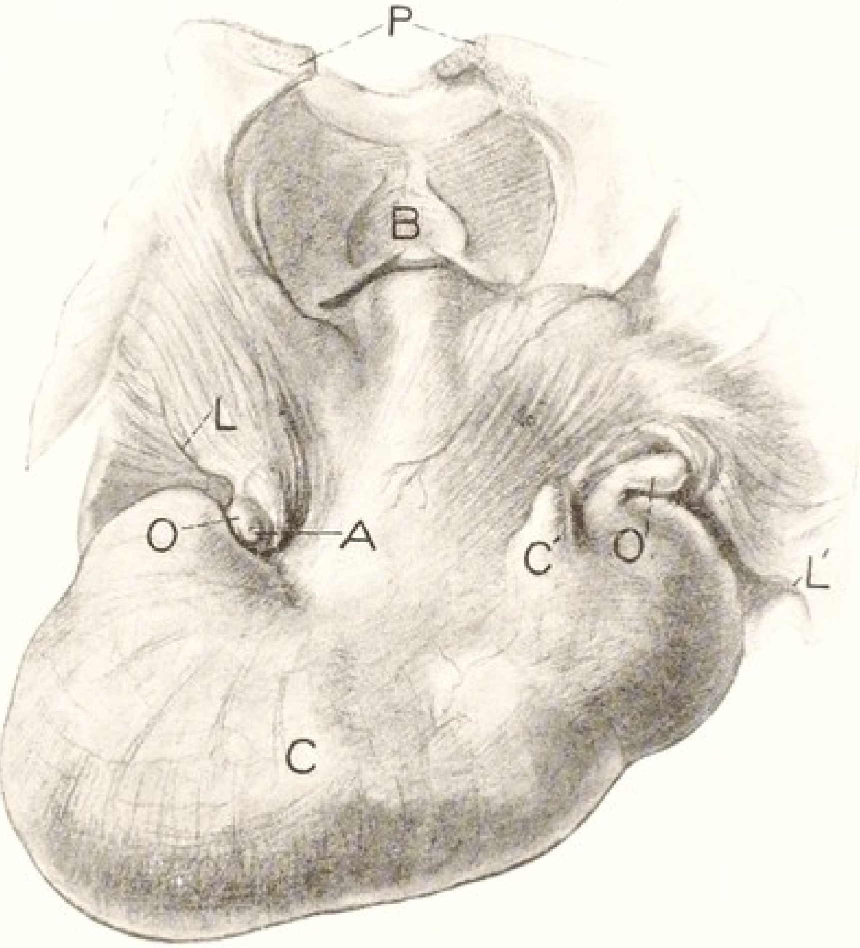


FIG. 86. THE MECHANISM OF TORSION OF THE UTERUS IN THE COW. GRAVID UTERUS IN NORMAL POSITION AT ABOUT THE 7TH MONTH OF PREGNANCY, SEEN FROM BELOW.

P, pubis. B, bladder. L, broad ligament. L′, point of attachment of broad ligament to abdominal wall. O, O, ovaries. C, right cornu. C′, left (non-gravid) cornu. A, corpus luteum.

pact upon the gravid uterus, such as a fall, a severe slip, running, jumping, or the jostling which animals get in transit upon railway trains, may accidentally cause the gravid uterus to revolve.

In one instance observed by me, a mare had the habit of climbing up a large stack of straw, and would then lie down in such a way that she was unable to get up except by rolling over backward. In several instances the owner was compelled to turn her over in this way and let her roll down the side of the straw stack before she could regain her feet. Finally she died because of torsion of the uterus.

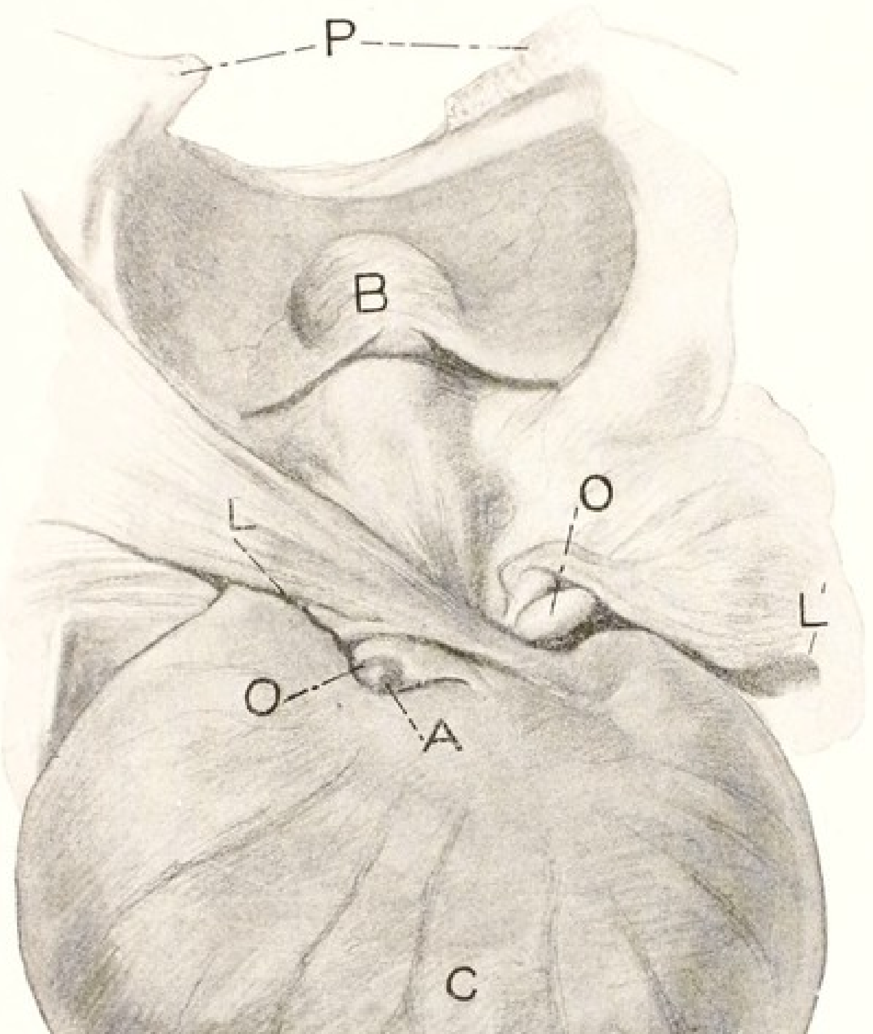


FIG. 87. THE MECHANISM OF TORSION OF THE UTERUS IN THE COW. ONE-HALF REVOLUTION OF THE GRAVID UTERUS ON ITS LONG AXIS AT ABOUT THE 7TH MONTH OF PREGNANCY.

Lettering same as Fig. 86.

The belief that rolling, or some similar movement, such as a slip, which causes the body to revolve very quickly, is the cause of torsion is supported by the results of the commonest form of handling of this difficulty—the rolling of the animal.

Some believe that violent movements of the fetus exert an influence in the production of torsion, but this can not be determined. The fetus would naturally move violently because of partial asphyxia after the torsion had occurred, and this consequence may be mistaken for the cause.

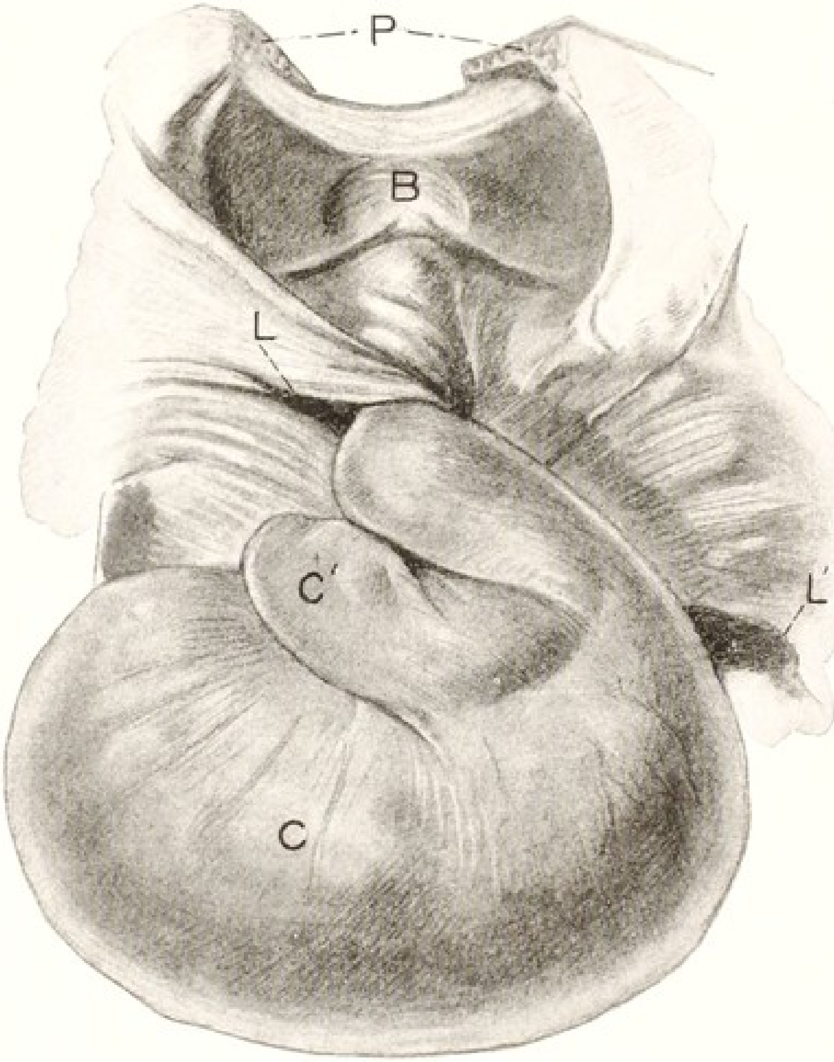


FIG. 88. THE MECHANISM OF TORSION OF THE UTERUS IN THE COW. COMPLETE REVOLUTION OF THE GRAVID UTERUS AT ABOUT THE 7TH MONTH OF PREGNANCY.
Lettering same as Fig. 86.

Symptoms. Torsion of the uterus may occur at any time after the fourth or fifth month of pregnancy in the cow, but not so early in the mare. As soon as the gravid organ extends far beyond the abdominal fixation of the broad ligaments, torsion becomes possible, but so long as the uterus is small the tendency to torsion is not marked. While the uterus is small, torsion tends to prompt spontaneous recovery. The small uterus has greater room in which to revolve freely, the cervix and vagina are comparatively much larger than at a later date, and the physiologic elasticity of the tissues tends to replace the organ. A colleague attended a cow in her fourth month of pregnancy. Prior to his visit, she had shown slight colicky pains, but these had disappeared and only dulness remained. Torsion was not suspected at so early a date in pregnancy, and the condition failed to be recognized. After three or four weeks, the animal died from uterine necrosis. The torsion, which was anterior to the cervix, could have been diagnosed by rectal palpation only.

As pregnancy advances, the tendency to torsion increases, so that it is most frequently seen very late in pregnancy. Not only does the tendency to torsion increase, but the great weight of the uterus, compared with the size of the cervix and vagina, renders the torsion more fixed.

The vast majority of cases of uterine torsion occur so late in pregnancy that obstetrists generally consider the accident as dystokia. This is evidently erroneous. While torsion renders birth impossible without aid, it is not primarily dystokia. It is a critical displacement of the pregnant uterus, full of peril for both mother and fetus, but in the ordinary course of events parturition does not begin and dystokia can not occur. The fallacy of classing torsion as dystokia is well emphasized by the case noted above, where physiologic parturition was yet five months away when the fatal displacement occurred.

The symptoms of torsion of the uterus are not diagnostic without the aid of an examination of the organ itself. Soon after the torsion occurs, there is more or less pain caused by the displacement of the organ, which may rather infrequently be expressed in a variety of ways, according to the degree of torsion and the period of gestation at which it occurs. In the simpler cases the pain is expressed by kicking at the belly, lying down and quickly getting up again, looking at the side, and switching the tail, with other symptoms which might be regarded as those of colic, and rarely more or less marked expulsive efforts, which may somewhat closely resemble normal labor pains, or may partake rather of the character of straining to defecate.

The general condition of the animal is variable. There may be a well marked loss of appetite, accompanied by more or less constipation. When the torsion becomes more complete, and the blood supply to the uterus is largely or wholly interrupted, the fetus dies. The dead fetus may not undergo rapid decomposition, in which case the mother will not be profoundly affected. Frequently the fetus undergoes rapid emphysematous decomposition, with immediate profound sepsis. Then follow such symptoms as would be caused by the presence of an emphysematous fetus and an inflamed or gangrenous uterus, with the resulting extensive peritonitis combined with sepsis. When the sepsis and peritonitis do not result fatally, the detached uterus constitutes an abscess. The abscess may eventually rupture through the abdominal walls and the fetal debris escape externally, or may rupture into the digestive tract and the fetal remains escape in that way. It has been alleged that the fetus sometimes undergoes mummification, followed by recovery of the patient. This must be extremely rare. I have observed no such case, nor authentic report of such.

Frequently the owner or caretaker fails to observe any signs which would lead him to suspect serious accident. The animal simply becomes dull, or if colic is present it passes unobserved, and it is not until the torsion has existed for days or even weeks that it has caused a sufficient disturbance to attract his attention. This is especially true of those who keep but a few cows and are about them but little. Cows at pasture are often scarcely seen at all, or merely are noticed for a few minutes each day, so that, unless there are very evident symptoms of disease, they pass unseen. In this way torsion of the uterus frequently passes unnoticed for a week or two, except that the owner may have recognized the fact that there was something amiss with the animal, though not in his judgment of a sufficiently serious character to call for veterinary attendance. In some cases of uterine torsion, the vulva seems smaller and drawn inward.

The diagnosis of the accident in the larger animals is comparatively easy by either vaginal or rectal exploration. When the hand is introduced into the vulva, it does not advance far until it comes in contact with folds of the vaginal walls, which pass in a spiral manner, either to the right or left, obliquely toward the cervix. In some cases the spiral folds are not very prominent and the vagina is not closed, so that the veterinarian may, without serious difficulty, advance his hand to the os uteri; sometimes, if the cervical canal is dilated, he may be able to pass the cervical canal and reach the cavity of the uterus.

In severe cases of torsion this can not be done, but the hand, after following the folds of the vaginal wall in a spiral manner for a time, can be advanced no further. In some cases the hand can barely be introduced to the os uteri, and in others it stops before the mouth of the uterus is reached.

This condition of the vagina is sufficient in itself clearly to identify the torsion, and render the diagnosis definite. Examined per rectum, the anterior part of the vagina and the cervix of the uterus appear as a more or less tense, spiral cord, in which the spiral folds of the organ can be somewhat readily felt and the direction in which the torsion has taken place may be determined. In the ewe the condition is not ordinarily diagnosed clinically, though there are apparently no insuperable difficulties.

Torsion is liable to occur at any time during the last third of gestation, sometimes earlier. Consequently, when the veterinarian is called to attend a pregnant animal, and finds it suffering from some disease, the character of which is not very clear upon external examination, he should not fail to investigate carefully the condition of the gravid uterus, in the course of which examination he would naturally discover uterine torsion if it existed.

Pathology. The changes which occur in the uterus and its contents depend very largely upon the extent of the displacement of the organ. In mild cases, where the torsion is but slight, it does not interfere seriously with the circulation of the uterus and the nutrition of the fetus. The contractile power of the uterine walls remains essentially intact, and the life of the fetus may not be threatened except by delay in its expulsion, caused by the narrowing of the birth canal, owing to the partial revolution of the organ. In such slight cases the torsion merely constitutes a mechanical impediment at the time of parturition, which, if not relieved, may end in the death of the fetus, to be followed by the ordinary consequences of fetal decomposition. Such mild cases are recorded, but I have not seen them.

When the torsion is extensive, it interferes primarily with the circulation in the uterus, and secondarily with the nutrition of the fetus. As shown in Figs. 86–88, whenever the uterus revolves upon its long axis all the uterine blood vessels become involved, so that the circulation is very promptly disturbed or completely cut off. This applies equally to vessels arising from the pudic or ovarian vessels. As soon as the circulation is disturbed, the effect upon the uterus is more or less profound, according to the degree of obstruction. Moderate obstruction to the circulation tends to cause congestion of the uterine walls and placenta. The obstruction affects first the venous circulation, and tends to cause

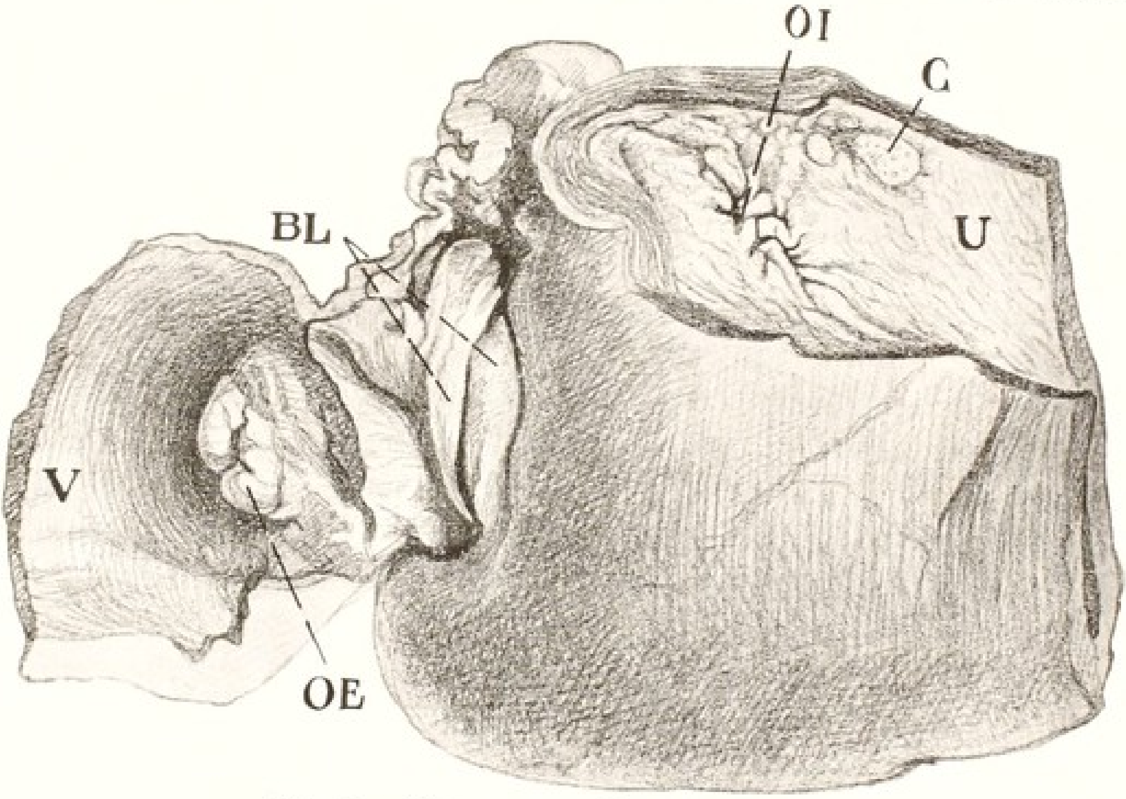


Fig. 89. Torsion of Uterus. Cow.

V, vagina. OE, os uteri externum. OI, os uteri internum. BL, broad ligament. C, cotyledon. U, uterine cavity.

asphyxiation of the fetus. As a result of this disturbance of the circulation, the fetus may show more or less violent movements, which may sometimes be misinterpreted and believed to be the cause of the displacement, whereas in fact they are the result of it. The disturbance in the circulation and the non-aëration of the blood of the fetus tend finally to bring about its death. This usually occurs promptly if the torsion is at all extreme.

The interference with the circulation affects first the return of the venous blood from the placenta and uterus, and as a consequence there is a constant tendency to an extensive transudation of serum and blood. The transudation involves the uterine walls, causing them to become immensely thickened and black; the maternal and fetal placentae undergo analogous changes; the fetal membranes become involved; and extensive exudation of bloody serum occurs in the peritoneal cavity of the mother, the utero-chorionic space, and the allantoic and amniotic cavities, increasing enormously the volume and weight of the gravid organ and its contents.

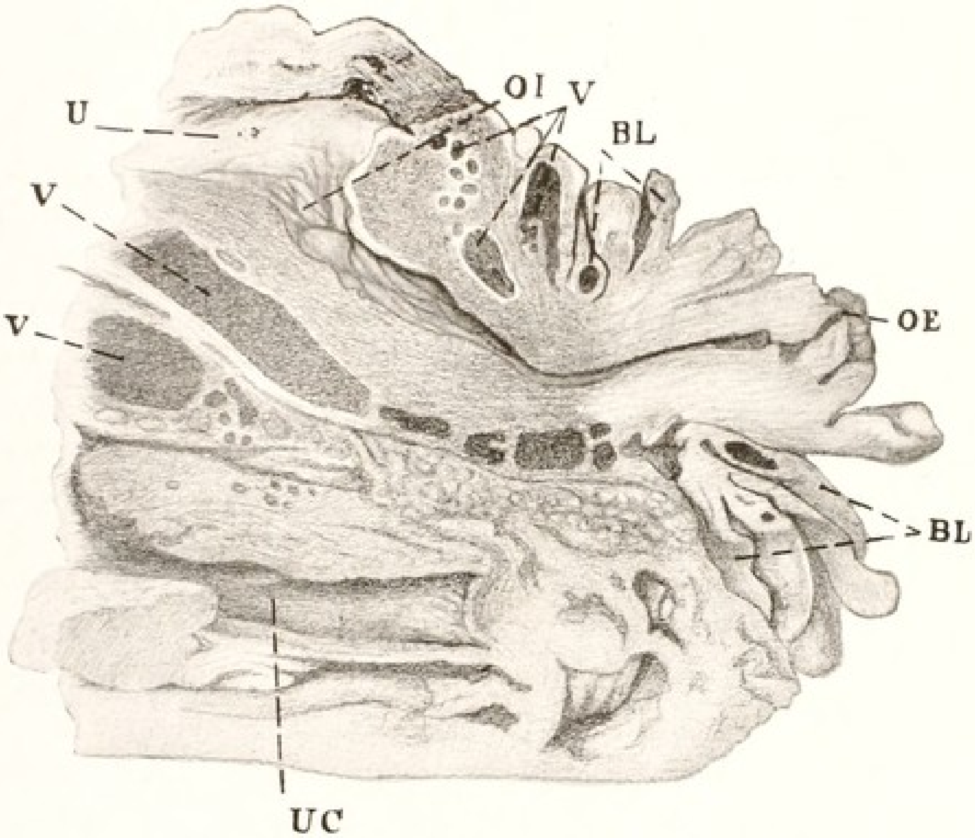


FIG. 90. SAGITTAL SECTION OF FIG. 117.

OE, os uteri externum. OI, os uteri internum. BL, BL, broad ligament. V, V, V, veins distended with coagulated blood. U, uterus. UC, uterine cornu.

It is said that in some cases the fetus undergoes mummification, but if this occurs it must be very rare. The tendency is rather for infection of the uterus and its contents to take place, leading to putrid decomposition. Under normal conditions, the cervix acts as an efficient guard against infection. The cervical canal is hermetically closed by the uterine seal. When torsion occurs, the tissues of the vagina and cervix at once lose partly or wholly their normal function. When the torsion is extreme and the vitality of the walls becomes depressed or destroyed, their resistance to bacterial invasion declines or ceases, and the diseased tissues serve rather as a favorable culture ground for bacteria, which consequently advance to the uterus and its contents, either along the cervical canal or through the tissues, thus causing fetal decomposition and septic metritis.

It has been stated by some veterinary obstetrists that the torsion of the uterus may take place at any point, or nearly so, in the entire genital tract : in the vagina, the cervix, the uterus, or the cornu. A study of the figures presented will answer this question. If the gravid uterus, as shown in Figure 86, is revolved upon its long axis, as has been done in 87 and 88, we find that we are dealing essentially with a large bag, containing solid (fetus) and liquid contents, in which the body of the uterus and the gravid cornu represent the sac, while the cervix and vagina represent the closed mouth, which is fixed to the immovable vulva.

Attempting to revolve this bag upon its long axis, we find at once that it will twist only at or near its point of fixation, where its mouth has been closed. If the uterus were empty, it could admittedly be twisted at any point throughout its entire extent, but when completely filled this can not occur. Instead, if it were forcibly revolved and forced to begin to twist in the distended middle part, it would be torn asunder because the contents do not permit of any decrease in volume. Therefore, in cases of uterine torsion in unipara, the twist must occur in the cervix or vagina in almost all cases. It can not occur elsewhere, except in very early pregnancy. In the case already mentioned, the torsion, which occurred at the fourth month, took place in the uterine body. In that case the fetal sac, which was not yet large, was pushed forward into the apex of the horn. At this stage of pregnancy, the fetus and most of the sac may be located far forward near the apex.

The contention that the gravid cornu of unipara may possibly be the only part involved in a twist is untenable where a portion of the fetus has developed and lies within the uterine body. The two horns of the ruminant uterus are so closely attached that the torsion of the gravid horn without involvement of the non-gravid is virtually an anatomical impossibility. In multipara, as the sow, bitch, and cat, torsion of one of the cornua may and does occur, and is more probable than the torsion of the entire uterus.

De Bruin suggests that in a large proportion of the cases of torsion the accident occurs after the os uteri has become dilated, and that it is favored by this fact. He bases his belief upon the clinical fact that, in a large proportion of cases of uterine torsion, when the torsion is reduced, the cervical canal is found to be dilated and ready for the passage of the fetus. His conclusion is not wholly acceptable. The gravid uterus has been likened to a bag filled with fluid. If the mouth of the bag, attached to an immovable object, is left open, and an attempt is made to turn it upon its long axis, this is found to be very difficult or even impossible.

De Bruin reasons that, because the uterus is contracted, there is more room for it to twist, but the uterus is certainly just as full as before it began to contract, unless the waters have escaped. The common clinical fact, that the cervical canal is found dilated in some cases immediately after torsion is reduced, may readily be explained by the torsion itself. In torsion, the cervix becomes very much stretched longitudinally ; this is one of the greatest elements in the dilation of the cervical canal. The torsion, by involving chiefly the cervix, would destroy first of all its contractile power, very greatly weaken its muscles, and tend to favor passive dilation as soon as the torsion is reduced. De Bruin admits this weakness of the cervical walls and cautions the obstetrist against applying great force upon the fetus after reduction of the torsion, lest the cervix rupture transversely, but this would scarcely occur except the muscles had already been seriously damaged by over-tension.

When the fetus becomes emphysematous or undergoes putrid decomposition, and the uterine cavity becomes filled with transuded liquids, the disease processes are not confined to the inner surface of the uterus and to its contents, but extend to and beyond the peritoneal covering of the organ. The peritoneal covering of the uterus becomes inflamed, and finally tends to adhere to other portions of the peritoneum with which it comes in contact. In one case which I observed, almost the entire peritoneal surface of the uterus was very firmly adherent to the intestines, rumen, bladder, and abdominal walls. In addition to these adhesions, in severe cases, the peritoneal cavity contains an abnormal amount of a reddish-colored serum.

Not only does the uterus become adherent to surrounding organs and tissues, but one part of the organ becomes firmly adherent to another part of it, or to its broad ligaments, especially about the cervix, so that even if the rest of the organ is free from adhesions it may be difficult to untwist because of adhesions existing between the coils in the twisted portion itself, as shown in Figs. 89 and 90.

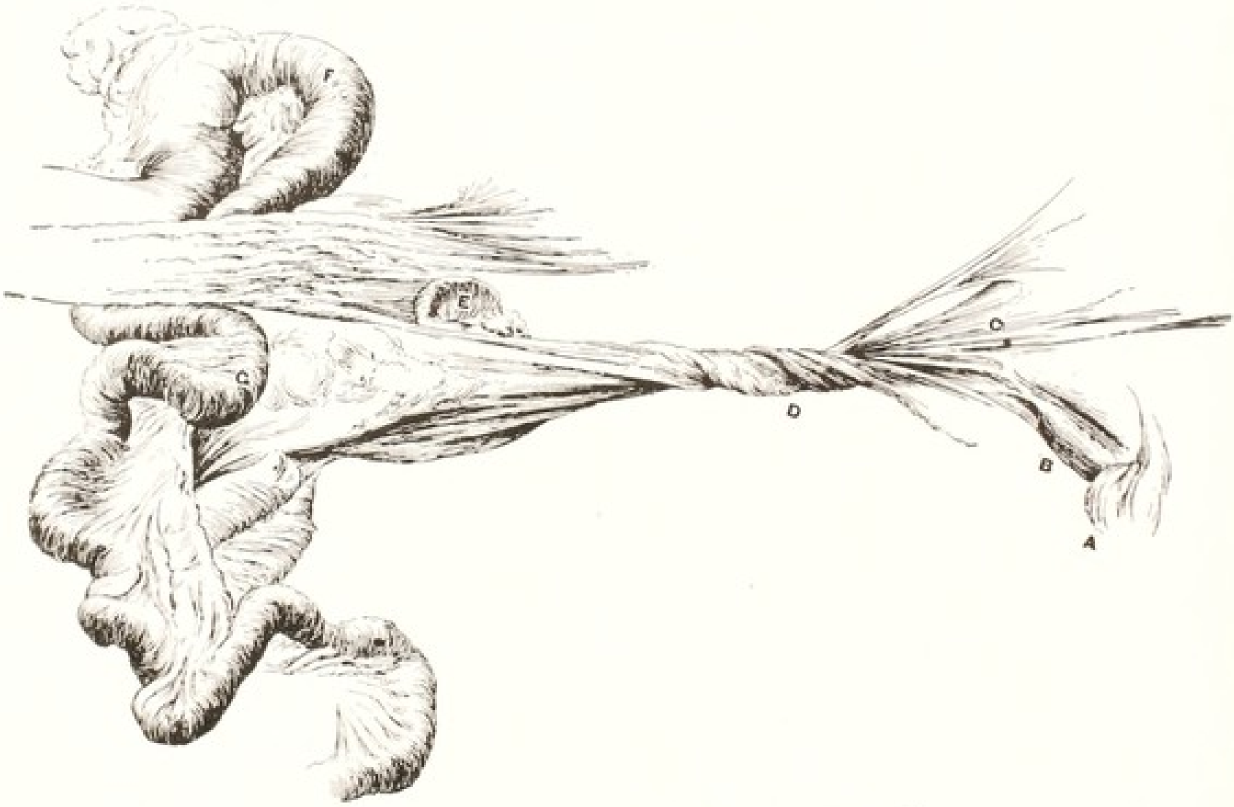


Fig. 91. Torsion of the Uterus in the Ewe.
(Museum New York State Veterinary College.)

Followed by transverse rupture of the vagina and sloughing of the putrid fetus through the abdominal floor.

A, vulva. B, vaginal stump. C, broad ligament. D, cord-like cervix, entwined with broad ligament. E, ovary. F, uterine cornu. G, intestine.

When the torsion continues to an extreme degree, the genital tube and its broad ligaments give way, and the uterus, with its contents, becomes almost or wholly detached and lies free within the peritoneal cavity. In my personal observation, the rupture occurs at the anterior end of the vagina. Since the cervix is too resistant and the uterus is too fully distended to undergo the twist, the anterior part of the vagina constitutes the area of least resistance. In the clinic of a colleague, a uterine torsion in a heifer, after two weeks' duration, was reduced by rolling. The vaginal mucosa had been torn entirely around the vagina, two inches posterior to the os uteri externum, but the muscular and peritoneal coats were intact. The walls of the uterus near the cervix were two inches thick. The uterine veins contained coagula one inch in their transverse diameter.

Just how far uterine torsion can advance in the living animal is a question not readily determined. Fleming, in his Veterinary Obstetrics, edition 1887, page 299, states that the uterus may make as many as four complete revolutions, but cites no cases which demonstrate clearly the correctness of such a statement. In my experience, the constant tendency has been for the vagina to rupture transversely whenever the torsion extends to an extreme degree. In Fig. 91, transverse rupture of the vagina in the ewe is shown. In this case the fetus and other uterine contents sloughed out through the abdominal floor in the region of the umbilicus. How many times the uterus had revolved before it had torn in two can not readily be determined, but apparently not much, if any, beyond one complete revolution. I question very much if, under ordinary conditions, the pregnant uterus, when near the close of gestation, will turn more than once or once and a half around without a transverse rupture.

In one instance, in a cow, which came under my observation, it would seem that the torsion did not equal one complete turn, because it was very promptly reduced by rolling the cow once over. Yet, when the fetus had been removed, a large transverse rupture of the vagina was found, which later caused the death of the animal. It is scarcely believable that the rupture was caused in delivering the calf, as this was accomplished very gently and easily.

Some authors state that occasionally the broad ligaments of the uterus also become ruptured, and make their statement in such a way as to carry the impression that the ligaments rupture independently of the transverse rupture of the organ itself. How true this may be, is not quite clear. When the organ ruptures transversely, as in Fig. 91, it is very evident that the broad ligaments must give way also, as they are firmly incarcerated in the part which ruptures, and the immense weight of the gravid organ, after it has become detached from the vagina, is such that the ligaments must necessarily be torn. It is difficult to understand, from a study of Figs. 86 and 87, how any serious rupture of these ligaments could take place without the organ itself having first given way.

Prognosis. The prognosis of torsion of the uterus must frequently be grave. The probability of recovery must be based largely upon the duration and extent of the lesion. When a recent torsion, to the extent of one-half of a revolution, exists, it is ordinarily not to be regarded as serious, because it may not greatly imperil the life of the fetus, or render the reduction of the torsion and extraction of the fetus a formidable matter. It may not interfere very greatly with the circulation in the uterus or with the nutrition of the uterus and the fetus. The prognosis is favorable in all those cases where the displacement is recognized and corrected early, the genital canal has not been ruptured, and the disturbances of the uterine and fetal circulations have not fatally injured the uterus or fetus. When the torsion becomes complete, as in Figs. 88–91, or there is almost a complete turn upon its long axis, the circulation of the organ is at once seriously interrupted. Unless prompt relief is afforded, the fetus must perish, and almost certainly undergo decomposition with all its consequences, and the uterus must become seriously diseased. If the twist proceeds a step further, a rupture of the vagina results, which must almost inevitably lead to the death of the animal; should she survive, her value is usually destroyed, because of the very slow, uncertain, and imperfect recovery, by the sloughing of the fetus through the abdominal walls or into the alimentary canal.

The prognosis must therefore always be very cautiously made.

The torsion may be reducible or irreducible. The fetus may be alive, or it may be dead and emphysematous, according to the duration and extent of the torsion. The putrid decomposition of the fetus and the serious disturbances in the circulation may have led to uterine paralysis, inflammation, or gangrene from which it is impossible for the animal to recover. The vagina may have suffered a fatal transverse rupture, which may not reveal itself until the torsion has been reduced and the fetus extracted.

The handling of torsion of the uterus must be based upon the period of pregnancy at which it occurs, the extent and duration of the torsion, and the character of the pathologic changes present. When torsion occurs early in pregnancy, especially before the seventh month in the cow, it might appear possible that the condition could be relieved without terminating the pregnancy; such success has been reported. Uterine torsion is diagnosed because definite incarceration accompanied by grave symptoms has occurred. When it is sufficiently severe to induce colic, inappetence, or other evidences of distress, there are serious disturbances in the uterine circulation which place the life of the fetus in immediate and extreme jeopardy. In the slight torsion occasionally reported, there is probably a revolution of not more than 45°, or one-eighth of a revolution. This is recognized only when the veterinarian is called to overcome the resultant dystokia. Prior to the advent of parturition, no evidences of such torsion appear.

The outstanding indications are to reduce the torsion and evacuate the uterus. When the symptoms are sufficient to attract attention and lead to a diagnosis, the fate of the fetus has ordinarily been decided adversely, and the uterine walls are paretic, engorged, inflamed, or necrotic. After the torsion has been reduced, it would ordinarily be disastrous not to evacuate the uterine cavity at once. The cervix is so affected that, immediately the torsion is reduced, the cervical canal is passively dilated. This is independent of the normal end of gestation; it is not due to the advent of parturition, but is one of the primary results of the torsion. The blood stasis and extravasation are greatest in the cervical region. Apparently the transuded lymph and blood in the cervical canal break up and destroy the uterine seal. The muscles of the cervix are wholly paretic. If the fetus and its membranes are not promptly removed, the dead uterine contents—fetus, fetal membranes and fluids, and great accumulations of transuded blood and lymph—invite rapid decomposition. Since the cervical canal is open, bacterial invasion is invited. The uterine walls are generally paretic, and the evacuation of the uterine cavity needs be made surgically.

In slight torsion, where the uterus has not made a complete revolution upon its long axis, it may be possible to advance the hand through the vagina and cervical canal into the uterus, rupture the fetal membranes, seize the presenting limbs, and, by exerting rotary force upon the fetus itself, cause the uterus to turn back to its normal position. In such a case the force is to be exerted in the direction opposite to the twist, turning the organ back to its original position. If the torsion has taken place to the right, the force, exerted indirectly upon the uterus through the fetus, should be to the left. If the birth canal is sufficiently open to permit the feet to pass through and beyond the vulva, the correction of the position of the uterus is rendered much simpler, because greater power is given to effect rotation of the fetal body by grasping the limbs. Having flexed the foot at the fetlock, the pastern may be used as a lever to exert power. Various machines and appliances have been suggested to aid the operator in these cases, but, as a general rule, where the torsion is so slight its correction constitutes a rather simple procedure, and little or no equipment is necessary. When slight torsion is to be corrected, the animal should preferably be in the standing position with the hind parts much elevated. I have not observed such slight torsion, though it has been reported by others.

When the torsion has advanced to such a degree that the hand can not be inserted into the uterine cavity, it is impossible to turn the uterus by the application of force from the vagina or rectum.

In severe torsion, the method most frequently employed for bringing about reduction is that of rolling the patient. The operation is best performed in the open field, if weather and other conditions permit. Otherwise, a commodious room is selected. The patient is to be cast with her hind parts elevated, so that the uterus may tend to drop away from the pelvis and hang attached by the vagina, much like a bag freely suspended from a fixed support. If the torsion is to the right—that is, if the spiral folds in the roof of the vagina turn to the right and those in the floor of the vagina to the left—the patient should be cast upon the right side. The two fore feet should be firmly bound to each other and the two hind feet to each other. The two fore feet may with advantage be lashed against the chest floor. This is accomplished by attaching securely to each pastern a cord or strap five or more feet in length. The limbs are flexed against the sternum. The free ends of the cords or straps are tied tightly over the withers. With the fore feet thus secured, the patient can not resist the rolling process by bracing with the feet. The fore feet should not be attached to the hind feet, because this exerts too great compression upon the abdomen, interferes with the rotation of the uterus upon its long axis, and consequently with the replacement of the organ.

The operator should be careful to keep the posterior parts of the patient well elevated. He should kneel or lie behind the patient and insert his hand as far as possible, to hold the vagina or uterus as firmly as may be and also to determine the result of the operation. The operation proceeds upon the assumption that, when the body of the animal is rolled, the gravid uterus may remain static, and consequently the normal relationship may be restored by the patient's body revolving around the gravid uterus in the same direction in which the latter had previously turned. The operator remains in the position named, and assistants turn the animal upon her right side, thence upon her back and over upon her left side. The patient's feet are folded beneath her body and she is again rolled upon her chest and over upon her right side. The posterior limbs are then extended and the rolling continued as before.

In discussing the cause of torsion, it was suggested that the accident probably results from a very sudden slip or turn of the animal. In attempting to overcome the displacement of the organ, it is advisable to imitate those conditions which are assumed to have caused the displacement. Consequently, the rolling process, at a critical point, should be more or less sudden, in the hope that the body of the patient, by being moved quickly, does not cause the gravid uterus to move with it, but leaves it standing still. To this end, then, when the rolling process is begun it should be done rather quickly, in order, if possible, to bring about the revolution of the body of the mother, without having the gravid uterus follow its motion.

Some favor a modified rolling process by causing a partial revolution of the body of the mother with an attempt to turn the gravid uterus in the opposite direction or to hold it from turning with the maternal body by means of external force applied to the fetus through the abdominal walls. The patient is turned slowly and gently upon her back, while the operator or an assistant identifies the fetus by palpating the abdominal floor. If the torsion is to the right, the operator pushes against the fetus from the right to the left and attempts to cause the gravid organ to revolve toward the left, or at least to aid materially in holding and preventing it from rotating to the right as the body of the patient is suddenly brought down on her right side.

This plan of operating is based upon the assumption that, when an animal suffering from uterine torsion is slowly and carefully rolled over, the gravid uterus may revolve to the same degree, but that an abrupt roll of the maternal body may change the relations of the gravid organ. This influence can be aided by external manipulation.

As soon as it is believed that the operation has been successful, the ropes are removed and the cow is allowed to stand. When the torsion has been reduced and the cervical canal is open, there is usually a gush of dark bloody exudate from the uterus escaping from the vulva. If the operation has been successful, the spiral folds of the vagina have disappeared, the hand can be advanced without difficulty to the os uteri, and, if the cervical canal is dilated, may be passed on into the uterine cavity and the fetus grasped.

It is highly important, in this operation, that the veterinarian should keep his hand in the vagina, or frequently insert it, in order to determine the progress which is being made. Sometimes the operator becomes confused in reference to the direction of the twist, and consequently in reference to the direction in which the animal should be rolled. If his hand is introduced into the birth canal, and the rolling process is begun in the wrong direction, he recognizes the fact at once by the increased pressure upon his hand as the twist becomes aggravated. If the turning is in the right direction, and the torsion is reducible, the vagina becomes more open and commodious, and the hand can be advanced further into it.

In some instances the torsion is not promptly reduced, although it may eventually be accomplished by perseverance, so that, if turning the animal once does not completely accomplish the object, one should not despair, but should resort to several or many turns and watch closely the result.

When the rolling process alone, or with external manipulation, fails to bring about a reduction of the torsion, it has been recommended to perform laparotomy. The operator reaches into the abdominal cavity with the hand, grasps the gravid uterus, and reduces the torsion by acting directly upon the organ. In the cow it would be preferable to operate upon the standing animal, making the incision somewhat high in the right flank. If the torsion is to the right, the operator reaches down between the right abdominal wall and the gravid uterus; inserting the hand as far as possible alongside and beneath the organ, lifts upward; and, drawing somewhat to the right, attempts to cause it to revolve to the left. If the twist is to the left, the operator passes his hand over the top of the organ to the left side, and downward as far as possible, and, grasping some projecting portion, draws the organ upward and to the right. How often this process succeeds, where rolling or external palpation fails, is unknown. Probably not often. The gravid uterus is so voluminous and heavy, its exterior so even and smooth, and it is so closely imprisoned in the abdomen that grasping the organ with the hand and exerting efficient force is not easy. The force must be largely exerted by placing the palm of the hand at a favorable point and pressing against the uterine walls in an advantageous direction to induce rotation. If the operator can grasp one of the feet of the fetus through the uterus, it affords a secure hold for the safe exertion of force. I have attempted the operation twice after rolling had failed, each time without result.

When the torsion has been reduced by one of the foregoing plans, the question of delivery arises. If the torsion has occurred early in pregnancy, and has been promptly discovered and remedied, it may not be advisable to encourage the immediate expulsion of the fetus. Cases have been recorded in cows, six to seven months pregnant, in which the torsion has been reduced, the pregnancy continued to its normal close, and a living calf born. These constitute very exceptional instances. In many cases the torsion is not discovered at this period.

When uterine torsion has been reduced, and has not caused pathologic changes which have destroyed the functions of the uterus, labor generally begins very shortly afterward, and the fetus is expelled. De Bruin and others recommend that as a rule the expulsion of the fetus should be left to the natural forces of the mother, unless there are conditions present which suggest otherwise. If the cervical canal is not yet dilated, though usually it is, time should be allowed for this to occur normally. If the canal is dilated, the fetus may be quite promptly expelled, so that very little assistance, if any, is required. Usually it is advisable to apply traction to the fetus. This should be done very cautiously, and abundant time should be given for the passage of the fetus through the birth canal. It is needless to state that, if the fetus presents abnormally, the deviation should be adjusted.

Before applying traction for the removal of the fetus or carrying out other manipulations, after the organ has been replaced, the practitioner should search for transverse rupture of the vagina or other important injuries. If such rupture has occurred during the torsion of the organ, it should be discovered promptly and the owner of the animal advised, that he may relieve the veterinarian from any responsibility which might rest upon him otherwise because of the later discovery of the condition.

De Bruin aptly remarks that, in these cases, examination should be made before any operation is begun, with a view to determining whether the case has already been handled by empirics or others, and in this way the outcome rendered more doubtful.

Torsion of the uterus is frequently irreducible. In one case which I attended, the torsion had apparently existed for about two weeks, and the spiral folds of the cervix and vagina had become so firmly adherent to each other (Figs. 89 and 90) that the organ could not very well have been untwisted. Reduction was also made virtually impossible by the fact that the fetus was dead, emphysematous, and swollen to thrice its normal volume, and so great a volume of fluid had transuded into the uterine cavity as to increase the weight and volume of the organ to such a degree that there was neither room within the abdominal cavity to turn the organ nor power enough in the arms of a man to bring about its rotation. In addition, the uterus was so firmly adherent over its entire surface to the surrounding organs and abdominal walls that replacement was impossible, after the patient had been killed and the abdomen opened, until the uterus had first been dissected loose.

In another case, the uterus was free from adhesions, the torsion had existed for some days, the emphysematous fetus and the transuded liquid had so thoroughly distended the uterus, and its walls were so voluminous, that it occupied virtually the whole abdominal cavity. There was simply no room in which to turn the organ, and its weight was entirely too great for a man to lift.

In those cases where the torsion has ended in a complete transverse rupture through the vagina, reduction is evidently impossible. When gangrene of the uterus has occurred, reduction, if possible, is useless.

When torsion is irreducible, there is virtually no hope for the life of the fetus, because in almost, if not all cases its life or value is excluded from consideration because it has perished before the condition has been realized.

If irreducible torsion has occurred early in pregnancy, it is possible, according to some writers, that infection may not reach the uterus and its contents, and that as a result the fetus may undergo mummification, in which instance the animal, if a meat-producing one, may be fatted for the butcher. There is no evidence that such desiccation of the fetus has occurred in uterine torsion.

In some instances the fetus undergoes putrid decomposition and sloughs out through the abdominal floor or into the digestive tract. By a long and tedious process, the animal may eventually recover. But the economic loss is well-nigh total, because of the total loss of breeding power and the long time required for recovery.

Caesarian Section. The chief hope in cases of irreducible torsion is laparo-hysterotomy, the value of which should always be judiciously considered. Usually there can be no hope for the life of the fetus, and the fertility of the mother is at an end. There remains for consideration the question of the economic value of the animal for meat, wool, or labor; or of the sentimental value of the saving of the life of the animal. Whether one operates or not should be determined after considering all these factors. The operation is described elsewhere.

Should gastro-hysterotomy be performed, it is to be remembered that, unless the torsion has been reduced, the evacuated uterus must not be completely closed and returned into the peritoneal cavity. If the torsion remains and the uterine incision is closed, the escape of uterine excretions is barred. The margins of the uterine incision may be securely sutured to the margins of the abdominal incision, thus providing an avenue for the escape of uterine discharges externally. Sometimes it might be preferable to amputate the diseased organ and secure the cervix to the margins of the abdominal incision. Sometimes the entire organ may be amputated, with a portion of the vagina, the vulvar end of the latter ligated and returned into the pelvic cavity, and the abdominal incision completely closed.

In the smaller animals, where one of the cornua undergoes torsion, reduction is practically out of .the question, and only gastro-hysterotomy remains.

Hemorrhage from the Gravid Uterus

Metrorrhagia

Hemorrhage from the gravid uterus is very rarely observed in domestic animals. Carsten-Harms records the accident in the cow and the mare and admits its occurrence in all domestic mammals. The symptoms are said to consist fundamentally of colic, expulsive efforts similar to those of parturition, and an escape of blood from the vulva. The symptoms are not constant; any one of them may be absent in a given case. Hemorrhage into the uterus is competent to cause abdominal pain comparable to colic. Hemorrhage from the uterus—the actual flow of blood out from the uterus—can not cause colic symptoms, except it is very profuse and causes acute anaemia. In douching the empty uterus of the cow, if inadvertently fluid is left in the uterus sufficient to distend it, colic follows at once.

Ere blood emanating from the cavity of the gravid uterus may escape externally, the uterine seal must be broken down in order to permit the blood to traverse the cervical canal. Perhaps this occurs rarely. Slight hemorrhage about the os uteri internum is so common in pregnant cows that it might in a way be considered normal, but it is very slight ordinarily—from 0.1 cc. to 10 or 20 cc. of blood coagula. This does not and can not escape. I have observed in the abattoir one instance of extensive inter-placental hemorrhage in the cow, where, between each maternal and fetal cotyledon, a uniform blood coagulum 1 mm. thick and co-extensive in area with the cotyledons was present, but none escaped. The phenomenon of desiccation or mummification of the fetus is apparently due to inter-placental hemorrhage, with dehiscence of the placenta *without* the escape of the blood from the uterine cavity. The records of hemorrhage from the gravid uteri of domestic animals are hazy and not well verified. I have not observed a case clinically except in dystokia from some mechanical injury. In abattoir examinations of more than two thousand gravid uteri, no suggestion of the escape of blood from the uterus was revealed. Probably most cases of hemorrhage diagnosed as emanating from the gravid uterus have been "terror" diagnoses, where blood is seen to flow from the vulva and the observer is afraid to investigate and learn its source. It may be from the posterior end of the cervix, the vagina, the vulva, the bladder, or the kidney. There has been so much unwarranted fear that an examination of the genitalia in a pregnant female will cause abortion that a timid veterinarian avoids examination and lets terror and fiction dictate the diagnosis. If the hemorrhage is very extensive, whether the blood escapes from the uterus or not, it produces the usual symptoms of internal bleeding, such as colic, imperceptible pulse, and blanched mucosa. In such severe cases the animal necessarily becomes very weak and staggers. The surface of the body becomes cold. In the mare there is profuse sweating. The heart-beat is violent, but the arterial impulse weak.

The diagnosis of uterine hemorrhage, in pregnant animals, is not easy except by manual exploration. It is necessary to determine the source of the bleeding. The necessary examination, *per vaginam et rectum*, for the proper diagnosis of the origin and character of the hemorrhage is devoid of material danger. Of course the animal may later abort, not because of the examination, but as a logical result of the injury itself.

The hemorrhage may cease, gestation may continue for the normal period of time, and either living or dead young may be produced. There may be but a single hemorrhage, or it may recur. In severe cases the hemorrhage may prove fatal.

The cause may be a rupture of some of the uterine vessels, due to the presence of a tumor or other disease, or, as is probably most frequently the case, to some traumatic injury.

The prognosis of uterine hemorrhage in the pregnant animal is usually very grave, alike for the mother and the fetus.

The treatment should consist, first, of absolute quiet, in the hope that the blood may form a thrombus and the hemorrhage from the wounded vessels cease. Harms recommends an application of cold water or of cooling mixtures or ice bags to the posterior part of the abdomen in the vicinity of the uterus, by which he hopes to favor the formation of thrombi. Adrenalin chloride in large doses hypodermically is highly effective. When the hemorrhage is very threatening, it may be desirable to bring about immediate delivery of the fetus. In this way one may save the life of the fetus, may cause the hemorrhage to cease spontaneously by permitting an involution or contraction of the uterus when relieved of its contents, and may be enabled to apply topical remedies directly to the bleeding parts. The conditions demand the greatest celerity compatible with safety, once the operation has been determined upon. The prompt evacuation of the uterus in the cow can not be readily attained because the cervix is so firm. In the mare, with the very dilatable os uteri, delivery can be brought about very quickly.

After emptying the uterus of its contents, it has been recommended that cold water or astringents be injected into its cavity or that it be packed thoroughly with gauze saturated with astringents, such as alum. Irritant astringents or styptics, such as the persulphate of iron and some others, should not be applied, because they tend to induce straining, causing the hemorrhage to continue and defeat the practitioner's aim.

Prolapse of the Vagina and Cervix Uteri
Vagino Cystocele

Prolapse, or eversion, of the vagina is observed in the pregnant cow and ewe, and more rarely in other domestic animals. The disease has been attributed to a relaxation of the genital organs. It has been claimed that it occurs mostly in those animals of a lymphatic temperament which are good milkers, have wide pelves, and are fed abundantly upon bulky food. It has been taught also that cows which are kept on floors sloping backwards are liable to this disease and that injuries of various kinds may cause it. Some assert that it occurs chiefly in adult animals which have previously given birth to young. It is observed in primiparae. The disease generally appears during the late stages of gestation, usually during the eighth or ninth month in the cow.

The actual cause is not well known. I have observed it more frequently in the ewe than in the cow. In the ewe it can not well depend upon lying upon a floor sloping backward. Sheep are not confined in stanchions and ordinarily lie upon a level floor. So far as I have observed, the affection is seen almost entirely in closely housed pregnant animals. I have especially noted the affection in ewes which were kept for growing winter, or "hot house" lambs. In these cases the ewes are bred about August or September, so that they may give birth to lambs during mid-winter, which are fitted for the early market when prices are high. The ewes are closely confined in very warm stables and highly fed. Under these conditions I have seen as high as five to ten per cent. of a herd of ewes affected with this malady. So far as I have observed, the conditions under which the disease arises in the cow are similar. I do not recall having seen a case of prolapse of the vagina in a pregnant animal of any species except it was closely housed or had met with some accident.

The nature of the disease varies. As a rule the primary displacement is the pushing backward of the cervix uteri. The displacement is at first visible only when the cow is lying down. Recumbency exalts the intra-abdominal pressure, and the gravid uterus is forced back toward the pelvis, pushing the cervix before it. This can not occur except there is present some disease of the genital tract, causing inertia, or the intra-abdominal pressure is enormous. Prolapse of vulva and vagina is observed in mares suffering from extreme intestinal tympany. Rumenal tympany in the cow and the ewe is not apt to induce prolapse of the pelvic organs. The intra-abdominal tension, sloping stall floors, etc., are not the foundation of vaginal prolapse, but merely aggravate a disease already present. As the disease advances, the cervix protrudes beyond the vulva when the cow is lying down, and finally may protrude constantly, whether the animal is lying or standing, though the protrusion is far greater when she is lying. The vaginal portion of the cervix then becomes soiled. Feces, urine, soiled bedding, and other filth come in contact with it and adhere to it. Inevitably, severe irritation follows, the cervix becomes inflamed, thickened, hard, and greatly enlarged. When the protrusion is severe and the displacement persists much of the time, the surface of the cervix and the vagina suppurates. The more exposed parts, the mucosa, and even deeper structures may undergo desiccation necrosis (dry gangrene). In some cases the uterine seal is plainly visible, resting securely in the cervical canal. In other cases the uterine seal is broken down and the mucosa of the cervical canal is suppurating. If time permits, the breaking down of the uterine seal may advance to the uterine cavity and cause death of the fetus. Sometimes the fetus is expelled but the cervicitis, acting as a formidable barrier, may prevent the discharge of the uterine contents. Then follows putrid decomposition of the fetus, with its sequelae. The death and decomposition of the fetus, followed by the death of the mother, has been common in my experience in ewes suffering from prolapse of the cervix. Indeed my observations indicate that the facts would be better expressed by stating that the disease is intra-uterine and that the prolapse is a consequence.

In a second group of cases, the cervix is not materially displaced. Instead, the vaginal floor is pushed upwards and then backwards by forces acting along the floor of the pelvis. The vaginal floor pushes out between the vulvar lips, and in immediate contact with it follows the urinary bladder, to constitute vagino-cystocele. The bladder becomes reversed : its fundus is posterior and the urethra anterior. The exterior of the tumor consists of the floor of the vagina ; the under side of the tumor is formed by the posterior segment of the vaginal floor, in which, along the bottom of the tumor at the inferior vulvar commissure, the urethra opens downwards. The bladder, finally becoming distended with urine, constitutes the principal bulk of the tumor.

The symptoms consist essentially of the obvious prolapse, which projects more or less beyond the vulvar opening, as a bright red tumor. If the tumor protrudes much of the time, and is replaced, the vulvar opening is seen to be abnormally large, the result of the prolonged stretching of the sphincter muscles. In many cases the prolapse does not cause great inconvenience to the animal. In others there is considerable irritation, with straining, increasing the size of the tumor and gradually resulting in systemic disturbances, which may cause the animal to lose flesh and vigor and finally to succumb. In the first type, the prolapse of the cervix, the os uteri externum is visible and recognizable. The presence or absence of the uterine seal will aid in determining the probable state of the uterine cavity and its contents. In the second form, the vagino-cystocele, the relationship between the urethra and the tumor serve to identify the character of the tumor. The condition needs to be differentiated from vaginal hernia, common in cows, consisting of a rupture through the muscular walls of the vagina, usually at the side, through which protrude viscera against the vaginal mucosa. The hernial contents are readily replaced and the hernial ring easily felt.

According to my observations, the essential cause of the disease is intra-uterine or vaginal infection, associated with a depression of the general vigor of the animal, intensified by close confinement and overfeeding. The condition is aggravated by the heightened intra-abdominal pressure due to the volume of the gravid uterus, and intensified by bulky feeding. The infection of the vaginal mucosa induces swelling accompanied by straining.

Prognosis. Once established, prolapse of the vagina in pregnant animals persists until parturition is completed, unless overcome by proper handling. There is no visible tendency toward spontaneous recovery. On the contrary, the malady tends to become aggravated with time.

The protruding organ may come in contact with bedding, manure, and other infecting and irritating objects. Occasionally it is lacerated by rubbing against the walls of the building or other objects. Feces from the patient must pass over the tumor and soil it. The tail, constantly in contact with the tumor, serves to abrade it. Under these conditions the prolapsed organ becomes more and more inflamed, thickened, and painful. Straining occurs frequently. The mucosa becomes greatly thickened and dark colored, and more or less gangrene may occur.

When vesico-vaginocele exists, the inverted position of the bladder, outside the body cavity, renders urination very difficult or impossible. All aid normally coming from the compression of the abdominal walls is lost; the expulsion of urine must be accomplished by the contraction of the bladder walls alone, against serious obstacles to the escape of the urine through the urethra. The accumulation of urine in the bladder, causing the distension of the organ, increases greatly the size of the prolapse and intensifies the suffering of the patient.

The straining consequent upon the prolapse does not dilate the cervical canal. The infection may exist already in the uterine cavity, or may extend into it through the cervical canal, bringing about the death of the fetus, followed by its septic decomposition.

The expulsive powers of the uterus are so weakened that the expulsion of the fetus is doubtful, and it is liable to be retained, decompose, and induce fatal sepsis of the mother. This is especially true in the ewe.

The affection is highly fatal in the ewe. In the cow it has proven more amenable to treatment. When the vaginal portion of the gravid uterus is so far displaced that it protrudes beyond the vulva, the gravity of the malady is heightened.

A serious feature of prolapse of the vagina is the weakening of the inflamed cervical and vaginal walls, which become greatly infiltrated, thickened, and inelastic. When the time for parturition arrives or it is deemed advisable to hasten birth, the cervicitis prevents the dilation of the cervical canal. If it is partly dilated and an attempt is made to remove the fetus by traction, the rigid cervical walls tear asunder, opening the peritoneal cavity. If vaginitis is extreme, rupture of that organ is also probable. In either case, the rupture is essentially fatal. The accident ends in fatal peritonitis.

Treatment. If the animal is forced to lie with the posterior parts depressed, the declivity of the floor should be corrected. Since the exalted intra-abdominal pressure has much to do, in a mechanical way, with the aggravation of the disease, this tension should be overcome as far as practicable by giving a concentrated diet in limited amount and of a laxative character, to reduce the volume of the abdominal contents.

In those cases where the disease is well established and the mucous membrane inflamed, general precautions do not serve to overcome the disease. The prolapsed organ must be returned to its position promptly and means employed which will cause it to remain in its normal situation. In order to maintain the organ in position, it is necessary to overcome the straining due to the pain and the infection. Before the prolapsed organ is replaced in its position, it must be cleansed thoroughly. After its replacement, it is to be straightened out in its normal situation. The replacement must be as thorough as possible in every detail. Later there should be introduced into the vagina remedies which will overcome the infection and ameliorate the pain.

Because of the straining, the replacement of the extruded organ is not always easy. First, the part should be bathed with a tepid neutral solution. Physiologic salt solution is probably best. Antiseptics, as they almost invariably irritate, should ordinarily be omitted. If the organ is very irritable and painful and its replacement causes great resistance, local anaesthetics, such as cocaine or eucaine, may be used. The addition of adrenalin to the anaesthetic solution blanches the mucosa and decreases the congestion. The replacement of the organ in the cow should be brought about by gentle and careful pressure with the palms of the hands, until it has retreated within the vulva, when one hand should be introduced and the walls of the organ straightened out in their normal position. If for any reason the animal should be recumbent, great difficulty may be found in replacing it. Whenever possible, the animal should be caused to stand, preferably with her hind parts much elevated, so that the abdominal viscera may drop forward away from the pelvis. If a cow can not, or will not stand for the replacement, she should be placed in lateral recumbency with the buttocks sharply elevated. The ewe, or other small patient, should be grasped by the hind legs and suspended with the head down ; the diseased organ will return to its position spontaneously or with very slight pressure. After the organ has been replaced, the operation may be completed by pouring into the vagina, through a funnel or a tube, a tepid physiologic salt solution. This tends to smooth out all irregularities and make the replacement complete.

In order to prevent a recurrence of the eversion and bring about disinfection and a decrease in the irritation of the part, I have found iodoform highly beneficial. It may be used as a powder, but, since this is somewhat desiccant, it is preferable to apply the iodoform suspended in a bland oil or in the form of a suppository incorporated with cocoa butter, lanolin, or tallow. Such treatment is very soothing to the irritated organ, and does much to overcome the infection and straining, which go hand in hand.

The application of bandages, trusses, or sutures to retain the diseased organ in position has been recommended. These are not wholly satisfactory, because there is no way, by either plan, to prevent the vagina from being pushed out against the mechanical devices, causing irritation by pressure against these. One can not successfully control the straining until the cause or causes, especially the infection and inflammation, have been eliminated. When this has been accomplished, the disease ceases. It is highly important that the recurrence and persistence of the prolapse be prevented. The infection and inflammation can not be controlled so long as the protrusion persists and soiling and abrasion of the tissues continue. Perhaps the most efficient means is by trans-vulvar sutures. A heavy needle, armed with silver wire or with tape, is inserted through the skin and aponeurosis at a point about two inches to one side of the vulva, and an equal distance below the superior commissure. The needle is carried downwards parallel to the vulvar opening and brought out at a point two inches above the lower commissure. The suture is then carried across the vulva to the opposite side, inserted as before, and brought out at a point opposite the place of beginning. This provides a double suture of secure bearings, which does not penetrate the vulvar mucosa.

The prolapse is often due to fetal death. The general assumption is that the prolapse induces the death of the fetus, thereby complicating the disease, but the reverse is frequently true. It is known that, following parturition, endometritis frequently induces vaginal prolapse, which persists until the endometritis is definitely relieved. A macerating fetus in the uterus may cause prolapse of the vagina in the pregnant animal. It would evidently be bad surgery to apply mechanical devices to overcome a prolapse dependent upon causes still existing, which the means applied would intensify rather than overcome. When metritis and a dead or diseased fetus are causing the prolapse, the condition may often be clearly recognized by the absence of the uterine seal. When parturition begins, all mechanical appliances are thrust aside ; sutures are torn out, with resulting deformity ; and labor proceeds in spite of obstacles. If the irritation is sufficiently great, all means are ineffectual in retaining the prolapsed organ.

Systemic medication should not be neglected. A prominent factor in aggravating the prolapse is a general atonic state combined with close confinement and heavy feeding. The intestinal tract should be promptly and judiciously unloaded. If the object can be promptly attained by the use of laxative foods, the administration of drugs may not be demanded. Generally the veterinarian is not warranted in permitting such delay, but should promptly administer purgatives, the promptest and safest of which are the alkaloids, eserine and arecoline. Given in small doses, they act within an hour ; if they fail to do so, the dose may be repeated. To an ordinary cow one-half to one grain of arecoline or eserine may be given. The ewe may take one-eighth to one-fifth of a grain, repeated in increased doses until the desired effect is obtained. Saline cathartics may be used instead, but they are very slow in action and cause disagreeable disturbances of the appetite. They have greater danger for the life of the fetus. The general tone of the system should be supported by the administration of tonics, especially of nux vomica or strychnine.

When the affected animal has reached the normal duration of gestation, if the prolapse is severe and inveterate, artificial delivery should be induced without delay. The os uteri should be dilated gradually and the fetus secured and brought away with careful traction. The veterinarian needs however, if possible, defer artificial delivery while the cervix is badly swollen and inflamed ; otherwise, attempts at forcible dilation of the canal are liable to end in a disastrous rupture.

The size of the ewe renders artificial delivery very difficult. If the ewe is large and the obstetrist's hand small, the task is greatly lightened and the operation rendered safer. When the smallness of the vulvo-vaginal canal or the large size of the operator's hand precludes artificial delivery through the genital canal, hysterotomy may be considered and applied if deemed judicious.

A heifer in our ambulatory clinic had suffered seriously from vesico-vaginocele for 24 hours. The animal had reached the end of the ninth month of gestation. When we were called, she was lying prone in the stanchion, unable to rise, even with assistance. She was somewhat emaciated, apparently very feeble. Possibly there was some degree of hydrops amnii. The floor of the vagina, within which was the bladder filled with urine, was extruded through the vulva and returnable only with great difficulty. It was impossible, from the beginning, to retain the organ in position after its return. It was evident that the only hope for the patient lay in immediate delivery. The animal was dragged from the stanchion to a suitable place for operating, where the posterior parts could be elevated. After much tedious and patient labor, the os uteri was dilated and the fetus removed. The afterbirth was left in the uterus, the cavity of which was filled with a warm disinfecting solution. The prolapsed organ remained in position without any mechanical appliance. Relieved of the weight of the fetus, the patient was soon able to regain her feet and made an uneventful recovery.

In all cases it is advised that the chief effort be directed toward overcoming the fundamental causes and that close attention be given to the cleanliness of the parts and to keeping them in position by the gentlest possible means. In many patients the repeated replacement and dressing of the parts may be essential. In some severe cases, the truss or sutures are advisable or necessary. However, I would urge the avoidance of mechanical appliances, so far as practicable.

It must be borne in mind that, since the disease is due very largely to close housing, we may accomplish much good by causing the animal to take invigorating exercise. This should not be severe, but should be abundant and regular. Such exercise aids in many ways: it stimulates the action of the bowels and decreases the fulness of the abdomen; it invigorates the general system and imparts an increased tone to the affected organ; and it serves to direct the patient's attention from irritation in the part, thus preventing straining. The movements of the animal tend to bring about a complete replacement of the uterus and vagina.

PRIMARY DISEASES OF THE FETUS AND ITS MEMBRANES

In many respects the diseases of the fetus can not be like those of the mother. It is well-nigh impossible for any external violence to imperil the life or well-being of the fetus without first gravely involving the dam. The pregnant animal may slip and fall violently, which may in turn cause a rupture of the uterus. The fetus, with its membranes, may then fall into the peritoneal cavity and die, but the mother will probably die also. The fetal death is secondary, not primary. A violent slip or fall may cause the gravid uterus to revolve upon its long axis—torsion of the uterus—and the fetus dies, not as a direct result of the torsion, but through asphyxia owing to the incarceration of the uterine vessels in the twist. Fatalities occur frequently in pregnant females and in other animals from heavy blows, but no such fatalities to the fetus are recognizable. A fetus may live and grow without a brain, it has no work for its lungs, and the digestive tract is a mere cesspool. It is doubtful if any blow or fall of the mother could cause the death of the fetus directly. After examining the uteri of more than two thousand pregnant cattle, I have found no evidences of physical injury to a fetus. The fetal placenta of the cow rarely, if ever, becomes detached from the maternal structures through violence. In one instance I observed intra-amniotic rupture of the umbilic cord, but that unquestionably occurred after the dam had been slaughtered, and almost certainly after the carcass had been hung up and the gravid uterus removed and roughly handled. I have not observed an instance and do not recall a recorded case where a fetus has been killed or damaged in utero without fatal injury to the mother, except by breaking down the uterine seal and, through the opening, introducing the hand or an instrument and rupturing the fetal membranes. While very slight disturbances of the segmenting ovum or of the blastoderm may lead to profound aberrations in the development of the mammalian embryo, probably such injuries rarely, if ever, destroy it. Physical injuries to the fetus, from exterior forces, without injuring the mother, are almost impossible.

Toxic drugs or other substances can not directly, so far as is known, destroy the life of, or seriously injure the fetus. It is alleged, though upon very inadequate grounds, that ergot and other toxic drugs may induce the death and expulsion of the fetus—abortion—but even in such case it is believed, first of all, to cause uterine contractions and indirectly kill the fetus later. It is not known that any toxic substance can pass through the maternal system with impunity and, reaching the fetus through the placenta, seriously imperil the health or life of the fetus.

Pathogenic organisms, so far as known, can not destroy or injure the fetus without first attacking successfully the mother. No bacteria are known to pass from the mother to the fetus through the healthy maternal placenta. Even should this occur, the disease germ must first invade successfully the maternal body, and multiply therein, before it can reach the fetus through the placental filter. The one known avenue through which the fetus becomes invaded by pathogenic organisms is the diseased uterine cavity of the mother, where the bacteria have first successfully attacked the uterine mucosa. From that vantage they (the bacillus abortus of Bang, colon bacilli, streptococci, etc.) successfully invade the fetal membranes, fluids, and body to cause abortion, retained placenta, etc., etc. Primarily, the infection causes a disease of the maternal uterine mucosa; secondarily, it invades the contiguous fetal structures.

The diseases of the fetus are separable into two groups:

(1) Primary fetal diseases or aberrations in development, such as fetal tumors and aberrations in the formation or function of fetal organs—hydronephrosis, hydrocephalus, etc. For the most part, they belong to the fetus alone. They have no counter part in the diseases of adult or young animals.

(2) Secondary fetal diseases, infections which involve first the maternal uterus and thence invade the fetal tissues. These will be discussed in a companion volume upon the diseases of the genital organs. The primary diseases of the fetus and its membranes are a sealed book clinically, except they react unfavorably upon the mother. Otherwise, their existence is revealed only when the diseased fetus has been expelled or is removed from the uterus after the death of the dam.

The veterinarian's interest in the primary diseases of the fetus is variable. In tracing the formation of the embryo, numerous aberrations have been discussed in order to forge a connecting link between physiologic, or orderly, and teratologic, or discordant, development. A few primary diseases of the fetus and its membranes may interfere with the health or imperil the life of the pregnant female prior to the completion of the normal duration of pregnancy, without causing first the death of the fetus. They do not usually imperil the life of the mother by causing dystokia in the literal sense, because ordinarily the life of the dam is jeopardized at an earlier date, wholly unconnected with any difficulty in or attempt at parturition. This small group is advantageously considered amongst the diseases of pregnancy.

A larger group of fetal diseases, including hydrocephalus, ascites, and others, may pass unobserved during gestation, affecting in no visible way the well-being of the mother until parturition begins, when they cause notably difficult birth. These are logically best considered in the chapter upon fetal dystokia, since the obstetric interest in them begins and ends at that point.

Another important group of primary diseases or aberrations of the fetus causes no peril to the life or general health of the mother or fetus during pregnancy and does not induce dystokia. The young are more or less capable of living after birth, but the defect interferes seriously with the efficiency of the new-born animal and may later compromise its life. These diseases have their essential interest for the veterinarian in connection with the diseases and defects of the young animal.

The chief primary diseases of the fetus and its envelops which may so react upon the pregnant animal as to interest the veterinarian are hydrops of the amnion or allantois and fetal anasarca.

Dropsy of the Amnion or Allantois
Hydrops Amnii. Hydrallantois

There is regularly present within the amnion and allantois an amount of fluid, the volume of which varies in different individuals of the same species. The quantity in the mare and cow is usually about five to six liters of amniotic, and six to fifteen liters of allantoic fluid. When it exceeds this amount materially, is is considered abnormal. Hydrops of the fetal sacs occurs in various domestic animals. It has been observed chiefly in the cow and the mare. Saint-Cyr records one case in the goat. Merrick has observed it in the ewe and bitch.

The exact nature of the disease has not been determined. In the majority of cases observed clinically, it has not been determined whether the fluid was chiefly or wholly within the amnion or the allantois. In woman, where the allantois is normally devoid of a cavity from an early date, the dropsy naturally occurs in the amnion. Because of this fact, veterinarians refer generally to the malady as *hydrops amnii*, though the collection may be in either or both sacs. It appears highly probable that the hydrops is usually amniotic. In the few cases I have had opportunity to observe, the fluid has been clear. Since normally the amniotic fluid is clear and the allantoic fluid turbid during late pregnancy, it is logical to assume that the collection is amniotic. According to Kammermann, however, most of the fluid is generally in the allantois, but may be in the amnion. In those cases which are attended during the life of the animal and in which the fetus is extracted, the evidence as to the location of the fluid is naturally obliterated. The fluid is all removed and the membranes are largely destroyed.

The increase in the amount of fluid varies greatly in different cases. Harms records an accumulation of 8 liters in the goat. Lindenburg and Georgi record 120 and 150 liters in the cow. In the mare, the amount may reach 100-160 liters, according to Kammermann and Georgi. These records, of course, indicate some of the more severe cases. Between these and the normal, there is every possible gradation. I have observed several instances in the cow, but have not accurately measured the fluid in any case. My estimates were 150 to 200 liters. The maximum amount of the fluid is virtually limited by the physical power of the pregnant animal to carry the load. Once obligatory decubitis occurs, a fatal termination soon follows.

The symptoms in the cow vary according to the volume of the fluid. In many cases the disease does not attract much attention until it has acquired an extreme degree. Then appear some of the general symptoms of ill health. The eyes may be dull and there are present general dullness, weakness, and anaemia. The pulse is weak and frequent and the heart beat more or less tumultuous. The respiration is labored. The movements of the animal are more or less difficult. The cow, in many cases, emits a grunt during expiration. The appetite finally becomes somewhat decreased. The bowels may be slightly constipated, though there is usually nothing very evident in this respect. In fact the cow eats little. Naturally, intestinal excreta are scant. Rumination may be decreased or suspended. The urine is decreased in quantity. The abdomen becomes abnormally enlarged, the abdominal walls exceedingly tense, and percussion gives a dull sound. If the animal is caused to move suddenly or the part is given a sudden thrust or blow with the hand, there may sometimes be a splashing sound. According to the acuteness of the malady, thirst is increased, since evidently the increased amount of fluid must be derived from the liquids which the animal consumes. Consequently in severe cases there is usually very great thirst. After trocarization of the fetal sac and withdrawing 12 to 15 gallons or more of the fluid, enabling a recumbent cow to get up readily and show great relief, I was surprised to see a restoration of the original volume within 48 hours, associated with inordinate thirst. Apparently the water consumed went almost immediately to the fetus and was deposited in the fetal membranes, while the cow, drinking greedily, was suffering from water starvation.

Examination per rectum reveals the uterus abnormally distended with fluid, constituting a vast, tense, immovable sac, pushing the other viscera aside and filling, more or less completely, the entire abdominal cavity. The enlarged state of the abdomen frequently leads the owner to suspect twin pregnancy or an abnormally large fetus. Since the fetus is of higher specific gravity than the surrounding liquid, it may lie so low down along the floor of the abdomen that it can not be felt per rectum in the uterus. The fetus, however, may be felt by abdominal ballottement. It may sometimes be determined, by the presence or absence of fetal movements, whether the fetus is living. The cervical canal is rigid. In the cow it is only after long and patient effort that it can be dilated sufficiently for the hand to pass through it. This does not differ materially from the normal condition.

The uterine walls are the fundamental agents in the dilation of the cervix. In amniotic dropsy, the walls become paretic and their power to dilate the cervix is at an end, and ordinarily can not be aroused by mechanical irritation of the cervical canal or by other known means.

The great weight of the accumulated fluid and the debilitated state of the animal cause it to lie down a great deal. When the amount of fluid becomes very great, it is frequently necessary to aid the cow in regaining her feet, and finally, as the disease advances, the patient becomes wholly unable to get up, even with assistance.

The diagnosis of the disease must depend largely upon the distension of the abdomen, the dullness upon percussion, and finally and decisively upon the exploration per rectum. It must be differentiated from dropsy of the abdomen, or ascites, from fetal anasarca, and from dropsy of the kidney, or hydronephrosis. The latter is exceedingly rare, except in swine. Ascites is quite rare in domestic animals, except in the bitch.

The causes of dropsy of the fetal membranes are not well determined. Logically, it must be finally ascribed to the functional derangement of the fetal kidneys or of the fetal circulation. Sometimes the disease seems to depend largely upon insufficient nourishment or improper diet of the mother, reflecting somehow upon the fetus. Kammermann records that in one year, following a wet summer causing much damage of fodder, the number of cases of dropsy of the amnion or allantois was unusually large. My observations agree with those of Kammermann. I have noted in certain districts that a large percentage of cows became affected with this malady in a year when the food had been much damaged, and consequently afforded insufficient nourishment.

In connection with hydrops of the fetal membranes, I observed a very interesting fact in a herd of Shorthorn cows. An American buffalo, or bison, was allowed to consort with several cows, a number of which became pregnant. With one exception, the cows which were in calf by the buffalo perished from hydrops amnii; the other cows upon the farm, of which there were one hundred or more, did not suffer from the malady. Similar observations have been recorded by others. In the Veterinary Journal for April, 1917, J. C. Lewis records a similar instance, where a bison bull was crossed with a zebu cow.

The cadaver of an animal which has died from this disease is emaciated and anaemic. In some cases the abdominal muscles are said to have become ruptured, because of the great weight which they have been called upon to bear, in addition to the weakened state of the muscles as a result of the dropsy. The uterus is greatly distended, pale, and thin-walled. Kammermann has recorded a rupture of the uterus. Garreau found the membranes destroyed. Harms observed them ruptured. Schutt found plastic clots floating in the fluid. Harms records that the fetuses are, as a rule, feebly developed, and may also be dropsical. The liver and kidneys show appearances of parenchymatous infiltration. The post-mortem appearances have not been well studied. Though most of the animals die, they have generally been handled before death, the fetal membranes torn, and the liquid contents expelled or removed, so that the evidences of the actual conditions present during life have been largely obliterated prior to the death of the animal.

The course of the disease is unfavorable. Most animals live until near the date for the normal close of pregnancy, but they do not as a rule give birth to young. There is no parturition, or attempt at parturition, no dystokia, no expulsive effort. If the uterus is to be evacuated, it must be done artificially. Most affected cows go down and are unable to stand before the veterinarian is called, and may perish long before the normal time for parturition arrives. When gestation continues for the normal time, there is an absence of power on the part of the mother to bring about the expulsion of the uterine contents. The long-continued, great distension of the uterus has destroyed the contractile powers of its walls. Without efficient muscular tone in the uterine walls, the cervical canal fails to be dilated. In this task the uterine walls must act alone and unaided. While contraction of the abdominal walls aids materially and powerfully in forcing the fetus through the pelvis, the dilation of the cervix is solely a uterine function. The abdominal walls also lose their power of contraction and can not aid effectively in the expulsion of the fetus and fluids, even after the cervical canal has been dilated mechanically. Should the patient live until time for parturition, she may show uneasiness and possibly some very slight evidences of labor pains of an indefinite character.

The prognosis of dropsy of the amnion is very grave for both the mother and the fetus. In the severe cases the fetus is generally too feeble to live after surgical removal. The mother, also, is usually so weak and her uterus so flaccid and open to infection that she is very liable to perish. Almost uniformly, hydrops amnii is followed by retention of the fetal membranes, which gives rise to serious complications.

The appearance of the patient is often very deceptive to the owner and the inexperienced veterinarian. She may be free from pain and fever, look bright and cheerful, and retain a fair appetite. It may be that in mild cases spontaneous birth sometimes occurs, but as a general rule assistance must be given in order to bring about the expulsion of the uterine contents. In very severe cases the animals show complete loss of appetite, become unable to rise, and soon succumb to the general weakness and decubitis. These symptoms are intensified by the interference with respiration caused by the pressure of the fluid upon the diaphragm. When the abdominal muscles give way and the uterus descends against the skin until it nearly reaches the ground, or rupture of the uterus occurs, as observed by Kammermann, death quickly follows.

Whenever the disease is well defined and securely diagnosed, complete evacuation of the uterine cavity should at once be brought about. The os uteri should be forcibly and carefully dilated until the hand can be passed into the uterine cavity, when the membranes should be ruptured and the fluids allowed to escape or siphoned out. The presenting parts of the fetus should be secured by cords and, by gradual traction, the further dilation of the cervical canal accomplished and the fetus extracted. This requires much patience and time, but should be persisted in until the operation is completed and the entire contents of the uterus, including the placenta, if possible, have been removed.

In my experience, when I have dilated the os uteri somewhat and ruptured the membranes, allowing the fluid to escape, and then awaited normal labor, I have been disappointed. The labor pains have not appeared, the weakened uterus has undergone infection, the fetus has quickly perished and become emphysematous, its extraction has been made highly difficult, and the mother has perished as a result. It appears better that the delivery should be completed as soon as possible after it has been begun, and that no interval should be allowed to occur between the dilation of the cervical canal, the rupture of the fetal membranes, and the extraction of the fetus. The effort should be continuous from the beginning to the end. Lewis succeeded in rescuing both the zebu cow and her hybrid bison calf by hysterotomy. Possibly this operation offers better results than the dilation of the cervical canal.

It should be observed, in inserting the hand into the uterus of the cow, that there is a peculiar condition of the organ, which tends to confuse the inexperienced operator. In normal pregnancy the body of the uterus becomes enlarged and the median partition between the two cornua recedes from the cervix and shifts to the side of the non-gravid horn. In hydrops amnii, since the intercornual partition does not recede from the cervix, as soon as the hand enters the uterus, it comes in contact, on the median line, with the perpendicular partition between the two cornua, in a very unexpected place, in close proximity to the cervix. This fact should be recognized, and injury to the structure avoided.

Harms suggests that, in some cases, where the os uteri has retreated so far into the abdominal cavity that it can not well be reached to be dilated, the animal should be turned upon its back in order to bring it well within reach. This position also favors the expulsion of the remaining waters. It is to be remembered, however, that a ruminant must on no account be confined long upon its back. Harms also suggests that animals which have suffered from hydramnii should not again be used for breeding purposes, although instances have been recorded where such cows have bred successfully.

In order to overcome the extreme weakness after the extraction of the fetus, stimulants and tonics should be administered for a few days. Full doses of strychnia, hypodermically, or strong coffee or other stimulants, as a drench, are indicated. It is highly essential that the uterus should be closely watched and involution favored in every way, in order to guard against infection. The animal should be given good, clean quarters, with abundant bedding, good and abundant food, and every possible hygienic care, until fully convalescent.

Fetal Anasarca

Fetal anasarca occurs rarely in domestic animals. It consists of a general edema of the entire body, so that the fetal bulk is greatly increased. The fetus appears as a somewhat rounded, soft mass with its tissues filled everywhere with fluid. Anasarca is seen almost, if not exclusively in ruminants. In Germany this disease has acquired the designation *wasserkalbe* or *speckkalbe*. The bovine fetus affected with anasarca perishes at the sixth to seventh month and is expelled. The skin is hairless and looks somewhat leathery; the limbs and neck seem excessively short because of the increased transverse diameter; and everywhere through its tissues there is a vast amount of liquid, which exudes freely when the parts are incised. A ewe which came under my observation carried anasarcous twins to presumably full term. The lambs, when removed post mortem, weighed 26 and 32 pounds respectively—a total weight of 58 pounds, which was more than half the weight of the non-pregnant ewe. The weight of the lambs was so great that the ewe finally could not stand, and apparently succumbed to decubitis. Each of the lambs (Fig. 92) showed, when removed from the uterus, a deep groove encircling the middle of the body. Beyond the abnormal distension of the maternal abdomen, apparently no symptoms occur during the life of the mother to indicate or suggest the presence of the fetal disease. The possibility of confusing fetal anasarca with hydrops amnii is evident. In the cow the two conditions may be differentiated by rectal palpation. In the ewe it is doubtful if a reliable clinical diagnosis can be made.

The causes of anasarca are not known. Some investigators have attributed the condition to an absence of the fetal thoracic duct.

When fetal anasarca is recognized clinically, the indications call for the prompt evacuation of the uterus. Any dystokia occurring is referable to the vastness of the edematous tissue. The careful gradual dilation of the cervical canal and mechanical removal of the fetus or fetuses constitute a rational procedure. The softness of the cadaver renders forced extraction feasible whenever the bulk is not too extreme. When the fetal bulk is too great to warrant forced extraction, embryotomy should be employed, but the best course to pursue, where the anasarca is extreme, as in the lambs mentioned above, is hysterotomy. These operations are described under "Obstetric Operations."

In most cases of anasarca, the condition is neither recognized nor suspected until parturition sets in and the disease expresses itself through such dystokia as it may induce owing to the ex-

FIG. 92. FETAL ANASARCA IN TWIN LAMBS. Weight 26 + 32 = 58 lbs. Seen from the dorsal surface.

(Museum New York State Veterinary College.)

cessive volume of the diseased fetus. Since the disease generally causes the early death of the fetus, or retards its growth, the anasarca may cause but trifling dystokia. When so severe as in the twin lambs mentioned, the dystokia becomes extreme or, more probably, parturition does not begin and the dam dies as a consequence of the fetal disease, without showing any effort at the expulsion of the uterine contents.

PHYSIOLOGIC PARTURITION

Physiologic parturition is the birth or expulsion of the living, healthy fetus at the natural time, promptly, without artificial assistance, and in a state of development which enables it to live. Physiologic parturition is difficult to define accurately. Usually parturition is designated "normal" or "abnormal". These terms are indefinite. "Normal" may mean the usual, or prevailing state; it may mean free from disease. The common, or prevailing behavior of females at parturition may be "normal" in the sense of "usual," and yet disastrously pathologic in fact. In some large dairy herds, thirty per cent. of heifers in first pregnancy abort year after year, and many of the other seventy per cent. have metritis, and perhaps retained fetal envelopes. If "normal" is defined as the usual condition, then such disasters are normal; if "normal" is defined as synonymous with physiologic, then the prevalent condition becomes abnormal. Although the act of parturition is a physiologic one, it is accompanied by pain and severe exertion upon the part of the mother and brings about sudden changes in the life of both mother and fetus.

The phenomena of birth vary greatly in detail in species and in individuals: in no two are they precisely the same in the period at which they occur after impregnation, the length of time required for the expulsion of the fetus by the mother, the amount of force required, or any other of the numerous details of parturition. Physiologically the fetus must present longitudinally—i.e., its long axis must be parallel to the long axis of the body of the mother. In minor details the precise attitude of the fetus and of its extremities may vary. Even in the details, certain limits of variation are fixed, beyond which a very slight deviation of a part may render birth more or less difficult, or even impossible without aid.

The causes of parturition are not definitely known. It has been stated in preceding chapters that birth normally takes place after a somewhat definite duration of intra-uterine life, but the variations of the length of time in the larger animals, as the mare and the cow, may reach thirty days or more. One can not say that parturition is inevitable at a certain time. It is known that the uterus and other portions of the genital tube undergo certain developments during pregnancy which constantly tend to fit them more and more for the act of birth. There seems to be nothing in this development which marks a limit and designates a definite stage at which the uterus will necessarily expel its contents.

In studying the development of the fetus, it has been noted that certain changes take place in its organs of circulation and nutrition, which gradually acquire a completeness simulating closely that seen in the adult animal. In this way the fetal organism becomes fitted for a hurried transition into an independent existence. However, there is nothing in this development which seems to mark a definite stage at which the fetus must be expelled.

Various writers have alleged that there is progressive fatty degeneration of that portion of the uterine mucous membrane which constitutes the external layer of the maternal placenta. The degeneration disturbs the nutrition of the fetus, and would eventually cut it off. Consequently the fetus must be born. This belief is in conflict with the general teachings of physiology. The rate of fetal growth quickens with the advancement of pregnancy. The areas of contact for the physiologic exchanges between mother and fetus must grow in size and intimacy to the end, and the supreme moment, at which the physiologic bond between mother and young must not fail, is at the time of parturition.

It is a quite common observation that, just prior to birth, the fetus shows more or less vigorous movements. These movements are apparently a reaction to the pressure exerted upon the fetus by the contractions of the uterus, preparatory to expulsion. It is very well known by clinical experience that, if one touches or grasps a fetus from the vagina or rectum, it struggles. If one of the extremities is grasped, the fetus immediately attempts to withdraw it. Accordingly, if the uterus begins contracting upon the fetus and disturbs its position, the fetus performs more or less vigorous movements, in an effort to adjust its position to the changes in form which are taking place in the uterine cavity, due to the contractions of its walls and the opening of the cervical canal.

Movements of the fetus are not essential to its expulsion, as is shown in abortion and in stillbirth, where the fetus is usually expelled promptly and under the same general conditions as in normal birth. It is only in exceptional instances that a dead fetus is long retained within the uterus, and then there is usually some recognizable cause for such retention, which fully explains the departure from the rule that, when a fetus dies, it is expelled.

In a vague way, birth may be attributed to a reflex irritation of the nerves of the uterus, the causes of which are not fully understood, and do not seem to be always the same. Expulsion of the uterine contents may be brought about by pressing out the corpus luteum. This apparently induces contractions of the uterus, which cause the expulsion of the immature fetus, thus showing, or tending to show, that the presence of the yellow body in the ovary of the pregnant female inhibits expulsive muscular contractions of the uterus. Some have held that normally the corpus luteum begins to disappear late during gestation and that at the time of birth it has become completely atrophied. This is wholly erroneous for the cow. The corpus luteum in the cow regularly remains full size up to and through parturition, and does not ordinarily atrophy until thirty to sixty days after the termination of pregnancy, when she is again in estrum. In the mare, where estrum regularly occurs eight to nine days after foaling, the corpus luteum presumably has disappeared at that date. In the rabbit, which is in estrum immediately after parturition, the disappearance of the corpora lutea is probably coincident with birth, but there is no evidence that the disappearance of the corpora lutea determined the birth. The death of the fetus may or may not excite a reflex action in the uterine walls, which will bring about contractions and the expulsion of the cadaver. Metritis causing septic death of the fetus may lead to its expulsion, but aseptic death followed by mummification of the fetus does not excite this reflex action and permits the dead fetus to remain as an inert body in the uterine cavity for an indefinite period of time. It is not impossible that the excretions of the fetus after a time become so important that, passing into the blood of the mother, they bring about a certain irritation upon the central nervous system and cause contractions of the uterus, with the expulsion of its contents.

The Expelling Powers. The initial power by which the fetus is expelled into the vagina and pelvis resides in the unstriped muscle walls of the uterus, but the final power to propel the fetus through the vagina and vulva is very largely derived from the abdominal walls, including the diaphragm.

The expulsive efforts of both uterus and abdominal walls are diminished or inhibited in many cases by circumstances of varying character. When there is torsion of the uterus to an extreme degree, there can be no vigorous expulsive efforts, because the contractile power of the uterus is destroyed. When transverse or bicornual development of the fetus occurs in the uterus of the mare, the mechanical relations of the fetus to the uterus are such that they inhibit any very marked expulsive efforts. There are good evidences of some uterine contraction in the dilation of the cervical canal and the expulsion of portions of the fetal membranes, but the vigorous expulsive efforts of normal parturition are not observed. Indeed, when the bicornual development is typical, the contractions of the two horns are directly antagonistic. The right horn pushes the fetus toward the left ; the left pushes its contents toward the right. The initial expulsive powers are exerted by the uterus, virtually alone. When the uterus has advanced portions of the fetus into the vagina and pelvis, the uterine contractions are supplemented by the more powerful contractions of the abdominal walls. The cervix, vagina, and vulva are devoid of important expulsive powers. When the fetus has been completely expelled from the uterus, its propulsion through the vagina and vulva is dependent wholly upon the contractions of the abdominal walls. These press the abdominal and pelvic viscera against the distal end of the fetus and force it along the passage. At all times the gravid uterus has the support of the normal intra-abdominal pressure, which affords noteworthy and important assurance of integrity. Without this support by the pressure of surrounding viscera and, through them, of the abdominal walls, the powers of the uterus to contract upon its contents would be greatly reduced and would probably be impotent to dilate the cervix or make any definite progress in the expulsion of the fetus.

The force of the uterine contractions is not very apparent externally. The obstetrist recognizes it during parturition when he inserts his hand between the fetus and the uterine walls. In cases of dystokia however, the obstetrist does not note so vividly the contractions of the uterus itself as he does the great pressure which is exerted upon his hand and arm when the animal makes violent expulsive efforts by the contraction of the abdominal walls, increasing enormously the intra-abdominal pressure.

The uterine contractions dilate the os uteri and tend to adjust the fetus to its proper position. By compression, the living fetus is caused so to adjust its extremities that the restricted room will cause the fetus no discomfort, especially that the contracting uterus may not cause painful flexures of the limbs. The uterus may expel the fetus unaided, in case the contractile power of the abdomen is destroyed by extensive rupture, though it does this slowly. After the birth of the fetus, the uterus expels the fetal membranes.

By observing the contractions of the pregnant uterus when exposed to the air, they are seen to be closely analogous to intestinal peristalsis. At what time these begin in connection with parturition, is not known. Doubtless contractions of a peristaltic type occur continuously throughout the entire period of gestation, not of a character to threaten the expulsion of the fetus, but favoring normal fetal and uterine development and maintaining the fetus in normal position.

Some veterinary obstetrists maintain that, while during parturition the entire uterus contracts, the fundus does so most energetically. The assertion is apparently copied from human obstetrics, since, because the uteri of domestic animals have virtually no fundus, contractions could not occur chiefly in that part.

Clinical observations upon large domestic animals, especially the mare, intimate that contractions of the muscular walls of the uterus frequently commence two or three days, or more, in advance of parturition, as manifested by the appearance of slight colicky pains (premonitory pains). As a general rule, they pass unnoticed, and it is not until there are added to the uterine contractions the expulsive powers of the abdominal walls that the actual parturient effort is clearly recognized.

Toward the end of gestation in the cow (See frontispiece) the head of the fetus regularly rests in a cul-de-sac above the vagina. When parturition comes on, if the abdominal muscles alone should act on the fetus, they would simply tend to push it further onward in this cul-de-sac and threaten finally to rupture the uterus, but, since the uterus contracts first, and especially the longitudinal fibres, the cul-de-sac of the uterus above the vagina is effaced. This brings the presenting part of the fetus into a conical cavity, with the os uteri as its apex, in a position and direction which will permit of its expulsion.

The uterine contractions are essential for the dilation of the cervical canal. Whenever these contractions take place, and consequently increase the intra-uterine tension, the walls yield at the point of least resistance. Normally this yielding occurs at the cervix, causing its canal to become dilated, and later the cervical constriction to become wholly effaced, so that the uterine and vaginal cavities are merged into one passage, without any line of demarcation between them.

The contractions of the uterus during the act of birth are essential to the maintenance of the organ in its position in the abdominal cavity. If the expulsive powers were dependent upon the abdominal muscles alone, the uterus would tend to be expelled along with the fetus, inducing a prolapse, but the uterus, by its contraction, is able to maintain a natural position throughout the act and to avoid being pushed back into the vagina. It is probably due largely to the uterine inertia of contagious abortion of cattle that prolapse of the bovine uterus is so common. That is, prolapse of the uterus is largely the result of deficient contraction in the uterus, while the expulsive powers exerted by the abdominal walls are normal.

The dilation of the cervical canal is dependent partly upon the shortening of the longitudinal muscle fibres of the uterus, but largely upon the pressure of the fetal membranes, with the contained fluids, against its anterior opening. With the increase of intra-abdominal tension, the fluids about the fetus tend to move most readily toward the cervical canal and push along with them the membranes. The fetal fluids within the membranes serve as an elastic dilator which, slowly becoming impacted in the cervical canal, gradually dilates the passage by exerting equal pressure upon every part. It is well to note that the cervical canal is very much more dilatable when the force is exerted from before backward—intra-uterine force—than when it is exerted from behind forward—extra-uterine force. When the obstetrist attempts forcible dilation of the cervical canal, it must generally be accomplished by the latter method. As the cervical canal becomes dilated and the constriction of the cervix effaced, the pressure within the uterus forces the fetal membranes, with the contained fluids, out through the cervical canal, vagina, and vulva, until they appear externally.

The relations of the various fetal membranes to each other and to the contained liquids bring about very marked differences in the various animals. The cervical end of the chorion ruptures without moving far from its original position or becoming extensively detached from the uterus. Normally, it can not protrude far through the cervical canal. It is essential that this should be so, because it is through the maintenance of the intimate relation between the chorion and the uterus that the life of the fetus is maintained during the time of parturition. If the chorion should become so detached from the uterus as to interrupt fetal respiration through the placenta, the life of the latter must quickly terminate unless the act of birth is abruptly completed. Normally therefore the chorion may push out only a little way, through the cervical canal, vagina, and vulva, before rupturing, or it will interfere materially with its general relations to the uterus through the placenta and imperil the life of the fetus. After the rupture of the chorion, some of the allantoic fluid may escape into the vagina, and thence externally. Through the rupture in the chorion, the posterior extremity of the amnion regularly protrudes until it reaches the vulva and may project out between the vulvar lips for some distance.

The allantoic sac of ruminants is so disposed that it may protrude through the cervix for a short distance, as the first water bag. In the mare this can not occur to the same degree as in the cow without serious disturbance of the placental relations. Rupture of the protruding allantoic sac occurs early, followed by the appearance of the second, or true water bag, which consists of a portion of the amniotic sac containing amniotic fluid. In the cow and mare the protruding portion of the amniotic water bag, appears as an elongated bladder with a thin, colorless membrane filled with fluid. Normally, the allantoic fluid is turbid, while the amniotic fluid is clear. The bag may extend for a distance of 6 to 10 inches beyond the vulva and contain from 1 to 4 or 5 pints of fluid. Each labor pain forces more amniotic fluid into the water bag, until finally the internal tension becomes too great and it ruptures. Usually the amniotic water bag ruptures before the presenting portion or portions of the fetus—generally the two anterior feet, followed closely by the nose—appear in the protruding amniotic sac.

Under more or less abnormal conditions, there are great variations in reference to the behavior of the fetal membranes. In the mare it is technically possible for the chorion to become completely detached from the uterus without becoming ruptured. Consequently it has been alleged that the fetus is in some cases expelled completely encased within all its membranes. This is apparently a loose statement of which no well authenticated instance has been recorded where a fully developed fetus has been so expelled. Expulsion of the fetus included in its chorion is frequently seen in the mare, cow, and other animals, when abortion takes place at an early period in gestation. In one case at full term in the mare, which I observed, the chorion ruptured at the anterior end and was pushed over the fetus and expelled, along with the amnion, while the dead fetus remained in the uterus, owing to deviation of its extremities which interfered with its expulsion.

In twin pregnancy, it is essential that but one fetus enter the birth passage at a time. In the cow and ewe ordinarily, when there are twins, one fetus occupies each horn and a part of each projects into the body of the uterus. When parturition sets in, that fetus which chances to be most advanced ordinarily gains the cervical canal and pelvic inlet first, and by its presence prevents the other from entering. Thus the two fetuses are born one after the other.

In practice, this favorable disposition of twin fetuses is occasionally interrupted by some portion or portions of each fetus entering the pelvic canal simultaneously and causing more or less serious dystokia.

There is no evidence to show that the uterine contractions in the two horns may not be essentially equal, but apparently they soon become concentrated upon that portion of the organ which contains the fetus in the most advanced position, and consequently where the contractions will prove most efficient. As soon as the first fetus is expelled and the passage thus vacated and dilated, the expulsion of the other one, as a rule, follows very promptly.

In the mare, only a few minutes usually elapse between the expulsion of the first and the second fetus. In the cow, where the act of parturition is more deliberate, there is a greater interval, sometimes twenty or thirty minutes. Under abnormal conditions the interval between the expulsion of the two fetuses may be much greater. The birth of the second of a pair of twins may be delayed for hours, or even days, after the birth of the first. Any great delay in the expulsion of the second fetus is usually due to some pathologic condition.

In multiparous animals, the entanglement of two fetuses during parturition can not well occur. No fetus, or parts of a fetus, normally occupies the uterine body. The fetuses are wholly lodged within the two cornua. The body of the uterus is actually narrower, when labor sets in, than are the two gravid cornua, so that it is quite impracticable for a fetus from each horn to enter simultaneously the body of the uterus. The bases of the cornua are so intimately and closely applied to each other that the advancement of a fetus in one horn exerts so great pressure against the median side of the other horn as to prevent a simultaneous advancement of a second fetus. One fetus enters the uterine body at a time. It is assumed that the fetuses enter alternately from each cornua, so that the two are emptied almost simultaneously—that is, one horn is not completely emptied of its fetuses until the other is also emptied of all but one.

Symptoms of Parturition. Preliminary to the completion of pregnancy there appear certain signs which indicate, with more or less certainty, the near approach of labor.

One of the most conspicuous of these is the increased functional activity of the milk glands. In all domestic animals there is a tendency for the glands to become gradually enlarged and tense as the period for giving birth to young approaches. The date at which this enlargement appears varies : it occurs earlier in primiparae than in those which have previously given birth to young. Usually a few weeks before birth there appears in the udder at first a watery secretion, which may be pressed from the teat, but which bears only a faint resemblance to milk. Later the secretion becomes more milk-like and assumes the characters of colostrum. When parturition is near, the milk secretion may be so profuse, especially in the mare, that it escapes from the teats in drops or in streams. However reliable the mammary enlargement may be as a sign that parturition is near, it may become very misleading. Sometimes during the early stages of pregnancy the glands become swollen and contain milk. The swelling of the mammae may disappear and not be seen again until at the close of pregnancy, weeks or months later. Sometimes the milk glands become much enlarged and show great functional activity long before parturition, so that in the mare a profuse flow of milk may escape from the glands for two or three weeks before the birth of the foal, though everything seems normal and parturition is regular. At times non-pregnant heifers have a flow of milk, up to twenty pounds or more a day, and the mare mule occasionally secretes milk very profusely. Sometimes, on the other hand, almost no milk is secreted prior to parturition and the glands are only slightly enlarged. Such is especially the case in very old mares which have been bred for the first time. It has been suggested that the enlargement and increased functional activity of the udder is due to the diversion to it of the excess of blood from the uterus, which this organ no longer requires. This explanation is not clear. The nutrive demands of the fetus at the close of intra-uterine life are greater than at an earlier period. The fetus is larger and growing rapidly. At the time of parturition, the blood supply to the uterus must be increased, in order that the uterus may perform its function in the expulsion of the fetus and placenta and repair of the injuries incident to parturition. The increased functional activity of the udder is rather a part of the general plan in preparing for the nutrition of the fetus after its birth.

A very important sign of approaching parturition in the cow is the relaxation of the sacro-sciatic ligaments, which allows the muscles passing over them to drop inward, causing a sinking of the croup. This relaxation increases the dilatability of the pelvic canal and makes it easier for the fetus to be propelled through it. The relaxation in these ligaments is thought by some to be due to changes taking place within them, consisting largely of an effusion of lymph into their structure, which leads to softening. Some refer the phenomenon to a change in the relationship between the ossa innominata and the sacrum and coccyx. The sacro-iliac ligaments, according to this view, become somewhat relaxed, so that the articulation becomes less rigid and the tuberosities of the ischia pass upward toward the sacrum, causing a decrease in the tension of the great sacro-sciatic ligaments.

Another symptom of approaching birth, which is important, is the preparation which is taking place in the vagina and the vulva. The vulvar lips become somewhat thickened and edematous and tend to stand apart more loosely than ordinarily. From the vulva there generally appears, especially in the cow, a more or less abundant discharge of a thick, lubricant mucus. Part of the mucus emanates from the glands in the vaginal mucosa, part from the voluminous uterine seal, and part apparently from exalted secretion of the mucous glands in the cervix. If the lips of the vulva are parted, there is observed an injection of the mucosa.

As the time for birth draws nearer, certain psychic signs are observed. The animal seems to be somewhat disturbed and anxious. She exhibits some desire to withdraw from her usual associates. She moves slowly and cautiously, There may be interruptions in feeding, suggesting that uterine contractions are taking place, which cause some degree of discomfort or pain. Sometimes the advent of the uterine contractions is suggested by the appearance of slight colic, accompanied by occasional pawing or lying down, or, in case of carnivora, whining or groaning. The mare may show evidence of pain by whisking the tail, a symptom which is seen to some extent also in the cow. Finally the pregnant animal, if at liberty, tends to withdraw from other animals of her own or other species and seeks a quiet and secluded place, where she may bring forth her young without disturbance or annoyance.

In herbivora, little care is taken in the selection of a place for giving birth to young, except that it is a quiet spot where the mother and young may for a time remain more or less in hiding. The carnivorous animal shows a tendency to select a comfortable bed. The sow, in a state of freedom, and not intensely domesticated, will habitually gather coarse herbage or small brush into a conical mound, in which she may give birth to her young. If allowed the fullest liberty, at a season of the year when vegetation is abundant, she will select a spot where she can gather an abundance of coarse weeds or fine twigs which are covered with leaves. Beginning at the spot which she selects for her nest, she will gather all the herbage in an ever widening circle and carry it to the central spot, where she deposits it in the form of a mound, until she has acquired sufficient to suit her purposes. Such mounds are sometimes as extensive as four or five feet in diameter and two or three feet in depth. Into the center of this mound she burrows in such a way as to become almost or quite hidden, and there gives birth to her young. In confinement, she builds such a nest as her environment makes possible or demands. This may vary in every degree from the bed we have already described to no bed at all in some cases where she is denied the proper material for its construction. Increased domestication brings decreased instinct in preparing such bed. The rabbit constructs a burrow and pulls from her own body a sufficient amount of fur to line a very complete and cozy nest in which to give birth to her very immature young.

In the cow, when parturition is near, definite preparations begin in the cervix, vagina, vulva, and pelvis, which serve to facilitate the passage of the fetus from the uterine cavity to the exterior. In discussing the pelvis, it has been pointed out that the pelvic girdle constitutes the sole undilatable, unyielding section of the avenue through which the fetus must pass to be born. The broad, or sacro-sciatic ligaments, page 8, Fig. 2, become relaxed, so that the posterior area of the pelvis, nominally smaller than the bony pelvic girdle, becomes dilatable to a size equal at least to the dimensions of the girdle. Ten to twenty days prior to parturition, the cervix begins to be relaxed and the uterine seal commences to be dissolved. In the vagina there is an increase in the quantity of mucus, which changes from the adhesive character of the vaginal mucus of pregnancy to a distinctively lubricant character. Quantities of mucus emerge from the vulva and hang in long strings. By vaginal examination, one may observe the gradual solution of the uterine seal, by which it is changed into a lubricant mucus, and the gradual dilation of the cervical canal. Finally, when parturition sets in, the cervix is relaxed ; its canal is dilated ; the uterine seal is softened and converted into mere lubricant mucus; the cervix, vagina and vulva are all relaxed and bathed in lubricant mucus; and the broad ligaments of the pelvis are relaxed and freely extensible.

When the cervical canal has become sufficiently dilated, the water bag passes into and through the opening, and portions of the fetus soon advance into the vagina. Then the definite symptoms of parturition—the second, or active stages—quickly become established. The uterine contractions now begin in earnest, accompanied by contractions of the abdominal walls and diaphragm. Depending somewhat upon species, the animal shows a tendency to lie down and rise frequently, and in general to show abdominal pain. The mare may paw with the fore feet and strike at the abdomen with the hind feet. The animal ceases to feed and shows much anxiety, indicated to some extent by a disturbance of the circulation, consisting chiefly of an increased pulse rate. In the mare there may be some sweating. The pain is somewhat intermittent. After each of the uterine contractions, which are of variable length, but rarely exceed two or three minutes, there is a pause in the pain and anxiety until another period of contraction comes on. As the uterus is an unstriped muscle organ, its contractions are more or less slow, are virtually involuntary, and, like other contractions of this type of muscle, are rhythmic and recur at more or less regular intervals. The uterine contractions may be indirectly modified by fear or other emotions. As soon as the fetal membranes or portions of the fetus pass into the vagina, the expulsive efforts increase in force and the full power of the abdominal and other muscles of the body is brought into play in a supreme effort to bring about the expulsion of the fetus.

When parturition becomes fully established, the animal assumes varying attitudes, somewhat according to the species and individual. The larger domestic animals alternate between the standing and recumbent position during labor. Multiparous animals lie almost continually, chiefly in lateral recumbency. The larger animals, when standing, arch the back, bring all the feet together, and strain violently. This straining is aided materially by the animal taking a deep inspiration, closing the glottis so that the air can not escape from the chest, and then powerfully contracting the muscles of the body, increasing enormously the intra-abdominal pressure and tending to force the contents of the abdomen in the direction of least resistance, toward and through the dilated cervical canal and out through the vagina and the vulva.

Herbivorous animals do not constantly maintain a given position during labor, but vary their attitude according to the progress of parturition and to individual temperament. During the earlier stages of the act, there is a greater tendency to maintain the standing position than later. When the fetus has been well propelled into the pelvis and the anterior feet and head have passed beyond the vulva, there is a very marked tendency, in the cow and mare, to assume the recumbent position. The animal may lie either in the sternal position, or prone upon the side, in lateral recumbency. The position tends to vary to some degree, especially in the mare, according to the stage of the act. The mare generally lies upon her sternum until the head of the fetus has protruded some distance beyond the vulva, when, should she continue in this position, there would be a tendency for the fetus to strike against the floor or ground and offer obstruction to its further expulsion. At this period she usually assumes lateral recumbency, in which position she is capable of exerting the maximum expulsive power. With the mother in this position, the fetus may be expelled without obstruction of its passage by contact with the ground.

In large animals the standing position at the close of the expulsion of the fetus is unfavorable for the well-being of the young, because of the possibility of its injury in falling. It is not the best position for the mother, because she can not exert the maximum degree of force.

In multiparous animals the contraction of the abdominal muscles plays a comparatively unimportant part in the expulsion of the fetus. In the very long uterus of multipara, the abdominal walls can not aid materially in the expulsion of the fetus, until it has entered the pelvic canal. Before this may occur, the fetus must travel a comparatively long distance. Hence the chief force in the expulsion of the fetus in multipara is the contractions of the muscular walls of the uterus.

The fetal fluids serve to lubricate the passages throughout labor. Ordinarily, portions of the fluids remain within the uterus until after the fetus has been expelled. The fluid in the fetal sac tends to fill out and efface all irregularities in the form of the fetus and prevent the uterus from closely investing the fetal body in such a way as to interfere with its expulsion.

Should the uterus contract directly upon the irregular fetal body and closely invest it throughout, it could not exert that power upon the fetus essential to its ready expulsion. The uterus maintains a more or less spherical shape while the fetal fluids are retained, and consequently presses alike upon all portions of the fetus and tends to force it backward through the vagina and vulva.

When dystokia occurs and the fetal fluids all escape, the obstetrist is made to realize the disadvantage of the absence of these and the close investment of the fetus by the uterine walls. This condition prevents him from readily adjusting the position of the fetus or from carrying out other manipulations. After the position of the fetus has been adjusted, the obstetrist still needs the passive aid of the fetal fluids in the completion of his task. The uterine and abdominal contractions tend to force out some of these liquids with each labor pain, and consequently keep the passage constantly moist and somewhat unctuous throughout the entire duration of normal parturition.

In the larger herbivora, the vast majority of fetuses present first the two anterior feet, followed shortly by the nose resting upon them at about the middle of the metacarpus. The three extremities constitute an elongated cone, which acts as a wedge in gradually dilating the passages. If the fetus presents posteriorly, the conditions are essentially the same, in reference to the mechanical plan: the two hind feet present together and, as the legs and thighs are advanced, serve as a long wedge or cone gradually dilating the passages for the expulsion of the fetus. In carnivorous animals, where the head is proportionately very large and the anterior limbs are comparatively small and flexible, the head usually advances alone and the fetus is expelled with the anterior limbs lying along the side or floor of the fetal chest.

When the young of large herbivora present anteriorly, there is usually no very serious impediment to their progress until the head of the fetus reaches the vulva, when, especially in primiparae, there is a delay because time is required to bring about the dilation of the vulva to such a degree that the fetus can pass through without serious injury to the parts. When the head emerges from the vulva, the other parts of the fetus usually pass with less difficulty, though there may be marked resistance when the chest enters the passages and again when the hips advance until they come in contact with the pelvic inlet of the mother.

It is important to bear in mind that in the large domestic animals the fetus lies *en arc* and that, in passing through the pelvic canal, in anterior presentation, the head and forefeet must pass upward and backward. When the extremities emerge from the vulva, the expulsion of the succeeding portions of the fetus most readily occurs with the head and shoulders passing at first backward, and later downward and backward, so that the fetus may retain its arciform disposition.

If an ordinary fetus is measured after its delivery, the diameters of its chest are found to be greater than those of the canal through which it has passed. Consequently there must be some change in these diameters during the passage of the fetus from the uterus. This is brought about, in the mare and cow, chiefly by the extreme extension of the shoulders, causing them to be displaced forward from the chest and to lie chiefly upon the sides of the neck, anterior to the first rib, with only the prolongation of the scapula resting upon the chest. The extreme extension of the anterior limbs, through the action of the sternal muscles, draws the sternum forward, so that the sterno-vertebral diameter of the chest is decreased. The maximum diameter of the fetal chest is attained when a perpendicular line drawn from the vertebra through the head of a rib passes through the sternal end of that bone. If the sternum is drawn either forward or backward beyond this line, it approaches the spinal column and the sterno-vertebral diameter is diminished. It is thus made possible for the fetal chest to pass through a canal which measures less than its own diameter. Analogous changes in the relations of the chest and anterior limbs occur in the large domestic animals, when the presentation is posterior.

Since the fetal hips are not so readily changed in form or volume as the shoulders and chest, when they reach the constricted portions of the passages they must necessarily pass through the birth canal more nearly in their normal form, size, and relation. Sometimes they constitute a more or less serious impediment in the expulsion of the fetus. Even here there is an important change in anatomic relation. The pelvis slopes downwards and backwards from the sacro-iliac articulation. Its approximate position is secured through the offices of the sacro-iliac and sacro-sciatic ligaments and the prepubian tendon. If the prepubian tendon is relaxed, the fetal pubis may move backwards and the ischium upwards, thereby decreasing the pubio-sacral diameter of the fetal pelvis, without increasing its transverse diameter.

The duration of parturition in animals is extremely variable, both according to species and according to individuals, and is dependent upon many circumstances. Just what constitutes the normal duration of parturition is unanswerable at present. As in the duration of pregnancy, so when considering the time required for parturition, it is impossible to reach an exact conclusion. If "normal" is defined as the average duration, the result may be one answer; if defined as physiologic birth, a wholly different answer. For example, in my experiment herd some cows calve in fifteen minutes, the fetal membranes are expelled in one to two hours, and the involution of the uterus is so complete in forty-eight hours that the entire uterus may be grasped per rectum and held in the hollow of the hand. The calf is very rugged and vigorous and has no inherent tendency to scours or pneumonia. At the close of another pregnancy, the expulsion of the fetus (without unfavorable size or presentation) may require five to twenty or thirty hours, unless traction is applied; following the expulsion of the fetus, the fetal membranes are retained for three hours to ten or more days; perhaps the maternal cotyledons become necrotic and slough away; the involution of the uterus is tardy and fifteen to thirty or more days are required for the uterus to regain its pre-conception volume, which in the other instance occurred in forty-eight hours. The calf is predisposed to sepsis, calf scours, or pneumonia. Its meconium is saturated with bacteria at the time of birth. Perhaps it has suffered from scours in utero.

These extremes are observed in the same animal in succeeding pregnancies. The first instance is quite certainly physiologic;

the second is just as certainly pathologic. Each observation is common. In a sense, each is "normal," so long as normal indicates the common trend. Between these two extremes, is a line of demarcation which can not at present be defined.

Physiologic parturition is much alike in all animals and at all ages. In cattle there is more frequent intra-uterine infection, and hence a greater degree of retardation in parturition due to uterine inertia. The average duration of parturition is accordingly greater in cows than in other uniparous animals.

It is generally stated that heifers require a longer time for parturition than cows. That is only partly true. Heifers do usually require a longer period for parturition than cows, but this difference is due chiefly to the fact that intra-uterine infection is more common in heifers than in cows. Experimentally, I find that a thoroughly healthy heifer calves with great rapidity, the fetal membranes come away quickly, and uterine involution is very prompt. When a heifer is perfectly healthy, parturition, from the first sign of labor pains, requires but fifteen to thirty minutes, but only a few heifers attain this standard. It is very doubtful if there is any appreciable difference in the time required for parturition in heifers and cows of corresponding health, especially of corresponding uterine soundness. In primipara the birth act is little, if any more prolonged because the birth canal has not previously been dilated. Under physiologic conditions, the cervix and vagina dilate very promptly. In fact, the cervical canal commences to dilate eight or ten days before parturition and the entire genital tract makes ready for the passage of the fetus. The pelvic inlet, the only inextensible part of the birth canal, acts as a serious obstruction to the passage of the fetus. The pelvis becomes no larger because a female has previously given birth to young.

The cervix, vagina, and vulva of the mare are very extensible. It is largely because the expulsive efforts in mares are very vigorous and powerful that parturition is exceedingly prompt, not to say tumultuous. This is necessitated, in a large measure, by the feeble attachment of the placenta, which tends to become separated very rapidly, causing the death of the fetus through the cutting off of the nutritive supply, including oxygen. Hence, foals generally perish if dystokia occurs. This is in sharp contrast to ruminants, where the fetus may continue to live for hours after labor has set in. Consequently, in the mare vigorous labor usually does not last more than a few minutes, and occasionally occurs so quickly in a work mare that she can scarcely be unhitched from the plow and have her harness removed before the living foal has been expelled.

In multiparous animals, the young are generally expelled in rapid succession, apparently alternately from the two horns. Necessarily, the membranes of each fetus are expelled immediately, or they bar the egress of the next fetus in the horn involved. A sow may bring forth eight to ten young in less than an hour.

When the fetus is expelled, the effect upon the umbilic cord will depend somewhat upon the position of the mother, but very largely upon the length of the cord. In the mare, since the umbilic cord is quite long, the fetus may be completely expelled and the cord continue intact so long as the animal remains in a recumbent position. When she rises, the cord will probably rupture; if not, it must give way when she turns to examine her young, if the chorion remains attached in the uterus. In some cases, however, the fetal membranes follow the fetus immediately and remain attached until the foal itself, by its struggles, ruptures the cord.

In the cow, the umbilic cord is so short that it usually ruptures, when the fetus presents anteriorly, before the hind feet of the fetus have escaped from the vulva.

The umbilic cord of the foal ordinarily ruptures at a point about two inches from the umbilic ring, just beyond the distinct line of demarcation between the cord proper and the cordiform extension of the abdominal wall, which is not covered with hair. The exact point of rupture may vary, however, and the cord may become torn in two, 5 or 6 inches or even more from the umbilic ring, or it may give way very close to the ring. It has been alleged that the rupture may occur in the ring, but such an accident may be doubted. Physiologically, the rupture of the umbilic cord is followed by no active hemorrhage. There is a passive escape of blood from both the fetal and the allantoic ends of the ruptured vessels. From the allantoic end of the navel cord, much of the blood within the allantoic arteries, capillaries, and veins escapes from the umbilic veins; from the fetal end there escapes from the veins a portion of the blood which they contain at the moment of the rupture. The amount of blood escaping from the fetal end of the vein is approximately that contained in the vein outside the fetal abdomen, while the blood in the intra-abdominal portion of the vein largely flows under negative pressure into the right auricle. Since the vein is freely collapsible, the negative pressure (suction) of the auricle, instead of causing all the blood to be drawn out of the vein, forces the vessel to collapse upon some of the blood in its abdominal course, where it clots. The blood contained in the segment of the vein in the umbilic stump almost all escapes externally by its own weight, and the vessel collapses, preventing aspiration. A few drops of blood escape from the fetal ends of the umbilic arteries, inside the abdomen in the line of retreat of the arteries from the umbilicus upwards and backwards to the fundus of the urinary bladder. In this area, the connective tissue is permeated by a small volume of escaped blood.

Some claim that there may be more or less serious hemorrhage from the umbilic arteries, but I have not observed this accident. This can occur only very rarely, because the arteries are so elastic that they promptly recoil and retract up into the abdominal cavity (Fig. 52) inverting and drawing with them their perivascular connective tissue envelopes, in such a way as to render hemorrhage virtually impossible. In all animals, there is a tendency for the mother to cleanse the ruptured navel cord with her tongue or lips.

EXPULSION OF THE FETAL MEMBRANES AND INVOLUTION OF THE UTERUS

Physiologically the expulsion of the fetal membranes follows birth after a very brief interval, varying according to species and individual, being promptest in those animals like the mare, in which, owing to the diffuse placenta, the contact of the chorion with the uterus is very simple. In ruminants, with the multiple placenta or cotyledons, the relations between the fetal and the maternal placenta are very intricate and the chorionic tufts very long and much branched, so that they do not so readily become detached from the maternal placenta.

The detachment of the placenta is passive. As soon as the fetal heart ceases to beat, blood ceases to flow through the chorionic, or fetal placenta. When the umbilic cord ruptures, all, or nearly all living blood in the placental capillaries is forced out through the umbilic veins, and the chorionic tufts collapse and fall away from the walls of the placental crypts. The physiologic attraction between the chorionic and uterine placental structures is at an end, and the two tissues, which have at no time had any continuity of structure, now separate automatically. Once the fetal and uterine placental structures have become separated, the contractions of the uterus, actively, and the weight of the fetal membranes, passively, bring about the expulsion of the membranes through the cervix, vagina, and vulva. The dehiscence of the fetal membranes is not due to the contraction of the uterus, but, when the detachment has occurred, the uterine contractions are the essential force in their final expulsion. It is quite true that when the fetal membranes are retained the uterus does not contract properly. The failure to contract is not a consequence of the retained placenta, nor the cause of it. The non-contraction of the uterus and the retention of the placenta are each due to a common cause—placentitis. The contraction or involution of the uterus and the expulsion of the membranes are therefore correlated phenomena, and when one fails the other fails.

In the mare, I have seen all the fetal membranes expelled promptly from the uterus, while the fetus remained naked in the organ, because of some slight deviation of a fetal part which prevented its ready expulsion. In this case, the contraction of the uterus, with the escape of the amniotic and allantoic fluids, was sufficient to cause the detachment and expulsion of the chorion. The same accident is alleged to occur in the cow, but this I have not observed. Owing to the character of the bovine placenta, such an occurrence must be extremely rare, except in cases of prolonged dystokia, with decomposition of the membranes.

In the mare, the placenta is usually expelled a few minutes after parturition; in the cow, at a somewhat later period. In multiparous animals, since the afterbirth which has belonged to a given fetus must be expelled before the succeeding fetus from the same horn can be born, as a rule the placenta of each fetus follows immediately, frequently still attached to the fetus.

The normal detachment of the fetal membranes or placenta has no tendency to induce or permit important hemorrhage. In the large animals, the amount of hemorrhage is insignificant and wholly without visible consequence to the animal. Serious or fatal hemorrhage sometimes occurs pathologically from the placenta of large animals.

As soon as the fetus has been expelled and the umbilic cord ruptured, the chorion, and other portions of the fetal membranes remaining, become essentially inert tissue, without circulation and without life. It is highly essential that these should come away promptly and that the involution of the uterus should take place quickly. Failure of the involution of the uterus and dehiscence of the membranes is evidence that serious infection is present in the uterus, as metritis or placentitis.

The expulsion of the fetus and its fluids is followed at once by the contraction of the uterine walls, decreased vascularity, reduction in size, and obliteration of the uterine cavity by the walls coming in contact with each other. The placentae disappear, the glandular layers of the deciduate placenta are detached and removed, and a new epithelial layer is formed at the site of placental attachments. The cervix contracts rapidly and the cervical canal is well closed in twenty-four to forty-eight hours. The uterus, having once been pregnant, fails to regain wholly the size of the virgin organ. The broad ligaments retract in harmony with the uterus.

Collectively, these processes are known as involution of the uterus. They are highly important for the well-being of the animal. The physiologic contraction of the uterus serves to hinder the entrance of infection and tends to expel or destroy any infection already present ; inertia or paralysis invites infection. If afterbirth or other dead tissues remains in the uterus, the infection present intensifies the inflammation of the uterus and increases the inertia or paralysis. In thoroughly healthy cows, the involution of the uterus is completed quickly, so that after forty-eight hours one may grasp the uterus of the cow through the rectum and hold the entire organ in the hand.

In ruminants, the mother habitually devours the entire fetal membranes immediately after their expulsion, provided they are fresh. It has been suggested that the devouring of the fetal envelopes by the mother is the persistence from the wild state of a precautionary measure for the defense of the mother and the new-born against predatory animals, by destroying the evidence of a recent birth. The devouring of the membranes rarely results in accident, but there have been a few cases recorded where a cow has become choked upon her placenta. In one case related to me, the cow became choked on one end of her placenta while the other end remained firmly attached in her uterus. Sometimes the placenta, after having been eaten, decomposes in the rumen or other portions of the alimentary canal and causes indigestion.

PHYSIOLOGIC PRESENTATIONS AND POSITIONS OF THE FETUS

In order that physiologic birth may occur, it is necessary that the fetus approach the birth canal in such a way that it will be practicable for it to pass through. There are various dispositions of the fetal body and extremities which make its passage possible ; others render it virtually impossible. The possibility of a normal fetus being born alive by a normal mother and without assistance depends fundamentally upon which parts of the fetal body present at the inlet, and secondarily upon the relations of the parts which present to the circumference of the pelvis. In dealing with the mechanism of parturition, we recognize three fundamental elements in reference to the attitude of the fetus—the presentation and position of the fetal body and the arrangement of the fetal extremities.

Presentation, mechanically expressed, is the relation existing between the spinal axes of the mother and the fetus. The term indicates that portion or general region of the fetus which offers at the pelvic inlet at the time of parturition.

The longitudinal disposition of the fetal body is essential to physiologic parturition. The uteri of domestic animals are tubular in their general outline, and the fetus represents an elongated oval, the long axis of which is parallel to the long axis of the uterine cavity. The transverse diameter of the body of the fetus equals approximately the diameter of the fully dilated birth canal, through which the fetus must necessarily pass in being born. The fetal chest and hips each have an even greater diameter than that of the bony canal through which they must pass. Not only is it necessary that the long axis of the fetus shall be parallel to that of the mother, but the transverse axis of the fetal chest must be temporarily reduced.

The mere fact that the spinal axes of the mother and the fetus are parallel does not insure the physiologic disposition of the fetus, or parturition without aid. The fetus may enter the birth canal by either the cephalic (anterior presentation) or caudal end (posterior presentation). In uniparous animals, most fetuses present, as they lie in the uterus, by their cephalic end

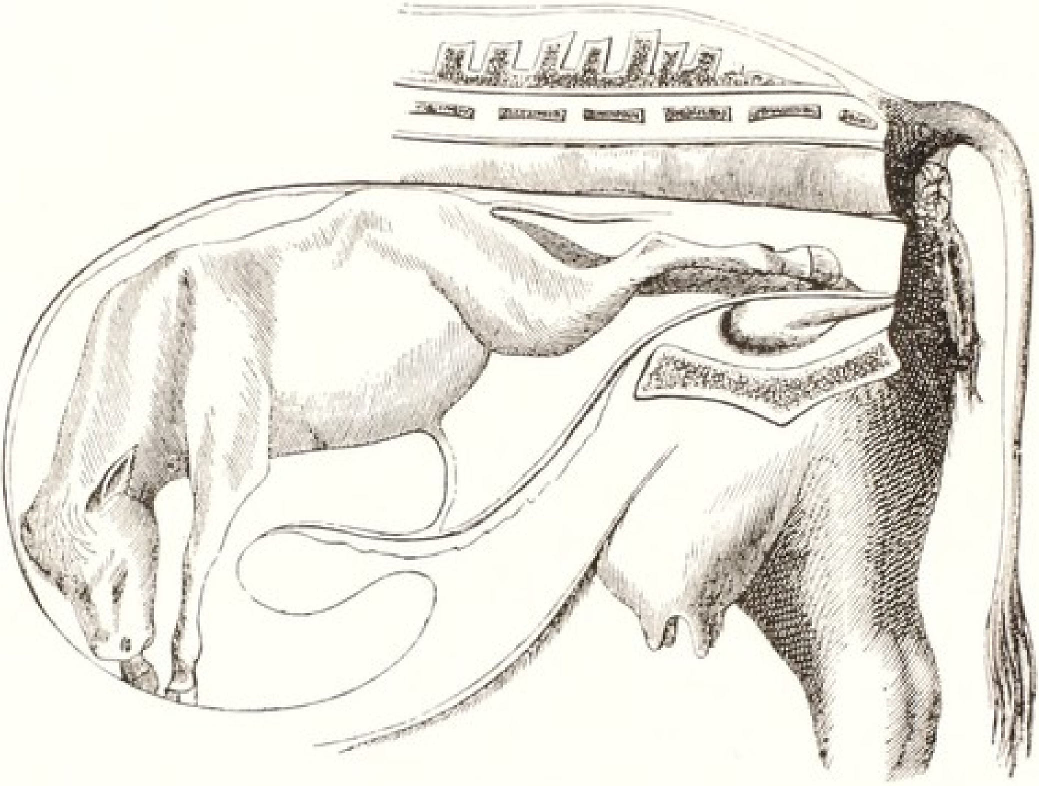


Fig. 93. Posterior, or Caudal Presentation
Dorso-sacral position. (Saint-Cyr.)

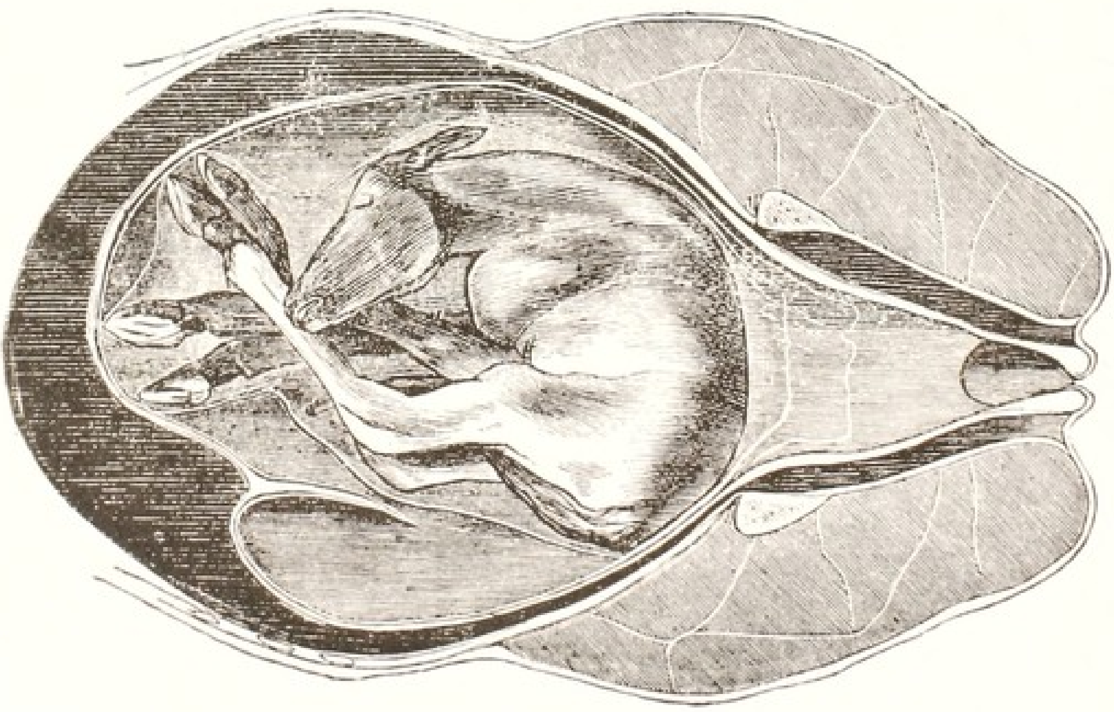


Fig. 94. Dorsal Presentation. Schematic. (Franck.)

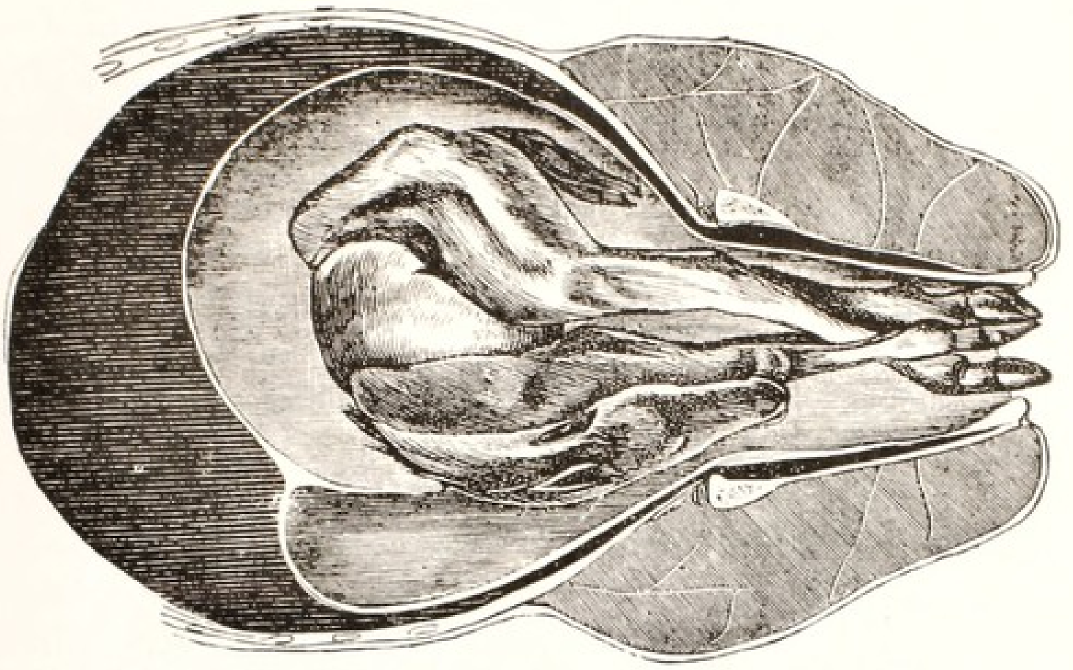


Fig. 95. Ventral Presentation. Schematic. (Franck.)

(See Plate I, Frontispiece). In biparous pregnancy, the fetuses ordinarily lie alternated—one with the cephalic, the other with the caudal end toward the vagina—and must so enter the birth canal. In multipara, the fetuses are largely alternated rather promiscuously.

Transverse presentations of the fetus, whether dorsal or ventral, are pathologic. They are confined essentially to the mare, and are dependent upon the cruciform uterus. The fetus necessarily lies horizontally—that is, it must lie upon its side—since any other attitude would be unstable. The cephalic end must lie in either the right or the left flank of the mother, in front of her right or left ilium. Accepting the head as the fixed point of the fetus for designating its position, there may exist either a right or a left cephalo-ilial position, according to whether the head end of the fetus corresponds to the right or the left ilium of the mother.

Very rarely, transverse or bicorunal pregnancy occurs in the bitch. In some, possibly in all, of these cases the fetus presents with its dorsum bent sharply ventralwards, the cephalic end lying in one horn, the caudal in the other.

Position is the relation existing between an arbitrarily selected part of the presenting portion of the fetal body and the circumference of the pelvic girdle. A fixed point upon the fetal body, the dorsum for the longitudinal presentations and the head end for the transverse presentations, is chosen as a basis. The pelvic inlet of the mother is divided into quadrants which represent the sacrum, pubis, and right and left ilia. Toward either of these regions the dorsum of the fetus may be directed, whether presenting by the cephalic or by the caudal end.

It does not follow that the dorsum of a longitudinally presenting fetus is always directed toward the center of one of the four regions mentioned, but there may be every possible degree of variation. The four cardinal points of the pelvic girdle serve as a basis for the designation of the intermediary, or oblique positions. Any one position may gradually merge into the next. In the longitudinal presentation, the fetus tends to assume spontaneously that position in which its dorsum corresponds to the sacrum of the mother. This is designated as the dorsal-sacral position. (See Frontispiece and Fig. 93). It is pre-eminently the normal position. While it is theoretically possible for birth to occur, without assistance, in other positions of the longitudinal presentations, such has but rarely been observed. In the anterior presentation and dorso-sacral position, the disposition of the three extremities—the head and two anterior limbs—determines the practicability of the fetus being expelled without assistance. In animals with long and rigid limbs and a small head, such as the large herbivora, the normal relationship is for the two anterior limbs to be fully extended, with the soles of the feet presenting downward, while upon these rest the head and neck with the nose somewhat less advanced than the two anterior feet. In the foal the nose rests in the vicinity of the fetlocks ; in the cow the nose is somewhat nearer to the hoofs. Any deviation in the relationship of these extremities at once causes difficulty in the passage of the fetus through the birth canal and brings about more or less serious dystokia.

If the fetus revolves upon its long axis to the extent of a quadrant of a circle, either to the right or the left, the dorsum of the fetus corresponds to the right or left ilium respectively and causes the right or left dorso-ilial position, a position of the fetus which renders spontaneous birth difficult in all cases, and usually impossible without obstetric aid.

Should the rotation of the fetus upon its long axis continue a quadrant further, the dorsum of the fetus corresponds to the pubis of the mother, to constitute the dorso-pubic position. This position of the fetus is pathologic, and birth can not take place without assistance. In all positions, numerous deviations or misplacements of any or all extremities may occur and add to the complications and difficulties of the expulsion of the fetus.

Throughout the orderly development of the fetus, its body is curved—its ventral line concave, its dorsal convex. The curvatures of the fetus and the uterus naturally correspond. The convex dorsum of the fetus is applied to the greater, or dorsal aspect of the uterus. The anatomy of the fetus prevents this arciform position from being readily reversed or altered. Consequently, the curve of the body should always correspond to whatever curvature exists in the birth canal. A study of the genital passage of the mother shows that this curvature, in the main, is concave above and convex below. Consequently, if the curved body of the fetus is to pass readily through the canal, it must present in such a position that its convex dorsal surface shall correspond to the concave line formed by the maternal sacrum and coccyx. Hence the dorso-sacral position is the only normal one, because it is the only one favorable to the prompt and easy passage of the fetus through the birth canal with safety alike to the fetus and the mother.

In those positions where the curvature of the fetal body does not correspond to that of the birth canal, the extremities of the fetus tend to push against the sides or walls of the canal and become impacted therein, injuring more or less seriously the soft parts of the mother or blocking the progress of the fetus. When the dorsum of the fetus corresponds to the sacrum of the mother, the greatest transverse diameter of the fetal body is parallel to the greatest diameter of the pelvis of the mother.

In the smaller domestic animals, the limbs of the fetus are not so long comparatively, nor so rigid, and the neck of the fetus is usually much shorter. The body is less curved and more pliable, so that it may be more readily bent dorsalwards than in the larger animals. The head, in some of the smaller animals, such as the carnivora, is large and offers alone as great an obstruction as the head and forefeet together in the larger animals. Therefore, in smaller animals, the anterior feet and legs usually project backward beneath the fetal body and the head presents alone. Because of the more direct and cylindrical form of the body, the position of the fetus in relation to the circumference of the pelvic inlet is not so important, although the fetus is generally and most readily expelled in the dorso-sacral position.

When the longitudinal presentation is caudal, instead of cephalic, the same modifications of position prevail and are similarly designated. There is the physiologic dorso-sacral position, with the dorsum of the fetus presenting toward the sacrum of the mother; the pathologic right and left dorso-ilial positions, with the dorsum of the fetus directed toward the right or left ilial shaft of the mother; and the dorso-pubic position, with the dorsum of the fetus directed toward the pubis of the mother.

Authors are not in accord upon the question of whether any position of the caudal presentation can properly be considered normal in the large herbivora. Certain it is that only rarely is a calf or a foal born alive in the posterior presentation, unless assistance has been promptly afforded and birth hastened. Whenever the fetal body has been so far expelled that the umbilicus has entered the pelvic inlet of the mother and the umbilic cord is compressed between the pelvic brim of the mother and the ventral wall of the fetal chest, the life of the fetus is at once threatened. It must quickly die from asphyxia unless very promptly expelled or extracted and permitted at once to breathe.

Precisely how long a fetus may live after the umbilic cord becomes compressed between the pubis of the mother and the body of the fetus, cutting off the fetal circulation, is not known, but it certainly can not be for more than a few minutes. Some authors have suggested that, if the circulation be thus interrupted, the fetus at once inhales the amniotic fluid and thus drowns itself. It has not been shown to what extent this is true. It is evidently well-nigh impossible for such inhalation of fluids to occur, because, at the moment of the strangulation of the cord, the chest of the young animal is so tightly impacted in the pelvis of the mother that it is difficult to understand how amniotic fluid or anything else could be inhaled. When the chest has passed through the birth canal, the head at once follows, and it only remains for the amnion to be removed from the nose to render respiration possible.

In the judgment of some obstetric writers, the expulsion of the fetus is more difficult in the posterior presentation than in the anterior. I have not been able to verify this opinion. In my experience in the larger domestic animals, the caudal presentation is favorable, in so far as the amount of resistance to the expulsion of the fetus is concerned. The posterior part of the body forms a very elongated cone—a more uniform and longer cone than is offered in the cephalic presentation—which tends to dilate the passages gradually and permit the fetus to be advanced with the least possible difficulty. Some obstetrists suggest that the direction of the hair, being opposite to that in which the fetus is passing, offers resistance, but it should be remembered that the fetal hairs are very soft and flexible and, if properly lubricated by the fetal fluids, offer virtually no obstacle. What little resistance they may theoretically offer is far more than counterbalanced by the length and regularity of the cone which the posterior presentation offers.

Dystokia is more liable to occur in the large animals when the fetus presents posteriorly than when it presents anteriorly. This is due largely to the tendency for the hind limbs to become deviated from the normal arrangement of extension and for one or both of them to be more or less completely retained beneath the fetal body. In the mare and cow, there is a constant tendency for the fetus, when presenting posteriorly, to be in the dorso-pubic or dorso-ilial position, by which the arc of the fetal body is contrary to the curvature of the genital passage.

Pulmonary respiration is inhibited because the fetal head is in the uterus and placental aëration of the blood is threatened. Birth must then be completed quickly, or the fetus strangles.

The **normal** and *abnormal* presentations and positions of the fetus may be tabulated as follows :

Presentations		Positions
Longitudinal	**Cephalic** **Caudal**	**Dorso-Sacral** *Dorso-Pubic* *Right Dorso-Ilial* *Left Dorso-Ilial*
Transverse	*Ventral* *Dorsal*	*Right Cephalo-Ilial* *Left Cephalo-Ilial*

The positions may be further complicated by a great variety of deviations of the extremities.

The nomenclature of presentations and positions varies according to different authors. Fleming designates the positions in the posterior **presentations** as lumbo-sacral, lumbo-ilial, etc., and in the transverse **presentations** designates the ventral as "sterno-abdominal" and the dorsal as "dorso-lumbar."

MANAGEMENT OF NORMAL PARTURITION

As an essential precaution when a pregnant animal is nearing parturition, it should first of all be ascertained that she is as clean as it is practicable to make her. In temperate climates, where cows are stabled much or all of the year, the body surface becomes extremely dirty. The current view that grooming prevents this is a fiction. The sebaceous secretions of the skin accumulate and detain other dirt in such a manner that ordinary grooming is an inefficient cleansing agent.

Virtually all cows have a vaginal discharge. There is a mucopurulent discharge which mats the vulvar tuft of hairs and forms in them black, hard crusts. This is so universal that it is termed normal. It is not physiologic, as has been shown experimentally (See Figs. 96 and 97).

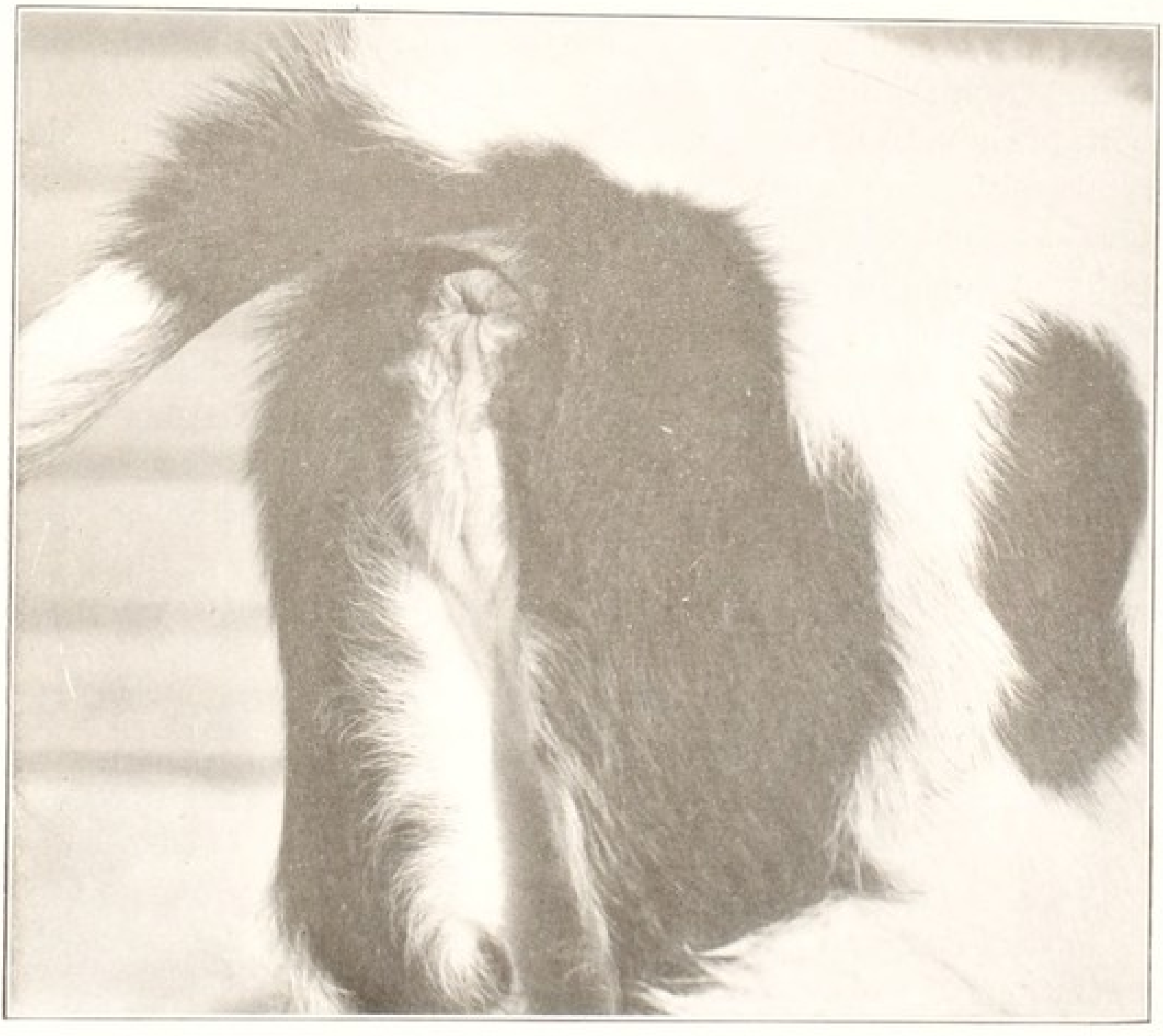


FIG. 96.

Experiment heifer grown upon sterilized milk, showing clean vulvar tuft.

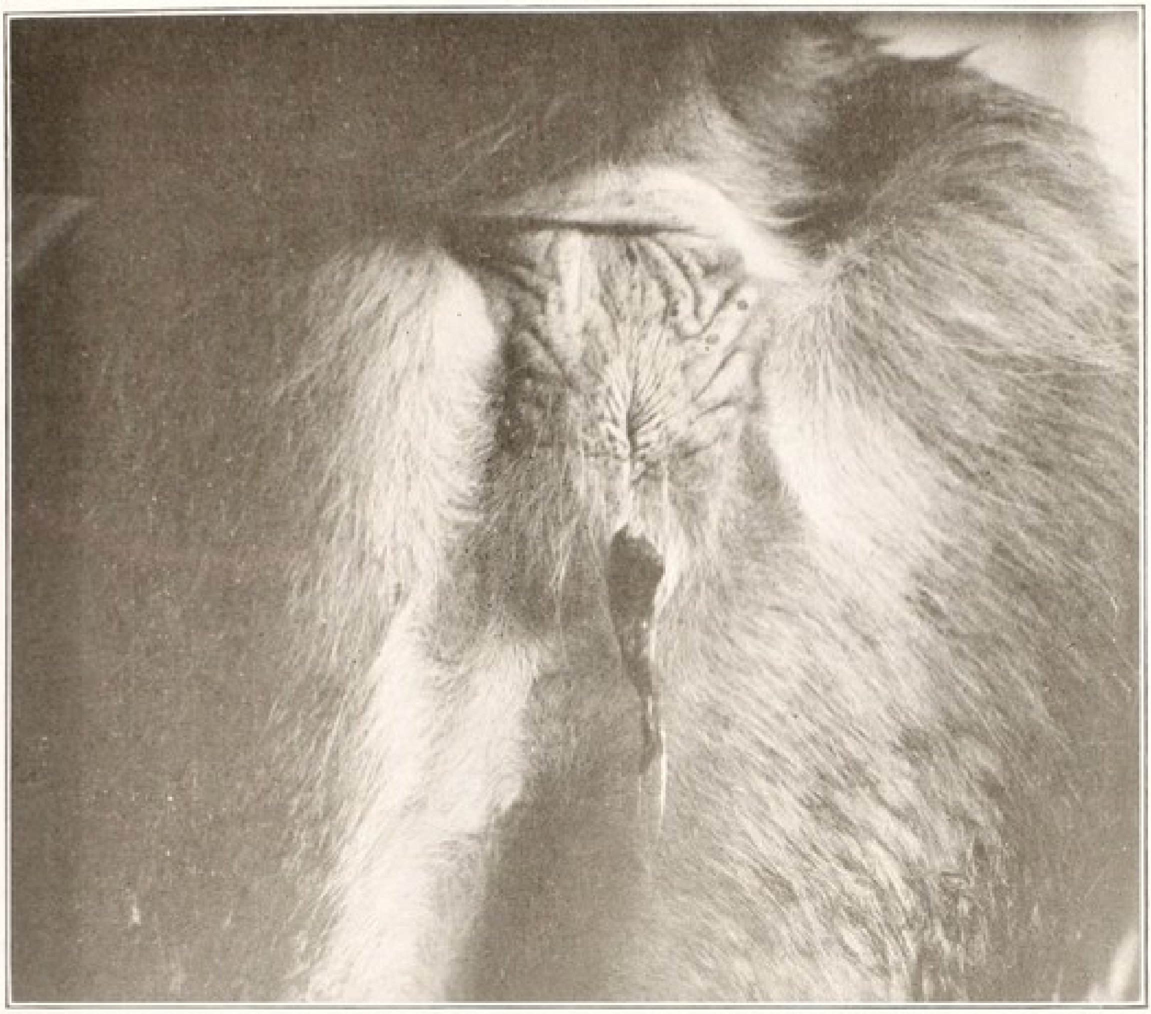


Fig. 97.

Heifer grown and handled in the ordinary manner, showing vulvar tuft of hairs matted together by muco-purulent discharges from the genital tract.

The new-born calf can best be guarded against infections from the mother by having the mother as clean as possible at the time of parturition. The cleanliness of the mother constitutes one of the cardinal necessities for the health of the new-born. It must develop in a clean uterus and escape intra-uterine infection. The exterior of the mother must be free from any dangerous infection. The environment (stall, paddock, etc.) must be clean. The food of the new-born must be safe. No emphasis upon any one of these precautions can render either of the others less necessary. In order to secure the required degree of cleanliness, the cow especially, and to a lesser degree other pregnant animals, should receive, shortly prior to parturition, a thorough bath with soap and warm water, to which is added a reliable antiseptic.

The vagina and vulva should be thoroughly douched with warm physiologic salt solution, to which a mild antiseptic may be added. The tail, buttocks, and udder should be thoroughly disinfected prior to the birth of the young, and again immediately after birth before the young is permitted to suck. Discharges from the genitalia of cows, just after calving, are so prevalent that each cow should be regarded as a source of danger to her new-born calf, especially from genital discharges flowing down the tail, buttocks, and udder to the teats, and so soiling these that the calf in sucking takes with its milk dangerous infections from the exterior of the teats.

Under domestication, the environment of animals has been so changed and modified that it is essential to consider the question of the care and surroundings of the mother and fetus during the period of parturition. The preparations should be such as to insure freedom and comfort. In the mare and the cow, which are habitually kept secured in stalls or stanchions, and frequently among a number of other animals, the safety of both the mother and the fetus is increased by providing greater liberty for the mother and separating her to some degree from other animals of the same or other species. Sometimes the owner is unable to command proper quarters for an animal giving birth to young, and may find it necessary to keep her tied by the head. This is usually comparatively safe, providing always that the stall is so arranged as to guard the animal against the danger of becoming cast, and thus injuring herself.

Provision should be made against injury to the fetus from defects in the stable or from the presence of other animals. A good stall in which the animal is tied up by the head is better than a poor box stall, because in the latter the mother is liable to lie down with her buttocks against or near to a wall in such a way that the fetus can not readily be expelled, whereas, if tied by the head in a single stall, such an accident could not readily occur, unless the stall were very short or the animal tied very long. Both cows and mares repeatedly give birth to young, while tied by the head in a stable with a number of other animals, and the mother escapes unharmed.

Some writers claim that the mother should be able to get to the fetus at once, in order to release it from its membranes, but clinically this is at least unimportant, if not untrue, and it is doubtful that the cow or mare ever saves the life of her fetus by quickly removing the fetal membranes from its nostrils so as to permit it to breathe. Admittedly, it is important that the mother be allowed to cleanse her fetus thoroughly by licking it as soon as she has recovered from the exhaustion incident to labor. An attendant equipped with dry towels may, however, rub a fetus dry with as good results as though it had been licked by its mother. In tuberculosis, it is even better that the dam shall not lick the fetus, lest she infect it, e. g., in the navel stump. A danger of great importance, in cases where animals are tied by the head in a stable with others, is that the fetus may blunder into an adjoining stall. Especially, a foal may be seriously injured by coming within reach of other horses, which may kick, bite, or trample it. With other domestic animals, especially with the cow, this danger is not so great, although present in a minor degree.

It is not always desirable to remove pregnant females too far from their usual place and surroundings at the time when they are to give birth to young, because many of them become nervous and restless, which may lead to more or less serious difficulty. Some animals, especially mares, become very nervous or even frantic when removed from their companions and placed in a strange stall. This should be avoided.

The stall in which an animal is to give birth to young should be ample in size and scrupulously clean. It should be well bedded with as clean bedding as practicable, and should be kept quite free from feces and accumulations of urine and other decomposing substances. It is desirable and economic to keep the stall disinfected in order to avoid the important and dangerous infections to both fetus and mother which may follow normal parturition. Bedding ordinarily used for animals is regularly infected prior to being placed in the stall. It is impracticable to disinfect it thoroughly. There are vast differences, however. The best available should be selected, and spoiled hay and straw discarded. Shavings are the most nearly aseptic bedding available for animals.

The best place in which a herbivorous animal may give birth to young is the open field or pasture, if the weather will permit, since there is no place so secure against mechanical accident or infection. Complications may arise which to some degree decrease the advantages to young of being born in the open pasture. During the hot summer months, flies offer considerable annoyance and have special dangers as infection bearers for the mother and young when the act of birth takes place in the open field.

The care of the pregnant animal during labor should not be of a kind which will in any way annoy or disturb her. When the animal is of material value, it is well that the course of birth should be sufficiently watched in order to determine whether it is proceeding regularly, since it is always important that, if help must be extended to an animal, it should be early. A great many parturient animals resent the presence of persons and become very nervous when too much attention is paid to them. Owners of mares have frequently noted, especially in those pregnant for the first time, that parturition sets in when the watcher is away. The animal sometimes seems to await a favorable moment to begin, so that, when a watch is set, labor is liable not to begin until some slight intermission in the supervision occurs. When the watch is resumed, it is found that birth has taken place during the interval. The watch upon an animal should therefore be barely sufficient to guard against any serious accident.

In the care of an animal during parturition, the breeder or his employees should be instructed by the veterinarian, as far as may be necessary, in reference to what constitutes the normal and when it is necessary to interfere. Should the veterinarian be called to attend a case of what is suspected as irregular or abnormal parturition, he should determine by a careful examination the exact state of affairs, and interfere only in those cases where there is some deviation, which, in his judgment, it is best to correct, or which would not be ultimately and safely overcome by the mother alone. He should determine whether the general condition of the mother is good and whether the expulsive efforts are normal and the genital passages of the mother are being dilated in a natural manner. The position of the fetus should be learned, and the veterinarian should know if it will probably be expelled without assistance.

When symptoms of impending birth are present and progress is not visible, the veterinarian should determine if birth may properly be hastened by artificial means or if obstetric interference should be delayed. For this purpose, it is essential to differentiate between false, or preparatory labor pains and real expulsive efforts designed to bring about the immediate expulsion of the fetus. There may be premonitory pains, indicated by some degree of uneasiness or slight colic symptoms, especially in the mare, some days prior to parturition. These should not be mistaken for parturition itself and the expulsion of the fetus hastened by artificial means, but the veterinarian should advise patient watching until labor definitely begins. In such cases however, it would be still more unfortunate to overlook some essential and fundamental difficulty preventing normal labor, which must eventually be overcome in order to save the life of the mother or the fetus, or both. For example, in torsion of the uterus, effective or vigorous labor pains do not usually occur, because the conditions of the uterus are such as to prevent them. It would be exceedingly unfortunate and perilous to the lives of both mother and fetus to pass over the displacement of the uterus without recognition of its character, because a few days, or even hours of delay may lead to insurmountable difficulties, which could readily have been remedied at the right time. In the bicornual development of the fetus in the uterus of the mare, one may not observe very pronounced and vigorous labor pains, and yet each hour that is permitted to pass makes the obstacle which is to be overcome more and more difficult and renders the death of both mother and fetus all the more certain to occur.

In other cases, as in the cow, where the cervix of the uterus is very long and dense and where its canal dilates very slowly, it is unwise to be hasty when it is probable that, with a little patience, the dilation will occur and the fetus be born alive without assistance. It is equally unwise to delay the dilation of the cervical canal and the extraction of the fetus if the conditions present indicate clearly that a natural dilation will not occur. For example, in a case of partial atresia of the cervical canal observed by me in a cow, which was allowed to go for ten weeks after the normal end of gestation with a fetus imprisoned within the uterus and undergoing putrefaction, it is evident that surgical interference should have occurred at the end of gestation, when it was noted that portions of the afterbirth had protruded beyond the vulva.

So long as the act of parturition seems to be progressing favorably, the caretaker of the animal should not in any way interfere. Owners of breeding animals should be carefully instructed by the veterinarian as to the dangers of unnecessary interference in cases of normal parturition. If the presence of the owner causes the animal to be nervous or irritable, he should remain at a safe distance until his services are required. On the other hand, it must be constantly borne in mind that the well-being, or even the life, of the mother and the fetus may depend upon prompt aid from the owner or the attendant, before the veterinarian can possibly arrive.

This applies with special force to the mare, where timely aid may preserve the life or value of the mother or the fetus, when the veterinarian could not possibly accomplish the same end later. It is a general rule, which we might almost say is merely emphasized by the few exceptions, that a veterinarian never saves the life of a foal in a case of dystokia, so abrupt is labor in the mare and so quickly does the foal perish because of the early separation between the fetal and maternal placentae. Therefore it is highly important that the owner or caretaker of breeding mares should be competent to give first aid in cases of parturition, and it is a part of the duty of the veterinary obstetrist to instruct the owners of such animals, so far as may be practicable, in these matters. This may be well illustrated by citing some of the common accidents of parturition in the mare. In some cases an extremity becomes pushed up against the roof of the vagina and into the rectum, so that a portion of the fetus may begin to protrude through the anus, still covered by the vaginal roof and rectal floor. If the owner promptly pushes these parts back and directs them properly in the genital passage, birth occurs safely, and perhaps a living foal is produced, but a few minutes' delay leads to the rupture of the perineum and the virtual destruction of the value of the mare. In another case a fetus presents almost normally, but the nose or a foot becomes impacted against or caught upon the pelvic girdle. If the owner intelligently releases the part and gives it proper direction, the foal is born alive without further difficulty, but if it is allowed to go without this slight aid until a veterinarian arrives, the deviation of the part has become much magnified, the life of the foal has been sacrificed, and that of the mare more or less seriously endangered.

The genital tract, at this time, is in an exceedingly receptive state for infection. Consequently the veterinarian, owner, or other person attempting any examination or manipulations should be exceedingly careful regarding cleanliness and the prevention of infection. No examination should ever be undertaken except it is first warranted by the apparent course of labor, which, after proper watching, seems to indicate the possibility of the presence of some obstacle to normal parturition.

The labor pains may be somewhat violent, clonic, and inefficient, instead of possessing that deliberate vigor which should be present. Some claim that this defect is seen chiefly in young and nervous animals, especially in primiparae, and that it is due to excessive pain accompanying the first uterine contractions and to the very slow dilation of the cervical canal and the genital passages. Recent studies intimate that the nature of the difficulty consists of a diseased uterus or cervix. Under such conditions, any precipitate expulsive effort causes severe pain which compels the patient to desist early in the effort, so that the labor is not marked by the expected efficiency. There is usually little need for interference. If the patient is kept quiet and allowed sufficient time, the labor pains acquire their normal vigor, the cervical canal dilates, and birth follows without assistance.

It has been alleged that contractions of the uterus, in some cases, are reversed—that they begin at the cervix of the organ and pass toward the fundus, a sort of anti-peristalsis—thus tending to force the fetus toward the apex of the horn rather than toward the vagina. Upon what clinical or experimental evidence such a theory depends, is unknown.

Some authors have emphasized the common clinical fact that easy parturition in the cow is more liable to be followed by parturient paresis than is a protracted birth. The connection between easy birth and parturient paresis is not fundamental nor essential, but simply coincident. Since parturient paresis occurs before birth and during labor, easy parturition can not serve as the fundamental cause. Clinically, difficult labor may serve as a bar to subsequent parturient paresis, but it does so indirectly, in a manner which is not comprehended, because the actual character of the disease is not understood. Parturient paresis belongs to that group of diseases affecting animals which, so far as can be determined in advance, are in a preëminently physiologic condition.

Prolonged parturition of every degree may occur, preventing the drawing of any fixed line of demarcation between normal and abnormal birth. What may be an abnormal duration of labor in one species may be wholly natural in another ; what may be abnormal birth in one animal may be wholly normal in another animal of the same species. In the mare the duration of labor is usually but a few minutes. In the cow it may continue from two to four hours, or even longer, and yet be considered by most persons as normal and without notable danger or inconvenience for either the mother or the calf. Recent research observations indicate however that such prolonged parturition is pathologic and that physiologic parturition in the cow is almost as rapid as in the mare and is often accomplished in fifteen to thirty minutes. It has been alleged that in primiparae the dilation is slow as compared with animals which have previously given birth to young. The correctness of this view is very doubtful. In my researches, I find that a perfectly healthy heifer in first pregnancy readily calves in fifteen to thirty minutes. If a heifer has been in labor for several hours and the cervix of the uterus is not fully relaxed, the condition should be attributed to uterine inertia because of intra-uterine infection, and not to the fact that she has not previously calved. If the position, size, and condition of the fetus, and the character of the birth canal are normal, the weakened uterus slowly dilates the cervical canal, and finally expels the fetus, after a delay of one to several hours. Many regard this as normal birth.

If animals are debilitated, whether from old age or inefficient feeding or care, they may be unable to give birth normally to young, although the fetus is in every way properly presented and the general condition of the genital organs is apparently normal. It has been claimed upon rather poor evidence that heifers which are bred very young are liable to become weak and emaciated, on account of the extra burden placed upon their nutritive systems, and arrive at the period of parturition in an enfeebled state, and that the fetus may be relatively large.

When it has been determined that there is a want of contractile power in the uterine walls, or other difficulty dependent upon some mechanical obstacle to parturition, the border line between normal birth and dystokia has been passed.

Traction upon the fetus is evidently unnecessary in physiologic parturition. It is well to point out that, in some of those cases which mark the border line between normal birth and dystokia, it may be desirable to apply more or less traction in order to aid the pregnant animal in her efforts to expel the fetus. Such aid should be intelligently applied in those cases where the pregnant animal is somewhat weak or debilitated, where for any reason the parturition has been more or less delayed and the animal is becoming exhausted, or where the life of the fetus may be imperiled by a tardy delivery. In primiparae, especially in young heifers, gentle and judicious traction upon the fetus is frequently desirable in order to lighten the task of the mother. It should always be borne in mind that any unnecessary traction may prove exceedingly harmful by forcing the fetus through the birth canal before the latter has had time to become fully and safely dilated.

When a fetus presents posteriorly, especially in the mare and cow, it is essential to hasten its expulsion as soon as the body has advanced far enough into the canal that the umbilic cord is engaged and compressed between the fetal body and the pubic brim of the mother. In managing such a case, the advancement of the fetus should be very deliberate until the buttocks of the young animal have appeared at the vulva and have passed through it, thus dilating normally the entire length of the passage. Then, when the critical moment has arrived, the fetus should be promptly and carefully withdrawn in order that it may not be suffocated.

It may be highly important to determine whether the fetus is alive or dead. This is frequently very difficult, especially when the fetus is firmly impacted in the pelvis, where it has no power to move and no opportunity to breathe or to show other definite signs of life. It has been asserted that fetor of the liquor amnii may not necessarily show that the fetus has perished. Upon what grounds such a statement is based, it is difficult to comprehend, unless any odor present is called fetid. When the fetal fluids are fetid, there is no longer reason for doubt that the fetus is dead, though admittedly the line of demarcation between a non-fetid and a fetid state of the fetal fluids is not always easily drawn. Any active movements of the fetus establish clearly that it is living.

When the fetus presents anteriorly, with the head protruded through the vulva, and remains incarcerated for some time, the head becomes engorged and swollen; the tongue swollen, blue-black and protruding from the mouth; and the eyes glassy and insensible. However, the conclusion is not to be hastily drawn that it is dead; on the other hand, it may be very much alive, revive immediately, and begin to move as soon as it is released from its perilous position. In fact, such engorgement of the head and cyanosis of the visible mucosa show that the fetus was alive when the head appeared. Had it been dead at the beginning of labor, the engorgement could not have occurred. In the mare, however, it may generally be considered that, if vigorous expulsive efforts have continued for two or three hours, or if the fetus has been engaged in the pelvis even half an hour, unless some definite sign of life can be observed, the foal has already perished.

The death of the fetus, some claim, retards parturition. This claim is apparently justified by clinical experience. The contractions of the uterus upon the living young tend to cause the latter to make spontaneous movements and, in doing so, to extend its extremities in the most favorable position for their passage through the birth canal. If dead, the extension of the limbs is not likely to occur, because of the absence of reflex movements and of the rigidity of the fetus. Some authors state that the death of the fetus tends to eliminate a certain stimulus to the uterine walls, which causes their contraction, but this is not verified clinically. Generally, there are just as vigorous expulsive efforts when the fetus is dead as when it is living. Some contend that the contractions of the uterus are not effective upon the dead fetus, because of the flaccid condition of its tissues. The position of the fetus prior to birth is essentially different from that which it is expected to assume during its expulsion. If the dead fetus presents in a proper position, the expulsion is as easy as though the young were alive. Of course, if the fetus has undergone partial decomposition and is emphysematous, its expulsion is very difficult.

The causes of the death of the fetus during labor may be exceedingly varied. The umbilic cord of the human fetus sometimes becomes knotted, and thus interrupts the umbilic circulation and causes fetal death. This does not occur in domestic animals, or at least not with sufficient frequency to become of clinical importance. The umbilic cord is too short to favor such an accident.

It has been claimed that the death of the fetus may be due to the premature rupture of the membranes, the escape of the fetal liquids, and the consequent immediate pressure of the uterus upon the fetus. It is difficult to understand how the pressure of the uterus upon the fetus can be any greater after the expulsion of the fetal liquids than before. Admittedly, the escape of the fetal fluids permits the uterus to invest the fetal body closely, and the uterus may thus be prevented from expelling the fetus from its cavity. The complete escape of the fetal fluids indicates rather a delayed expulsion of the fetus than a premature rupture of the membranes: that is, the membranes rupture normally, but later some mechanical obstacle or some weakness of the uterus serves to prevent the expulsion of the fetus and leads to its death.

Indirectly, the rupture of the fetal membranes, followed by the escape of the fluids, is probably the commonest cause of the death of the fetus during labor. The fact that the foal does not usually live more than one to three hours after the first expulsive efforts, while the calf may continue to live much longer, is explained by the differences in the character of the placenta. The attachments in the mare are less intimate and become detached very shortly after labor sets in. The escape of the fluids permits a contraction of the uterus which exerts an important influence upon the dehiscence of the placenta and may lead to the death of the fetus.

The rupture of the water bag in an approximately normal parturition should be left wholly to nature, as it will naturally occur at the most appropriate time. The water bag can not protrude far beyond the vulva, in the cow or other ruminant, without rupturing, because the amnion is adherent to the chorion over a large part of its area, so that it can not pass out with the fetus, but must rupture, and the fetus be born naked.

Some writers claim that it is at times necessary for an attendant to rupture, or even cut the chorion of the new-born. I have not observed any such necessity. A living foal can not be born in the chorion, because it would necessarily die from asphyxia before it could possibly be expelled. It would then be useless to open the chorion. The expulsion of the aborted fetus in all its membranes is not rare, but the expulsion of a full-sized fetus enclosed within the chorion is improbable, if not impossible. Should such expulsion be threatened, and the chorion protrude into the vulva, it should be opened to allow the fluids to escape and render the expulsion of the fetus easier.

Occasionally the foal is born more or less enveloped in the amnion, but this is so delicate that a very slight struggle will free it from any adherent portions. It has also been stated that the mother gnaws through this membrane and releases the young animal, but, since she always rests for a time after the expulsion of the fetus, if its life were jeopardized by being expelled included in its membranes, it would become asphyxiated long before the mother would give it any attention. I have not known a fetus to perish because of inclusion within the membranes. It is needless to remark that, in cases where a living fetus is expelled more or less enclosed in the amnion in such a way as to interfere with respiration, the attendant should remove the obstruction promptly.

THE CARE OF THE PUERPERAL ANIMAL

After the completion of labor, the mother should not be annoyed by the presence of other animals of her own or other species, or by the unnecessary presence of persons. She should have clean and comfortable quarters, whether in the stable or in the field, and her body should be kept as clean as circumstances permit. Any blood or discharges should be washed off her tail and thighs or other parts of her body which have become soiled. The afterbirth, if it has come away, should be removed and destroyed, although, as a general rule, no material harm comes to the mother from eating it. If the animal is stabled, allowing the expelled afterbirth to remain in the stall permits it to undergo rapid decomposition, entices flies, and tends to render infection of the mother or fetus more probable.

An abundance of good drinking water and suitable food should be allowed. For herbivorous animals which have given birth to young during the warm season of the year, grass constitutes the most favorable diet. Mares which are used for work purposes should be rested for a few days after parturition, as a safeguard against disease. As a general rule the mare may safely return to work in the course of three or four days, if parturition has been easy and without accident, but the labor must be of a gentle character.

If the genital organs have suffered any material injury during the act of birth, proper precautions should be taken against ininfection. For this purpose physiologic salt solution should be used to flush out the vulva and vagina. Unless such interferences are necessary, the animal should be left quite alone.

Immediately following parturition there occurs a series of rapid changes by which the genital organs resume the form and functions of the non-pregnant animal. In domestic animals this interval is brief, usually extending over but three to five days, and is marked by little exterior change. It is a period in which the maternal body is highly susceptible to insults of various kinds and in which pathologic changes occur very readily in case of accident or undue exposure. Normally this interval passes almost unnoticed in domestic animals, and it is only when close attention is given that the changes which are taking place are observed.

After-pains are not ordinarily observed in domestic animals. As a general rule, when evidences of abdominal pain follow shortly after parturition, they suggest some pathologic condition, which may be more or less important, such as the retention of a portion of the fetal membranes or some genital displacement, such as a beginning inversion (intussusception) of the uterus. Consequently, whenever such pains are observed following parturition a careful manual exploration of the uterus should be made to determine the cause, followed by the application of the necessary remedies.

After the expulsion of the fetus and its membranes, there follows immediately from the uterus a small volume of blood and placental debris. Since this is inconspicuous, one needs observe quite closely in order to recognize the presence of any discharge following an easy birth. Except for this very trivial discharge, which is designated lochia, amounting in cows and mares to barely a few ounces, expelled within the first two or three hours after parturition, there is physiologically no puerperal genital discharge in domestic animals. Very commonly—or, it might be said, generally—there is a puerperal discharge in cows, but it is pathologic, not physiologic. At first it is a reddish or grayish red discharge, owing to the admixture of blood, but it quickly changes to mucus, muco-pus, or pus, which may persist for a varying period of time.

Fleming considers this as a physiologic lochial discharge and thinks it may continue for days or weeks. He states that seven to eight quarts of lochial discharge have been removed from the uterine cavity of the mare three days after parturition. Apparently he and others have failed to recognize the proper line of demarcation between the physiology and the pathology of the puerperal state. When these discharges become very apparent and acquire marked characters, they are no longer physiologic, but pathologic.

In the cow such discharges signify the presence in the uterine cavity of the infection of contagious abortion (the metritis of contagious abortion) an infection already present in the utero-chorionic space during pregnancy and capable of inducing serious pathologic changes following the disturbances of parturition.

The mother often resents the approach of other animals or of persons, and is very liable to injure her young by treading upon them in an effort to protect them. Such danger is often observed with nervous mares. If a sow is disturbed, she is liable to trample or lie upon her young as a consequence of her excitement. It should not be forgotten that many domestic animals are prepared to defend their young strenuously and will attack vigorously other animals or man when they approach. Such an attitude is not confined to any one species, but is a maternal instinct which is shown to some extent by all animals which naturally fight in self-defense. It is very common in the mare, and in many cases it is more or less dangerous to approach her when she is giving her first attention to a new-born foal. Not only may she trample the foal, but she may bite, strike, or kick any person who approaches her. A mare resented strongly the actions of an attendant, who had placed his arms about her foal in order to move it from one enclosure to another. In an effort to defend the foal she kicked so vigorously at the attendant that, striking instead the head of the foal, she killed it instantly in the attendant's arms. It is frequently dangerous to approach cows with new-born calves, especially those which have been allowed to run at large most of their lives and have acquired rather a strong sense of self-defense. The danger of approaching a bitch with new-born puppies is very well known, and should always be recognized. The sow, which habitually and vigorously defends her young, sometimes imperils the life or limb of any attendant who may injudiciously approach her.

In some instances the mother fails to show any maternal affection for her young, will repel it, take no care of it, not allow it to suck, and may even injure or destroy it because of its attempts to approach her. In such instances some writers suggest various expedients to induce the mother to permit the young to suckle or to cause her to care for it, but as a rule these efforts are not highly successful if the repulsion is well marked and strong. In some cases attendants may be able to quiet the mother and, by carefully bringing the young animal in contact with her for a time, overcome her repulsion. Frequently such refusal of the mother to own and care for her young is referable to interference and annoyance by attendants.

Sometimes the mother, owing to some abnormal appetite, proceeds to destroy her young and eat them. This is epecially notable in the sow, which will not infrequently eat her entire litter of pigs shortly after they are born. In some instances the abnormal appetite, or cannibalism, does not confine itself to one mother, but seems to involve an entire herd of sows during a given season, so that the pig crop on a given farm may be utterly destroyed. The causes of this abnormal appetite are not well understood. It occurs most frequently in those sows which are kept in sties, but sometimes also in those which run at large. In individual cases it would seem to be due sometimes to the accidental death of one or more of the young, followed by the eating of it by the mother, in conformity with her general omnivorous character. Once having tasted flesh, she may proceed to kill and devour the others, but this does not account for the wholesale perversion which is sometimes observed. In one instance related to me, a flock of ewes devoured their new-born lambs with great uniformity, so that the entire lamb crop of one year was virtually destroyed. The cat occasionally devours her new-born kittens.

One can attribute these cases, in the present want of knowledge, only to some general defect in the care of the pregnant or puerperal animals. In such instances it might be well to try changing the animal's food and allowing some alterative, for instance an increased ration of salt or alkalies, such as bicarbonate of soda.

Harms recommends, as a remedy for sows which devour their young, that they be watched during parturition and the fetal membranes be removed so that they can not eat them and thereby arouse their appetite for eating their young. He suggests, in addition, that the sows be given veratri radix, and cites Vogel as recommending 0.3 to 0.5 grammes given internally. Harms prefers to take a small piece of the root cut in the form of a wedge and insert it beneath the skin of the animal. Others suggest that vomition be induced by administering tartar emetic, or that opium or camphor be given. Harms also cites Professor Landois, who mentions an instance of a sow which showed a tendency to devour her young and was cured of the habit by sorcery. In this instance a local expert repeated a series of words one hundred consecutive times, stroking the sow over the head, and thereafter she showed no further tendency to eat her young. As Harms remarks, however, the best known remedy for animals in which the vice has once manifested itself is to fatten and send them to the butcher.

Multiparous animals sometimes give birth to more young than the mother has teats, in which case the supernumerary young usually perish. In the sow and other multiparious animals, each young has its own particular teat, to which it regularly goes at feeding time. The sternal teats of the sow are generally better developed and supply more milk than the posterior ones; the most vigorous young usually take to these teats and crowd the weaker ones to those glands which supply the lesser amount. In this way one or more of the pigs is frequently very poorly nourished. It has been suggested that the weaker individuals be put upon the larger teats, but this is not a very easy process to carry out, since the selection of the teats is generally made by the pigs themselves and adhered to quite vigorously. When there are more young than there are teats, the excess should be destroyed, reared by hand, or placed upon another animal. The latter plan is most convenient, but does not always succeed, because the foster mother will not always allow the young animal to suck.

Sometimes, when several animals of the same species, with young, are kept in the same enclosure, the older or stronger young animals may rob the younger ones of food by sucking, not only their own mother, but also that of their weaker neighbors. Such an occurrence should be recognized, and the needed measures taken to insure the younger or weaker animal its normal food supply.

The identification of the new-born of a given parent sometimes offers serious difficulty, and the veterinarian should be in as good a position as possible to aid owners in determining the parentage of the young animals. When females of the same species give birth to young at about the same time and in the same enclosure, their offspring may become interchanged. The young of one may be stolen by another mother, and considerable confusion thus brought about. Sometimes an animal which has not yet given birth to young may take the young of another animal, suckle it, and drive away the mother. One case, which I observed, raised a serious question as to pedigree. A client owned a valuable herd of pedigreed draft mares, among which there was a grade draft mare of very low value. The client, upon going to the pasture one morning, found a very excellent foal being cared for by the cheap grade mare. The disparity between the form and quality of the foal and what he would expect from the inferior mare was so great that his suspicions were at once aroused. In the same enclosure was one of his best pedigreed mares, which looked as though she had foaled, although it was not clear. There were scarcely any traces of blood or fetal fluids upon the tail or thighs. On the other hand, the grade mare had her tail and thighs badly soiled and portions of the afterbirth were hanging from her vulva. Under the circumstances, I was asked to aid in solving the problem. Upon examination, it was found that the valuable mare had indeed given birth to a foal and that her uterus was vacant ; upon examining the grade mare, it was found that her foal was lying dead in her uterus. Thus it became clearly established that she had stolen the foal of the pedigreed mare and the pedigree of the foal was made clear.

THE CARE OF THE NEW-BORN

A new-born animal usually gets the best care from its mother, when she has been given natural and proper environment in which to bring forth her young and the birth has been normal. So far as is practicable, the care of the young should be left to the instinct of the mother, but the conditions of domestication impose certain dangers and risks to the new-born which intelligent care upon the part of the owner may minimize or obviate.

It is essential to an intelligent consideration of the question to bear in mind the changes in environment and function which must occur when the fetus is expelled from the uterus and begins its extra-uterine life. The safe transition from the intra-uterine to the extra-uterine state, during which the vital functions, such as respiration and digestion, are abruptly shifted from the placenta to the organs within the body of the young animal, offers chiefly the following elements of interest :

1. Prior to birth, the supply of oxygen for the fetus has been carried from the lungs of the mother to the maternal placenta, and thence to the fetus, while the carbon dioxide and other waste substances have been carried from the fetal circulation through the fetal placenta, and thence through the circulation of the mother, to be excreted from her lungs or other organs. This relationship has become suddenly interrupted by the act of birth and must quickly be replaced by direct respiration through the lungs of the new-born animal. The establishment of respiration is so urgent that it permits no delay. The first object, therefore, of a care-taker of new-born animals is to see that they begin breathing promptly, that any impediments to respiration are removed quickly, and that any other means necessary for the prompt establishment of respiration are employed.

It should immediately be seen that the nostrils of the fetus are free, so that air may readily enter the lungs : if portions of the fetal membranes cover the nose, they should be removed ; if mucus has collected in the nostrils, it should be taken away promptly. In a litter of new-born pigs there was difficult respiration, although the nostrils were not blocked. Upon post-mortem examination of some of these, I found that a clot of firm mucus was lodged in the larynx. It is quite possible that such a condition sometimes exists in other young animals, and should have the attention of the caretaker. In many cases perhaps, this mucus could be dislodged by manipulating the tongue—by alternately drawing it forward and allowing it to retract.

It has been claimed that in some cases the fetus has been strangled during birth, owing to the inhalation of fluids because of interruption of the umbilic circulation. This is rarely, if ever, true, but if suspected it may be advisable to drain out some of the fluid by suspending the young animal for a few moments by the hind legs or by placing it in a position with its head lowered. This is good practice, even though the supposed strangling is mere fiction, as the lowering of the head stimulates the respiratory centre in the brain. If however the fetal circulation is good, any fetal fluids which may have been inhaled are promptly absorbed and cease to have danger for the young animal.

In tardy birth, suspended animation may occur because of a too long delayed respiration. According to some writers, the principal stimulus in establishing respiration is the shock which the new-born receives in being expelled from the uterus, where the temperature has been 105° to 108° F., to the exterior, in the cold dry air. The importance of this in arousing respiration is not very clear clinically. It seems to make little difference whether a fetus be born where the temperature is at zero or 90 to 100° F. It seems, however, that the dashing of cold water upon the fetus or vigorous stroking of the chest will arouse the act of respiration in some cases. Generally, the induction of respiration should be attributed to the reflex influence of the venous blood upon the central nervous system. This reflex is best aroused by suspending the new-born by its hind legs, as mentioned in the preceding paragraph.

Artificial respiration may also be induced by the usual compression and relaxation of the chest walls, or by inflating the lungs by forcing air through the nostrils with a small bellows, should such an apparatus be at hand. So long as the heart continues to beat, there is a possibility of inducing respiration, and efforts should consequently be continued, so long as the cardiac action persists. As a general rule, respiration can not be established at all unless it succeeds very promptly, so that in those cases where the animal does not breathe within two or three minutes it will probably die in spite of the fact that the heart may continue to act for ten or fifteen minutes.

2. The umbilic cord must be divided and the previous relation between the mother and young severed. This results in a wound which involves the arteries, veins, and urachus, each of which communicates with internal parts of the system of the young animal. Naturally, the umbilic cord becomes ruptured in a variety of ways. In the foal the cord is so long that it is usually not ruptured when the fetus is expelled, if the mare is recumbent, but gives way only when she rises to her feet, and even then in some cases not until she turns her head toward the fetus in order to care for it, and in so doing pulls the cord in two near the umbilicus. In other cases, in the mare, the chorion becomes detached from the uterus almost immediately after the expulsion of the fetus and comes away with the cord still intact. It is then ruptured later by the struggles of the fetus itself. The mare may step upon some portion of the membranes when the foal is attempting to get up, and the foal, in falling, throws its weight upon the cord in such a way as to rupture it. In the cow the umbilic cord is so short that it is almost always ruptured just as the fetus emerges from the birth canal, or even slightly before. In carnivora and the sow the umbilic cord is frequently not ruptured spontaneously, but is torn in two by the teeth of the mother.

The point at which the navel cord naturally ruptures or is divided by the mother corresponds quite closely in all domestic animals. In examining the navel cord of the foal, one finds that immediately against the umbilicus there is a dense area extending for a distance of about 1½ inches, which changes somewhat abruptly at a marked ring to the soft umbilic cord. This projection (A, Fig. 98) consists of a hairless skin, which, in the healing of the navel, atrophies and disappears. In the calf, the corresponding cutaneous navel persists for some months as a conical projection of skin, thickly covered with long hairs. Just beyond this point, one or two inches from it in the foal, is the weakest point in the cord, where it ruptures or is torn in two.

The rupture of the umbilic cord stands apart as a universal physiologic wound, which under favorable conditions pursues a course in healing which fulfills the highest ideals of surgery. The processes involved in the healing of the wound include prompt and efficient hemostasis, thorough drainage, and the rapid aseptic desiccation of a large mass of necrotic tissue, which hermetically seals the tissues of the young animal against invasion by bacteria. In normal environment, these fundamental processes of repair proceed perfectly and rapidly, far more safely than the healing of accidental or surgical wounds, in the hands of many surgeons. The hemostasis is notable for its promptness

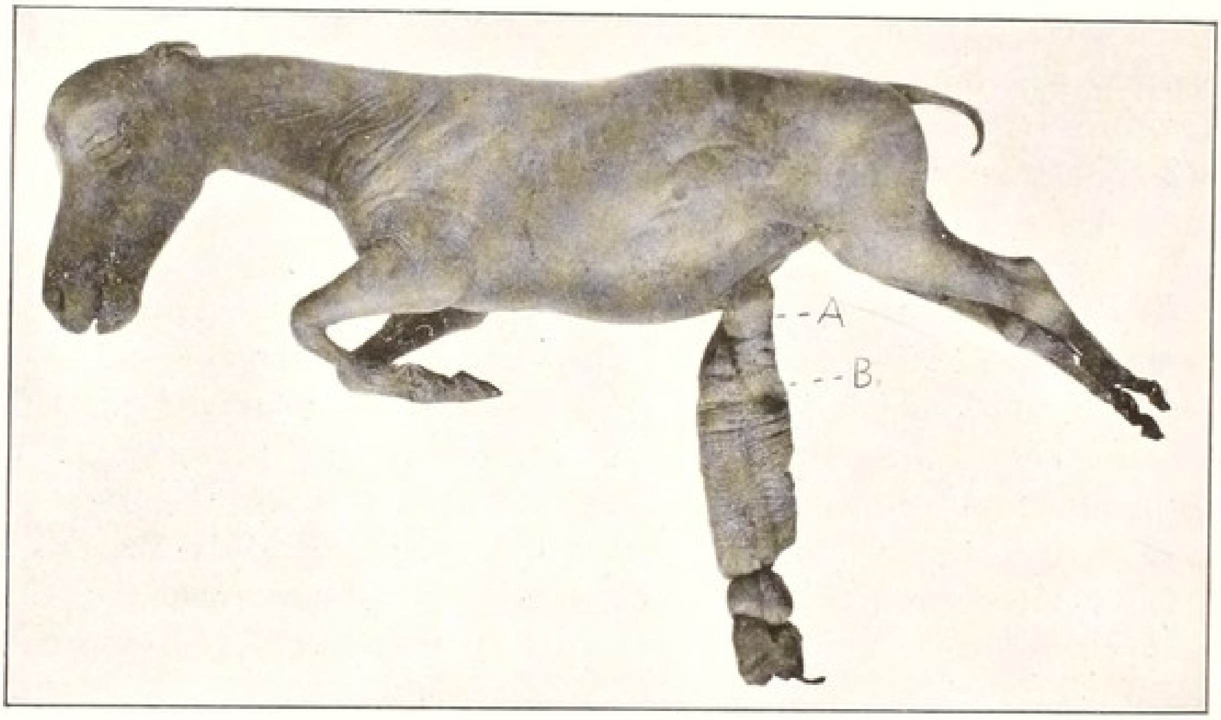


FIG. 98. UMBILIC CORD OF FOAL.

A, cutaneous portion of cord. B, amniotic portion of cord.

and perfection in detail. The umbilic arteries, usually ruptured by linear tension, at a distance of about two inches outside the umbilicus in the calf or foal, recoil like elastic cords, and their broken ends come to rest at or near the urachal end, or fundus, of the urinary bladder (See *UA*, Fig. 53, page 103). Some observers have erroneously concluded that the arteries rupture within the abdomen. The ruptured ends are somewhat fibrillated, their walls become greatly thickened as a consequence of the recoil, and their lumen becomes virtually eliminated. The recoiling artery drags the loose perivascular connective tissue with it, invaginating the fibrous mass to form an intricate entanglement which serves as an impassable barrier to blood. A few drops of blood, and only a few, escape from the broken ends of the arteries, to constitute a very limited extravasate. The broken arteries then rest far afield from any threatening infection. I have seen abscesses in the ends of the umbilic arteries, but always after they had been ligated and held outside the umbilicus for a while, where infection may invade them. The fetal end of the urachus, flanked on the right and the left by the umbilic arteries, retracts with them into the peritoneal cavity and comes to rest two or three inches above and behind the umbilicus. The behavior of the urachus is parallel to that of the arteries: no urine escapes from it physiologically. Pathologically, if the urethra is not open, the pressure of urine within the bladder forces open the recently ruptured tube, and the urine escapes through the navel. This is extremely rare. I have not observed an instance. Not infrequently when the cord is ligated and the urachus held in the decaying umbilic stump—less commonly when the umbilic stump is let alone—the urachus re-opens, similarly to the secondary hemorrhage of infection.

The umbilic vein, without material retractile power, remains in its original position after its rupture. Immediately after its rupture, most of the blood contained in it at the moment falls away exteriorly. Perhaps some of its blood—how much is unknown—is drawn into the auricle and remains a part of the living blood mass. The absence of valves in the vein permits an almost perfect drainage. As soon as the chief volume of blood has escaped, the thin-walled vein collapses, retaining only a very small amount of blood. If, however, the vein is ligated prior to the escape of the blood, it becomes imprisoned, necrotic, and subject to the same laws of decay as a hematom in a wound. After the vessel has collapsed, its walls adhere, and it remains in the adult as a fibrous vestige constituting a small ligament passing from the umbilicus to the liver. This behavior of the umbilic stump is highly important in relation to the well-being of the young, since through this portal serious infection frequently occurs to constitute the disease known as navel infection, or omphalo-phlebitis.

The lymphoid Whartonian jelly, which fills and rounds out the space between the amniotic sheath of the umbilic cord and the vessels, is detained feebly by a very loose, frail connective tissue. Following physiologic rupture, the jelly quickly oozes away. There remains in the umbilic stump the vein, the amniotic sheath, and any remnants of Whartonian jelly not yet escaped. The circulation in the stump ceases at once; the lymph, serum, and other liquids in the necrotic stump ooze away; the stump desiccates and hardens; and the body tissues beyond are hermetically sealed. Beneath the desiccated stump, healing proceeds rapidly and perfectly, and within a few days the necrotic mass drops away, leaving an intact surface. When the surgeon secures the healing of a wound so simply, promptly, and perfectly, he is justly proud.

Occasionally there are variations in promptness and exact position of the rupture of the umbilic cord. Cases have been recorded where it has given way immediately against the umbilicus, but these accidents are very rare and apparently accompanied by little, if any danger. A commoner deviation from the normal rupture of the cord is its giving way at a point too remote from the abdomen, so that in some cases we find the navel stump of the foal or calf five or six inches in length. This leads to two dangers. The extra length of the cord prevents the rapid escape of the Whartonian jelly and the retraction of the umbilic arteries from the exterior; infection and putrefaction occur in the cord, which may lead to an inflammation of the veins, arteries or urachus, thereby imperilling greatly the life of the fetus. In other cases, when the cord is too long, it may be trampled upon or become otherwise caught, and the fetus, in struggling, may tear it away too close to the umbilicus and make a fresh wound, inviting infection.

Two conflicting courses in the care of the navel stump, are advised by veterinary obstetrists—with and without ligation. I prefer either to allow the cord to be ruptured naturally or to imitate and supplement nature with antisepsis and artificial desiccation. If the cord has not ruptured spontaneously, or if the stump is too long, it is to be ruptured at the proper point by linear tension. The cord is grasped at the point where it is desired to sever it, with the thumb and index finger of each hand

and, by drawing the hands apart, is torn asunder between them. If the cord is too strong, one may facilitate the rupture with the thumb nail, or by scraping the cord in two with a dull scalpel.

After the cord has been divided, the Whartonian jelly and all fluids should be pressed out of the remaining stump as completely as possible, by grasping it close against the umbilicus, between the thumb and finger, and then drawing downward, forcing the fluids out from the broken end. This operation is to be carried out under strict antiseptic precautions, and as soon as completed there should be applied a desiccating antiseptic powder, consisting of almost any reliable antiseptic of a character which will not prove caustic to the surrounding parts. Such an antiseptic powder may be composed of equal parts of alum, tannin, and oxide of zinc, or of equal parts of tannin and iodoform. A variety of antiseptics may be selected, according to the custom and habit of the practitioner. The essential point is thorough antisepsis and prompt desiccation of the stump. It is aimed simply to second the efforts of nature to bring about aseptic desiccation of the stump. The application of the desiccant antiseptic powder is advised as soon as possible after birth, to be repeated every hour or two until the desiccation of the stump is complete.

Many veterinary obstetrists advise that the cord be ligated and then divided beyond the ligature ; others advise that two ligatures be applied and the division be made between the two. Some suggest that the ligated fetal stump should later be frequently washed with a liquid antiseptic, and thus guarded against serious infection. It is evident that, if antiseptic solutions are applied with sufficient frequency and thoroughness, they may accomplish their purpose of preventing putrefaction of the cord, with its accompanying dangers. This is neither as efficacious nor as convenient as the preceding plan. The presence of the ligature tends to prevent the retraction of the stumps of the umbilic arteries, and keeps them in a position where they are far more exposed to the possibilities of infection. Ligation is wholly superfluous as a protection against hemorrhage. I have known of but one fatality from umbilic hemorrhage. This occurred in a foal in which the cord was ligated and excised. One must recognize clearly the far greater tendency toward hemorrhage from an artery when it has been divided by cutting instead of by linear tension, scraping, or other kind of mutilation. If, in addition to this, the artery is not allowed to retract or its proper retraction is interfered with, the tendency to bleeding is greatly increased. In the one case of fatal umbilic hemorrhage related to me, the source and cause were not learned. It was possibly from the umbilic vein, and caused by imperfect heart valves.

Ligation of the umbilic cord by an ignorant layman or careless veterinarian is one of the most dangerous interferences with a wound known to surgery. Frequently the work is done with dirty hands, and a common cord is used without sterilization. Often the ligature used is repulsively dirty. The Whartonian jelly is imprisoned by the ligature, within the almost impervious amniotic sheath of the cord. The ligature also imprisons the blood in the umbilic veins. The imprisoned fluid furnishes an excellent culture medium for decomposition bacteria; the dirty hands of the operator, the dirty ligature, or the flies attracted by the moist cord furnish the infection. The ligature may detain the arteries, veins, and urachus in the infected area, and eventually these may be involved in a more or less extensive infection causing a series of highly fatal maladies.

After all, what has the obstetrist accomplished by ligation? He has not prevented hemorrhage, because none threatened. He has not prevented infection. If he has modified the danger from infection, he has only increased the peril. Fortunately, in most domestic animals the ligation of the navel cord is mere fiction. In the foal, with the long cord, the meddler may tie the unbroken cord, incarcerate and detain the urachus and umbilic arteries, and imprison the Whartonian jelly and the blood within the umbilic vein or elsewhere. Consequently umbilic infection is far more common in foals than in other newborn animals. Fortunately the navel cord of the calf ruptures almost always before the meddler can interfere. The arteries recoil at once into the peritoneal cavity, the blood in the umbilic vein immediately falls out almost entirely, and the enthusiastic ligator ties a cord about an empty, dead, cordiform piece of tissue, consisting chiefly of an empty, collapsed vein, a bit of

Whartonian jelly, and the empty amniotic sheath. He has accomplished no surgical good, he may have escaped doing material harm, and he has held fast to a tradition from the human midwifery of the dark ages.

3. The urethra, anus, and other external openings should be observed, to see whether they are normal.

4. It should be learned whether the various excretions are taking place normally. It must be learned that the intestinal contents are being expelled normally. The chief concern is with the accumulated fetal feces, or meconium, in the large intestines. Normally, much of this should be expelled very shortly after birth and the evacuation repeated at frequent intervals until all has escaped. In some cases this does not occur, especially in the foal, and symptoms of retention of the meconium follow. The early discharge of the meconium is also important because in many cases infection has existed in the uterine cavity, penetrated the amniotic cavity, been swallowed by the fetus, and stored up as a part of the meconium as in a cesspool. After birth, the accumulated infection tends to become active and cause scours and other serious affections of the new-born. It is highly important that the caretaker should see that the meconium is promptly expelled. If necessary, this should be favored by means of enemas of warm water, warm normal salt solution, or soda bicarbonate solution. The enemas should be continued until all hard pellets of meconium have come away and there follows instead a soft, pasty mass. The enema is best given by means of a hospital irrigator with a pure gum horse catheter attached. The catheter is gently insinuated into the bowel for a distance of eighteen to twenty-four inches, while the enema is flowing, and the enema continued and repeated until the object has been accomplished.

The question of food for the new-born animal should be considered early. There is a legend that it is essential for the new-born animal to be fed milk immediately. There seems to be an impression that the fetus has been imprisoned in the uterus for the entire span of pregnancy without food, and is famishing. People forget that the mother has all along supplied nutriment and has not ceased to furnish an abundance up to the moment of the rupture of the umbilic cord. The legend is supported apparently by the fact that the young, when it has gained its feet, soon makes its way to the teat and sucks. This is not proof of necessity nor of advisability, but rather of ability and of instinct. Experimentally, calves suffer no serious consequences by being kept from milk or other food for twenty-four to thirty-six hours, nor do they show any distress from the ordeal if put away from the dam and left alone. It has been believed and taught that a weak foal or calf, unable to get up, should be helped to its feet very promptly and assisted to the teat, or that milk should be drawn and fed to it. Such a young animal is sick and needs physic more than milk. A good rubbing, a comfortable place, and enemas to unload its bowels are worth far more than food. There should be no haste in getting the young to feeding. A pound of milk two or three times a day to a foal or calf is ample until the meconium is all out of the alimentary canal and it is seen that the young animal is really well and in fit condition to digest food.

The young animal should not be allowed too much milk, since it will frequently overfeed. This is especially true of the foal, which sometimes shows an inordinate appetite and seems to consider it incumbent upon it to take all the milk which the udder of the mother contains, thereby seriously overfeeding, which may end in more or less severe indigestion. It is consequently advisable, in many instances, to milk out a portion of the milk for the first few days in order to prevent the overfeeding of the foal. This danger does not exist to the same degree in other young animals.

Some writers insist that it is highly essential for the young animal to receive from the mother the first milk, or colostrum, because, they say, this acts as a laxative and brings away the meconium which has become accumulated in the intestinal tract. Clinically this theory is apparently not so important as some persons would have us believe. The udder of the mare frequently becomes so distended that the milk flows out in large quantities for hours, days, or even weeks before the birth of the foal. Yet this does not seem to have any very definite relation to the retention of the meconium, although it would be assumed that the colostrum had wholly disappeared before the birth of the foal. As the foal is born with the rectum impacted with hard masses of meconium, the condition is not acquired after birth through the absence of the colostrum. Clinically the retention of the meconium is no more probable or serious in the foal of a mare from which the colostrum has escaped than in one where it has not. In young animals which get all the colostrum, retention of the meconium is just as common as in those which get none of the colostrum. In apparently sound calves six or seven days old, which have had all the colostrum, I have seen meconium still being expelled. A good enema will clean out more meconium in fifteen minutes than colostrum will in a week.

The artificial feeding of the new-born has long been considered a difficult and uncertain task. The chief difficulty has been in reference to the question of intestinal infection because of contaminated food. The comparative composition of the milk from various species of animals has been well studied and understood, and attempts have been made in artificial feeding to modify the milk by the addition of sugar, water, or other normal constituents, in amounts which would cause it to approximate in composition that of the species to which the young animal belongs. Thus, in case of the artificial feeding of a foal upon cow's milk, the milk is diluted with ten to twenty per cent. of water, and sugar is added, in order to have it approach the composition of the milk of the mare. This is attempted under the assumption that the young of a given species thrives best upon the milk derived from that species, and next best upon a milk which has been artificially modified to resemble closely that of the mother. Though important, this artificial change in the composition of milk, which has not produced the satisfactory results expected, is not of the same value as the control of the bacterial contents of the milk.

At present the chief emphasis in artificial feeding is placed upon having the milk, as far as possible, free from the presence of pathogenic bacteria. Hence it is aimed to keep the milk, and the vessels from which it is fed, scrupuously clean, and to take every measure known to prevent its contamination with dangerous bacteria. Some advise the sterilization of the milk; others are opposed to it. If the milk is clean and free from injurious bacteria, it is better for the young given in the raw state; if it is contaminated or comes from an animal suffering from an infectious disease, as tuberculosis, it must be sterilized before being fed to the young, if the spread of the infection is to be controlled.

Naturally, the young sucks at frequent intervals, but the amount of milk available is comparatively small. The milk-producing powers of domestic animals are greatly increased, and especially in high class dairy animals where the volume of milk far surpasses the capacity of the young to consume it. The young animal will generally take more milk than it can digest, if given free access to it. Two feeds a day suffice for a calf, and the amount at a feed may be gradually increased from one or two pounds up to ten or more pounds. The cow may milk continuously. If milked through the entire period of gestation and not dried up prior to parturition, there is little if any change noted in the milk, except that it is increased somewhat in amount just before calving. In all domestic animals there is a tendency for lactation to be well established when the young is born, especially in the larger herbivora, where the young are very active immediately after birth in the wild state. Since these must at once possess strength and endurance to escape from predatory animals, abundant nutrition in the form of milk is necessary. Consequently, in the cow, mare, and ewe, the milk secretion has become well established before the birth of the young, and the amount is frequently so great that it escapes from the udder in streams for days or weeks before parturition.

Soon after parturition, the colostrum disappears and ordinary milk is present, so that in dairy animals the milk is generally considered to be normal in from 3 to 5 days after parturition and is sold as human food. The milk has a density of 1032 to 1041 and is composed essentially of water, fat, casein, albumen, milk-sugar and salts. The principal constituents of milk are somewhat easily separated by various means.

The composition of milk varies widely according to species and individuality, the methods of feeding, the period of lactation, and numerous other conditions. The following table by Vernois and Becquerel gives a comparative idea of the composition of the milk of various animals, the figures representing the amounts of each constituent in 1000 parts of milk.

Cows which give a large volume of milk may do so at the expense of the solid constituents, especially of the butter fat. Thus, a cow which yields a very large amount of milk may show two or three per cent. of butter fat, while another, which yields much less milk, may show six to seven per cent. of butter fat.

	Woman	Cow	Goat	Sheep	Camel
Specific Gravity	1032.67	1033.38	1033.53	1040.98	------
Weight of Water	889.08	864.06	844.90	832.32	------
Weight of Solid Parts	110.92	135.94	155.10	167.68	134.00
Fat	26.66	36.12	56.87	51.31	36.00
Casein and Extractive Matters	39.24	55.15	55.14	69.78	40.00
Milk-sugar	43.64	38.03	36.91	39.43	58.00
Salts (by incineration)	1.38	6.64	6.18	7.16	------
	Mare	**Ass**	**Sow**	**Bitch**	------
Specific Gravity	1033.74	1034.57	------	1041.62	------
Weight of Water	904.30	890.12	854.90	772.08	------
Weight of Solid Parts	95.70	109.88	145.10	227.92	------
Fat	24.36	18.53	19.50	87.95	------
Casein and Extractive Matters	33.35	35.65	84.50	116.88	------
Milk-sugar	32.76	50.46	30.30	15.29	------
Salts (by incineration)	5.23	5.24	10.90	7.80	------

Generally speaking, the milk of the smaller domestic animals is richer in casein and fat than that of the larger species. The milk of the mare, compared with the milk of other animals, is very rich in sugar. The milk of carnivora is exceedingly rich in casein and fat, so that, while it is not abundant, it nevertheless has a very high nutritive value, as is well shown by the exceedingly rapid growth of their young. On the other hand, the milk of carnivora, in marked contrast to that of other animals, is said to contain almost no sugar.

Milk, containing all the elements necessary for nutrition, constitutes the natural food for new-born animals and induces in them, when supplied in due quantity and of proper quality, very rapid growth.

6. The young animal should be placed and kept under comfortable and favorable conditions, free from extremes of temperature. Although it may withstand quite high and low temperatures without serious injury, if the temperature be extremely low the extremities of the new-born, especially the ears and tail, very readily freeze, or its life may be quickly imperiled under such extreme conditions. In very hot weather flies

may be exceedingly troublesome and annoying. They may carry putrid infection to the navel of the young animal, causing serious and fatal disease.

7. Exercise is quite as essential to the new-born animal as to the adult. The young of some species, as the carnivora and rabbit, are born in so immature a state that no marked degree of exercise is possible, but the young of the larger herbivora is ready for a considerable degree of exercise within a few hours after birth, which should be promptly provided in all cases. When the mare is allowed to run at pasture, the foal has plenty of exercise. In other animals, similar freedom accomplishes the necessary ends in the safest and best manner. Otherwise, some provision should be made for the daily exercise of the young animal as soon as it is capable of taking it. With work animals it is not injurious, but rather beneficial, for the foal to follow the mother if she is engaged in slow, light work.

DYSTOKIA

Though physiologic birth is accompanied by pain and violent efforts on the part of the mother, the act is safe for both the mother and the young. There is constant danger that birth may become difficult or impossible without artificial aid. When these difficulties arise, the condition is designated dystokia, or difficult labor.

Normally the obstacles to parturition are overcome by the expelling powers of the female. The obstacles to normal birth consist chiefly of the narrowness and undilated condition of the birth canal as related to the size, form, and presentation or position of the fetus. When any one of these impediments becomes exaggerated in any way, the obstacles to birth become accentuated. Constriction of the birth canal from any cause may render parturition difficult or impossible except by surgical aid. If the fetus should be of abnormal size, if it should be deformed or distorted from disease or aberration in development, if its presentation or position should be unnatural, or there should be present some deviation of an extremity or other part of the body from a natural attitude, the impediment to birth may be so great as to render artificial aid essential.

Accordingly, dystokia may be divided into two fundamental classes:

1. **Maternal dystokia** dependent upon some defect, disease, or displacement of the maternal organs, some disease of an adjacent organ which obstructs the genital passage, or some systemic disease which interrupts the physiologic action of the expulsive powers.

2. **Fetal dystokia,** due to some primary disease of the fetus or to abnormality in its size, form, presentation, or position.

It is difficult to state whether the comparative frequency of dystokia is dependent directly upon species or upon the prevailing environment or care of the species of animal under consideration. The comparative frequency of dystokia in the cow and in the mare varies greatly in different regions of the country, according to the character of the breeding industry. Veterinary obstetrists, as a whole, agree that the cow is far more subject to dystokia than the mare. For example, Fleming cites two Danish veterinarians, who have had 17 to 19 cases of dystokia in the cow to one in the mare, even though there were more horses than cows reared in their districts. My experience does not verify this view, probably because of the difference in the character of my practice as compared with that of most writers upon veterinary obstetrics.

In private practice I met constantly with more cases of dystokia in the mare than in the cow, although there were annually more cows than mares giving birth to young in my territory. It should be explained, however, that the calves were raised for beef purposes and that the pregnant cows were habitually out of doors throughout the entire year, were well-fed and strong, were not bred until they had attained sufficient size that they would not be likely to suffer from dystokia because of immaturity, and were usually sent to the butcher before they had attained extreme old age. In these animals dystokia was exceedingly rare. One other element probably served largely to make an apparent difference in the frequency of dystokia in the two animals. Since owners very generally did not hesitate to attempt assistance to the cow, and very frequently succeeded fairly well, I was not called. In the mares, which were of high value, the owners usually desisted from any attempts at bringing about delivery themselves, and I was promptly called.

Dystokia constantly runs parallel in frequency to the confinement of the animal. Those females which are most closely housed and least exercised are the ones which suffer most frequently and seriously from dystokia. Hence the dairy cow, which is frequently kept constantly confined in a stanchion, takes the first place in reference to difficult labor. Cows of the same or similar breeds, when not so closely confined nor so intensely used for dairy purposes, are not so subject to these difficulties. In beef cows, which are habitually permitted to run at large throughout the year, dystokia is apparently almost, if not quite as rare as in any domestic animal.

The frequency of dystokia as related to environment is illustrated by observations upon the bitch and cat. In agricultural communities, where these animals are habitually out of doors daily and lead an active life, dystokia is almost unknown; in pets which are kept closely confined in cities, dystokia is frequent. In Illinois, in an extensive swine-breeding district, dystokia in the sow was almost unknown. In New York, where swine breeding is very limited, but the sows are kept closely confined in sties, dystokia is comparatively common.

Recent observations render it clearer and clearer that the increase of dystokia with close confinement is not a direct consequence of the confinement. Indirectly, the confinement lowers the vitality of the cow and decreases her power of resistance to disease. This and other elements entering into the dairy problem lead to a concentration of disease in the uterus (contagious abortion) where it is a menace to the spermatozoön, the ovum, and the fetus in every stage of intra-uterine life, and disturbs the uterine functions at the time of parturition, to cause the dystokia of contagious abortion, which readily takes first place in the dystokia of cows.

The influence of the number of young at a given birth upon the occurrence of dystokia does not seem to be of very great importance. In the cow, ewe, and goat, twins may simultaneously approach the pelvic inlet and, by one or more of the extremities of each entering the pelvis, bring about dystokia, but this is not very common. In multiparous animals, the simultaneous entrance of two fetuses into the pelvis does not readily occur, and dystokia is dependent upon the individual fetus, so that the possibility of difficult birth is simply multiplied by the number of fetuses in the uterus, any one of which, except the first, which is the most dangerous, is almost equally liable to cause difficulty. Should dystokia occur from one of the first fetuses to be expelled, it inevitably blocks the passage of the following fetuses, either from both horns, if lodged in the uterine body or in the vagina, or from the involved horn in case it becomes arrested in its passage before leaving the cornu.

The importance of dystokia, as related to the possibility or probability of delivery, as well as to the recovery of the mother and the life of the fetus, varies greatly according to species. Dystokia in the mare is more serious for the life of the mother than in any other species. The great seriousness of dystokia in the mare is largely the result of the tumultuous character of labor, her susceptibility to infection, and the differences in the conformation of the fetus, which renders an adjustment more difficult and injuries to the uterus or other parts more liable to occur. Parturition is so tumultuous in the mare that serious and fatal injuries often occur to her very quickly, frequently long before the obstetrist can arrive, even if called without delay. This is in sharp contrast to the cow, in which serious injury from labor is not liable to occur until several hours have passed.

In the mare the exceedingly rapid birth tends constantly to produce ruptures of the uterus, in which the wounds penetrate the peritoneal cavity and, as a general rule, end fatally for the mother. In the cow penetrant wounds of the peritoneal cavity are less frequent.

The length and rigidity of the extremities of the foal increase the difficulty of labor in all cases of vicious position, because they are far more difficult to adjust, so that embryotomy is more frequently required. The foal is usually larger, and consequently not so readily adjusted as the calf.

Dystokia is not only more serious for the mare than for the cow, but is also far more serious for the foal than for the calf. During an extensive experience with obstetrics in mares, it has not been my fortune to deliver a living foal where there was actual dystokia. My experience is in accord with that of most practitioners. It is only very rarely that the veterinary obstetrist succeeds in delivering a live foal in cases of dystokia. I have attended mares when living foals were born, but in those instances was hurriedly called by owners under the impression that there was something abnormal, which, upon my arrival, proved to be normal, and the fetus was very quickly born in a natural manner. On the other hand, in the cow the common experience is that, if the fetus is alive when labor sets in and the veterinarian is called promptly, a living calf is secured. This dissimilarity in the two animals has its basis largely in the differences in the placentae. The foal quickly perishes because of the detachment of the fetal from the maternal placenta, whereas the calf continues to live because the placental circulation is not interrupted for a long time after the advent of labor pains.

From the standpoint of the veterinary obstetrist, dystokia is usually far more formidable in the mare than in the cow. The tumultuous labor in the mare usually expels the fetal fluids very quickly and leaves the passages dry, while it also tends constantly to accentuate any deviation of fetal parts and otherwise to increase rapidly the obstacles to delivery. When the veterinarian arrives, the violent expulsive efforts of the mare interfere very seriously with his operations and try his patience and endurance to the utmost degree. The cow is more deliberate and the labor pains are much less violent. The size of the foal, its very long and rigid limbs, and the excessively long neck all conspire to render the obstetrist's task more difficult and laborious. The tumultuous character of labor in the mare calls for greater promptness in bringing about the delivery of the fetus, from the standpoint of its own life and that of the mare. The mare is also liable to annoy and endanger the operator by vicious kicking.

The cow offers one marked disadvantage in manipulation, because she is less amenable to command in reference to her position. Though the obstetrist usually prefers to carry out his examinations and operations with the animal in the standing position, the cow is frequently very obstinate and will persistently maintain the recumbent position. The mare will habitually stand throughout the operation or will promptly rise, if able, after she has once gone down. It is worthy of note also that inability to rise in the case of the mare is very rare, while in the cow it is not uncommon.

The difficulties of dystokia in all animals bear an almost constant relation to the promptness of veterinary attendance. If the case has been neglected for a long time, the fetal fluids escape and permit the fetus to become closely invested by the uterus so that any changes desired in the position of the fetus become much more difficult. During the period of delay, any vicious position of the fetus tends to be constantly accentuated. An extremity, which in the beginning was only slightly deviated from the normal and could have been corrected in a moment, may have become very greatly displaced, and its adjustment rendered exceedingly difficult or even impossible, so that it may call for embryotomy.

If the veterinarian is not called promptly, the fetus may perish and rigor mortis set in, which renders any adjustment of its position more laborious. After death, the fetus undergoes very rapid decomposition, accompanied by emphysema, which increases its size by fifty to two hundred per cent. or even more, thus greatly increasing the difficulties in delivery and the dangers to both the animal and the operator from the standpoint of infection. In the meantime the mother becomes more and more exhausted and less capable of enduring the ordeal through which she must pass.

A very important element in veterinary obstetrics is the meddling of inexperienced, if not ignorant laymen, or, still worse, of charlatans, with their crude instruments and dirty hands and arms, which have perhaps been befouled in attending other cases of a septic character. They frequently carry out operations which increase very greatly the difficulty for the obstetrist and the risk to the animal. Perhaps they have already, by some awkwardness, placed the life of the mother beyond the possibility of rescue. It is consequently essential that the veterinarian should use every opportunity to instruct his clients in reference to the great importance of calling him early and of leaving the case entirely alone until his arrival, except in those instances where a little intelligent manipulation may bring about a prompt and easy delivery.

The subject of veterinary obstetrics has not been well studied or taught, and the work of many veterinary obstetrists has been entirely too inefficient to command that confidence and respect of the stock-owner which it should. If the practitioner desires to be called early, he must first be able to impress upon his clients, by means of efficient work, the economic advantage of an early call. In order to do this, the veterinary obstetrist needs prepare himself in an intelligent manner, by study, experience and equipment, to render the highest possible service in promptness and efficiency.

Some writers upon obstetrics would well-nigh exclude many veterinarians from obstetric practice because of their physique. Some of the conditions which they regard as essential to success are not really of such great importance as they would have one believe. Any man of moderate size, strength, and power of endurance can succeed as an obstetrist, if he will but give the subject that amount of study and research which its importance demands. Some say that long and powerful arms are absolutely necessary. It must be admitted that they possess certain advantages, but long arms are not a substitute for the intelligent and persistent application of professional skill. As in other surgical operations, the veterinary obstetrist requires, above all, intelligence, education, experience, and determination. He must husband his strength, must possess the ability to have others carry out any manipulations or work which they can properly do under his directions, and must reserve his own force and strength for the proper direction of the work of others and for those manipulations which he alone is competent to perform properly. It is not his office to exert traction upon a fetus when a bystander can do it equally well. Such labor is directly opposed to the interests of the animal, the owner, and the veterinarian.

The veterinarian is called upon to carry out no work which is more exacting than the overcoming of dystokia in large domestic animals. It calls for the highest possible training and the readiest mental resources at every turn. No two cases are alike, and each demands effective judgment rather than conformity to a fixed rule of procedure. The veterinarian must be ready to meet judiciously each obstacle as it presents itself, must meet it promptly, sometimes in a moment, and yet throughout the entire procedure, from the beginning of the examination to the extraction of the fetus, must preserve his patience and equanimity. In order to do this, he must conserve his physical powers as far as possible.

EQUIPMENT FOR OBSTETRIC WORK

In order to succeed in obstetric work, the veterinarian must be judiciously equipped. The equipment should be carefully selected, should include every article which is likely to be needed during any obstetric operation, and should be carefully packed in one or more containers ready for immediate transportation, so that no article of importance will be omitted. The instruments should be simple in character. Since obstetric instruments are of the greatest possible variety in design, it is not practicable to enter into detail in relation to the multitudinous varieties which have been proposed by various operators and writers. The catalogs of instrument manufacturers contain descriptions of almost all obstetric instruments which have been known in the history of veterinary science. Many of them are obsolete, many are useless, and many others are defective in important respects. Obstetrical instruments are intended to aid in or accomplish three distinct offices—traction, repulsion, and incision or excision.

Appliances for Traction

For the production of traction, the appliances most frequently used are cords, bands, halters, hooks, forceps, and nooses.

Cords and bands are of every possible variety and may be either very simple or quite complex. The simplest are the best. With simply a looped cord, any operation possible with the most complex may be accomplished. When a cord has been used in one operation it is of no further value because of its danger as a carrier of infection.

A twisted cotton cord (Fig. 99a) four feet long, one end wound with strong thread to prevent ravelling and the other fitted with a spliced loop of sufficient size to permit the cord to play through it freely, is the simplest, most economic and convenient type. It is advantageous to have assorted sizes, because in some instances where the traction is not to be severe a small cord may be more easily applied and retain its hold more securely upon a part. The rule should be to use the smallest cord capable of resisting the needed strain. A cord about three-eighths of an inch in diameter is quite suitable for most uses, but in many cases smaller or larger sizes are preferable. In some cases it is advantageous to use cords of various sizes because they may thus be more readily distinguishable from each other. When severe traction is required, a one-half-inch rope may be found necessary.

The ropes should be prepared carefully and should preferably be sterilized or disinfected in advance and carefully wrapped in impervious paper in such a way that they will not become contaminated before ready for use. They should be made in sufficient numbers, according to the volume of the practitioner's

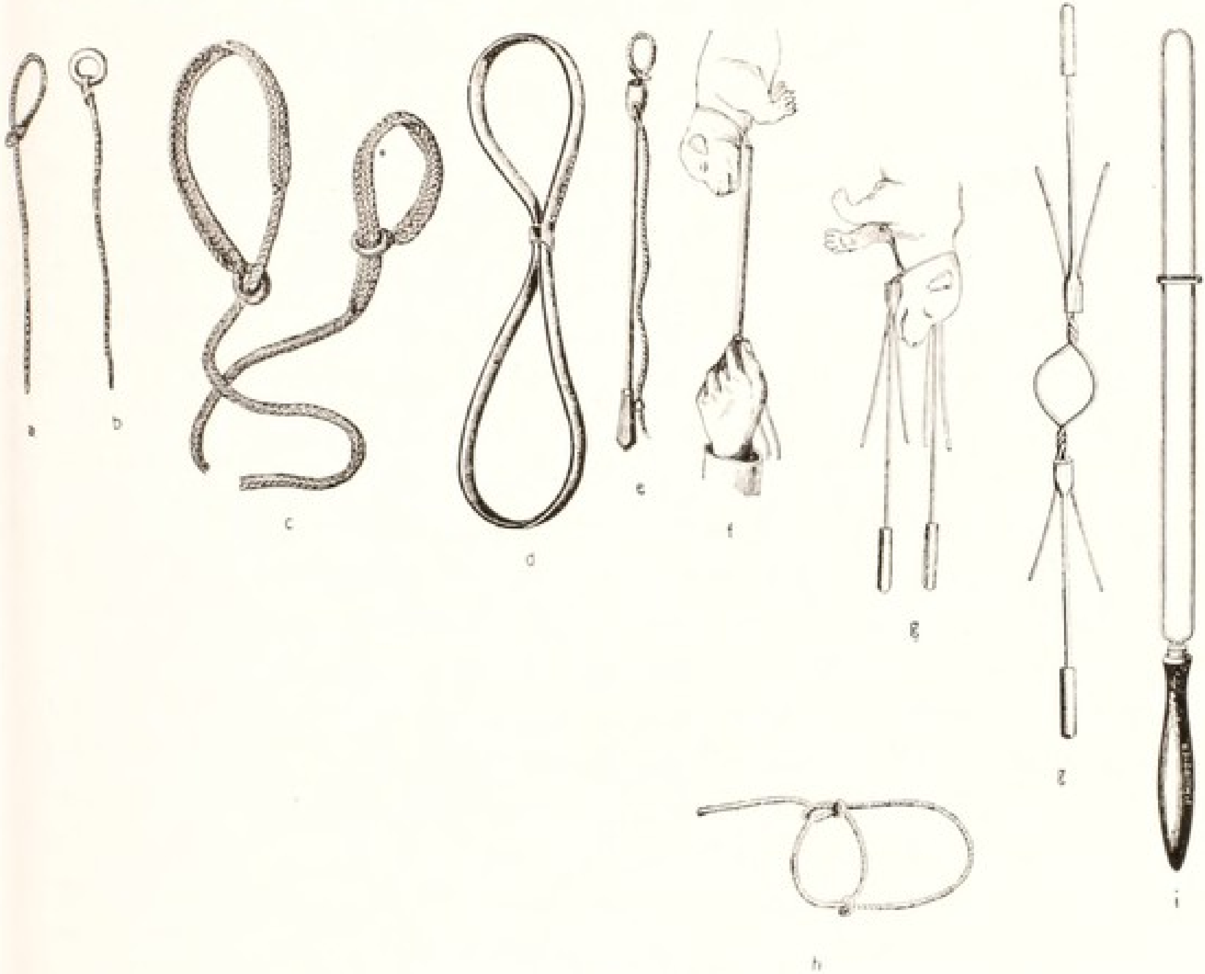


FIG. 99. CORDS AND TRACTION APPLIANCES.

a, ordinary noose with spliced loop.
b, ring noose.
c, braided obstetric noose.
d, Loweg's obstetric strap.
e, Darreau's long noose carrier.
f, Breulet's obstetric noose for dogs.
g,g, Defay's obstetric noose for dogs, closed and open respectively.
h, Rueff's obstetric halter.
i, obstetric noose of annealed copper wire. (Hauptner.)

obstetric work, and should be ready when wanted. Some writers claim that a cord with a running noose may injure the part of the fetus to which it has been attached, but this I have never observed.

Halters (Fig. 99 h) are recommended by some obstetrists, where traction is to be applied to the head, but these are exceedingly difficult of adjustment and are but little, if any, superior in efficiency to the simple cord or to the hook. It has been claimed that when the halter has been applied to the head of the fetus it possesses an advantage over the simple noose around the neck because it tends to keep the head in a direct line, which favors its passage through the canal. If a long cord is applied as a noose about the neck of the fetus and a second noose is thrown around the nose in the proper manner, one can draw directly upon the median line of the ventral surface of the head with the same accuracy and efficiency as with the best adjusted halter. The application of the cord in this way is simpler and easier than the halter. The objection may be raised that the running noose about the neck may strangle or otherwise injure the fetus. This is sentimental. While traction is being exerted, the fetus is not breathing, and consequently there is no interference with respiration, and evidently no other serious harm is probable.

Cords are applied to the limbs by two distinct plans. When the toe of the fetus presents toward the operator, the noose is introduced into the genital passages and slipped over the foot upon the pastern or above the fetlock, as may be desired. The noose is then drawn taut by the operator or an assistant, and secured upon the part.

A second method of applying the cord is used when the toe is directed away from the operator. The looped end of the cord is carried in the hollow of the hand to and around the limb which it is desired to secure. The end is carried around the limb as far as possible, dropped, and then grasped from the opposite side of the limb and drawn out through the vulva. By passing the distal end of the cord through the loop and drawing upon it with one hand while pressing upon the loop with the other, the noose is guided back to that part of the limb to which it is desirable or possible to secure it, and drawn tight.

In order to apply the cord, the fetal membranes must be removed from the limb at the point to be secured. Sometimes this offers considerable difficulty. If the cord is passed partly around the limb and released before the membranes have been well ruptured, the elasticity of the membranes throws the end of the cord away from the position in which it was deposited, and consequently it can not be secured from the other side. Even when the membranes are fairly well ruptured, there is sometimes difficulty because the cord follows the hand as it is withdrawn, and thus becomes displaced. It is of great advantage, in overcoming this difficulty, to fold and carry in the hollow of the hand the looped end of the rope in a mass. When the folded cord is delivered as far around the limb as is practicable, while the hand is being withdrawn the rope may partly uncoil and follow it, but most of the rope, including the loop, will remain in position, and may be grasped from the other side and drawn out. Some practitioners use a porte-corde, or cord-carrier (Fig. 111 f) in order to aid in securing the limb under the conditions just named.

When a cord is to be applied to the neck, and the head is in a direct line, it is best accomplished by slipping the noose back over the head until it rests upon the poll above and in the pharyngeal region below. With a simple loop about the neck, there will be a constant tendency for the head to deviate from a direct line, which may be overcome by taking a half hitch around the nose or the lower jaw, so that any traction which may be exerted will keep the nose and the head in a direct line with the genital canal.

One of the most useful places for the attachment of cords is the inferior maxilla of the fetus. In the various deviations of the head there are few methods which are more advantageous to the practitioner than traction upon the lower jaw. When properly applied, it affords a very secure attachment, which permits almost unlimited traction in a very advantageous direction. Some obstetrists have said that a cord could not be applied securely to the lower jaw of the fetus, especially the foal, because it very readily slips off. A cord can be very securely fastened to this part by the plan shown in Fig. 113. First, with the ring-knife or other cutting instrument, make an incision three or four cm. long, between the rami of the lower jaw, through the skin and superposed tissues, into the oral cavity. Next, pass the prepared noose of the cord over the jaw and push it back beyond the incision with the loop resting in the mouth of the fetus.

Then pass the free end of the cord through the incision from the oral cavity outward, and draw firmly upon the cord so as to tighten it, after which any amount of traction desired may be employed without any danger of slipping or of tearing out. By this method the two rami of the jaw are held together, instead of being split apart as when a hook is used. The objection may be raised that, in case of a living fetus, mutilation is caused, but the wound is so insignificant in character that there is no reason why it should not heal very promptly and without blemish.

In addition to cords and bands, there are used for applying traction, for small animals, such devices as a small tube of metal or other suitable material, through which is passed a wire loop, as shown in Fig. 99,f, or the more complex device of Defay, Fig. 99,g,g.

Hooks. Few obstetric instruments have been so much used and made of so many patterns as hooks. They may be either long or short, sharp or blunt. Some hooks are used singly and others in pairs. With short hooks or finger hooks, the traction must be applied by means of a cord passed through an eye in the hook or the hook is held in the operator's hand. Long hooks are applied to the desired point, accompanied by the hand of the operator, and traction is exerted from the outside through the aid of an assistant.

The advantages and disadvantages of long and short hooks are largely matters of personal experience. One practitioner becomes accustomed to the short hook, another to the long, and each believes that his kind is the better. As a matter of fact there are few things which can be accomplished with one of these hooks which can not be done with almost the same facility with the other. There are few, if any, places that a short hook can be applied where a long hook could not be inserted with equal facility, or vice versa.

There is one difference which is of importance. With the long hook the operator may, by pushing upon the instrument from the outside, aid the hand in reaching a trifle further and implanting the hook in a part which can not be reached with the short instrument. Also, the point of the long hook may be turned in any direction, through the agency of the outside hand, when such control might not be possible with the short hook wholly dependent for guidance upon the inserted hand.

In comparing the sharp and blunt hooks, most practitioners favor the latter for most excellent reasons. It is exceedingly difficult to apply a sharp hook with safety for either the mother or the operator. It is an ugly instrument to handle unless the patient is first placed under complete anaesthesia. When an

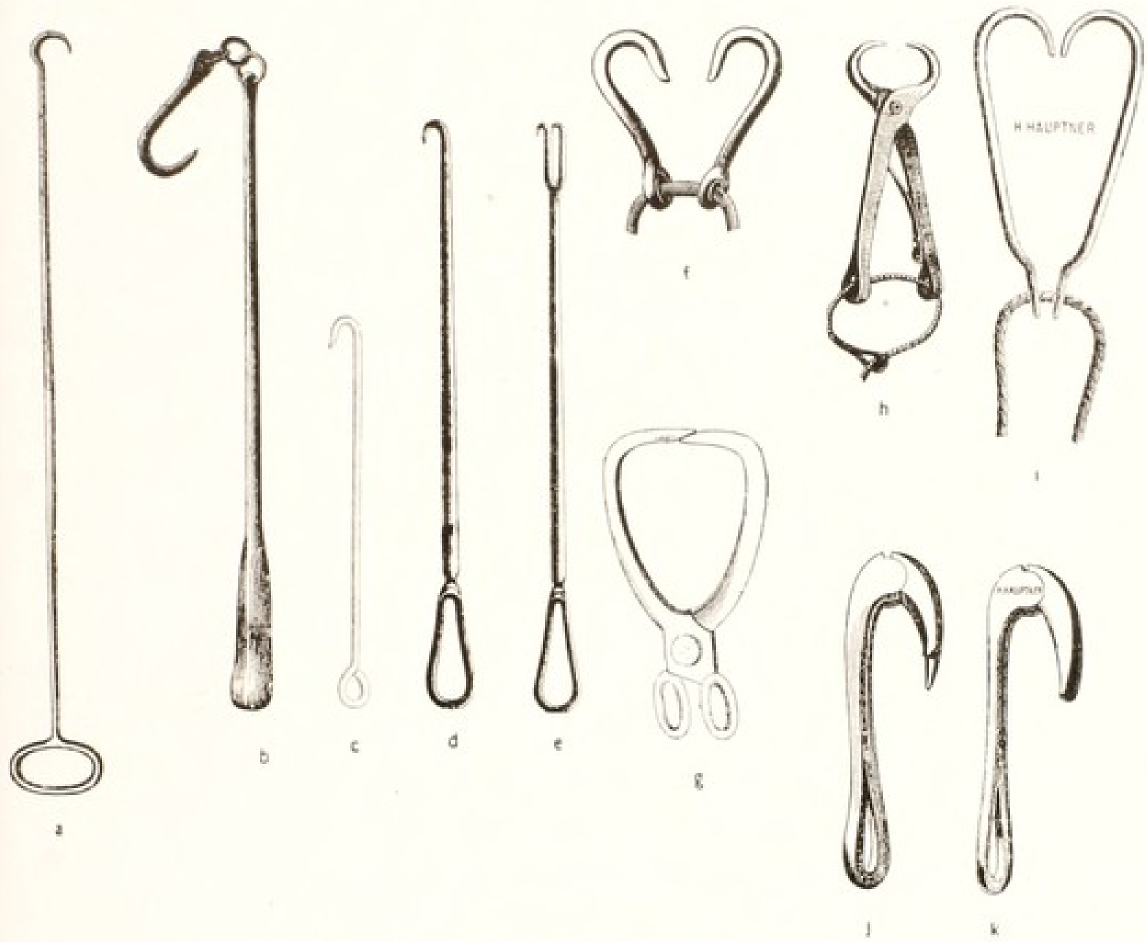


FIG. 100. OBSTETRIC HOOKS.

a, long embryotomy hook (39 in).
b, jointed obstetric hook.
c, rectal hook of Harms.
d, single hook for small animals.
e, double hook for small animals.
f, Harms' eye hooks.
g, Riemer's double obstetric hooks.
h, Brogniez's obstetric hooks.
i, Harms' flank hooks.
j, sharp hinged hook of Scharnier.
k, blunt hinged hook of Scharnier.
(Hauptner).

operator is carrying a sharp hook in his hand for insertion at a given point, the operation is almost certainly interrupted by violent expulsive efforts. It is only by the very greatest caution and dexterity that one can avoid at such times serious wounds of his hands or of the genital organs of the dam. After repeated trials with the sharp hooks, without finding them valuable in a single case, I finally abandoned all attempts to use them. Even should it be desired to fix a hook in a part where the blunt point would not penetrate, the skin may be incised and an opening provided for the blunt instrument.

The form of the hook is highly important. It is made in every conceivable form. Many makers, apparently ignoring all mechanical principles, construct an instrument which does not serve the purpose with that security and safety desired. Aside from the question of strength and finish, it is essential that a hook be so constructed that, when once inserted into the tissues and traction is exerted upon it, its form shall cause it to sink deeper and deeper into the parts and acquire a hold with constantly increasing security. The hook should leave the shaft at an angle of about 45° and continue in a straight line, or nearly so, to the end. The right and wrong forms of hooks are illustrated by Figs. 111 g and 100 a d respectively. A study of these instruments will show that 100 a, would have scarcely any tendency to sink deeper into the tissue, while 111 g would constantly press deeper into the parts to which it is applied. The width of the opening of the hook should not exceed 2.5 to 3 inches so that the operator may readily conceal it in his hand during insertion or withdrawal.

When a hook is used for the development of traction, whenever force is applied, the instrument must be constantly guarded by the operator's hand, lest it slip or tear out and lacerate the uterus. This applies with special force to the sharp hook.

In the application of hooks, the operator should always aim to select a point where the instrument will be secure against tearing out. In order to do this he needs have well in mind the anatomical structure of the fetus and the resistance of various parts.

Anteriorly, the hooks may be inserted with comparative safety in the orbit. The point of the hook should be sunk deeply into the orbit and should force its way through the bony walls of that cavity into the sinuses of the face. For this purpose the hook should be about three inches in length. In correcting a slight deviation of the head, it may be allowable at times to insert the hook into the lower jaw between its two branches, but this constitutes a very insecure hold, which will give way under very moderate traction and consequently does not permit of great force. When it is wished to apply severe traction to the lower jaw, the cord should be used as already described.

In the anterior presentation with deviation of the head so that it is directed away from the vulva, the nostril or the commissure of the lips may form an adequate point of insertion for the blunt hook for moderate traction, but as soon as the head is drawn to a position where it lies transversely to the pelvic canal the hold becomes insecure. However, the most urgent part of the correction has been accomplished.

When the fetus presents posteriorly, the points which offer the most secure insertion for hooks are the anterior borders of the bones of the pelvis. The hooks may be implanted in front of the pubic brim or of the ilium, or in the oval foramen, either

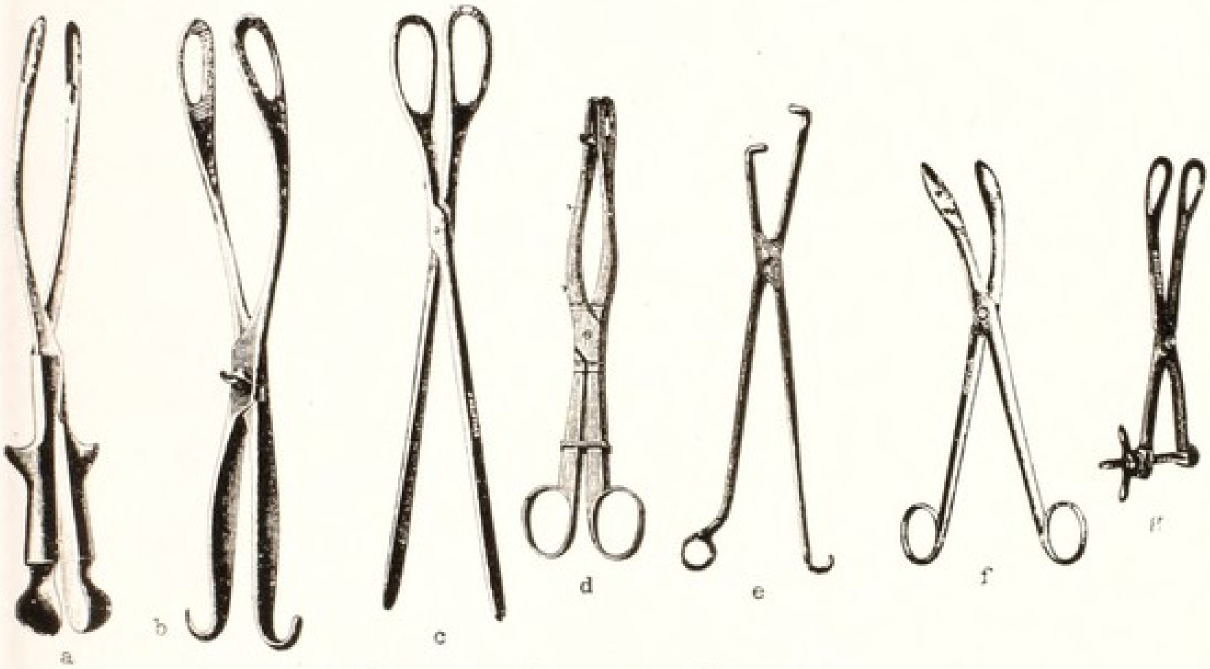


FIG. 101. OBSTETRIC FORCEPS.

a, Roeder's obstetric forceps for swine.
b, Walch's pig forceps.
c, Witt's obstetric forceps for swine and goats.
d, Moeller's bitch forceps.
e, Ellinger's pig forceps.
f, deBruin's forceps for sheep.
g, deBruin's bitch forceps.
(Hauptner.)

from without or from within. It is much safer to insert the hook in the pelvis from without, inwards. If inserted from within, the point of the hook must be constantly guarded, lest it push through the soft tissues of the fetus and lacerate the genital canal of the mother.

Obstetric forceps of great variety have been proposed, but they have not come into general use in large animals. The immense forceps of Jörg are too voluminous and heavy to be applied to the head of the fetus in the genital canal; if applied, no power of any efficiency could be exerted. Various types of these forceps have been invented, but each alike has failed to serve any purpose.

In small animals, obstetric forceps have proven highly useful and practical. They constitute one of the safest and most efficient methods for applying traction to the fetus of the cat, bitch, and sow. Some of the most useful of these are illustrated in Fig. 101.

Among the various means for the application of traction, the safest is the cord. It is the only appliance which the operator can leave unguarded.

Repellers

In obstetrical operations it frequently becomes essential that the fetus be pushed away from the vagina or cervix into the uterine cavity or the abdomen, in order that room may be obtained in which to make certain changes in the position of parts or to carry out other operations which may be essential to the extraction of the fetus. This procedure is designated repulsion, or retropulsion. The most primitive method is that of pushing the fetus backward by means of the operator's hand. This is the most effective means for bringing about changes in the location and direction of the fetus, because the force may be constantly applied at the proper angle and may be at once modified according to any changes in the position of the fetus during the progress of the operation.

Manual repulsion has the great disadvantage that it places upon the operator the full burden of a more or less difficult task and makes a demand upon his physical resources, which may later be sorely needed for the accomplishment of other important operations. In harmony with the rule already suggested, that the operator should delegate to other persons whatever they may safely and properly do, leaving him to direct the application of force, various appliances have been introduced to relieve the obstetrist from the physical strain involved in this operation. Some obstetrists have an assistant push against the operator's shoulder or, grasping his arm, push it forward so as to increase his power in that way, but, however great additional force he may secure in this manner, the impact still falls wholly upon the operator's hand and tends finally to produce fatigue. Another plan is to have an assistant insert his hand and arm alongside that of the operator and the two push unitedly against the fetus, but this does not give the very best results because the room for working with the two arms in the passages is not very ample and the two persons are somewhat in each other's way. In attempting this method of repulsion, the assistant stands with his back to the back of the operator. If the operator is using his right hand, the assistant inserts his left.

More commonly and preferably the extra force is applied by means of instruments, usually by a repeller or crutch, (Fig. 102). This instrument is made of variable size and form, usually about 30 to 36 inches in length. Cleanliness and neatness dictate that it should be of steel, well polished and plated so that it will not rust. Usually the crutch, or repelling end, is solid and describes the segment of a circle. It is made of varying width, usually entirely too wide. When made of good steel, ½ inch in diameter, it is abundantly strong. The length of the crutch should not exceed 3 inches. Some make the crutch very much wider than this, with the idea that it may thereby secure a safer hold upon the fetus and prevent the instrument from slipping off and injuring the mother. There is no occasion for a repeller to slip from its point of fixation, if properly made, applied, and guarded. If the instrument has too great a diameter, it is exceedingly difficult to introduce and may cause injury to the soft parts of the mother while being applied. After it has been located at the proper point and force applied to it, if the transverse diameter of the crutch is very great, the ends may project beyond the parts of the fetus to which it is applied, catch in the walls of the uterus or vagina, and more or less seriously injure them. A repeller with a very short crutch, or transverse piece, which may be readily introduced completely covered by the hand and easily applied to the desired part of the fetus, is greatly preferable. The repeller should be fitted with a moveable spike, as shown in E, Fig. 111.

Instruments for Section

Frequently the obstetrist is compelled to diminish the size of the fetus by excising one or more parts in order to permit of its easy passage through the birth canal. A great variety of instruments has been devised for this purpose. Each operator has his preference, and for each those instruments to which he is accustomed may be the best, because there is no place in the realm of surgery where familiarity with an instrument constitutes a greater part of its value to the operator than in embryotomy.

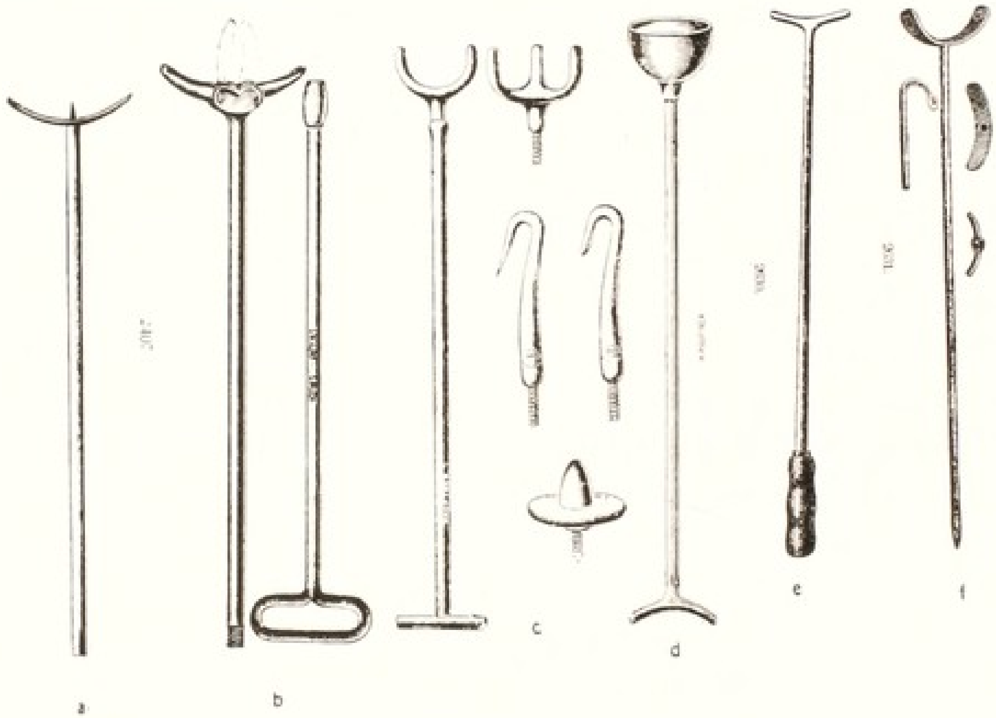


FIG. 102. REPELLERS.

a, Withers' repeller, (Sharp & Smith)
b, hinged repeller.
c, Reindl's repeller with attachments (2- and 3-pronged repellers, blunt and sharp hooks, and vaginal dilator). (Hauptner)
d, cup-shaped repeller of Binz. (Hauptner)
e, Günther's repeller. (Hauptner)
f, Kaiser's repeller with two detachable repellers and one cord-carrying hook.

Knives. First in importance in this group of instruments are the knives, of which there is an infinite variety. These may be divided into two great classes—the finger-knife, and the short-handled knife or scalpel.

The Finger-Knife (Fig. 103) which is attached to one of the fingers by means of one or two rings, is one of the simplest and most effective of all embryotomy section instruments, and is perhaps the most universally used. It is made in various shapes, according to the individual preferences of the operator. Most frequently it consists of a somewhat narrow blade which is curved downward.

For all those operations where it is desired to make a long, drawing cut, by inserting the hand to the point where the incision is to be begun and then making the cut as the hand is drawn outward, the blade may advantageously be hooked. In such a case the hooked knife sinks into the tissues automatically and the operator simply keeps his hand against the surface which he wishes to cut and draws the knife, guarded by his hand, backward.

Finger-knives, as made by most instrument dealers, are too long for the average operator and can not be easily handled. The operator with a small hand can not guard the ordinary finger-knife in such a way that he can readily introduce it to the point where he desires to work. Because of this difficulty obstetrists

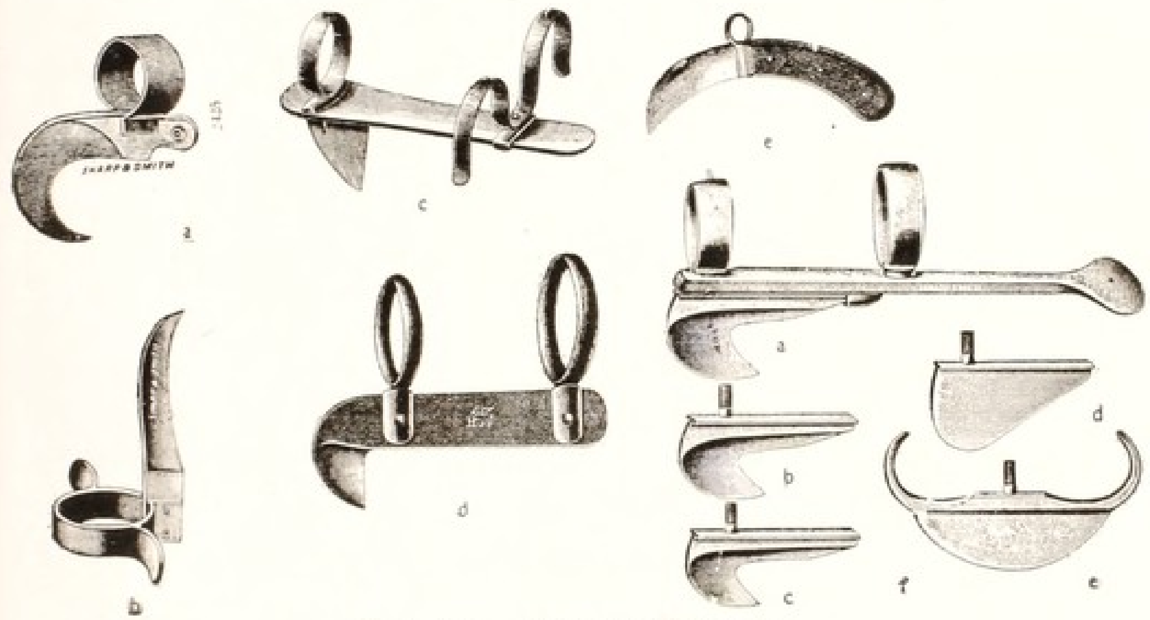


FIG. 103. FINGER-KNIVES.

a, full-curved obstetric knife.
b, half-curved obstetric knife.
c, Karl's embryotomy knife.
d, Günther's embryotomy knife.
e, Vienna embryotomy knife.
f, Danish embryotomy knife, with detachable blades of various patterns.

with short fingers need have finger-knives constructed to order. The blade of the finger-knife should be of such a length that, when it is placed upon the finger, the hand can close about it in such a way as to protect the point completely, with safety to the operator and to the patient alike.

The types of finger-knives (Fig. 103) are exceedingly variable, but the simpler ones (a and b) are as efficient as any after the operator once becomes accustomed to them. These instruments, which admit chiefly of incisions in a line parallel to the long axis of the operator's hand and arm, can not very well be used for a transverse section. One of the finger-knives with a single ring, which is larger than the finger, may be turned more or less obliquely across the hand and, by bending the finger somewhat, the operator may be enabled to make a transverse incision.

Scalpels. There is also a very extensive list of scalpels or bistouries with straight handles, the blades of which may be either naked or concealed. In some the blade is concealed within the handle; in others by a moveable guard.

The concealed types have a tendency to become swollen and refuse to work after they have been immersed in liquids for a time, especially those with wooden or bone handles. This criti-

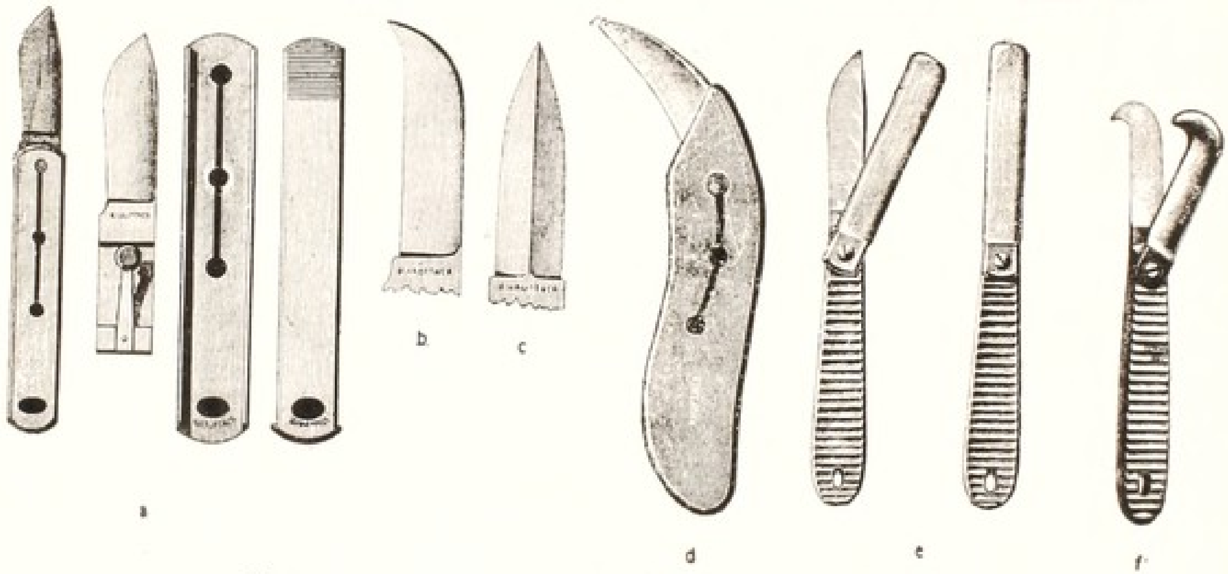


FIG. 104. CONCEALED AND GUARDED KNIVES.

a, b, c, concealed knife of Günther, with convex, concave, and double-edged blades. d, concealed knife of Deutsch. e, f, guarded knife of Kauffman, with convex and hooked blades.

cism does not apply when the instrument is constructed entirely of metal. A very good type of the concealed knife is that of Kauffmann (Fig. 104, e, f). An equally convenient, if not superior type of knife, is the Colin scalpel (Fig. 111 b). It is decidedly preferable that the instrument be constructed wholly of metal, so that the guard will not become caught because of the swelling of the handle.

The advantage of the scalpel over the finger-knife is that it may be turned in any direction, so that an incision may be made longitudinally or transversely, as the operator may desire. With it the operator may also make either a pushing (stab) or drawing cut, as may be desired. It has been suggested that an objection to this kind of knife is the possibility of losing it in the uterus, but in my experience this objection is not well grounded. To guard against such a possibility, some of these instruments

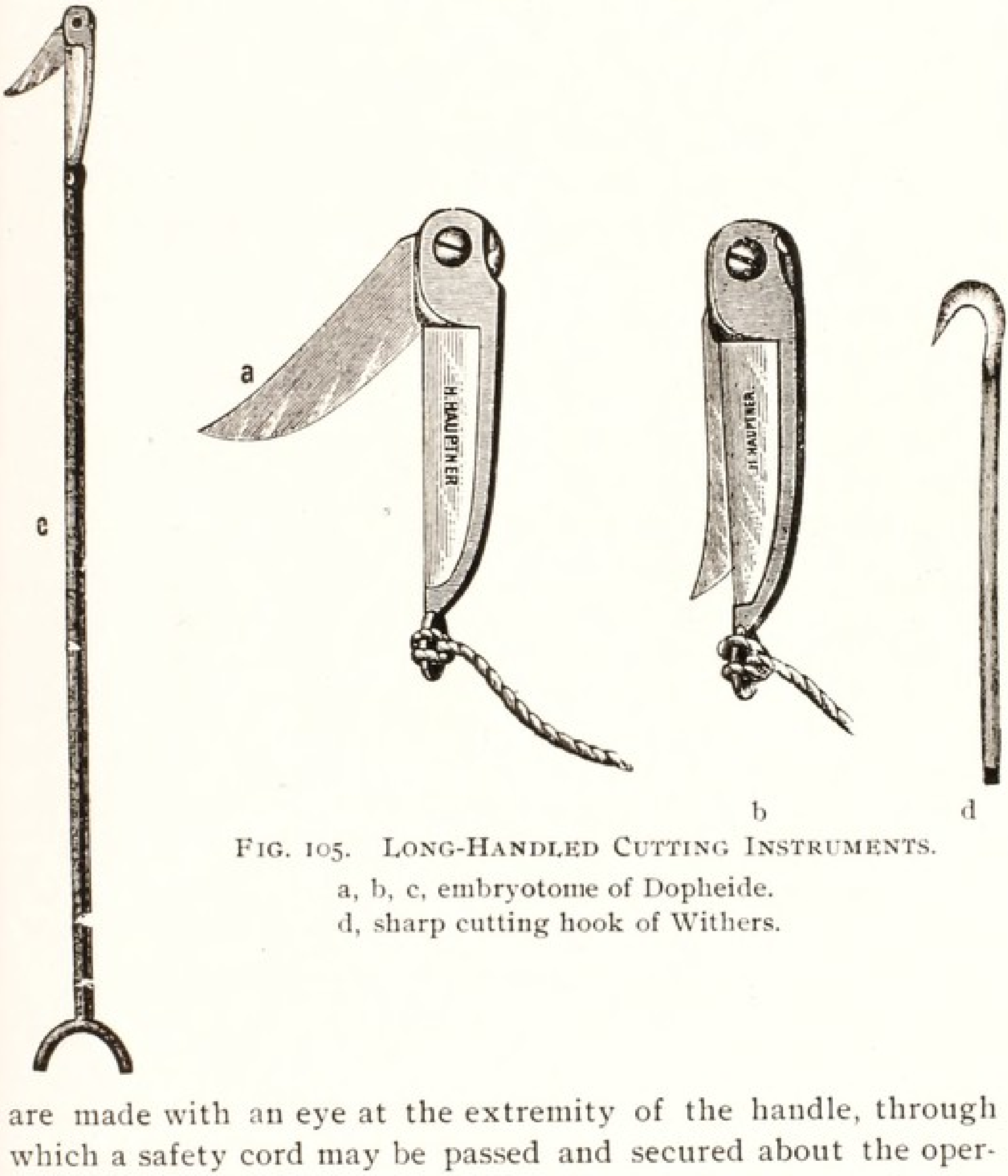


FIG. 105. LONG-HANDLED CUTTING INSTRUMENTS.
a, b, c, embryotome of Dopheide.
d, sharp cutting hook of Withers.

are made with an eye at the extremity of the handle, through which a safety cord may be passed and secured about the operator's wrist. It is important that these scalpels be made very short and the handle be of such a character as to afford a firm hold. The knife should not exceed four inches in length, so that it may readily be concealed in the hand aud carried to any part of the uterus.

Long Cutting Hooks, Sectors, and Embryotomes. In addition to the finger knives and scalpels, a great variety of larger instruments has been devised for section or other divisions of the fetus, known as long cutting hooks, sectors, embryotomes, etc.

The Long Cutting Hook is a long-handled hook the concave face of which has a cutting edge, as in Fig. 105, or h in Fig. 111. The cutting end is introduced to the desired point, carefully guarded by the operator's hand, and a drawing incision is made as the instrument is withdrawn, the operator's hand still accompanying the hook and controlling the extent and degree of the cut. The sharp pointed hooks are very dangerous to handle. If they are to be used at all, the hook should be very small and short, so that it can be easily guarded. The long, stiff handle makes it exceedingly difficult to guard the instrument while it is being introduced, so that any violent expulsive efforts or sudden movements of the mother are liable to cause a displacement of the instrument, with painful consequences to the hand of the operator or to the uterus of the mother.

The objections are overcome in some of these instruments by making the hook probe-pointed, as in h, Fig. 111. This instrument, which is easily and safely handled, proves highly useful wherever it may be applied. The obstetrist may readily sever the fetal ribs with it after evisceration, may divide the pelvic symphysis, or the pelvic girdle at other points, and accomplish other operations. It can not be used for cutting the skin unless an incision be made, through which the probe or sphere may be introduced.

Embryotomes. Embryotomes are of great variety in design and purpose. Some of the simpler ones do not differ essentially from the cutting hooks. The embryotome of Dopheide (Fig. 105) consists essentially of a closed knife attached to a long and rigid handle. When introduced to the part upon which it is desired to operate, the instrument opens automatically when the operator begins to withdraw it, and cuts deeply and freely through the soft tissues. In case it is desired to stop the incision at a given point, it is simply necessary to push the instrument backward again, when it closes, and can be grasped by the hand of the operator, which has been in contact with it at all times, and be easily withdrawn.

The embryotome of Oehmke, which appears to be a very practical instrument, has a lance-like blade which is exposed by pressing upon a spring with the finger and is kept exposed as long as the pressure is continued.

Most embryotomes (Fig. 106) consist of more complex machines, designed to cut, crush, or tear through any portion of a fetus to which they may be applied, whether the tissues be soft or hard. They have been used in obstetric practice for a great many years, but have not acquired a very wide application. They consist in many cases of two powerful, sharp blades

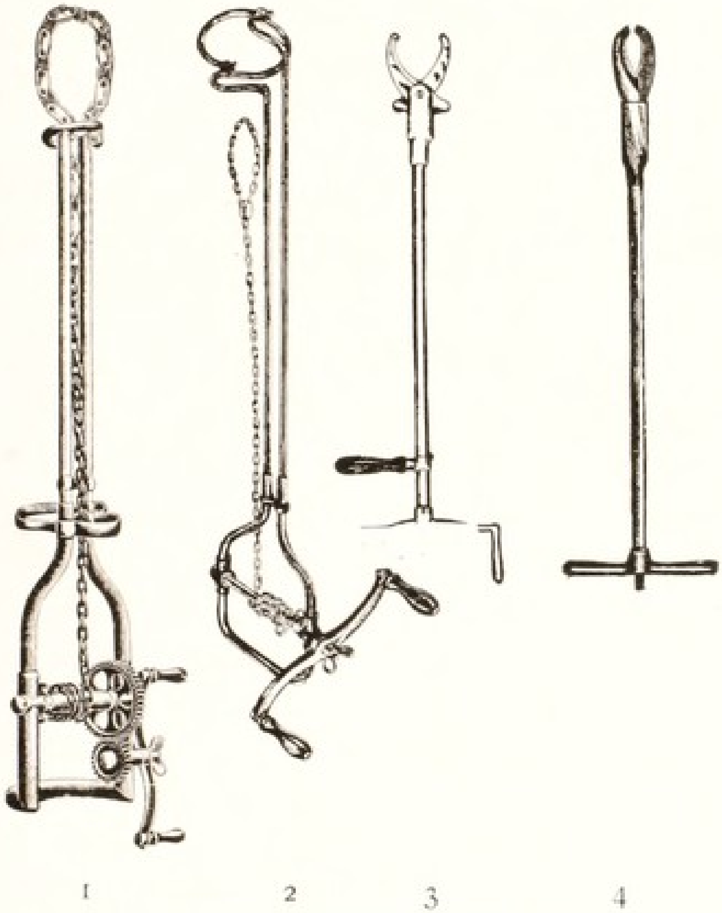


FIG. 106. EMBRYOTOMES, ETC.

1, Pflanz's embryotome (Hauptner). 3, obstetric shears (Haussman).
2, Pflanz's extractor (Hauptner). 4, Cullen's embryotome.

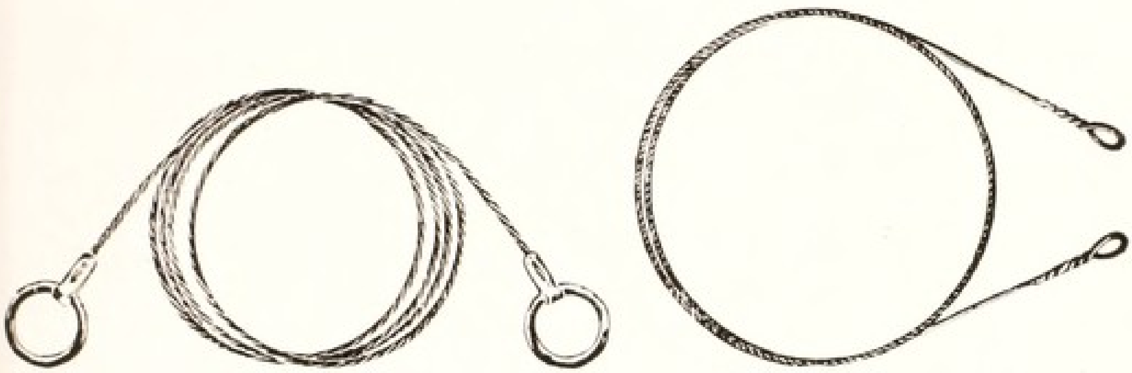
operated as shears by some mechanism which gives them sufficient power to cut through an extremity at any point where it may be grasped. Sometimes the instrument is constructed on the plan of an ecraseur, and a sharp chain is forced through the tissues. The Pflanz embryotome, (1, Fig. 106) and the Pflanz extractor (2, Fig. 106) popular in Germany, illustrate this type of instrument. The former consists of a heavy frame-work which might be likened to that of an ecraseur, with an ordinary strong chain, which is passed around the part of the fetus to be divided. By drawing upon this, the sharp chain or sector is brought in contact with the part to be amputated and forced through the soft tissues and bone. The instrument is said to be highly effective, but according to reports by some of those who are its most enthusiastic admirers, it frequently can not be applied to a part which is to be amputated. The instrument is expensive, weighs approximately ten pounds, and is quite cumbersome. Similar objections apply to other embryotomes. They are so large and heavy that they are exceedingly difficult to introduce into the genital passages. When they have been introduced, the part which is to be amputated must present in a position essentially perpendicular to the long axis of the pelvic canal, since otherwise the instrument can not be applied to it.

a b c

FIG. 107. OBSTETRIC SAWS AND SECTORS.
a, Persson's obstetric saw. b, chain sector of Masch.
c, obstetric saw of Öhmke.

Aside from their expense, their cumbersomeness in carrying, and the difficulty or impossibility of applying them to the desired part, they are exceedingly difficult to care for and disinfect. When once applied, their action is generally satisfactory, if not ideal. The extractor of Pflanz, (Fig. 106) is designed, through its powerful mechanism, to tear away a fetal limb, the ring at the distal end receiving the entire impact of the tension upon the limb by the chain, thus relieving the maternal parts from any pressure.

Chain Saws. Somewhat closely allied to the embryotomes are the chain-saws, like that of Persson, (Fig. 107 a) or the chain sector of Masch (Fig. 107 b) which have been recommended for the same purposes as the embryotomes and are operated by being passed around the limb or neck of the fetus which is to be amputated, and then drawn back and forth in a sawing manner. They are effective in their work and in some cases offer special advantages, but on the whole they have not come into general use. They are comparatively expensive, rather difficult to apply, not very rapid in execution, and exceedingly difficult to maintain in aseptic and working condition.



a b

FIG. 108.

a, five-foot wire saw of Van.
b, three-foot wire saw of Gigli.

Recently the wire saw has been introduced and found highly efficient. It is cheap, light, and compact, readily applied, works very rapidly in skin, muscles, and bone, and is readily sterilized. It is not durable. Since it is cheap, the obstetrist should always carry a reserve instrument, to avoid embarrasment in case of a break.

Stiff-handled obstetric saws are also recommended by some practitioners. Short finger saws, with short handle and finger-ring like c, Fig. 107, are recommended by some, but they have little efficiency in most cases because wholly dependent upon the inserted hand, tightly compressed and largely powerless, for any use. Long-handled saws are more workable because the saw can be guarded with the inserted hand and the force applied with the free hand. They can be used in no operation and applied to no part for which the obstetric chisel is not equally efficient and safe. I have repeatedly attempted the use of chain-saws, sectors, and stiff-handled saws, and have always laid them aside as greatly inferior to the chisel.

Obstetric Chisels. The simplest, and one of the most effective implements for section of fetal bones is the embryotomy chisel, which, like other instruments, is constructed in a variety of forms. I use a chisel (Fig. 111 d) made of the best steel, $\frac{1}{2}$ or $\frac{5}{8}$ inch in diameter and 30 inches in length, with the chisel end 2 inches wide and tapering gradually backward toward the handle for a distance of 4 or 5 inches. The chisel blade is about $\frac{3}{16}$ to $\frac{1}{4}$ inch thick, so that it may safely pass through the hardest bone in the fetal body. The cutting edge of the chisel is made slightly concave in order to render it less liable to slip to one side.

Grasping the chisel blade in his hand, the obstetrist carries it to the part to be operated upon and, placing the instrument in the best direction possible, against the part, he instructs an assistant to drive it through the tissue with a mallet or hammer. When driving the instrument through bone, it should be forced but a short distance at a time, then loosened, and perhaps revolved on its long axis in order to pry the bones apart and also to avoid driving the chisel too far and having it become caught in such a way that it is difficult to remove.

In amputating a limb, the chisel should not be placed upon its centre, but at one side, so that it will cut completely through the tissues on that side to which it is applied, and not be driven clear through the limb with some of the tissues intact upon either side, and thus caught and held as though in a vice.

Such an instrument is cheap, is easily and safely applied by the operator to any point within his reach, can be readily driven through any tissue of the body, whether soft or hard, has little tendency to break or get out of order, is easily kept clean, and will accomplish any task in embryotomy which can be performed by the chain-saw, by the Pflanz embryotome, or by any machine, however complicated or expensive. It can be applied to any part where the other instruments can, and in many places where they can not be, or only with very great difficulty. In the amputation of the pelvis and posterior limbs, in the breech presentation, it is the instrument par excellence. In the amputation of the limbs, it is quickly applied and safe, and its work is rapid and efficient. Other types of obstetric chisels are shown in Fig. 109.

Supplementary to instruments for section, there have been introduced and recommended by various operators a group of blunt, flat instruments known as spatulae, designed primarily

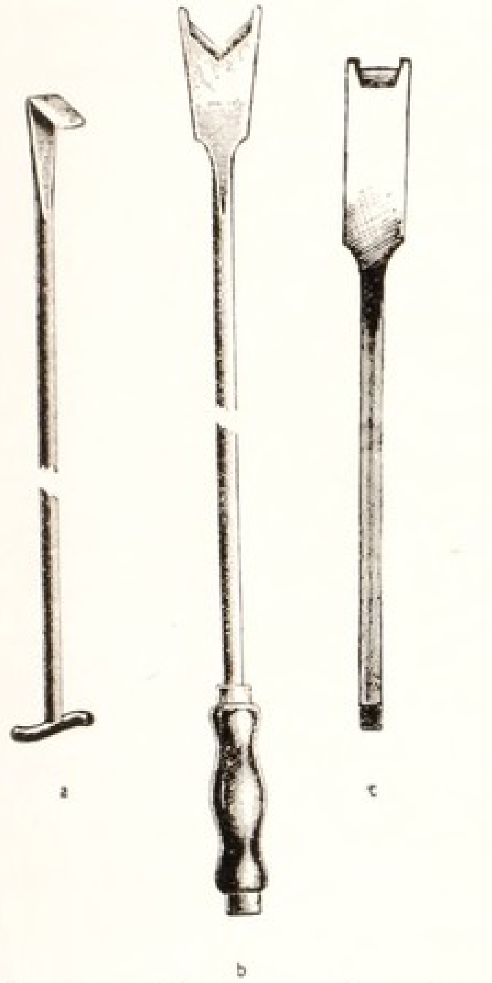


FIG. 109. OBSTETRIC CHISELS.

a, de Bruin's vertebra knife.
b, de Bruin's embryotomy chisel.
c, Withers' embryotomy chisel.

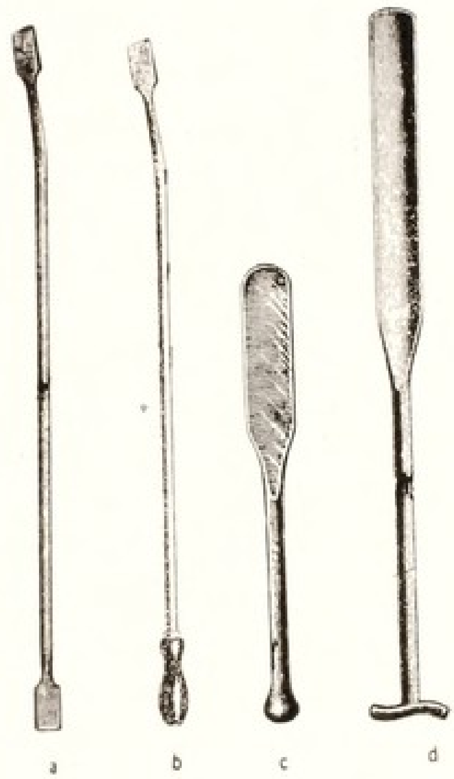


FIG. 110. SPATULAS.

a, spatula of Harms.
b, spatula with handle.
c, small spatula of de Bruin.
d, curved spatula of de Bruin.

for the purpose of separating the skin of the fetus from the subjacent tissues. They have a degree of merit, and aid considerably at times in hastening the operation of detaching the skin from the fetus, thus facilitating an early completion of the operation. Like all instruments, they are made in a great variety of types. Some of the most useful of these are shown in Fig. 110. They are not essential, but rather auxiliary, and their place may well be taken by other instruments. In separating the skin from the subjacent tissues, one may with convenience and efficiency use the thumb, fingers, or entire hand.

General Observations Upon the Construction of Obstetric Instruments.

Obstetric instruments should be of such a character as to render them easily cleaned. They are most readily kept in order when constructed of steel, highly polished and nickel plated. Such instruments are not readily attacked by rust, are very clean, and present the smoothest possible surface, reducing to the minimum the irritation to the genital organs. They should be as smooth and well rounded as practicable, not only that they may work more readily, but also that there may be less opportunity for the collection of dirt at any point, which may interfere with their operation or constitute a bearer of infection. This naturally suggests that the instruments should be of the simplest character consistent with efficiency and that screws, joints, links and chains should be avoided whenever and wherever practicable.

There has recently entered into veterinary practice a strong tendency to the construction of jointed instruments which may be unscrewed and consequently occupy a small compass, or rather a shorter space, than if made solid. It must be granted that such instruments admit of being placed in a more compact case, and this is really the only advantage which can be claimed for them. They possess many disadvantages. The jointed instrument is inevitably weaker than the solid one, and must be made heavier in order to compensate for the joint. The joint, especially the screw, constitutes an ever present danger from the standpoint of infection and renders the instrument exceedingly difficult to clean. One of the most serious objections to the obstetric instrument with a joint is its inefficiency at a critical moment. An operator works for a long time to apply an instrument at the proper point in order to accomplish a certain purpose, and, just as he is ready to do his work, a sudden movement of the animal, or other causes, leads to an unscrewing of the instrument. His time and labor have been wholly lost: the instrument must be withdrawn and the screw joint tightened, and the operator must begin over.

It is a custom also to fit a series of obstetric instruments to one handle by means of a screw, with the idea that the outfit is rendered cheaper, lighter, and more compact. This plan has a very serious disadvantage in reference to efficiency in practice. Convenience in carrying an instrument should be subordinate to the question of efficiency when the operator has reached his case. If he has been using an adjustable handle with a hook, and finds that he would like very much to have a repeller instead, he will perhaps find the hook so tightly screwed fast that he can not release it and must ask some bystander with dirty hands to unscrew it for him. In the meantime, delay of an important character may have occurred, and the position of the fetus may have undergone unfavorable change. He may desire to hold a certain part with the hook while he uses the bone chisel or some other instrument, but, since he is without a handle for the other, he can not simultaneously use the two. At every point the plan of a universal handle for all obstetric instruments is wasteful of time and detrimental to efficiency. After all, the gain in reference to compactness is not very great. If the instruments are solid, the case or roll to contain them is necessarily longer, but need not be so wide nor so thick, and the actual cubic space occupied by them is not changed. The weight is no greater with the solid than with the jointed instrument. It is therefore a question of the form of a container, and not of its cubical contents or weight. Therefore I favor a solid instrument, believing that with it the veterinarian can do more rapid, more efficient, and safer work.

The handles of obstetric instruments are variously formed and have certain advantages in their structure. The most efficient handle is that consisting of an oval ring of sufficient size for the insertion of a man's hand, or about 3½ inches. With the ring handle, the operator or an assistant can exert his full power either in repulsion or in traction, may revolve the instrument upon its long axis, or may push it in any direction. The revolving of the instrument upon its long axis is frequently of supreme importance in obstetric operations, and one needs have a secure hold in order to accomplish this movement.

It is especially important to be able to rotate a chisel upon its long axis when it is being driven through bones and it is desired to break apart and separate the bone which has been only partially divided. It is also highly important that the operator or assistant shall be able to revolve the instrument upon its long axis in case he is attempting to implant a hook in a given part. The repeller also is much safer if the operator or assistant can control it completely and either turn it upon its long axis or prevent it from turning, as demanded. The other forms of handle ordinarily seen in obstetric instruments are the straight or olive-shaped handle, usually of wood, and the bar or transverse handle, usually of metal. The olive-shaped handle is in many respects the neatest and occupies less space in a container, but it is decidedly wanting in efficiency as compared with the ring handle. The bar handle is efficient, but less convenient for grasping than the ring, and the projecting bars tend to catch against objects.

Obstetric Outfits.

The veterinarian should have ready at hand an outfit for obstetrics, which he can secure promptly upon the receipt of a call, knowing that he will have in his possession every instrument and appliance or other material which the exigencies of difficult labor may demand. Many instrument makers prepare sets of obstetric instruments in neat cases, which are very convenient in so far as the instruments themselves are concerned. They contain, as a general rule, an extensive array of instruments which, in many cases, are better fitted to impress the bystander than to accomplish efficient work. The obstetrist's outfit need not be expensive nor consist of a great number of instruments or appliances. Figure 111, with wire saws (Fig. 108) added, illustrates a simple and efficient outfit for obstetric work.

These instruments should be placed, in an orderly manner, in a compact case of metal (tinned copper) or in a canvas roll, that may at any time be thoroughly disinfected, either with or without the instruments, by immersing it in an antiseptic fluid or by boiling. If it is desired to protect a metal case of this character in handling and carrying, it can be enclosed in a canvas jacket.

In addition to the instruments suggested here, the veterinarian may readily add others, which he can include in the same case if he desires, and which may in his experience possess a very high value which would fully warrant their use. For a number of years I carried a list of instruments considerably in excess of those here designated, but from time to time first one and then another was discarded or left unused, until finally they were narrowed down to the very brief list shown.

In addition to these instruments, there are other necessaries, which the veterinarian should always carry in a separate container. This, like the instrument case, should be of a construction which will render it capable of convenient and thorough dis-

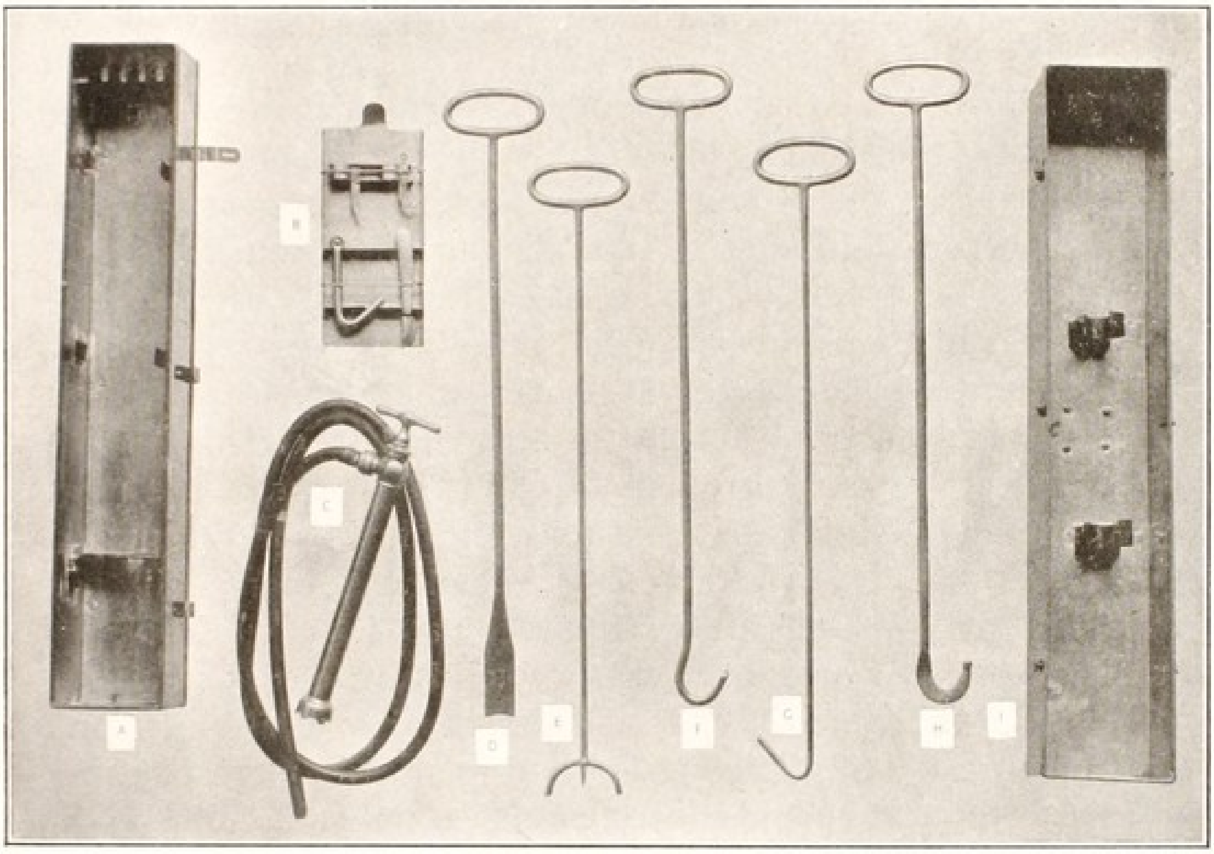


FIG. III. OBSTETRIC SET.

a, tinned copper case.
b, tray containing 1 short blunt hook, 1 Colin's scalpel, 1 curved finger knife, and 1 straight finger knife.
c, enema pump, with pure gum horse stomach tube instead of customary tube and nozzle.
d, embryotomy chisel.
e, repeller with detachable spike.
f, curved cord carrier which may be used as a blunt hook.
g, long blunt hook.
h, long-handled cutting hook with probe point, for severing ribs and pelvic bones.

infection or sterilization. In it one should carry clothing for the operator ; disinfectants ; anaesthetics ; general operating instruments, including a trachea tube and a trocar; hypodermic syringe; strychnine, adrenalin, pituitrin, or other hypodermic remedies.

The Dress of the Operator

In dressing for an obstetric operation, the veterinarian should have due regard for his health and comfort, for the safety of himself and the animal from infection, and for convenience and economy. He is quite unwarranted in going into work with dirty clothing. It is a disgrace to his profession, an insult to his client, and a danger to his patient. The veterinary obstetrist is equally unwarranted in ruining expensive clothing in the course of his work. The habit of some veterinarians of wearing filthy overalls which have been used previously in general work and befouled with discharges from suppurating wounds, putrid afterbirths, etc., without having been thoroughly washed and sterilized, can not be too strongly condemned.

The clothing of the obstetrist should afford ample protection from cold and wet, and should be scrupulously clean. Whenever the weather and surroundings will permit, one of the most convenient and efficient methods for operating is for the practitioner to strip to his waist line; when conditions will not warrant this he should, after stripping, put on a white blouse without sleeves, which has been thoroughly washed and boiled and is at least practically, if not technically sterile. If it is necessary for his comfort that he shall wear still more clothing about his chest, it should consist of cotton under-clothing without sleeves.

One may work fairly well in a blouse with long sleeves by rolling them up, but the rolled sleeves soon become saturated with discharges from the animal and probably annoy the operator also by becoming unrolled. Moreover, the roll interferes to some degree with the reach of the arm, and the operator can not bring the shoulder in so close contact with the vulva of the patient.

Some writers upon obstetrics advise the use of woolen instead of cotton clothing and speak especially of a warm woolen jacket, but this material is difficult to cleanse because it will not withstand boiling. The operator is consequently forced to resort to the use of disinfectants which may prove more or less inefficient for the purpose desired. The protection of the lower parts of the body is an important problem.

Frequently the operator must kneel or lie down behind a recumbent animal in a place which is none too clean, with the result that, with any form of pervious clothing, he is soon saturated to the skin. The operator is best guarded by wearing rubber trousers, which are highly efficient for the purpose and are reasonably cheap and durable. Made of rubber cloth, they are quite impervious to fluids of every kind, so that one can kneel, sit, or lie in any position behind a recumbent animal with impunity. If to these is added rubber leggin boots, the operator is in a position to protect himself and to come out of the worst and most repulsive dystokia operation reasonably clean and comfortable. The rubber trousers and leggin boots have the disadvantage of not being very resistant to some antiseptics. A strong solution of carbolic acid may ruin the fabric. However, they will withstand moderately strong solutions of antiseptics, as strong as needed in the work, with comparative impunity. They present a smooth surface, which washes so easily that they can be quite thoroughly cleansed in a mechanical way. They may be quite well disinfected after use with a solution of formalin or other antiseptic which will not destroy the rubber.

Position and Control of the Patient

One of the most disagreeable features to the veterinary obstetrist is the surroundings in which he finds his patient and is compelled to do his work. In many cases this is inimical to his comfort and health, and it is sometimes a question how far it is proper for him to ignore these factors in the course of his professional duties. It is clearly the duty of the owners of animals to provide a comfortable and proper place in which the veterinary obstetrist may work, and it is clearly not the duty or function of the veterinarian to ignore comfort beyond a reasonable degree.

Sometimes a stable is exceedingly cold, but this, as a rule, does not seriously discomfort the veterinary obstetrist, since once he is engaged in his work he can usually keep warm. Sometimes the place for his work is disagreeably hot. In one instance, working in the hot sun upon a recumbent mare in an open field, my arms were so badly sunburnt that I was incapacitated for some days. Clearly it is the duty of an owner of an animal in such a position either to provide some means for transporting it elsewhere or a shade for the protection of the operator during the work.

In many cases the animal affected with dystokia is confined in an exceedingly filthy place, where one can not touch anything without becoming begrimed with dirt. The veterinarian should demand that such a place be cleaned up, and that appropriate tables or other conveniences be supplied upon which his instruments and apparatus can be placed, where they can be handled without getting them befouled. In other instances, the stall or stanchion is wet and filthy from feces and urine. The practitioner shonld demand that the filth be removed and an abundance of clean, dry straw or hay supplied to cover the floor, where the work must be done.

Sometimes the room is inadequate, so that one can not operate. The room may even be unsafe, as when an upright post stands in close proximity to the rear end of the patient, so that in case of lateral movements the operator may be caught between the post and the patient, and his arm more or less seriously injured. In other cases a cow suffering from dystokia may be confined in a stanchion with a deep gutter behind her, which may be a constant menace to the veterinarian, if he makes a misstep. If an animal must be operated upon with such a gutter in close proximity, it should be securely covered over with boards in such a manner as to insure against accident, and over these there should be spread a goodly amount of clean bedding.

If the room where the animal suffering from dystokia is confined is wholly inadequate, for any of the reasons mentioned or for others, the animal should be removed to a proper place for the work. If a mare or cow is able to walk, it is an easy matter to move her to another building, where reasonable comfort and convenience can be had ; if she is recumbent, that is no bar to getting her into a comfortable place. If a goodly amount of bedding is thrown upon the floor, a cow or mare can be taken by four or five men for a few feet, or a few rods for that matter, without much delay or difficulty, if the veterinarian knows how to control their efforts. For this purpose it may be necessary to demolish a partition or to take other action which may to some extent injure the owner's property or cause him some labor to repair, but the operator is entitled to such surroundings as will furnish him with a reasonable degree of safety and comfort and permit him to do his work in a way which will promise success.

The position of the pregnant animal during obstetric operations is of fundamental importance. In the larger animals most operations can be best carried out with the patient in the standing position. In this position the abdominal floor slopes downward and forward below the pubis and the gravid uterus drops forward toward the diaphragm. This admits of readier repulsion of the fetus, facilitates the correction of any deviations in its extremities, and favors the carrying out of most obstetric operations.

Sometimes the animal, especially the cow, is exceedingly obstinate and refuses to stand even under the greatest punishment. It is usually of little use to lift the cow by force, because she absolutely refuses to try to stand. If slings are placed under her and she is raised by means of pulleys, she still thwarts the obstetrist's aim by lying limp in the apparatus and producing the same or even worse conditions than though she were lying down. The most efficient method of getting an obstinate cow to stand is by means of a well-trained dog. When such a dog is brought into the stall and will take hold of the cow in a vigorous manner, if she has enough strength to rise, she will get up very promptly, and, as long as the dog will stand by, ready to interfere the moment she attempts to lie down, she will continue to stand as long as she is able.

Some animals suffering from dystokia are vicious, and the operator must take precautions against injury from them. In carnivora it is wise to muzzle the patient before attempting any work which may induce any vicious resistance. In ruminants there is almost no danger to the operator because of any viciousness upon the part of the patient. Very rarely the cow may kick, but this is usually more annoying than dangerous. It is very rare that the mare offers any violent resistance to the work of the operator. It has been suggested that in all, or in most cases, an assistant should hold up the mare's forefoot, but in an extensive experience among mares I encountered only one which required any definite restraint in so far as viciousness was concerned. Almost always the mare stands quietly, or at most merely steps from side to side, and does not offer to kick. In one case I found it necessary to cast the mare and tie all four feet, because she persistently and viciously kicked and fought, rendering our work both highly dangerous and wholly inefficient, until she was thoroughly secured. Securing the animal, by tying, compressed the abdomen and increased greatly the difficulty of the operation. The difficulty would have been completely and far better obviated by general anaesthesia. When anaesthesia is not available and a mare must be tied down, it is best to secure her in lateral recumbency with her croup markedly elevated. The anterior and posterior limbs should not be tied together, as this brings pressure upon the abdomen and thence upon the uterus and its contents. It is best to secure the patient by the head to a post or other fixed object, and then stretch her by firmly drawing the hind feet backwards and securely fixing them there.

Although the standing position is usually the most favorable one for operating, in some instances recumbency is preferable. Whether the recumbency is unavoidable or is brought about by the operator for special reasons, the position of the recumbent animal is highly important. If, for instance, an animal is recumbent and there is a deviation of the fetal head toward the left side of the mother, it would be highly unfavorable for the operator, should the mother lie upon her left side, because the weight of the fetal body would thus be thrown upon its head. This would necessitate lifting the fetal body in order to correct the deviation of the head and bring it into the proper position. If the patient lay upon her right side instead, the fetal head would rest upon its body and it would be more readily extended. Hence in many instances it is desirable to change the attitude of the recumbent animal or even to cast the patient in order to effect certain manipulations or changes of position. Usually, when an animal is recumbent, she should be placed with her hind parts elevated, in order that the fetus may drop away forward toward the diaphragm, affording increased room for repulsion, changes in position, or other desired operations. It is important generally that the recumbent animal should lie prone upon her side with all her limbs free and extended.

It is very disadvantageous to the operator for the patient to lie upon her sternum, since this position causes undue pressure upon the abdomen and crowds the gravid uterus against or into the pelvis so tightly as to render repulsion well-nigh impossible, and any other changes in the position of the fetus or the correction of any deviation of an extremity very difficult.

In order to elevate the hind quarters of a recumbent animal, extra bedding is sometimes placed beneath the posterior parts to any degree desired, but this is not at all efficient. Sometimes advantage may be taken of sloping ground, such as a terrace. I have sometimes placed an animal in a door-way where the floor within was higher than the ground without. The door-sill is well padded with straw, and the cow is placed with her head outward and her buttocks in the stable, at the higher elevation. The elevation of the posterior parts is best and most efficiently obtained by placing the recumbent animal upon a heavy door or on a platform of heavy boards, and raising that portion of the door or platform upon which the posterior portion of her body rests, supporting it by means of blocks placed underneath. Usually, the greater the elevation of the posterior parts of the recumbent animal, the better for the operator. In order to prevent the patient from sliding down the incline, ropes may be attached to the hind feet, and held by assistants or attached to a post or beam.

Even greater advantage may be afforded sometimes by placing stout ropes upon the hind legs, carrying them over pulleys attached to a beam above, and, turning the patient upon her back, more or less completely suspending her with the head downwards. This causes the fetus, along with the rumen and other viscera, to drop forward by gravity, and affords room for version or other manipulations. The position can not be maintained for a very long period. The question of the exact position of the patient during obstetric operations is to be determined in each case by the character of the obstacle to parturition.

The expulsive efforts of the mother frequently constitute an important impediment to obstetric operations, and sometimes render an otherwise very trivial procedure exceedingly difficult, or impossible. Sometimes the slight deviation of a forelimb could be corrected in a few minutes if the patient would not strain, but under constant and violent expulsive efforts it may become a very laborious operation of long duration. So with many other manipulations. It is consequently important that one should understand and apply as fully as possible all means for controlling the expulsive efforts of the mother.

In many cases the expulsive efforts may be largely prevented by attracting the animal's attention, either by frightening it somewhat or by some physical punishment of a moderate character. In the mare a twitch upon the nose will sometimes tend to inhibit violent expulsive efforts. In other cases slight strokes upon the nose and lips with a strap, stick, or rope will so attract her attention as to stop the straining. The owner may be able to attract her attention by gently stroking her with the hand, moving her head up and down, or otherwise holding her attention.

The mare and cow may be, to some degree, prevented from straining by pinching the back or loins with the fingers or by placing a stick of wood, especially one with square corners, across the loins, and having a man on either side press down upon it in a way to cause pain when she attempts to arch her back in an expulsive effort. In the cow straining may be overcome by tying a hard rope across the back in such a way that it will not permit her to elevate the spinal column. One end of a coarse rope is attached near the floor on one side and carried over her loins, drawn through a ring or around a post near the floor upon the other side, and made fast so that the cow's back can not be raised above the normal level.

It has been proposed to overcome the violent expulsive efforts of large domestic animals by means of tracheotomy. In this way the animal can not strain so hard because she can not close the larynx and retain the air in the lungs. This can not however overcome wholly the expulsive efforts, but is worthy of trial.

When these expedients fail or it is desired to control wholly the struggles and expulsive efforts of the animal, one should resort to anaesthesia. I have used chloroform anaesthesia in dystokia in the mare, with the best results, and feel that this method of control has been entirely too much neglected by veterinary practitioners. The veterinary obstetrist, especially when dealing with mares, should always carry a sufficient amount of chloroform to produce anaesthesia, and should be ready to resort to it whenever the exigencies of the case, either from a humane or a surgical standpoint, may demand it. An intelligent layman, with such oversight as the obstetrist can give, can as a rule continue the anaesthesia, in the absence of a trained anaesthetist, after it has once been established.

The Examination of the Patient

Before proceeding with any operations in cases of dystokia, it is essential that the practitioner should make a careful examination of his patient. First he should determine as well as practicable her condition, whether she is strong and vigorous or weak and debilitated. He should note if there is anything in her general condition which would suggest some serious or fatal internal lesion, such as hemorrhage from a uterine rupture. This knowledge can be gained partly by the general appearance of the patient and partly by the examination of the pulse and visible mucous membranes.

It is highly important, both from a forensic and a professional standpoint, that the veterinarian determine very early whether empirics or others have meddled with the case prior to his arrival and have caused thereby more or less serious injury, which, if passed unnoticed, may lead later to serious embarrassment. It is exceedingly unfortunate, for example, for a veterinarian to be called to attend a case which has previously been meddled with by an empiric, to the extent of rupturing the uterus or causing some other fatal lesion, and to proceed with the operation of delivering the animal without having first discovered that the fatal injury exists. Should this error be committed, the veterinarian is almost inevitably blamed for having caused the injury himself, and may even be unjustly held legally responsible for the consequences. I was called to attend a valuable mare suffering from dystokia, in which the head of the fetus was deviated to the side. An empiric had attempted to catch the head with a butcher's hook in order to correct the deviation, but failed to do this and ruptured the uterus. I was not advised that anyone had attempted delivery, and in fact meddling with the case was denied. Embryotomy was proceeded with without examining the uterus very carefully except in the posterior part. When nearly through, the rupture was discovered owing to the prolapse of the intestines of the mare through the rent in the uterus. It was only under hard pressure that the owner was finally compelled to admit that other parties had attempted the delivery before I had been called. Similar experiences are common in veterinary practice, and should always be guarded against as carefully as possible, because such oversight is liable at any time to affect very unfavorably the professional standing of the veterinarian.

In such an examination the practitioner should also determine the condition of the genital organs in every way—whether the passages are fully dilated or are dilatable, whether they are normal or obstructed, and whether they are inflamed, swollen or necrotic. It is highly important also to learn at once whether there is any displacement of the uterus, such as torsion. The condition of the fetus is also highly important in reference to the course to be pursued and the prognosis. It should be determined as early as possible whether the fetus be dead or alive; in case it is dead, much depends upon whether it has undergone decomposition.

Since ruminants are very resistant to infection, an emphysematous or putrid fetus may frequently be removed with excellent results. It is difficult to save the life of a mare if her fetus has become putrid. It is also exceedingly difficult to save the life of a mare if she has been in labor more than twenty-four hours, although much will depend upon the position in which the fetus lies, whether it has become impacted in the pelvic canal, and the amount of interference which the mare has suffered at the hands of incompetent persons.

The veterinarian needs determine precisely the nature of the obstacle which is to be overcome, to which end it is essential that he shall be able to identify the various portions of the fetus by the sense of touch, and to determine thereby the presentation, position, and deviation with which he has to deal. While apparently it should be easy for the operator to determine the portion of the fetus which he touches, it is not, after all, a light task.

The differentiation between the anterior and posterior limbs sometimes offers very great difficulty. Some writers give certain rules by which one may differentiate between an anterior and a posterior limb, but their rules are not wholly applicable. Some suggest that certain joints of the limb bend in a given direction. In dystokia, however, a limb may be in such a position that it can not possibly be determined in which direction it would bend, because it is so firmly impacted that it can not be bent or moved in any direction. With the fetus inside the uterus, and that organ closely investing it, the differences, to the touch, between the anterior and posterior limbs are sometimes not so marked as the obstetrist would wish. If he can readily reach the fetal body, he may quite easily determine which leg he is dealing with. He can not, however, tell the fore and hind feet apart until he at least reaches the carpus and tarsus. Even then the tarsus may be so extended that it may present a very strong resemblance to the carpus, though the two articulations may generally be differentiated because the os calcis, with the tendo-Achilles attached to its summit, is more prominent and clear-cut than the pisiform bone of the carpus with its attached tendons. If the elbow can be reached and compared with the stifle, they are generally quite easily distinguished, and as soon as one can reach above these two parts the difficulty of differentiation usually ceases to exist.

In examining the limbs for purposes of identification, the inexperienced veterinarian must preserve his equanimity and not be too hasty in his conclusions, but deliberately search the extremities with which he is dealing until they are clearly identified upon anatomical grounds. In the event of three or four limbs being presented simultaneously, it is sometimes more difficult because of their intricate entanglement to trace and identify each member. The passages are so filled, because of the extra number of limbs, that one can insert the arm only with difficulty, and under such severe pressure that the sense of touch is somewhat dulled. When the feet of two fetuses present simultaneously, they are liable to cause very great confusion in diagnosis, and one needs be very careful to determine whether twins exist. Sometimes each twin may offer in the inlet one hind limb or the head and one or both fore feet of one, with one or both hind feet of the other twin, or other confusing variations. All such possibilities are to be carefully considered.

As a rule in practice, a foot should not be drawn upon with a view to extracting a fetus, unless it has first been determined by exploration that it belongs to the fetus which it is desired to exert traction upon. If the veterinarian is at all careless in his diagnosis, he may get hold of one limb belonging to one fetus and another limb belonging to a second fetus, and proceed to draw upon them as belonging to one, with embarrassing results. It must be constantly remembered also, in the identification of the feet of one or more fetuses which are presenting, that a single fetus may be so deformed that both the anterior and posterior parts of the body are presented simultaneously. Thus there may be offered at the pelvic inlet the head and all four feet. This is especially true in the cow, where two forms of monsters are encountered which are exceedingly confusing—*schistocormus reflexus*, and *campylorrhachis contortus*—which are later described.

In some cases, where there are important teratologic conditions, it is difficult to determine the part of the body with which one is dealing. It is necessary to study carefully the anatomical relations of each part. In hydrocephalus, with a large amount of fluid in the greatly distended cranial cavity, the part sometimes reminds one very much of the fluctuating abdomen of the fetus, and can be differentiated only by finding and recognizing the ears, eyes, mouth, or some other definite part of the fetus.

The veterinarian must continue his search until he is able to recognize the anatomical characters with which he is dealing. It may be necessary, for this purpose, to extend his search for a considerable distance in every direction in order to make out fully and safely the character of the position with which he has to deal. The special difficulties of diagnosis in given cases will be more fully considered under their various heads.

The Prevention of Infection During Obstetric Operations

There is no place in veterinary practice where the rules of disinfection are more important than in obstetric work. Nowhere else do we encounter so large and highly receptive a surface for infection as in the uterus, denuded as it is of its protective epithelium at the time of birth. Neither is there any part of veterinary service where the veterinarian so frequently becomes infected. With his hands and arms submerged in the most virulent excretions for hours and the heaviness of the work excluding the protection of rubber gloves, so useful to the human obstetrist, his work is one of peril except he be constantly and intelligently on his guard.

The operator should be provided with ample clothing, which has been thoroughly sterilized and disinfected. If he has recently been engaged in the handling of a putrid wound or some infectious or transmissible disease, and especially if he has recently been engaged upon a case of retained afterbirth or in removing a putrid fetus from another animal, he should first, by all rules of surgical practice, have taken a thorough bath and had a complete change of clothing, in addition to having thoroughly and carefully disinfected all those portions of his body which have been in any way soiled or contaminated during the previous operation. He owes this duty, not only to the owner of the animal, but equally to his own reputation as a practitioner.

When called to a case of dystokia, he should prepare an abundant supply of efficient disinfecting solutions which he can use in disinfecting anew his hands and arms immediately before beginning his operation. The thorough cleansing and disinfection of the hands and arms serves a double purpose in practice. It protects the patient against any infection which the operator may carry upon his hands or arms and, when the skin and skin glands of the operator's hands and arms are well saturated with a disinfecting solution, it affords to him a maximum protection against infection from the animal.

The danger from infection, especially in cases of a putrid fetus or afterbirth, constitutes one of the greatest risks with which the veterinarian has to contend. There are few veterinarians who have not, at one or more times, suffered more or less seriously from infection in this way, and it is of fundamental importance that this danger be guarded against as thoroughly as possible. Such infection usually occurs, not on the hands, but on the arms, where the skin is more delicate and the hair follicles and sweat glands offer a better opportunity for the entrance of micro-organisms. Apparently those persons who sweat freely are most subject to infection in obstetric operations.

Some depend chiefly upon the lubrication of the hands and arms with oil or fat, to which possibly some disinfectant has been added, but fats and oils are immediately dissolved by the fetal fluids, and consequently cease to afford any protection almost as soon as the hand and arm have been introduced into the genital passages. Such anointing of the arms is of little value from the standpoint of the prevention of infection of the operator, but has lubricant value.

Infection of the operator's hands and arms may be largely prevented in several ways. He may use a variety of disinfectants. The thorough use of any one of them will render an efficient service. Soapy disinfectants, such as cresol compound and lysol, are valuable because, in addition to possessing a high bactericidal power, the solution is unctuous and renders the hands and arms slippery, as would oil or fat, thus favoring their introduction into the genital passages. A better protection to the operator may be afforded by astringent antiseptics. Corrosive sublimate, with its high bactericidal power, possesses astringency to a considerable degree, and tends thereby to close the mouths of the hair follicles and glands in a way to prevent the invasion of the disease organisms. Permanganate of potash also has a very high efficiency, and is more astringent than the corrosive sublimate. It has still another very estimable quality, in cases of putrid decomposition of the fetus, in that it is one of the best, if not the best deodorizer in common use. After using potassium permanganate, followed at the close of the operation by a warm concentrated solution of oxalic acid to decolorize the stain on the skin, the hands and arms are clean and almost wholly free from odor. The operator should pause frequently in his work, especially when severe infection in the uterus is evident, and immerse and bathe his hands and arms in the disinfecting solution. He should have at hand an abundance of clean normal salt solution, in which his hands and arms should be carefully rinsed after disinfecting before they are inserted again in the genital passage of the patient. Disinfectants upon the hands and arms irritate the genital mucosa severely. Such irritation is frequently the cause of much severe straining, which interferes seriously with the operative work. If some reliable antiseptic is used frequently and freely in this way, and as soon as one supply of the solution becomes contaminated it is thrown away and a fresh supply prepared, much will be accomplished toward preventing any infection of the operator's hands or arms.

The first step in the prevention of infection of the hands and arms of the operator should be the cleansing of the patient Before undertaking the examination or operation, the tail, vulva, and all the surrounding parts should be thoroughly cleansed and disinfected. If the vaginal canal is soiled, it should be thoroughly flushed out with a neutral aseptic solution, such as one ounce of common salt in one gallon of boiled water. If the fetus is putrid, large volumes of warm normal salt solution should be repeatedly forced into the uterine cavity, alongside the fetus. Not only should the uterine cavity be filled with large volumes of such solution prior to the beginning of the operation, but the filling of the uterus with the solution should be repeated frequently throughout the entire operation. By such a plan, not only is the operator protected in the largest measure possible, but the patient also is protected against serious infection through abrasions which may exist or be caused in the course of the operations.

If the animal is recumbent and can not be induced to stand, it is desirable to spread a clean sheet or cloth, which has been dipped in a disinfecting solution, immediately behind the animal in a way to cover over any bedding or litter and prevent it from being dragged into the genital tract of the mother upon the hands or arms of the operator.

After the removal of the fetus, in all cases of dystokia, it is important at once to follow with the removal of the membranes, if practical, after which the uterus should again be cleansed thoroughly with a large volume of sterile liquid, providing always that the integrity of the uterine walls has been preserved and there are no penetrating wounds into the peritoneal cavity. In the latter case one should simply attempt to remove mechanically all the infectious material and debris, and be very careful not to inject fluids into the uterus to find their way into the peritoneal cavity and probably cause at once the collapse and death of the patient. If it has been clearly determined that the uterus is wholly intact, the injection of large volumes of warm aseptic salt solution into its cavity produces three important results: it cleanses the cavity of debris and decreases the danger to the patient later, from infection and its consequences; it straightens out the walls of the uterus and tends to correct any displacements of the organ—for example, if one of the horns is somewhat displaced or has begun to invaginate or intussuscept, it tends to restore it to its proper position ; in sufficient volume to cause distention, it stimulates quite a vigorous contraction of the organ—involution—which tends strongly to close the uterine cavity and prevent future prolapse of the uterus or vagina.

The General Handling of Dystokia

A thorough examination, such as already outlined, should result in a diagnosis of the presentation and position of the fetus and its relation to the genital organs and the pelvis, give a clear conception of the difficulties which are to be overcome, and indicate the method by which they may be surmounted. It should also enable the veterinarian to make a judicious prognosis regarding both the mother and the fetus or fetuses. It should be determined whether the life of the mother can probably be saved, by what means, and whether, in case she is saved, her condition will be such as to render the operation worth while either from an economic or a sentimental standpoint. If the life of the mother can not be saved by an operation, it is evidently needless to make a prolonged effort in her behalf. If she may be saved, but her condition will render her of little or no economic value, or would overcome any sentimental reasons for preserving her life, then the situation should be made perfectly clear to the owner. For example, in a case of dystokia in the mare, which has been meddled with by an empiric, and in which the fetus has been dead for a long period of time and has become putrid, and perhaps in addition there is a rupture in the uterus which must inevitably lead to a fatal termination, it is clearly injudicious for the veterinarian to attempt delivery, and he should strongly insist upon the destruction of the animal. On the other hand, so long as there is reasonable hope that the animal's life may be saved, it is the duty of the veterinarian to do whatever may be in his power to accomplish this purpose.

The veterinarian, in his prognosis, should refrain with equal care from radical optimism and pessimism. The destruction of a patient suffering from dystokia should not be recommended or urged except upon the most unequivocal grounds. Often one veterinarian pronounces a case hopeless and the dystokia insurmountable, and another veterinarian, by intelligent work, saves the life and value of the animal.

Sometimes the veterinarian gives an unfavorable prognosis and advises destruction in order to escape a difficult or repulsive task. This is unprofessional and lowers the standing of the veterinarian. If possible to save the patient, the veterinarian should proceed to make an earnest attempt to do so. After having done his utmost, his responsibility ends. In other instances, as in severe cases of rupture of the prepubian tendon, it is impossible to bring about a recovery of the mother from the injury, in so far as her general appearance is concerned. She must be left forever with an immense hernia which virtually destroys her value for any use where appearances have any weight. Hence, although the life of the mare may be saved, her value is usually destroyed. But she may have a temporary value for raising the foal which is to be born at the time, or even a permanent value if the owner does not object to the appearances.

The obstetrist must also reach as reliable a conclusion as possible in reference to the life of the fetus, and determine whether it is possible to save it. The foal perishes quickly when expulsive efforts set in; the calf does not. This should be considered in determining the probability of extracting the fetus. In the mare, if the obstacles to birth are of such a character that much time will inevitably be demanded to overcome them, it is quite clear that a living foal is not to be expected, and consequently, if conditions so indicate, the veterinarian is fully warranted in proceeding at once with embryotomy.

Sometimes the obstacles are such that the veterinarian may save the life of either the mother or the fetus, but can not save both. In such instances the veterinarian is placed in a position where it is necessary to consider which of the animals, the mother or the fetus, possesses the greater value, and the life of which can most certainly be saved. The decision must rest largely with the owner, though the veterinarian needs be in a position to place the question clearly before him.

Having reached a satisfactory diagnosis and prognosis, the veterinarian needs determine upon a definite plan of procedure. This may be either tentative or final. Generally speaking, the veterinarian must consider the consequences of his plan upon the mother and the fetus, the amount of labor which will devolve upon him, and the consequent economic interest of the owner. In many cases it is desirable to adopt a tentative plan of procedure, with an alternate final operation in case the first should fail. It is essential that the tentative plan should possess certain definite possibilities, and consequently offer hope of a favorable solution. This might be illustrated by comparing two analogous positions in the foal and the calf. In each of these, in the anterior presentation and dorso-sacral position, the head is frequently deviated laterally. In the calf the neck is very short, and the head is usually within reach, so that the deviation may be corrected with more or less facility. In the foal this deviation is quite frequently due to a deformity of the neck—wry-neck—in which the neck has been extremely bent during a great part of intra-uterine life and the head rests far back in the flank, where it is difficult or impossible for the obstetrist to reach it. Even if it can be secured, it may still be almost impossible because of the deformity to correct the deviation. In the calf, the tentative plan of correcting the deviation almost always succeeds, and should be applied. In many instances, in the foal, the correction of the deviation is so improbable that it may be injudicious to attempt it; instead, the veterinarian should proceed at once to embryotomy. Even if such a foal be extracted alive, it is practically worthless because of its deformed head and neck. Judgment must be used, and a tentative plan not carried too far, exhausting the strength of both obstetrist and patient in an attempt to accomplish something which must eventually be abandoned and another plan substituted.

The obstetrist should carefully husband his strength. There is still an abundance of work for him. The overcoming of dystokia not infrequently proves a herculean task and leaves him in the end quite exhausted from the severe ordeal. The strain upon the physical powers of the veterinary obstetrist should not, however, be exaggerated as it has been by some writers. It is not usually extraordinarily trying or dangerous, and offers no markedly greater difficulties than other surgical procedures. When the veterinary obstetrist attends a case promptly, he usually has time to plan his work deliberately and to carry it out without extraordinary haste. There come crises in these operations, as well as in others, where a man must act quickly at a given point in order to accomplish his purpose, but as a general rule there is every reason for deliberation and careful planning of every portion of the work.

A great source of strength and efficiency to the veterinary obstetrist is ambidextrousness, which can be acquired by any one with proper practice. When the operator can use each hand and arm with equal facility, his efficiency is more than doubled. It is usually the hands and arms, not the body, which really become fatigued during obstetric operations.

OBSTETRIC OPERATIONS

In overcoming dystokia, a number of operations may be demanded, which vary greatly in character and may admit of many variations in technic. It is but natural that the obstetrist should be as conservative as possible in the selection and carrying out of a plan for the overcoming of obstacles to delivery. He should have in mind the entire list of available obstetric operations, and determine which of these he should elect to carry out in a given case. In determining upon a plan for operating, he should consider first that plan which is the most conservative, since if it succeeds it is best from the standpoint of the well-being of the mother, the fetus, and the operator, and of the economic interests of the owner.

The chief obstetric operations are :

I. Mutation.
II. Forced extraction.
III. Embryotomy.
IV. Hysterotomy and hysterectomy.

I. Mutation

It has been indicated that, in order for birth to take place normally, it is essential that the fetus should present in a longitudinal direction, either anteriorly or posteriorly, and that it should be in the dorso-sacral position. In the large domestic animals, it is essential that, in the anterior presentation, both fore feet should be well extended, and the head resting upon these with the nose reaching nearly to the fetlock joint. In the posterior presentation, the two posterior limbs should be fully extended. Any deviation from this arrangement in the larger animals calls for more or less interference on the part of the obstetrist, in order that birth may occur.

In the smaller domestic animals the attitude of the fetus in its passage through the birth canal differs somewhat from that assumed in the larger animals. In carnivora, the fetus, when in the anterior presentation, usually presents by the head alone, with the anterior feet folded back beneath the chest. The abnormal positions of the fetus and the deviation of parts are exceedingly variable. It is the function of the obstetrist to bring each part into the normal relation and position, or otherwise overcome the obstacles to birth. The chief operations or manipulations, collectively designated mutations, by which it is hoped to correct the position or attitude of a fetus, are repulsion, rotation, version, and extension.

A. **Repulsion or retropulsion** of the fetus consists of pushing it backward, or away from the pelvis, toward the diaphragm, in order that it may be returned into the abdominal cavity, and contemporaneously into the uterine cavity, where space is available for changing the position of the various extremities or of the entire body. Repulsion is necessitated by the fact that the pelvic canal is so narrow, and so completely filled by the fetus when it has once entered, that there is little or no room for carrying out any extensive changes in the attitude of the fetus, which must consequently be repelled or pushed out of this narrow channel into a more commodious cavity, where ample room may be obtained.

It is to be recognized that repulsion is not wholly the actual pushing of the fetus forward toward the head of the mother in a direct line. It consists largely of the partial version of the fetus. The body of the fetus as a whole is driven away from the vulva but little, though a given part of the fetus is driven through a considerable distance. Ordinarily when repulsion is performed the fetus is lying inclined, if in the longitudinal presentation, that end of the fetus presenting toward the vulva of the mother higher than the opposite end of the fetus. When it is repelled, the posterior end is ordinarily pushed obliquely upward toward the maternal spine and forward toward the head of the mother. At the same time the distal end of the fetus probably approaches nearer to the pelvis than it was at the beginning of the repulsion. Repulsion therefore commonly means that a certain part of the fetus is pushed away from the pelvic inlet, not that the entire fetus is pushed toward the mother's head.

Frequently when repulsion is desired the fetus is dead. It is then best to use a repeller having a sharp spike in its centre (Figs. 102 and 111) which sinks into the tissues of the fetus and gives the instrument a secure hold. Even if the fetus is alive, the small spike, passing into the soft tissues, usually produces an aseptic wound, which, healing without inflammation and without requiring material attention, is not highly objectionable. In order to overcome any such objection, however, the spike should be detachable. In case the fetus is alive and the spike not absolutely necessary to secure fixation of the instrument, it may be unscrewed and removed and the instrument used without it.

When using any type of repeller, the hand of the operator should constantly accompany the end which is in contact with the fetus during the entire operation of repulsion, thereby guiding and directing the force of the repeller and guarding constantly against its slipping or otherwise injuring adjacent parts. When the repulsion has been accomplished and it is desired to hold the fetus in its position while the operator carries out some change in the position of an extremity or brings about some other modification in position, it is allowable to take the hand away from the instrument and instruct the assistant to press steadily upon it. The person handling the repeller must be prepared to withdraw his force immediately, and even the instrument, in case there is any suspicious change in position of the fetal body, especially if it seems to yield in such a way as to suggest that the instrument may become displaced.

Some obstetrists condemn the repeller as a dangerous instrument, but this is not true if it is used prudently. The repeller should be used in most cases where repulsion is desired. The operator should, as a rule, abstain from using his own strength for bringing about repulsion. Others may do this quite as well, or better, if the operator will place the instrument securely against the desired portion of the fetus and, accompanying it constantly with his hand, direct the force of the assistant.

Whenever force is applied to repel the fetus, the movements almost inevitably arouse more or less vigorous expulsive efforts, which tend to prevent the attainment of the desired end. During expulsive efforts, little progress, if any, can be made, and the operator must wait until the expulsive efforts cease and then, by a prompt thrust, push the fetus away toward the anterior end of the uterus. During the expulsive efforts, however, the operator should attempt to prevent the fetus from being driven far toward the pelvis or into it, by maintaining a steady pressure in the opposite direction and then being ready, as soon as the expulsive efforts relax, to accomplish quickly the results which are desired.

B. **Rotation.** In order that a fetus may pass readily through the birth canal, it must offer in the longitudinal presentation and the dorso-sacral position. When presenting otherwise, it is desirable, if not necessary, that the fetus be rotated upon its long axis until it is brought into the dorso-sacral position, and its expulsion or extraction thus facilitated or rendered possible.

The rotation of the fetus upon its long axis is naturally most practicable when its body is lying within the abdominal cavity. When it is advanced into the pelvic canal, it is exceedingly difficult to bring about rotation. It is to be borne in mind that a fetus entering the birth canal in any other than the dorso-sacral position is in an unstable attitude and tends to rotate to the proper position, except as prevented by the firm impaction of the fetal body in the narrow channel.

The aim of the obstetrist is to aid these natural forces as far as possible in accomplishing the object desired. First of all, the body of the fetus should be pushed away, if possible, into the abdominal cavity, while its limbs are retained in the pelvic canal, as levers through which the rotation may be largely accomplished. Preparatory to rotation, it is highly advantageous to inject into the uterus, about the fetus, a warm normal salt solution or other aseptic liquid, to lubricate the uterine cavity and permit the body of the fetus to be more readily revolved.

Most cases demanding rotation offer in the posterior presentation, and usually in the dorso-pubic position. After the repulsion of the fetus and lubrication of the parts, the two posterior feet should be secured by means of cords, to be held by assistants. The operator inserts one hand with the palm upwards and passes it over the brim of the pubis beneath the buttocks of the fetus in such a way that the buttocks rest in the palm of his hand. The pubic brim serves as a fulcrum, upon which the operator uses his hand and arm as a lever of the first class. Lifting upwards against the buttocks of the fetus renders its position less stable and tends to cause it to revolve to the right or left and approach the dorso-sacral position. The instability which has thus been produced may be accentuated by the operator exerting his force somewhat obliquely upwards to the right or left, instead of pushing directly upward. This tends to rotate the body of the fetus in that direction which may seem most favorable.

The assistants in charge of the corded hind feet actively second the efforts of the operator by such means as he may direct. It has been suggested by some writers that the two feet may be tied together and a short lever passed between them, upon which the assistant may exert a rotary force upon the fetal body in that direction which the operator may direct, thus rendering his efforts effective. I have usually had an assistant grasp one or both of the hind limbs, flex the feet at the fetlock until the pastern of each foot is at right angles to the metatarsus, and, using the pastern as a lever, exert a rotary force upon the limb and through it upon the fetal body. This method is highly efficient. The most effective method is the application of cross traction upon the hind limbs. A cord is placed upon each limb, and each cord given into the hands of a separate assistant. The operator places his hand beneath the croup of the fetus, over the brim of the pubis of the mother, as in the preceding plan. If he wishes to rotate the ventral surface of the body of the fetus toward the right of the mother, he lifts upward and to the left, upon the buttocks, while the assistant having charge of the cord upon the right foot stands upon the right side of the patient and draws to the right, first obliquely upward, then horizontally, and finally downwards. The assistant having charge of the cord upon the left foot crosses it behind and beneath the right, and draws downwards and obliquely to the left. The cross traction exerted upon the two coxo-femoral joints causes the fetus to revolve upon its long axis. The simultaneous and equal traction upon the two sides of the fetal pelvis prevents it from becoming impacted against the pelvic girdle of the mother.

In the anterior presentation, the general plan of the operation is similar, though it may be rendered more difficult by the presence of the head and neck. It may even be necessary that the head be amputated before the rotation can be effected. Aside from this the plan should be carried out essentially the same, the operator's hand acting upon the withers of the fetus, instead of upon the buttocks, as in the preceding case.

C. **Version.** Since it is essential that a fetus present longitudinally in order to be expelled, it follows that, when it presents transversely, the position of the fetus needs be changed to the longitudinal presentation before it can enter the pelvic canal.

Empirics occasionally state that they have accomplished version of the fetus when it has presented longitudinally and have changed a posterior presentation into an anterior one. This assertion has been to some extent copied by veterinary writers. It must be very plain to any intelligent veterinary obstetrist of experience that such an operation is impossible, under normal conditions, and could be performed only in cases where the uterine cavity is very large and the fetus very small, in which case there is evidently no justification whatever for carrying it out. Version is exceedingly limited in veterinary practice ; its usefulness is restricted to the transverse presentation, which is confined essentially to the mare, with her cruciform uterus. The operation is therefore best described later in connection with the dystokia of the transverse presentation.

D. **Extension and Adjustments of the Extremities.** In discussing physiologic parturition and the normal presentations and positions, the physiologic arrangement of the extremities has been described. When they become materially deviated, they produce more or less serious obstacles to the expulsion of the fetus. The deviations of the extremities with which the obstetrist must deal are those of the head, neck, and limbs.

Since the correction of these deviations must be carried out anterior to the pelvic cavity, within the abdomen, it is essential in most cases that the fetus be repelled. The repulsion of the body of the fetus and those extremities which are presenting normally has a tendency to bring about the correction of the abnormality of the deviated member.

If the head is deviated to the right or the left, upward or downward, repulsion of the fetal body tends to cause the head and neck to become extended. The reflexed head comes in contact with the uterine walls, which resist its retreat while the body is being repelled, and the head then tends to come forward into its normal place. The elasticity of the neck tends to bring the head and neck into a straight line with the long axis of the fetal body whenever the pressure causing the deviation is relaxed. The same is more or less true with most of the deviations of the extremities, which are constantly aggravated as the fetus advances toward the vulva, and tend as constantly to be ameliorated or even overcome when the fetus is repelled into the uterine cavity.

The veterinarian must intelligently apply his knowledge of mechanics and anatomy to his task. If the fetal head is deflected to its left side along the right side of the mother, it is very evident that, if the patient is lying upon her right side, the weight of the fetus upon its bent neck will offer a serious mechanical obstacle to the correction of the deviation. In such a case the recumbent patient should be turned to her left side. Similar directions apply also to deviations of the limbs, and should constantly be borne in mind in all such work.

Another mechanical principle which should be constantly applied is that, if it is wished to extend a flexed extremity, one may at least double the efficiency of his efforts by the simultaneous application of traction upon the distal end of the flexed ex-

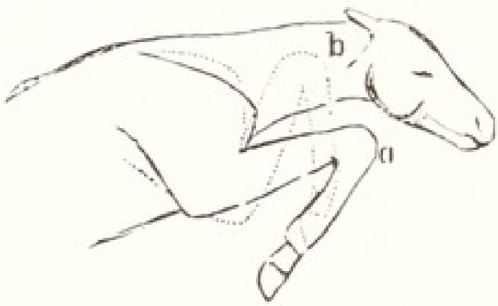


Fig. 112. Schematic Illustration of the Extension of a Fore Limb Flexed at the Carpus. (Franck.)

tremity and repulsion upon its proximal end or upon the fetal body. For example, in the deviation of the head to the left, if traction can be applied to the head by means of a hook in the orbit, mouth, or nose, or by a cord attached to the inferior maxilla, as shown in Fig. 113, and described on page 379, while the body of the fetus is being repelled by force applied to the sternum or to the base of the neck, the efficiency of the effort is very greatly increased. The simultaneous application of these two forces should be the constant aim of the veterinarian. The traction may be applied with hooks or cords; the repulsion by the operator's hand, or by a repeller in the hands of an assistant, guarded by the operator.

In extending a flexed limb, the same general mechanical rules are to be applied. For example when a fetus, presenting anteriorly in the dorso-sacral position, an anterior limb flexed at the carpus, as in Fig. 112, has been repelled, with or without decapitation, and sufficient room for operating obtained, the retained foot is corded at the pastern, or as near to that point as is possible, by one of the two methods described on page 332. The cord is entrusted to an assistant.

If impossible at first to attach the cord about the pastern, it should be made fast as low down on the metacarpus as possible. While traction is applied upon this cord by an assistant, the operator may pass a second cord beyond the first, and, as the foot is being brought nearer by traction upon the first cord, the noose of the second may be pushed over the fetlock and engaged upon

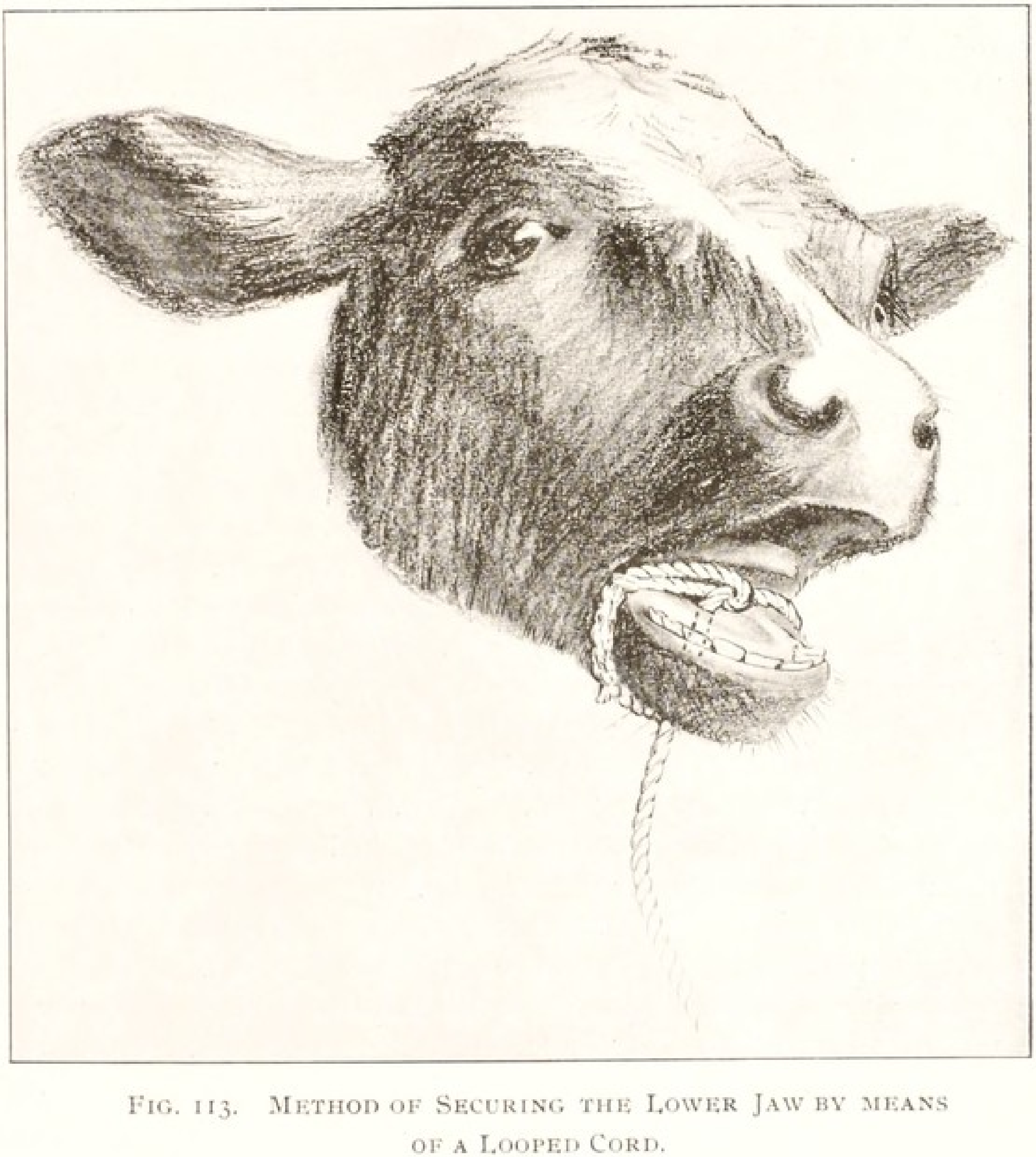


FIG. 113. METHOD OF SECURING THE LOWER JAW BY MEANS OF A LOOPED CORD.

the pastern. It is to be emphasized that in correcting a deviation of a limb, whether anterior or posterior, the ultimate aim is to get the noose upon the pastern. Until that can be accomplished, the correction of the deviation is uncertain.

While the fetus is being repelled, the assistant draws upon the cord and advances the foot. The carpus, by this process, and with the aid of the operator, passes into the lumbar region, directed obliquely outwards and upwards into the upper portion of the flank in order to afford the greatest possible amount of room. The carpus (or tarsus) must not, for this purpose, abut against the unyielding lumbar vertebrae or their lateral processes, but must be pushed outward against the yielding flank, and room thereby afforded for the necessary extension of the foot. At the proper time the operator inserts his hand, palm upwards, between the pubic brim and the foot of the fetus. Grasping the toe in the palm of his hand, the assistant, by the operator's direction, applies traction upon the cord. The foot glides over the pubic brim, to become extended in the pelvic canal.

Should the anterior limb be completely retained, instead of merely flexed at the carpus, the procedure is similar. The foot is now wholly out of reach, and the forearm can be reached only with difficulty, or not at all until repulsion has occurred. When sufficiently repelled, the forearm advances by its own elasticity towards the vulva, and may then be grasped with the hand and corded while the repulsion is continued. The carpus is gradually drawn up until it comes against the pubic brim, when its further correction is carried out in the manner above suggested.

Similar rules apply to the corrections of the deviations of the posterior limbs: that is, the fetus must be repelled from the pelvic inlet, and that part of the limb which can be reached must be corded and brought up. This in itself acts as a repellant to the fetal body. Finally the tarsus is pushed obliquely outwards and upwards into the upper flank region, the pastern is corded, and the toe, resting in the hollow of the operator's hand, is guided over the pubic brim and extended in the pelvic canal.

The changes in the position of deviated members constantly require a careful application of mechanical principles, combined with caution. The work should be done as gently as possible, in order to avoid arousing violent expulsive efforts. When they do occur, and constitute too great an obstacle, they should be overcome by such means as those suggested on page 359. While generally the corrections should be brought about without haste, when a critical point is reached it is frequently essential that the operation should be completed very promptly. Thus, when the carpus or tarsus has been pushed into the upper flank region and the toe or fetlock is impacted against the brim of the pubis, it is important that the operation be completed promptly, both because any unnecessary delay may lead to a return of the foot to its former position and because violent expulsive efforts of the patient may cause serious injuries to the uterus or other parts.

II. Forced Extraction

By forced extraction is understood the withdrawal of the fetus from the mother, through the genital canal, by the application of traction, in that position in which the fetus, torso, or any deviated extremities may be at the time of the operation. It is applied in those cases where the abnormal size or position of the fetus, or of one of its extremities, is such that the obstetrist believes it better to draw the fetus away by force than to correct the position or deviation, to reduce the volume of the fetus or torso by embryotomy, or to perform hysterotomy.

The reasons which may prompt the obstetrist to resort to forced extraction may be quite varied. It may be that forced extraction will offer the best or only opportunity for saving the life of the fetus. In the foal, for instance, forced extraction, in rare cases, might save its life, whereas the delay which might be essential to the correction of the position would lead to its death.

From the standpoint of saving the life of the mother, it may sometimes be safer to resort to forced extraction than to submit her to a tedious operation, not unaccompanied by dangers, in correcting the position of the fetus, in embryotomy or in hysterotomy. As a general rule, in the larger animals embryotomy, properly carried out, is less dangerous to the mother than forced extraction. It is only occasionally that this rule is reversed. In the smaller animals embryotomy is usually impracticable, and the choice of procedure frequently rests between forced extraction and hysterotomy.

From the standpoint of the operator, forced extraction is easier and consumes much less time, but unless the cases are intelligently selected and the operation carried out judiciously, the results are unsatisfactory. The higher the knowledge and skill of the veterinary obstetrist, the less frequently does he resort to severe forced extraction of the fetus.

The empiric habitually resorts to forced extraction in a very brutal manner, and with great losses to the owners of patients. I have known empirics, who were not competent to perform embryotomy when a foal presented anteriorly with the two anterior limbs in the birth canal and the head completely deviated to the side, to apply an amount of brute force sufficient to tear the fetus away in a most inhuman manner. Sometimes they hitch a horse or horses to the foal, and tear it away very roughly. One empiric in my territory resorted habitually to tying a strong rope to the two anterior feet of the foal and fixing the other end of it to a tree or a strong post, and then, by means of a whip or other punishment, forcing the mare to pull away her own fetus in a most brutal manner. So far as I was able to follow his operations, they invariably resulted in the death of both the mare and the fetus.

Some veterinary obstetrists advise forced extraction in various deviations, though with more or less foresight and care. Some report good results, but so far as can be learned never so good as though embryotomy had been properly performed. Forced extraction should not be employed in improper presentation or position of the fetus. It can not succeed in any transverse presentation, but only in those which are longitudinal. The application of forced extraction should be limited to those cases where the fetus is comparatively large and in the normal position, and in which the withdrawal of the fetus by force will, in the judgment of the obstetrist, prove better for the interests of the owner, as affecting the life of the mother, the fetus, or both, than would other means of delivery.

I have limited forced extraction to rather a restricted series of cases. It is advisable where a large live or recently dead fetus, or a fetus originally of normal size, enlarged because of emphysema, presents in a normal position. Forced extraction has a wide application in the dystokia of uterine inertia, where the uterus is paretic because of disease. The forced extraction then takes the place of the normal expulsive efforts. Sometimes forced extraction is amply justified when the cervical canal, vagina, or vulva is constricted or compressed from without. Frequently after embryotomy has been carried to a certain degree, and parts of the fetus removed, the fetal remnant, or torso, may be removed by traction. It is not a question of the application of force by traction, but a problem of when, where, in what manner, and how much traction shall be applied.

The application of traction to the fetus in cases of dystokia will vary largely in the direction in which it is best to exert it, the intensity allowable, and the means which may most usefully be employed in developing the necessary force.

The direction in which traction is to be applied will depend very largely upon the attitude of the fetus and the point which it has reached in the birth channel. The fetus is normally somewhat curved—the ventral surface concave and the dorsal convex. This may be increased very greatly by artificial means, but the normal curve in the fetal body does not readily undergo obliteration or reversal by the fetal body being bent dorsalwards.

As the fetus approaches the pelvic inlet, in the larger domestic animals, and especially in those cases where the animal is standing, much of its volume and weight is located below the pubic brim and must mount that obstacle in order to gain the pelvic canal. If traction is desired, it should be applied to the fetus obliquely upward and backward, to lift it over the pubic brim.

During the progress of the fetal head through the pelvis, the traction should be directly backward or slightly upward and backward, but, when the fetal head arrives at the vulva, if the traction is continued upward it tends to force the poll of the head too powerfully against the superior vulvar commissure, and not only tends thereby to cause an obstruction to delivery by jamming the fetal head against this part, but also endangers the integrity of the superior commissure of the vulva itself and tends to cause more or less laceration of it. The inferior vulvar commissure is fixed in the ischial notch. The fetus can not be impacted or caught against the inferior commissure, because of the presence of the ischium. The superior commissure, attached to the anus, is open to injury. The fetal head or other part may push the vagino-vulvar floor upwards and become caught in front of and above the superior commissure, threatening the integrity of the perineum. Consequently the direction at this point should be somewhat downward in order to avoid as far as possible any injury to the soft parts.

After the head has passed through the vulva, the traction should be continued, more and more downward as the body of the fetus advances, until finally, when the withers have passed the vulva, the line of traction should be almost perpendicular to the long axis of the spinal column of the mother or parallel to the long axis of her posterior limbs. Traction thus directed permits the ventral wall of the fetal body to become relaxed, so that the fetal viscera may shift backward or forward in the body cavity and thus escape from that part of the cavity which is being most compressed in the birth passage, thereby decreasing the diameter of the fetal body at the most critical point. The fetal body should be regarded as a parallelogram, the four lines of which are the spinal column; the sternum and linea alba, or prepubian tendon; the ribs; and the pelvis. If the direction of the traction in the last stage of the anterior presentation, dorso-sacral position, bends the fetal body ventralwards, the prepubian tendon is relaxed, the fetal pubis and ischium move backwards and upwards, the supero-external ilial tuberosities are depressed, and the distance between the dorsal and ventral lines of the fetal parallelogram decreased. In this way, the fetal pelvis becomes extended backward upon the fetal spine, and its pubio-sacral diameter is rendered unimportant. The impact against the maternal pubic brim is thereby greatly decreased. Frequently in the mare and the cow there is a sharp conical elevation of the pubic symphysis at the brim, which may cause a penetrant contusion of the vaginal floor if the impact of the fetus is too severe. Any impact of the fetus against the maternal pubis tends also to decrease the ischio-sacral diameter by extending the maternal pelvis as far backwards as the rigidity of the sacro-iliac articulation will permit.

Unless care is exercised at this time, the fetal and maternal pelves become immovably locked. I have repeatedly seen this occur where one or two horses have been hitched to the head of a calf and violent traction employed in a direct line without moving the fetus, although the presentation, position, fetus, and maternal pelvis were each normal. The tension of the dorsum of the fetus in downward traction pulls the tuberosities of the fetal ilia downward from the uppermost part of the maternal pelvis and prevents their becoming interlocked with those of the mother.

The amount of traction. In passing through the birth canal, the fetus and the maternal parts in contact with the fetus undergo an enormous pressure, which is to a great extent inevitable. Only when it becomes excessively high has it danger for the fetus or mother.

In veterinary practice danger to the fetus from the pressure during its passage through the birth canal is scarcely recognizable, nor as a rule is there observed any injury to the fetus because of traction applied to any of its extremities. The amount of traction which a live fetus will bear by the head or the limbs during its passage through the canal is astonishing. It far surpasses any amount which an average person would believe possible for the fetus to endure without more or less serious injury. As a rule, strain or other injury to the fetus from such traction is virtually unknown in practice.

The mother, however, not infrequently suffers seriously from severe, or rather injudicious traction. How much pressure the pelves of domestic animals will withstand, when applied through the medium of a fetus impacted within its canal, is not known. Experimentally, it has required from 375 to 635 pounds of pressure upon a round ball representing the head of the fetus, to produce a fracture of the bones or disunion of the pelvis of woman. The chief danger to the organs of the domestic animal is not to the bony, but to the soft parts, which are the first to be injured by an excessive pressure.

The amount of traction which may safely be applied to the fetus is modified by its position. Since when the fetus presents normally and the traction is exerted in the direction advised above, there is no point where the soft tissues of the fetus may not to some extent move upon each other, thus relieving the pressure upon a given point, normally the pressure of the fetus against the walls of the birth canal is well-nigh equal over the entire surface.

When the fetus presents improperly, with an extremity retained in such a way that a greatly increased pressure is brought to bear upon a small area of the genital passages of the mother, the question of the amount of admissible traction changes abruptly. If a fetus is presenting with its head deviated to the side, one man by drawing upon it may cause far more injury than five men might if the fetus were presenting normally.

Different practitioners, working under varying conditions, have obtained apparently contradictory results in reference to the amount of traction which it is desirable to employ. Some claim that only moderate traction should be employed, and define their term "moderate" as the force of from two to four men pulling simultaneously. Others have unhesitatingly employed the combined strength of from six to ten men, and have claimed that their success has fully warranted the amount of force employed. When hard pressed, I have applied a force equal to that of six to ten ordinary men, in those cases in the cow and mare where the fetus lay in a wholly natural position, so that the force of the traction fell alike over the entire birth canal. Usually, when it reaches the point where so great force has become necessary, I have not used this number of men, but have substituted some mechanical appliance for their power, such as the lever or pulley.

Donnareix claims that three assistants are usually sufficient for handling dystokia in the cow. Of these, he places one at the head, another at the tail, and a third to aid the operator. In contrast with this he finds ten men necessary for the mare, and distributes them somewhat similarly, except that an extra man is needed to confine the limbs of the animal, while five or six are needed to pull at the fetus. While the amount of assistance required in a given case constantly varies in either the mare or the cow, I have never found a great number of men either necessary or desirable, and have always considered that I could better manage from three to five men than a larger number and could readily develop mechanical force of sufficient degree to get the power desired.

When traction is applied to a fetus which is not in a proper position and in which the fetal pressure is not alike upon the entire area of the maternal passages, great and even fatal injuries to the mother are constantly threatened. If a limb is retained or misdirected, it is liable at any time to be forced through the uterine wall into the peritoneal cavity and cause fatal injury.

When a portion of the fetus is deviated, the walls of the uterus, which are closely investing the fetal body, may be caught during severe traction and dragged along until a small rupture is caused, or the uterine walls so seriously crushed and maimed that they later became necrotic and a secondary perforation of the uterus occurs. When the fetus is further advanced in the pelvic canal and approaches the outlet, any great deviation of the presenting parts of the fetus may cause a very serious rupture of the perineum. **Therefore, the application of great force to a fetus in an improper position is constantly to be condemned.**

In the selection of assistants, when there is a sufficient number present to permit of selection, one should take by preference those persons who are somewhat experienced in the handling of animals and who are strong and of equable temperament. One needs to have the men thoroughly at his command and to know that they will obey his orders promptly and without question. My experience has been, when I have asked two or three men to exert traction, that upon turning my head I find the number doubled or trebled. This must be constantly watched in case of a crowd of bystanders.

When traction is being applied the operator should take his place immediately behind the patient, constantly watch and examine the progress of the fetus, command the direction and amount of force to be applied at this or that time, and determine when the traction should cease. When there seems to be any great impediment which apparently bars the progress of the fetus at a given point, the traction should cease and the operator should determine the nature of the obstacle and devise the necessary means for overcoming it. The operator should not join in the traction unless circumstances should arise making it necessary, but should devote his attention to the direction of the force to be applied by others.

Haste in traction upon a fetus is justifiable only very rarely. The maternal parts should be allowed to dilate gradually as the fetus slowly advances in the form of a wedge. In the posterior presentation, when a supposedly live fetus is well advanced in the pelvis, so that the umbilic cord is impinged between the fetal body and the maternal pelvis, hasty extraction of the fetus may be warranted in order to save its life. Very rarely, possibly, other conditions arise to warrant hasty extraction of the fetus.

Traction should, if possible, only be applied during the expulsive efforts of the mother, since at these times it is very much safer and more efficient. Traction applied in the absence of expulsive efforts tends constantly to drag the uterus along with the fetus, with danger of uterine rupture.

Expulsive efforts of the mother may usually be artificially aroused by slight traction upon the fetus or by the operator passing his hand between the fetus and the vaginal walls. When aroused, they should promptly be seconded by firm traction, to be regulated according to the circumstances in each case. Before traction is applied, and as far as possible during its continuance, the birth canal should be kept moist and well lubricated by means of oil, fat, or warm physiologic salt solution. Conditions arise however, in which expulsive efforts are wanting—the uterine inertia of contagious abortion, rupture of the prepubian tendon, anaesthesia, etc., etc. Then the fetus needs be removed by traction, unaided by expulsive efforts.

The general rules for the application of traction—the direction, amount, and method—are essentially the same whether the fetus presents anteriorly or posteriorly.

The development of the required amount of force, when applying traction to the fetus, may be brought about in a variety of ways. When men are used, the difficulties increase as the number increases, because a large number of men is difficult to control. They are almost always excited and tend to exert their force in an irrational manner. Since they necessarily work behind the operator's back, he has little opportunity to watch them while giving proper attention to the progress of the fetus. In some cases the men who are at the command of the operator are not very intelligent, and such persons at once render his task more difficult in controlling the application of force. The barbarous method of hitching one or more horses to the foal or calf requires no condemnation.

When power must be developed requiring the force of more than four or five men, it is preferable to supplant men with mechanical appliances—the lever and the pulley.

The lever is universally available and can be applied under almost all conditions, except possibly in those instances where the stall in which the operation is undertaken is too small to permit of its use. In such instances, however, it is almost equally difficult to apply other mechanical force. A stout beam from eight to ten feet in length may be procured and a secure resting place obtained for the fixed end, or fulcrum, against a door, post, or other solid object. If the animal is in the pasture, or otherwise in the open, and recumbent, a stake may be driven in the ground to serve as a fulcrum, or a hole may be made in the ground or in the floor and the end of the lever inserted into this. The cord or rope which is attached to the fetus may then be made fast to the lever at a distance of about two feet from the fulcrum, and the power applied to the long arm of the lever, by one, two or more men, as conditions may warrant. The amount of power which may be developed in this way is virtually unlimited, its direction is under excellent control, and it is free from irregularities in application.

Much the same may be said of the pulley, which enables the obstetrist to increase the force at will and to control quite readily the direction of the traction at every stage. The pulley has the one very marked advantage that it may be carried in a very compact form by the operator, as a part of his equipment, and be ready for application whenever occasion arises.

Mechanical means for the application of force are far more under the control of the operator, more continuous, and more easily directed than the use of a number of men. When an amount of force is necessary, which can not be accomplished by three or four men, the mechanical appliance is safer and more effective. Admittedly, with mechanical means such an unlimited force may be applied as to tear either the fetus or mother asunder, but so may man force if we but multiply sufficiently the number of men.

The amount of force to be applied in a given case constitutes a severe test of the judgment of the veterinarian. It is a practical question which should be decided upon sound principles. In almost any case of dystokia one may reduce the size of the fetus, by embryotomy, to such dimensions that but little force will be required to bring about its extraction from the uterus. If this can be readily accomplished, and the fetus is dead, it follows that such is the proper action to take. The obstetrist is not justified, for example, in applying great traction to a fetus presenting posteriorly with the two hind feet completely retained, when, by intra-fetal embryotomy, with the removal of the two hind limbs, the size of the fetus may be so reduced in the course of an hour as to permit of its easy extraction.

On the other hand, I recall an instance where a foal was in the breech presentation with both hind limbs completely retained and, as it had been dead for some time, the waters had all escaped. The fetus was enormously enlarged because of emphysema. The two hind limbs, the pelvis, and all the fetal viscera were removed, a cord attached to the posterior end of the spinal column, and traction applied. The fetus was in the dorso-sacral position and there was no impediment to its extraction except the great emphysema. The size of the fetal remnant might have been further reduced by removing the ribs, securing one of the shoulders, and then withdrawing the fore leg. The process might have been repeated upon the other fore leg. Perhaps this would have been the better method, but before the seriousness of the obstacle to extraction had been realized the fetus had become wedged quite tightly in the birth canal, so that further operation was rendered exceedingly difficult. Rather than go through the tedious work essential for the desired reduction in size, force was applied estimated at more than one thousand pounds, by means of a lever, and the fetus was drawn away. However cruel some might consider the operation, the animal did well. It may well be doubted that she could have done better or suffered less had further reduction been made in the size of the fetus by a very tedious and difficult operation.

It can not be too strongly insisted that, if such great force is to be applied, the fetus should first be brought into a natural position, so that in its passage all the soft tissues will be pressed upon alike, and consequently the danger of predominant pressure upon one area reduced to a minimum. It must be remembered also that an emphysematous fetus offers safer ground for severe traction, because the gases move readily through the soft tissues, equalizing perfectly the pressure in every part.

In the application of powerful traction, the operator should take particular care to command properly the direction and amount of force. In some cases it is essential to fix the animal's body so that it shall not be drawn from its position instead of the fetus being extracted; in other cases it is necessary that the body of the parent be fixed in order to permit the application of traction in the desired direction.

Since a general rule, when severe traction is applied the animal assumes the recumbent position, when the fetus is well advanced in the pelvic canal it may be necessary to fasten the posterior part of the body of the mother so that, when the fetus is well advanced and the traction is directed toward her feet, she is not constantly moved from her position. In order to overcome this movement of the body of the mother, one may in the mare fix a rope to the tail and, by attaching it to a solid object, prevent the constant slipping of the body in a ventral direction. In either the cow or the mare, a long rope may be passed between the hind limbs or around the buttocks somewhat below the vulva and then attached to some solid object beyond the dorsum of the mother in such a way as to prevent her gliding in a ventral direction.

III. Embryotomy

Embryotomy is the diminution of the size of the fetus by means of the removal of some of its parts, in a manner to overcome the obstacles to its birth. Necessarily embryotomy involves the sacrifice of the life of the fetus, if it is still living, and the object of the operation becomes limited to the preservation of the life of the mother. It is comparatively a common operation in the larger animals, but is virtually inapplicable in the smaller ones.

Embryotomy possesses certain dangers, such as injuries to the maternal organs, from a slip or misdirection of an instrument or from the projection of a severed fetal bone which may wound or penetrate the uterus or other parts. Not infrequently it involves a long and tedious operation, which may greatly exhaust the strength of the patient.

For the operator, embryotomy frequently means a protracted and disagreeable operation, with danger of wounds from instruments, injuries from the mother, or infection in case the fetus is putrid. Nevertheless embryotomy is one of the most valuable obstetric operations. It requires, for its proper application, thorough study, supplemented by extensive practical experience.

The performance of embryotomy may involve any portion of the fetal body, and presents the greatest possible variations, according to the presentation and position. The veterinarian must have a thoroughly practical knowledge of the anatomy of the fetus and the resistance of tissues and parts. Embryotomy may be necessary or advisable in any presentation or position which the fetus may assume, whether normal or abnormal. The technic of the removal or destruction of certain portions of the fetal body will be discussed here in the order of the fundamental presentations. The application of these operations will be considered under the various forms of dystokia.

1. Embryotomy in the Anterior Presentation

(*a*) **Amputation of the Head. Decapitation.** In the anterior presentation, with one or both fore limbs retained and the fetal head engaged in the pelvic canal or protruding from the vulva, repulsion of the fetus is generally necessary in order to correct the deviation of the limb. In many cases the repulsion of the head is inexpedient or impossible, and its amputation is made advisable or necessary in order that the fetal body may be repelled and the deviated extremity brought into position.

Technic. Attach a cord to the inferior maxilla, as shown in Fig. 113, or fix a blunt hook in the orbit, and have an assistant draw the head out as far as practicable. Make an incision through the integument, encircling the head at a convenient point, and separate the skin backward, by forcing the hand between it and the bones, by using the chisel or spatula, or by dissecting it away with a scalpel, continuing the separation over the occiput to the atloid region. Make a transverse incision below, across the trachea and esophagus and surrounding muscles, and above through the ligamentum nuchae and cervical muscles. Grasp the head firmly with both hands, flex it upon the neck, twist it forcibly on its long axis, rupturing the articular ligaments and the remaining soft tissues, and detach the head at the occipito-atloid articulation. The skin flap should be caught and secured over the exposed atlas by means of a small cord in the form of a running noose. The remnant is then to be repelled, the deviated parts brought into the desired position, or other operations performed.

b. **Cephalotomy.** When the fetal head, owing to hydrocephalus or other cause, is so large that it can not pass through the pelvic canal, or when the pelvic canal is narrowed or compressed by a callus following pelvic fracture, as in Fig. 118, or a callus following a coxo-femoral dislocation, as in Fig. 119, it may become necessary to diminish the size of the head by comminution when it is not in a position to be amputated. Sometimes the vulva of a heifer may be too small for the exit of the fetal head, rendering cephalotomy desirable.

Technic. In some cases the head is so firmly engaged in the canal that no further fixation is necessary. In hydrocephalus it may be necessary to engage the head with a hook or cord and hold it in position by traction. After thoroughly cleansing and disinfecting the parts, inject a copious amount of warm normal salt solution into the vagina. Carry the obstetric chisel into the passage, carefully guarded in the hand, and place it accurately upon that part of the fetal head where it is desired to begin the operation, generally on the median line of the nose, with the blade of the chisel standing parallel to the septum nasi of the fetus. Holding the blade of the chisel firmly against the part, with the hand in such a position as to guard the instrument from slipping aside and wounding the maternal organs, steady and direct the handle with the other hand and have an assistant drive the chisel, by means of blows of proper vigor with a mallet, into the bones of the face and head.

Do not drive the chisel deeper than the length of the blade without first stopping and forcibly revolving the instrument upon its long axis, breaking the fetal bones apart. The partially detached pieces of bone may be grasped by the operator and torn away. While the partially detached fragment is held with one hand, the operator, introducing the chisel with the other hand, may complete the detachment. The removal of the partially detached pieces of bone may in many cases be greatly facilitated by looping a small cord over them and having an assistant apply sufficient traction to pull them away, while the operator guards the maternal organs by holding the piece of bone, during its detachment and extraction, in the palm of his hand. The use of the chisel should be repeated here and there upon the head, as often as may be necessary in order to bring about the required diminution, taking care at all times not to wound the maternal parts and to conserve as far as practicable the fetal skin of the face and head, in order that it may protect the maternal parts from the jagged fetal bones during the remainder of the operation.

In hydrocephalus the diminution of the head alone usually removes the sole obstacle to delivery. The same is true occasionally of beginning emphysema, where only the head is greatly involved. In other cases, the destruction of the head and face does not wholly relieve the dystokia. It may be necessary to continue the diminution by decreasing the volume of the neck and body. The cervical vertebrae may be divided with the chisel on their median line, the muscular and ligamentous attachments broken down or cut with the chisel, and the bone fragments secured in a rope noose and drawn away, covered by the hand. Later the fetal body may be further diminished by subcutaneous amputation of the fore limbs at the shoulder, evisceration, destruction of the pelvic girdle, or other means to be described later.

c. **Amputation of the Head and Neck.** When the head is completely deviated in a manner to render adjustment impossible or impracticable, amputation is sometimes advisable through the middle of the neck, removing the head with the cephalic portion of the neck, after which the body of the fetus may be extracted.

Technic. Some obstetrists advise the use of Persson's chain-saw (Fig. 107) or the chain sector of Masch. More recently there has come into high repute, in some portions of continental Europe, the embryotome of Pflanz (Fig. 106). The chain is passed between the curved neck and the chest, and forced through the neck by operating the windlass. Extra power is supplied by rack and pinion. Any one of the instruments named will accomplish the purpose, once it has been passed around the neck, but this offers considerable difficulty. The chain-saw and sector have the disadvantage, as compared with the Pflanz embryotome, that they must be drawn backward and forward in order to saw their way through the tissues. The operation tends constantly to wound the genital canal. This may be largely or wholly obviated by working the chain through a sheath of leather or other material. When the Pflanz embryotome has been applied to the part, danger of injury becomes virtually excluded, and the work of section is rapidly and easily carried out. In the application of these instruments, some operators claim that there is an advantage in first passing a cord around the neck, with the bent porte-cord or the bent cord-sound. Once the cord has been passed around the neck and is attached to the chain-saw or sector, the latter may be easily drawn into position. The Pflanz instrument has a smooth chain which is first passed around the neck. This smooth chain is free from material danger of injury to the soft parts of the mother and is comparatively easy to handle.

Other operators divide the neck by means of cutting instruments acting upon the posterior, or vulvar surface. For this purpose, they use the finger-knife, bistoury, or chisel. The process is a comparatively tedious one, as it is difficult to cut through every portion of the tissues. With the knife, it is impracticable to sever the cervical column, since the vertebrae can not be disarticulated, and it becomes necessary to use some more powerful instrument for severing the bony column. This may best be done with the chisel.

Recently the wire saw (Fig. 108) has been introduced. It appears to be a very decided advance in this operation. It is comparatively easy to apply and is highly efficient in severing the tissues. Apparently the wire saw is preëminently the best instrument for severing the neck when the head is deviated. I have not found it desirable to resort to the amputation of the neck in cases of deviation of the head, but have constantly preferred to amputate one anterior limb subcutaneously, followed by evisceration. If however the wire saw can be applied, the amputation of the neck becomes far simpler than the amputation of the leg and evisceration.

d. **Subcutaneous Amputation of the Anterior Limbs.** Amputation of the anterior limbs is very frequently advisable, especially with the foal in the ventral transverse presentations, with all four feet offering and the head retained ; in wry neck of the foal in the anterior presentation, dorso-sacral position, when it is impracticable to correct the deviation of the head or to amputate the head and neck with the wire saw, as described in the preceding paragraph ; or in any case in the mare or the cow where deviation of the head can not be otherwise so readily overcome as by the amputation of the limb.

Technic. The larger herbivorous animals are devoid of a clavicle, and the anterior limb, attached to the thorax by means of the skin and muscles only, is comparatively easily amputated. A cord is to be attached to the pastern of the limb, traction exerted upon it by one or two assistants, and the limb drawn out as far as possible with safety to the mother. The operator introduces one hand, armed with the hooked ring embryotomy knife, well guarded in the palm of the hand and resting against the limb of the fetus, up to the top of the scapula, or as near thereto as can be reached. The knife is then pressed into the skin and subcutaneous tissues, and, as the hand is drawn downward along the leg, the skin and subcutaneous tissues are slit freely and deeply from the top of the scapula down to the pastern. The knife is then laid aside and, while an assistant keeps the limb stretched by moderate traction, the operator forces his thumb, fingers, or hand between the skin and subcutaneous tissues and, pushing the hand towards the fetal body, detaches the skin from the limb until the upper region of the scapula is reached.

The separation of the skin may require at certain points, such as the region of the olecranon or carpus, the aid of the chisel, spatula, or knife to divide the firm bands of connective tissue. The separation of the skin from the subjacent parts removes the chief resistance to tearing of the limb away from the body. Until the separation of the skin from the leg and shoulder has been completed, the skin should be kept intact at the pastern, so that when traction is applied the integument, as well as the leg, is rendered tense and the operation is greatly favored. When the skinning of the leg and shoulder is completed, the skin is to be divided at the foot by girdling the pastern. The detached skin will be of no further importance, and may be ignored. If required, it may be grasped and corded with a small cord.

After the detachment of the skin, the chief remaining resistance to the removal of the limb is the pectoral muscles. These may be torn asunder by first being separated into small bundles and then torn through with the fingers, between the sternum and the limb. The process may be aided by incision with the knife or the chisel.

When the pectoral muscles have been divided, the remaining impediments to tearing the shoulder away consist essentially of the trapezius and rhomboideus muscles at the top, the latissimus dorsi behind, and the serratus beneath the scapula, all of which come into action only when the shoulder is nearly severed, and then offer no serious resistance. Consequently it is only necessary to separate the skin from the limb and divide the pectoral muscles in order to draw the limb away by traction.

When the skin has been detached and the pectoral muscles divided, two or three assistants exert traction upon the limb, while the operator places his hand against the sternum and pushes in the opposite direction. The impact upon the maternal organs from the traction may be reduced to any desired degree, by applying a repelling force to the sternum of the fetus. The impact upon the maternal organs equals the difference between the traction applied upon the cord and the repulsion applied to the fetal sternum. Should the hand of the operator not suffice, the repeller should be applied, carefully guarded by the hand of the operator, and any additional force required supplied by one or more assistants. Should the traction fail to bring the limb away promptly, the operator should attempt to extend the division of the muscles attaching the limb to the thorax, while moderate traction upon the limb is continued.

Further diminution of the size of the fetus may now be had by the removal of the other limb in the same way. This is especially desirable in the transverse presentation with all four limbs in the passage. The size of the trunk may also be reduced by evisceration.

The subcutaneous removal of both anterior limbs greatly facilitates version, and eliminates the serious danger of a fore foot becoming caught in the uterus and puncturing its walls.

When a fetus presents anteriorly in the dorso-sacral position, with lateral deviation of the head which does not readily admit of correction, the subcutaneous removal of one anterior limb, followed by evisceration, so reduces the volume that the remnant can be easily withdrawn without correcting the deviation of the head. The removal of the anterior limb, the severing of the ribs, and the evisceration render the fetal remnant so flaccid, and so increase the room by the reduction in size, that the deviation is easily corrected.

e. **Amputation at the Humero-Radial Articulation.** Amputation at this point is rarely desirable, but I have at times found it necessary in the mare in order to remove an anterior limb when it was impossible, on account of the position, to reach the shoulder.

Technic. Attach a cord to the pastern and have an assistant render the leg tense by exerting moderate traction. Introduce the hand, armed with the embryotomy knife, carefully concealed in the palm, and girdle the skin around the articulation. Passing above the head of the olecranon on the posterior side, divide the attachment of the anconean group of muscles by a cut directed forward. Then divide transversely, as far as possible, the muscles and ligaments passing over the articulation. Rotate the limb forcibly on its long axis, while strong traction is maintained, and rupture the remaining ligaments until the limb is completely detached and comes away.

In cases of limited room, it may sometimes be easier to detach the skin of the limb from the pastern up to the articulation, as in the operation for the subcutaneous amputation of the limb at the shoulder, described above. By this plan the skin is separated up to the olecranon, the muscles divided transversely, and the operation otherwise carried out as in the preceding paragraph.

f. **Detruncation in the Anterior Presentation.** In the mare, when a fetus in the anterior presentation has one or both posterior limbs deviated forward beneath its body, and the feet engaged against or in the pelvis, it is generally necessary or advisable that the trunk of the fetus be divided in order to bring about delivery without serious or fatal injury to the mother.

Technic. If practicable, secure the two hind feet by means of cords. Apply cords to the two anterior limbs and head, and have one or two assistants draw the anterior part of the fetus as far out as is safe. Then girdle the fetal body immediately against the maternal vulva, by making an incision through the skin and skin muscle. It is frequently best to remove first one or both shoulders subcutaneously, as described on page 395, and follow with evisceration, as described on page 408, in order to give greater operative room and increased mobility of the fetus.

Insinuate the hand between the skin and the deeper structures, and forcibly separate the skin from the fetal body backward until the last rib is passed. Force the finger tips through the abdominal wall behind the last rib and, passing along the entire posterior border of each last rib, separate the abdominal walls from the ribs and sternum. After the abdominal muscles have been detached from the last rib, and the fetus has been eviscerated, rotate the thorax upon its long axis. This causes a division of the vertebral column near the dorso-lumbar articulation, and the anterior portion of the fetus falls away.

Secure the two posterior feet with cords, unless this has already been done. Spread the detached skin, which has been pushed back from the thorax, carefully over the stump of the lumbar vertebrae. Push the remnant of the fetal trunk into the uterus while an attendant draws upon the cords attached to the hind feet and advances them along the genital passages, thus causing a posterior presentation. This may result in a dorso-pubic position, which should be converted by rotation into the dorso-sacral, when the extraction of the torso can be readily brought about.

g. **Destruction of the Pelvic Girdle in the Anterior Presentation.** Somewhat rarely, perhaps most frequently in the cow, the pelves of the mother and fetus become interlocked and the antero-external angles of the fetal ilia, I′, Fig. 114, become locked with the shafts of the maternal ilia, I, at C, in such a manner that any safe degree of traction fails to overcome it. In most cases, if the veterinarian has observed the rules for traction laid down on page 381, the interlocking can be prevented or overcome, but if violent traction has been misapplied it may be difficult or impossible to overcome except by destruction of the pelvic girdle of the fetus.

Technic. Remove one anterior limb subcutaneously, as directed on page 395, and eviscerate, as described on page 408, through an opening made by the removal of two or three of the ribs exposed in removing the shoulder. Introduce the chisel through the eviscerated body cavity, carry it back, carefully guarded by the hand, and place it against the shaft of the fetal ilium, I′. Have an assistant drive the chisel deeply into the iliac shaft, from before to behind, and, when the chisel blade is well

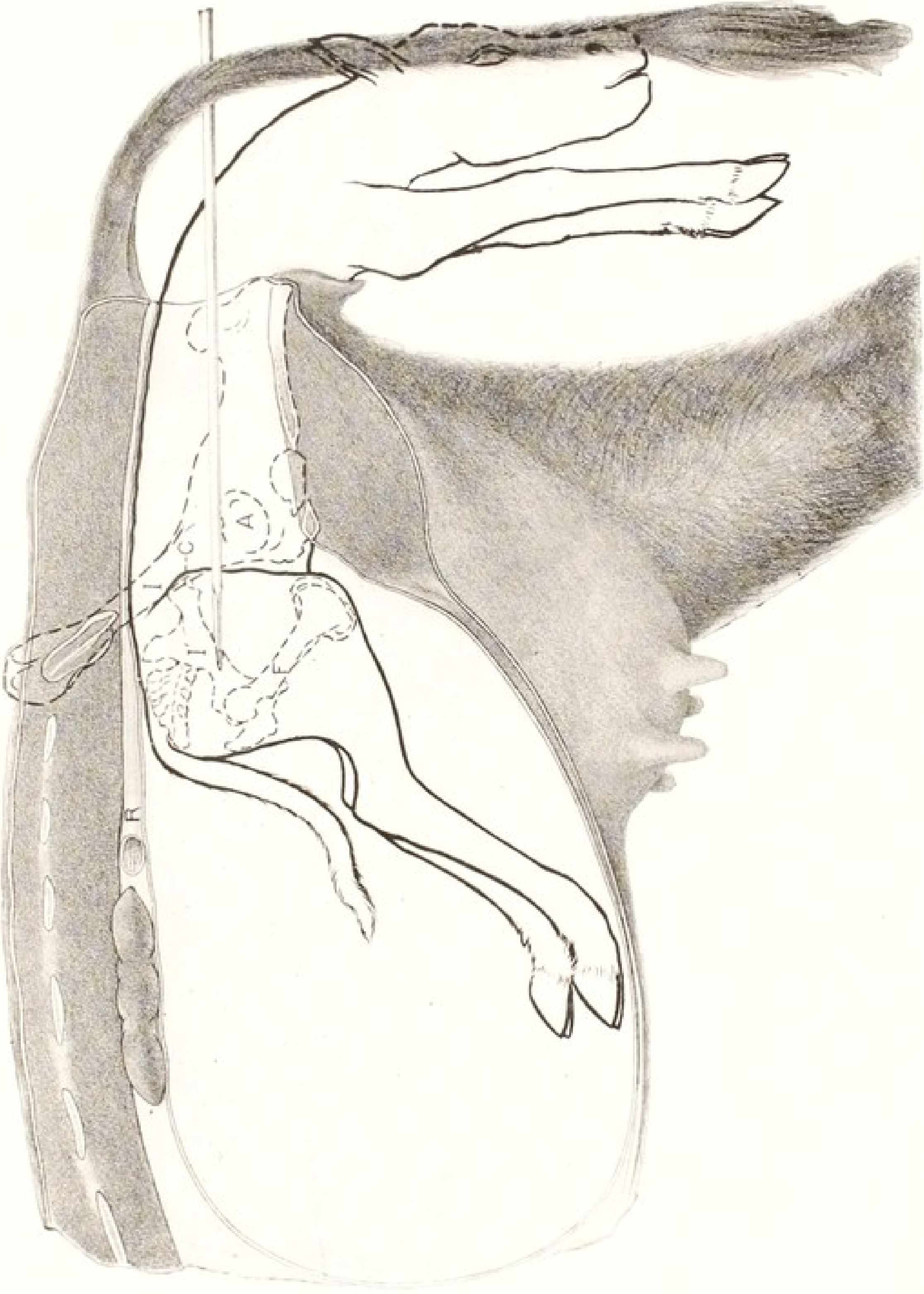


FIG. 114. DESTRUCTION OF PELVIC GIRDLE, ANTERIOR PRESENTATION. C, chief point of impact between pelves of fetus and dam; I, maternal ilium; I′, fetal ilium, representing chisel passing through its shaft; A, coxo-femoral articulation of mother.

buried in the ilium, revolve the instrument forcibly upon its long axis, and thoroughly divide the pelvic girdle by separating the cut ends of the bone. Then withdraw the chisel, replace it against the pubic brim, either at the symphysis pubis or opposite the foramen ovale, and drive it through the pubis and ischium at either of these points. Again revolve the chisel forcibly upon its long axis, and thoroughly break the bones apart. The coxo-femoral articulation is thus detached and isolated, so that the entire limb may drop backward beyond its fellow, and the remnant of the severed ilium, I′, can drop inward or move in any direction. The entire pelvis thus loses its rigidity and undergoes diminution in size, so that it can readily be withdrawn.

2. Embryotomy in the Posterior Presentation.

a. **Amputation of the Posterior Limbs at the Tarsus.** When a fetus, especially a foal, presents posteriorly, with one or both posterior limbs retained at the tarsus, the conditions may be such that it may be difficult or impossible to repel the fetus and extend the feet. I recall one case in the mare where I could not effect repulsion preparatory to correcting the deviation, and was forced to amputate. In a second case, in the transverse ventral presentation, the two posterior limbs were crosssed over the two anterior limbs, crossing the pelvic inlet and barring all progress until I had amputated each at the tarsus. The need for the operation is rare in the mare, and probably never arises in other animals. The difficulty of the correction of such a deviation is intensified by recumbency, the comparatively large size of the fetus, and fetal emphysema.

Technic. The best method for amputating at the tarsus is with the wire saw (Fig. 108). The wire saw is readily passed around the leg, and its work is rapid and efficient. Care is to be taken, in using the saw, not to pull too hard, especially when the limb is partly severed, as the bone may bind the saw and break it. Since the wire saw gives the cleanest cut through the bone, the stump offers less danger to the soft parts.

The chisel (Fig. 111d) is also highly efficient in this amputation, is readily applied, and acts rapidly. A cord should be passed around the leg above the summit of the os calcis, and an assistant should hold the leg steady by gentle traction. The chisel should be introduced, carefully guarded in the palm of the hand, and placed against the lower part of the tarsus, as nearly perpendicular to the long axis of the metatarsus as possible. The proper direction of the chisel may at times be greatly favored by placing the cord upon the metatarsus instead of the tibia, thus forcing the tarsus toward the sacrum of the mother and tending to throw the metatarsus straight across the pelvic inlet.

The chisel should at all times be held in the palm of the hand, with the dorsal surface of the hand against the vaginal or uterine wall, and the instrument carefully guarded and guided during the entire operation. The amputation should preferably be through the lower section of the tarsus, but may be made through the head of the metatarsus. The chisel should not be driven entirely through without removal, as it may become caught and clamped between the divided bones; instead, drive it first for only a few inches along the lateral side of the tarsus, being sure that the skin at that point is included in the cut along with the bone. Then loosen the chisel, and force the divided bones apart by rotating the instrument upon its long axis, after which it may be driven somewhat deeper into the tarsus, until the foot is completely severed.

Withdraw the severed metatarsus, remove any dangerous fragments of bone remaining on the stump, and see that the latter is safety secured by a cord passing around the leg above the os calcis. Repeat the operation on the other hock. Apply traction to the two stumps, and effect a posterior delivery. Amputation at the tarsus may also be performed with the chain-saw, sector, Pflanz instrument, or other form of embryotome. Any one of them is efficient, providing always that the hock is easily reached and lies, or can be placed, in such a position that the instrument can be applied. It is possible also, though very difficult, to amputate the hock with a scalpel.

Instead of amputating the hock, in cases where it is offering a serious obstacle to parturition, some recommend that the tendo-Achilles be severed and the metatarsus made to fold against the inferior surface of the tibia and the toe of the foot to become somewhat extended, so that it will offer less obstruction.

b. **Intra-Pelvic Amputation of the Posterior Limbs When Completely Retained.** This operation is designed for the overcoming of dystokia due to the so-called breech presentation, when the deviation can not be readily corrected.

Introduce the hand, armed with the embryotomy knife, scalpel, or chisel, through the maternal passages, until the perineum of the fetus is reached, and make a free incision through that part, including the anus in the male fetus and the anus and vulva in the female, enlarging the incision to the full size of the outlet of the fetal pelvis.

Locate the sacro-sciatic ligament of the fetal pelvis and divide it from its posterior border to the shaft of the ilium, thus enlarging the pelvic cavity and giving ample room for the insertion of the operator's hand. The severing of the sciatic ligament may be accomplished by cautiously cutting from behind forward, either with Colin's scalpel or with the chisel.

When this has been severed and sufficient operating room attained, carry the chisel in the hand and place it against the shaft of the ilium, as shown between I′ and I′, Fig. 115, as nearly perpendicular to the long axis of the iliac shaft as possible. Keeping the hand in touch with the chisel blade, have an assistant drive it through the bone until it and its periosteum are completely severed. Forcibly rotate the chisel upon its long axis, in order to complete the division of the bone and attached soft parts. Disengage the chisel, place it against the symphysis pubis or against the ischium opposite the foramen ovale, and drive it through the ischium and pubis at either of these points. Again revolve the chisel upon its long axis and, using it as a lever, separate the isolated portion of the pelvis as completely as practicable from the surrounding tissues. The value of revolving the chisel upon its long axis in order to separate completely the ends of the bones should always be recognized. If this is not done, the periosteum, tendons, or aponeurosis may hold the severed ends together and prevent the operator from passing the cord noose over the isolated segment of the pelvic girdle. The rotation of the chisel should therefore be continued as long as there is material resistance, and the segment of the pelvis detached as completely as possible.

With the fingers, aided by the chisel if necessary, detach the muscles from the isolated segment of the pelvic girdle for a short distance from each severed end. It is especially important to separate the skin, aponeurosis, and muscles from the ischial tuberosity so that the noose will readily engage the pelvic fragment and the skin and muscle attachments will offer no re-

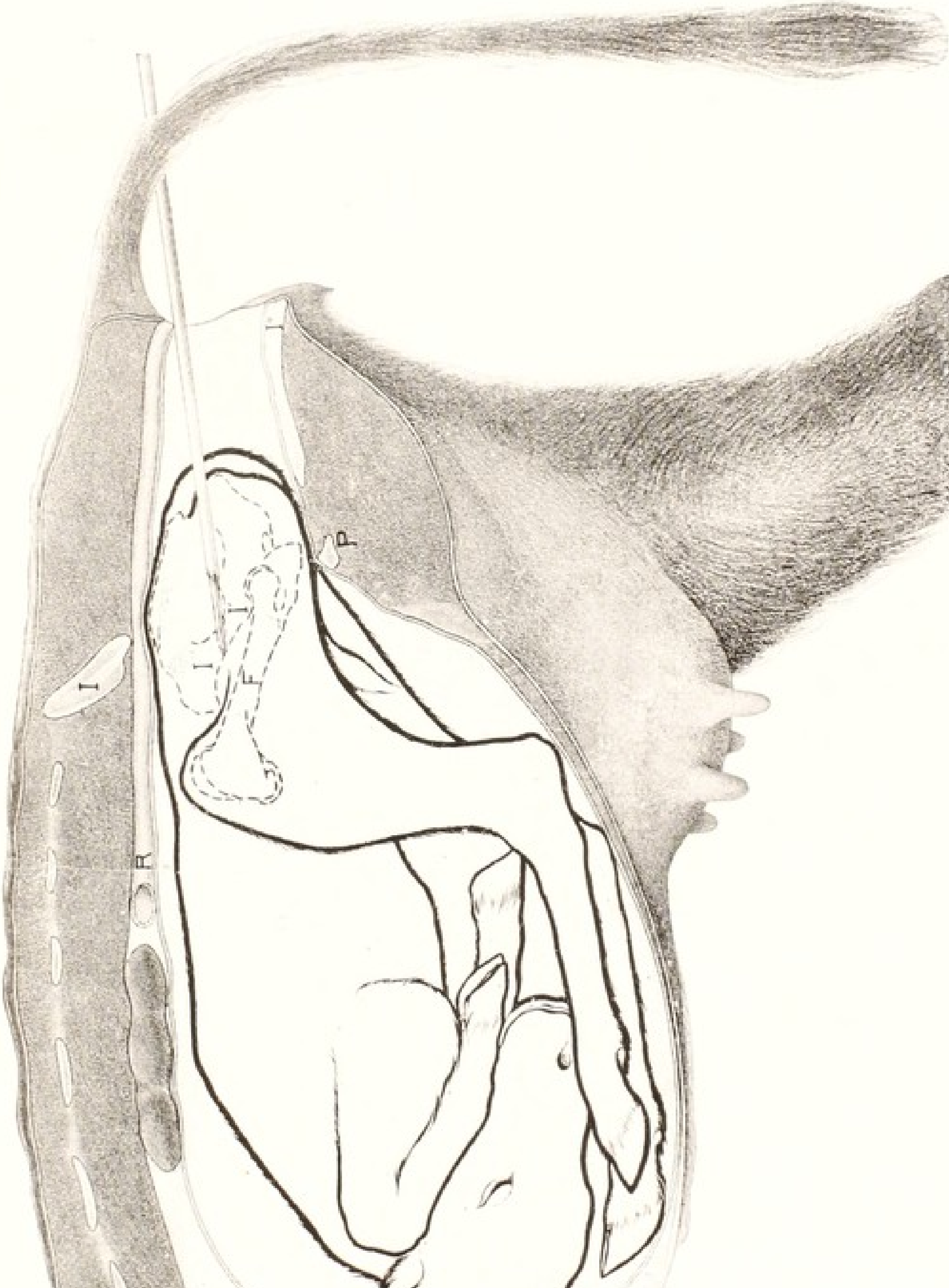


FIG. 115. INTRA-PELVIC AMPUTATION OF POSTERIOR LIMBS. Representing chisel as severing ilium at I'.

sistance. The skin should be slit freely from in front of the trochanter major back over the ischial tuberosity. Attach a strong looped cord about the detached pelvic segment, and tighten the noose. Have one or more assistants apply traction, as indicated in Fig. 116. The chief obstacle to the withdrawal of the limb is the great gluteus muscle, which should be sought for, identified, and torn through with the fingers, or otherwise divided at a distance of five or six cm. from its attachment to the great trochanter of the femur. This is best done while steady, firm traction is being applied to the limb by an assistant, thus tensing the muscle.

Vigorous traction may now be applied to the isolated pelvic segment by means of the cord, while the operator guards the advancing end of the detached bone with the palm of the hand, in order to prevent injury to the maternal organs. Sometimes the round ligament of the hip joint breaks, and the isolated piece of the pelvis, tearing loose from the femur, comes away alone. The cord is then to be applied over the head and trochanter of the femur, and traction again exerted, drawing the limb away in a reversed position. As it advances, the skin is turned backward or everted until the region of the hock is reached, where the integument does not so readily separate and only requires division to allow the limb to drop away.

During the removal of the limb, the operator is to note constantly the progress by manual exploration, and sever by tearing or cutting any tendons or muscles which offer special obstruction to the operation. During the tearing away of the limb, the operator largely or wholly counteracts the impact of the traction upon the maternal organs, by applying repulsion to other portions of the fetal pelvis, either with his hand or with the aid of a repeller in the hands of an assistant.

Repeat the operation upon the opposite limb. This requires but one incision through the bone, that is, through the shaft of the ilium. During the entire work the operation is carried out subcutaneously, or rather intra-fetally. If properly performed, the maternal parts are amply guarded against injury.

The size of the fetal trunk may be further reduced, if desired, by evisceration, as described on page 408. The remnant of the fetus may then be extracted, by traction upon a cord looped about the lumbar vertebrae.

After evisceration has been accomplished, should the fetal remnant still seem too large, because of emphysema or for other reasons, to be safely drawn through the pelvic canal, further diminution in volume should be accomplished. The chisel may be carried into the fetal cavity and placed against the last rib,

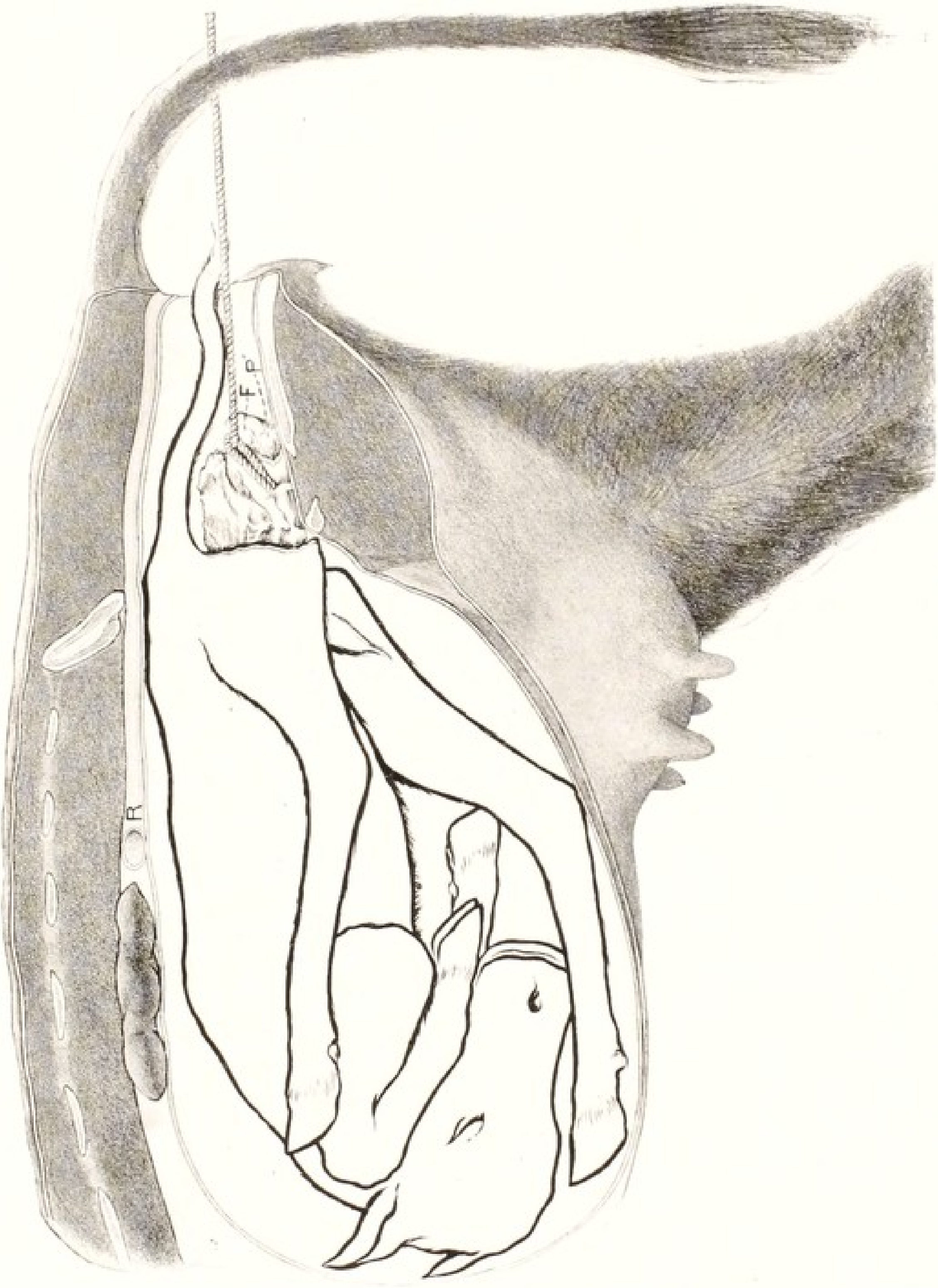


Fig. 116. Intra-Pelvic Amputation of Pelvis and Posterior Limbs. Extracting hind limb with cord.

close alongside the spinal column. Light blows upon the chisel by an assistant, while the cutting end is constantly accompanied and guarded by the operator's hand, readily sever each rib successively. The operation can be applied on both sides of the spinal column, dividing all the ribs.

The ribs may also be severed by means of the long-handled sphere-pointed cutting hook, Fig. 111 h. The instrument is introduced into the fetal body-cavity and hooked over the first anterior rib, or the most anterior rib within reach, and the ribs are cut one after another as the instrument is drawn backward. The sphere upon the point obviates the danger of the instrument penetrating the fetal skin and wounding the maternal organs.

If neither of these instruments is at hand, the obstetrist may destroy the ribs by manual force. The tips of one or more fingers may be forced through the intercostal muscles between the last two ribs, the intercostals then torn asunder from the base or spinal end down to the sternal cartilages, and the rib grasped and broken. Rib after rib may be treated thus until all are broken. This is a tedious operation, and there is constant danger to the operator of wounds from the sharp broken rib ends.

The division of the ribs is of very great importance. It allows complete collapse and obliteration of the fetal body cavity, and renders the fetal remnant very flaccid and pliable. More important, it permits the escape of the imprisoned gases of emphysema under the pressure of the labor pains. It should always be borne in mind in emphysema that, the greater the mutilation—especially the more thoroughly the skin, the pleura, and the peritoneum are incised or lacerated—the more readily the gases are pressed out, and hence the cadaver decreased in volume.

When the ribs have been destroyed, further diminution may be accomplished by securing a scapula from inside the chest, cording it and drawing the leg out through the cavity of the fetal body.

The amputation of the hind limbs may be accomplished by other means. The above plan offers the greatest decrease in the volume of the fetus. The manipulations are carried on exclusively within the fetal body. This insures the greatest possible safety to the patient. When completed the operation affords ready means for evisceration. The operation is neither tedious nor difficult, when compared with obstetric operations generally.

Some operators advise the use of Persson's chain-saw or the Pflanz machine, and amputate the posterior limbs as close to the hip joint as possible. The application of these instruments is not always easy. With either instrument, a cord or chain is passed around the limb as close as possible to the hip joint and the limb is severed in the manner described on page 394 for the amputation of the neck in the anterior presentation.

Other operators would cut through the soft tissues with a scalpel and attempt to disarticulate the femur from the pelvis. It must be extremely difficult to disarticulate such a joint as this while the fetus is confined in the uterus and the limb is virtually immovable.

The wire saw, once passed around the thigh, will amputate it very much more easily and quickly than the chisel can, but the operation is not so valuable, because with the pelvis, hips, and hind legs entirely away the torso is left much smaller, evisceration is easy, and the gases of emphysema can escape far better.

c. **Evisceration.** Evisceration of the fetus is frequently desirable. It decreases the volume of the fetal trunk greatly, renders it flaccid by removing the support of the distending viscera, allows the body remnant to be bent or moved more readily for the correction of any deviations, and permits freedom of intra-fetal operations directed against other parts as for detruncation or for destruction of the pelvic girdle. When a putrefying fetus becomes enormously enlarged as a result of emphysema, evisceration removes the gases collected in the viscera and body cavity, and permits the escape, under pressure in the birth canal, of much of the gas imprisoned within the fetal tissues.

Technic. Evisceration may be employed in the anterior, posterior, or transverse presentations.

1. **In the anterior presentation**, unless the fetus is far advanced through the vulva, evisceration is best performed by the removal of one or more of the anterior ribs. The ribs are best reached by the subcutaneous amputation of the anterior limbs, as described on page 395.

When the ribs have been laid bare in the manner described, the operator can thrust the finger tips through the muscles in the first intercostal space, and enlarge the opening thus made by tearing through the muscles, upwards to the spinal column and downwards to the sternum. Then, grasping the rib near its middle, he can fracture it by means of a sudden and vigorous pull. The fractured ends may then be grasped, and pulled, broken, or twisted off.

The chisel may be brought into use, if necessary, in order to divide the rib, the hand of the operator constantly guiding and guarding the chisel blade. The operation is then to be repeated, if required, upon the second and third ribs, until an opening into the chest is secured, ample in size for the introduction of the operator's hand.

Force one hand through the opening, and tear the mediastium from the thoracic walls, above and below. Then grasp either the trachea at its bifurcation, or the heart, and tear away the lungs and heart, as nearly as possible in one mass. The heart, which constitutes the greatest bulk of the thoracic viscera, is best grasped by engaging the fingers in the aorta and pulmonary arteries.

When the thoracic viscera have been withdrawn, thrust the fingers through the diaphragm, locate the liver, isolate the area of the diaphragm to which it is attached, and, engaging both with the fingers, remove the two together.

The liver, in a normal fetus, constitutes the chief intra-abdominal mass, and occupies more space than all the other organs combined. After the liver has been removed, the intestinal tube, with its contents, may be withdrawn without difficulty, as its attachments are feeble. The kidneys may also be removed.

2. **In the posterior presentation**, evisceration is preferably performed through the pelvis, generally in connection with intrapelvic amputation of the posterior limbs, as described on page 402. It may be performed without destruction of the pelvic girdle, by making an incision through the perineal region and then severing the sacro-sciatic ligament as directed for intrapelvic amputation.

When free entrance has been gained into the abdominal cavity, introduce the hand and withdraw the alimentary tube. Then rupture the diaphragm about the liver and tear away the latter organ in the same manner as in the anterior presentation. The liver is so friable that it can not well be removed by grasping the organ itself, but comes away entire, with the central part of the diaphragm. Remove the heart and lungs as directed in the anterior presentation.

The decrease in the volume and rigidity of the fetal body may be pursued further by the division of the fetal ribs as noted on page 406.

Miscellaneous Embryotomy Operations

Having briefly described embryotomy as it may be carried out in dystokia, with the fetus presenting under conditions which are more or less subject to classification, there remain innumerable atypical cases to which the general principles must be adapted.

In the various forms of monstrosities, some plan must be evolved by which the monster may be sufficiently reduced in size to permit of its removal. Double monsters may be divided equally, if possible, or a portion of each body may be removed, so that the remnants of the more or less double body may be removed together.

Sometimes other persons have performed partial embryotomy, in such a way as to embarrass the veterinarian. A limb has been amputated at such a place that the stump becomes a positive menace to the patient and interferes with delivery. For example, the amputation of an anterior limb at the carpus, when the foal is presenting anteriorly or in the transverse presentation, is an obstacle and a menace. In such cases the stump of the limb must not be pushed back into the uterine cavity and permitted to puncture the uterus, but must be amputated higher up, until at least the fore-arm has been removed. Similar mutilations are met when the fetus presents posteriorly and some portion which has protruded beyond the vulva has been cut away. I met with an anterior presentation, with the two hind feet projecting forward and engaged in the pelvis, in which detruncation had been performed through the thorax, without preserving a skin-flap, and jagged bones left, which seriously abraded the soft tissues of the mother. It is absolutely necessary in such a case that the spinal column be shortened by the removal of all the dorsal vertebrae and ribs, in order that version may be accomplished and the remnant converted into the posterior presentation. It is equally necessary that the spinal column be shortened in order that a flap of the skin and soft tissues may be acquired, which will cover the stump and protect the uterus and vagina from injury.

Early in my obstetric career I was called to a cow which was suffering from dystokia. The presentation had been anterior, and apparently normal, but the calf was large and it was necessary to apply traction. A local practitioner hitched a horse to the calf and succeeded in advancing it until the fetal and maternal ilia became interlocked. The fetus was then cut in two in the lumbar region, and the posterior portion dropped back into the uterus. Inexperienced in such cases, I failed to accomplish delivery. It should not have been difficult to reach into the fetal pelvis and secure it with a blunt hook fixed over the posterior border of the shaft of one ilium. With the fetal remnant securely held by means of the hook, the chisel could have been placed against the other iliac shaft and the bone divided. The chisel could next have been driven through the pelvic symphysis or the foramen ovale, and the pelvic girdle divided again, on the median side of the hip joint. It would then have been comparatively easy to extract the torso entire by traction, as the pelvis would collapse completely, permitting one half to drop behind the other, or a noose could have been slipped over the isolated segment of the pelvic girdle and the corresponding limb extracted as in intra-pelvic amputation of the hind limbs, described on page 402.

Complications of the greatest variety may thus arise, and are to be met by judicious planning and having the necessary instruments and appliances at hand for carrying out the work.

IV. Gastro-Hysterotomy

Gastro-hysterotomy, or Caesarian section, is the removal of a fetus or fetuses from the uterus by incision through the abdominal and uterine walls. It is a last resort in an attempt to save the life of the fetus, the mother, or both, when other forms of delivery are impossible or impracticable. It is one of the oldest operations in history, both in human and in veterinary obstetrics. At first it was performed chiefly with a view to saving the life of the fetus, and in many cases that of the mother was deliberately sacrificed in order to accomplish this end. With anaesthesia and antisepsis, the operation has attained a wider application and tends to conserve the lives of both mother and fetus.

The chief indications for the performance of gastro-hysterotomy in the larger animals are: impending death of the mother, where there is hope of saving the life of the fetus; displacements of the gravid uterus, such as irreducible torsion or hernia; hydrops amnii, fetal anasarca, and other conditions not amenable to embryotomy or other more favorable procedure.

In the sow, bitch, and cat, should the pelvis be abnormally narrow or a fetus become lodged anterior to the pelvis, whether from over-size, mal-presentation, emphysema, or a variety of other conditions, embryotomy is impossible, owing to the smallness of the pelvic canal; mutations for the correction of deviations or of vicious positions are well-nigh impossible; forced extraction is frequently dangerous or impossible; and gastro-hysterotomy is the one remaining hope. Perhaps the commonest and most valuable application of gastro-hysterotomy is in the uterine inertia of contagious abortion, where the intra-uterine infection with metritis renders the uterine contractions too feeble to expel the fetus.

Technic. When a pregnant animal meets with a sudden and critical accident, is in death throes, or her death is imminent, hysterotomy may be roughly performed by quickly making a free incision through the abdomen at the most convenient point, exposing the uterus, incising its walls, and promptly liberating the fetus.

When the operation may be deliberately planned, the technic may be varied according to surroundings. The operation of laparotomy upon domestic animals is practicable only in the flank. In the mare and the cow, the operation through the linea alba is impracticable for the life of the mother, because the immense weight of the abdominal viscera prevents the surgeon from closing the abdominal incision in such a manner as to support the viscera and prevent their protrusion. In all animals the flank operation is evidently safer in reference to prolapse of the abdominal organs as a result of the breaking or tearing out of sutures. After the operation, the flank wound may be kept cleaner, since it does not constantly come into such immediate contact with the ground or floor when the animal is lying down. In the bitch and the sow, the double row of mammae leaves the median line in a deep furrow, which renders suturing extremely difficult.

It is essential that the patient be cast, or placed upon the operating table in lateral recumbency. In securing an animal for the operation, she should always be extended at full length, the hind legs drawn backward and the fore legs forward, so that they will be completely out of the way. In small animals the extension of the limbs may be maintained with the aid of assistants, but in the larger animals it is essential that the patient be stretched by means of a rope attached to the hind limbs and another to the fore limbs, the other ends of which are securely fixed to posts or other secure objects. The mare is to be confined upon the right side; the cow upon the left.

From a humane, as well as an operative standpoint, anaesthesia or narcosis is essential. Keller (Zeitschrift für Tiermedizin, B. 11, S. 122) recommends for the bitch the subcutaneous injection of muriate of morphine in doses not exceeding 0.6 g., and later, if marked pain and struggling ensue, the inhalation of a small amount of ether. De Bruin (B. T. W., January 3, 1907) considers chloroform or other anaesthesia highly dangerous in the sow, and has had unfortunate results therefrom, so that he recommends local anaesthesia, consisting of cocaine muriate 0.3—0.5 g. in 10 cc. of distilled water, with the addition of 5 drops of 1-1000 solution of adrenalin chloride. Other plans for inducing local anaesthesia of the abdominal walls may be used, and when the abdominal cavity is open the anaesthesia may be extended to the uterus itself.

Chloroform anaesthesia in the cow and sheep is somewhat dangerous, because of their great tendency to regurgitate food from the rumen and then inhale it into the bronchii. If chloroform anaesthesia is to be produced in the cow, it might be well to administer the drug through a trachea tube in order to guard against food inhalation. Local anaesthesia may be very successfully used in the cow, remembering constantly that the principal pain in the operation consists of the incision through the skin, after which as a general rule there is little evidence of intense pain. Complete anaesthesia is essential in the mare, if it is proposed to attempt to save her life.

The obstetrist should be careful to select a place for operating which is clean and free from dust. If the animal is placed upon a bed of straw or other material, the bedding should be carefully moistened with an antiseptic and all necessary means taken to prevent any stirring up of dust by the struggles of the animal. A stout piece of canvas spread over a straw bed and well moistened with an antiseptic solution serves excellently.

The operating field should be carefully cleaned and disinfected. The hair should be removed by shaving over an ample area, which should then be disinfected by cleansing with soap and hot water with a stiff brush, followed by a thorough washing with alcohol or ether to dissolve the fat, after which the part should be thoroughly washed with 1-1000 corrosive sublimate solution or other reliable disinfectant.

In addition to these precautions, Keller suggests that at the point of incision the area should be saturated with tincture of iodine in order to complete the disinfection of this region. Prior to the application of the tincture of iodine, all water should be wiped away with antiseptic gauze.

After thorough disinfection, the entire surface of the body should be covered over with several layers of gauze or other suitable fabric, which has been saturated with an antiseptic solution to prevent dust and hair from the animal's body from getting into the wound. The sterile or antiseptic cover also affords a safe resting place for any protruding abdominal viscera. At the location where the laparotomy incision is to be made, an opening is made through the gauze, of the same dimensions as that to be made through the abdominal wall.

The laparotomy incision is then made. Preferably, the scalpel used for making the skin incision should be laid aside, and a second scalpel used to continue the incision into and through the deeper parts. After the skin incision has been completed, a valuable precautionary measure is to take a few stout sutures through the margins of the skin wound and the contiguous margins of the gauze covering. In this way the protective covering of gauze is held securely in place, greatly facilitating the later stages of the operation. The incision should begin at about the level of, or slightly below the supero-external angle of the ilium, midway between it and the last rib, and extend downward approximately perpendicularly.

After the skin has been divided, the incision may be continued directly through the abdominal muscles, or the bundles of each muscular layer may be separated longitudinally with the scalpel handle and the fibres not cut across. This involves a different direction of the opening for each layer of abdominal muscles. The division through the external oblique muscle is obliquely downward and backward, while that of the internal oblique is downward and forward. The two openings cross each other like an X.

The peritoneum may be rendered tense by pushing a finger tip against it and then incising with the scalpel. The incision is to be made carefully in order to avoid wounding the viscera. As soon as the scalpel has penetrated the peritoneal cavity, as indicated by the disappearance of resistance, the instrument should be promptly withdrawn. The margin of the peritoneal wound may then be picked up with forceps and the incision enlarged by means of a probe-pointed bistoury or scissors, guided by the finger, or may be readily torn by the fingers. The peritoneal incision may also be made by first picking up the peritoneum with forceps and pulling it away from the viscera, when it may safely be punctured with the scalpel and the incision extended.

The X-formed incision closes automatically, without sutures, after the completion of the operation and largely prevents any protrusion of the viscera. It leaves the abdominal walls far stronger than when the muscles have been divided transversely. It is more tedious than a direct incision into the peritoneal cavity, and is not so convenient for the operator. A very important part of the advantage of inter-fascicular division of the abdominal muscles can be had by applying the plan to the external oblique muscle only. This would furnish an X-formed incision through the skin and external oblique and a direct incision in the deeper layers. The size of the wound must necessarily depend upon that of the species: it should be no larger than necessary to permit the ready withdrawal of the presenting portion of the fetus, enclosed within the uterus.

In the mare and the cow, the uterus is not ordinarily to be removed from the peritoneal cavity, but the presenting part caused to protrude somewhat above the laparotomy wound, filling it tightly. Before the uterine incision is made, efficient provision needs be made against the liquid uterine contents flowing into the peritoneal cavity or laparotomy wound. Ordinarily the ventral commissure of the laparotomy wound is lower than the dorsal and the presenting portion of the gravid uterus tends to protrude and drop down ventralwards. This disposition may be favored by having the patient secured upon an inclined plane with the ventral portion of the body lower than the dorsum. An assistant may stand behind the animal and push the protruding uterus ventralwards, forcing it tightly against the inferior commissure of the wound. Dry sterilized pads are then to be packed about the protruding uterus. Special care needs be taken in these provisions against the escape of the uterine contents into the peritoneal cavity if the contents are infected. The uterine incision should be made as nearly as possible along the median line of the greater curvature. At this point the vessels are few and unimportant. In ruminants there are normally no cotyledons in this area.

The protruding portion of the uterus should be so adjusted that the incision along the line indicated will be approximately parallel to the long axis of the patient's body. The incision should be made first through the uterine wall only. Immediately the incision has been made into the utero-chorionic cavity, the ventral margins of the uterine incision should be grasped with forceps at several points and the uterine wall drawn down over the ventral end of the laparotomy wound and held there by assistants. If assistants are not available, the operator may secure the ventral lip of the uterine wound by means of sutures to the gauze covering of the patient. By these means, the laparotomy wound and peritoneal cavity are fortified against contamination by the uterine contents. In ruminants any fluids within the utero-chorionic cavity may then be drained off or taken up with absorbent material. The fluids, if any, in this cavity having been satisfactorily removed, the operator may proceed to penetrate the allantoic cavity in the mare or the amniotic cavity in the cow. In the cow it is preferable not to open the allantoic sac until the fetus has been removed. If care is taken to make the incision into the fetal sac above the horizontal line, 6, in Plate I, Frontispiece, only the amnion need be opened. The fetus may then be removed, and later the large volume of allantoic fluid more conveniently removed without so great danger of contaminating the laparotomy wound and the peritoneal cavity.

In the mare, the operator must pass through the allantoic sac in order to reach the amnion. Ordinarily the incision in the allantois and amnion should merely suffice for the ready extraction of the fetus. In the small multiparous animals, after having made the incision into the peritoneal cavity, the operator passes his hand around the gravid uterus, draws it out, and lays it carefully upon the sterilized gauze surrounding the wound. A longitudinal incision is then made into the uterus at the desired point, upon its greater curvature.

In multiparous animals it is usually desirable to extract all the fetuses through a single uterine incision. For this purpose, it is more convenient to make the opening in one cornu, near the bifurcation, so that the fetuses from the other horn may be readily pressed around through the uterine body to the incision. In some cases, where the fetuses are emphysematous and the adjacent uterine walls are inevitably seriously inflamed, the fetuses adhere so firmly to the uterine walls that they can not be moved far without serious injury to the organ. Consequently it may be necessary to make two or more incisions.

In multiparous animals, when the incision into the uterus has been made, it is to be continued through the membranes to the fetus, if it is alive, the fetus grasped, and withdrawn. If the fetus is dead, wherever practicable it should be pressed out through the wound, with the membranes intact, by compressing the uterus, or the hand may be passed into the uterine cavity and the fetus grasped in its membranes and drawn out. When a putrid fetus can be extracted in its intact membranes, the peril from contamination of the wounds and peritoneum is lessened. The other fetuses in the same horn are then to be pressed toward the opening, one after another, or the operator should introduce his hand into the organ and remove the fetuses one by one. When the incised horn has been emptied, the opposite horn is to be emptied by pressing the fetuses into the body of the uterus and then turning them toward the incision.

If the fetuses are living, they should be freed from their membranes as soon as extracted, and given proper care. After the fetus or fetuses have been removed, the fetal membranes and any liquids or other debris should be removed as far as practicable. The fetal membranes, especially in the cow, are not always detachable. If the metritis of contagious abortion exists in the uterine cavity, placentitis may be present in such degree that the membranes can not be detached. Any fluids present in the uterus should be carefully removed by mopping up with aseptic or antiseptic gauze, or other suitable material. If the cervical canal is open, the uterine incision may be closed. If the cervical canal or other portion of the posterior genital tube is impervious, the wound in the uterus can not be safely closed. If the closure of the uterine incision is considered justifiable, the peritoneal surface should be thoroughly cleansed with physiologic salt solution and the organ carefully returned until nearing the incision. The wound in the uterus is then to be closed by means of Lembert's or other intestinal sutures of silk. After the uterine wound has been closed, the remainder of the organ should be allowed to drop back into the peritoneal cavity.

The peritoneal wound should be closed with continuous or interrupted catgut sutures which have been immersed in tincture of iodine or otherwise rendered thoroughly aseptic or antiseptic. The sutures for the muscles and skin should be of strong silk, thoroughly sterilized or rendered antiseptic. After the skin has been sutured, the external sutures should be saturated with tincture of iodine or other antiseptic, to guard against suture infection.

The animal should then be placed in a comfortable room to recover from the anaesthesia, and allowed to rest quietly. No food whatever, and only small quantities of water, should be allowed for 24 to 48 hours after the operation, but later she may have a small allowance of suitable food, such as a restricted allowance of succulent or soft food, and finally in the course of eight or ten days may be put upon a regular diet.

If the cervical canal is not open or the closure of the uterine wound appears otherwise imprudent, the operator may resort to complete or partial hysterectomy, a description of which follows, or without the removal of any portion of the organ may detain the uterine wound in the laparotomy incision by suturing the margins of the uterine wound to those of the cutaneous incision. In such event the uterine wound is to be closed by sutures except for an opening of sufficient size to afford ample drainage. The laparotomy wound is closed snugly about the protruding uterus and the remaining free uterine margins sutured to the cutaneous wound at its ventral commissure. The broad ligament of the uterus should be carefully caught and made fast in the laparotomy wound, with the uterus, in order to prevent the formation of an artificial foramen between the uterus and the abdominal wound, through which viscera might fall and become incarcerated. With the uterus fixed in the laparotomy wound, efficient drainage of the uterine cavity is available. A piece of rubber tubing, preferably a pure gum horse catheter, may be passed through the open portion of the uterine incision and fixed by sutures to the margins of the cutaneous wound. Through the drainage tube, the uterine cavity may be effectively douched as long as may be deemed advisable.

Prognosis. The prognosis of gastro-hysterotomy is most favorable in small domestic animals, in which there is less susceptibility to wound infection, although perhaps the main consideration is the size of the animal and the practicability of the proper control of the wound after the operation. In swine and carnivora, especially, the abdominal viscera are light, as compared with those of ruminants and solipeds, and offer far less difficulty in controlling the laparotomy incision. Keller records the operation of hysterotomy in ten bitches, with recovery of eight of the mothers, or eighty per cent. In eight out of the ten cases, some or all of the fetuses were saved. In the other cases the fetuses were dead when the operation was begun.

De Bruin records 23 hysterotomies in the sow, with 11 recoveries and 12 deaths, or a loss of 60 per cent., but he accepted all cases of dystokia which were offered and which it seemed impossible to deliver in any other way. Among these were several sows which were already comatose and virtually dying when presented. He concludes that when the fetuses have become emphysematous ; the sow has a high temperature accompanied by loss of appetite, with no milk in the teats; or is in a comatose condition, the operation will quite probably be followed by death. He states also that, according to the statistics of the cases which he publishes, the results are very favorable, if the patient has not been manipulated prior to the operation, and there is no extensive necrosis of the vaginal walls as a result of the forcible extraction of one or more fetuses or attempts at that operation by laymen. De Bruin regards the operation as highly successful in those cases where no manipulation of the genital tract has been made, except by the veterinarian, under proper precautions, for purposes of diagnosis, and where labor has not continued for more than 24 hours.

Kasselman (D. T. W., 1899) operated on 25 sows, with recoveries in 19 cases. In his statistics, all those cases in which the fetuses were putrid perished.

So far as can be determined by the available literature, the operation is somewhat less favorable in carnivora. My colleague, Dr. Milks, has discarded hysterotomy generally and substituted hysterectomy (including the ovaries) as greatly preferable and highly successfully.

Hysterotomy in the sheep and goat has not been largely practiced, so far as indicated by the literature, although a few successful operations have been chronicled.

In the cow gastro-hysterotomy is highly favorable for the calf, because the attachments of the fetal to the maternal placenta are of such a character that it is easy to preserve the life of the fetus if it is in good, vigorous condition at the beginning of the operation. Little is known regarding the percentage of recoveries in the cow, although recovery does occur. Franck places the loss in cows at 65 per cent. This appears severe and suggests that perhaps many of the cases were virtually hopeless before the operation was undertaken. The cow withstands laparotomy splendidly, as is well shown by the operation of spaying through the flank. She is quite resistant to lesions of the uterine walls. It would appear that she could withstand hysterotomy with comparative safety if the uterus and uterine contents are healthy. The difficulty with the operation is largely due to the fact that the fetus and its membranes have undergone putrid decomposition and that the uterine cavity has become infected before the operation is considered. Under such conditions, success can scarcely be hoped for in a reasonable number of cases. In many instances it is quite impracticable for the veterinarian to determine early the advisability of the operation.

Frequently living foals have been removed from the mare by gastro-hysterotomy, but the mare ordinarily, if not always, perishes. Such total want of success is not necessary. With modern surgical methods, laparotomy can be performed in the horse without serious danger. Since this is true, there is no essential reason why hysterotomy should not succeed in prudently selected cases. There are cases, especially of one type of transverse or bi-cornual development of the fetus, in which no successful delivery has yet been recorded, where the prompt performance of hysterotomy might offer some hope for the life of the mother. The foal is already dead when the veterinarian is called, but it and the uterus need not yet be infected to any great degree.

With the modern advances in surgery, gastro-hysterotomy is becoming more and more successful in large animals. Anaesthesia is fully available, and there is abundant opportunity for the successful application of aseptic or antiseptic precautions so that the outlook for the operation is not at all discouraging. The bogy of the unsupportable weight of the viscera in ruminants and solipeds is well under control. There is room enough in the upper flank for gastro-hysterotomy without invading the abdominal floor. Laparotomy may be performed by separating the muscle bundles longitudinally and not weakening them transversely, so that the danger of the abdominal wall giving way under the great weight of the viscera is virtually eliminated. There is no longer any insurmountable barrier to successful hysterotomy in the mare, having regard for the lives of both mare and foal. For the foal however, the operation must be early.

When gastro-hysterotomy is undertaken, and the abdomen, and perhaps the uterus, has been opened, the operator frequently encounters intense intra-uterine infection, putrid fetus or fetuses and fetal membranes, and not rarely uterine gangrene, either of the placenta, the mucosa, or the entire organ. Under such conditions, recovery is exceedingly doubtful or is clearly impossible if the diseased uterus is permitted to remain. Hysterectomy then offers the only hope for the rescue of the mother. In torsion of the uterus in the ewe, and less frequently in the cow, the uterus or the vagina ruptures transversely and the gravid organ drops loose into the abdomen. It can not be restored to its position or retained as a living organ, and the only hope lies in the removal of the virtually detached organ.

In some cases the operator knows before the operation is begun that severe intra-uterine infection, a putrid fetus or fetuses, or perhaps uterine gangrene exists and there is no reasonable hope that hysterotomy may save the life of the patient.

V. Hysterectomy

Hysterectomy, or the total ablation of the uterus, with the ovaries, has a wide application in dystokia of the multiparous domestic animals.

The operation involves the total destruction of the breeding life of the animal. Frequently the fetus is dead, so that its life does not enter into consideration. This is not an invariable rule. When spaying bitches at full term I have not hesitated to remove the entire uterus with the contained fetuses. Frequently the fetuses are removed in vigorous and viable condition and the mother does well. In so far as the life of the fetus is concerned, hysterotomy and hysterectomy offer no essential differences. Neither does hysterectomy present materially greater obstacles to the recovery of the mother than does hysterotomy in the larger animals. In the smaller animals hysterectomy frequently offers much better opportunity for the life of the mother. Hysterotomy is admittedly the more conservative operation, as it is possible thereby to preserve the breeding life of the animal, but this is of scant consequence, since as a rule the breeding life is already at an end. The total ablation of the organ necessarily causes a greater shock to the patient than a mere incision at its least vascular part. It has the definite advantage over hysterotomy that the gangrenous or critically diseased organ, with its putrid contents, is removed, eliminating their menace to the life of the mother. There is no insuperable barrier to the success of hysterectomy in any animal. Amputation of the uterus is occasionally performed successfully in cows and mares, after the organ has become prolapsed. Hysterectomy in itself is no more dangerous because the organ is in situ. Any increase in peril must be attributed to the laparotomy or to the intensity of the intra-uterine infection present.

The confinement of the patient, disinfection of the operative area, anaesthesia, or narcosis, and other preparations, along with the abdominal incision, are the same as for hysterotomy, and the uterus is to be lifted out of the abdominal cavity in the same manner. After the organ has been exposed, the utero-ovarian arteries, the chief uterine arteries, and, if need be, the uterine branch of the posterior uterine or vaginal trunk and any other visible arteries in the broad ligaments should be securely ligated. The point of amputation is to be decided by the conditions presenting. In the sow and carnivora, it may rarely be practicable to amputate one horn only and conserve the breeding power of the patient. In solipeds and ruminants, the amputation of one horn only would be imprudent. The ovaries should accompany the uterus; otherwise, after recovery the patient comes regularly in estrum and may become a nymphomaniac. The amputation should be through the uterine body, the cervix, or the vagina. It is best not to amputate through the cervix as a rule, because the amputated end can not well be invaginated, since the cervical walls are too thick and rigid.

At a point several inches nearer the vulva than that selected for amputation, the genital tube should be securely ligated or grasped with forceps in such a manner that, through compression, the stump may be held safely and the canal be securely closed. It may also be desirable to ligate the genital tube firmly upon the ovarian side of the intended point of excision. Ample measures need be taken to prevent the escape of any uterine contents into the peritoneal cavity or the laparotomy wound, chiefly by means of an abundance of absorbent packs or dams. The uterus is then to be excised and removed with its contents.

The interior of the stump is to be carefully disinfected. First it should be thoroughly mopped out with dry aseptic gauze or cotton, and then very thoroughly disinfected. It may be very abundantly swabbed with tincture of iodine or with other reliable disinfectant. The margins of the wound are then to be invaginated into the genital passage, a layer of heavy silk sutures applied by the Lembert, or other method, and a second layer of intestinal sutures over the first with catgut. The stump of the vagina is then to be allowed to return into the abdominal cavity. If infection of the peritoneal cavity is evidently present or is feared, the cavity should be irrigated with normal salt solution in the hope of mechanically cleansing it.

Sometimes partial hysterectomy is preferable. In irreducible torsion of the uterus or transverse rupture of the uterus from torsion, the uterine cavity may not be safely closed as in hysterotomy, nor completely amputated because of adhesions. A portion of the organ may then be excised and the margins of the stump securely fixed to the margins of the abdominal incision, thus affording exterior drainage for the suppurating uterine cavity.

MATERNAL DYSTOKIA

Dystokia referable to a pathologic state of the mother may be dependent upon some disease of the uterus which inhibits the physiologic expulsive powers; diseases of the cervix, vagina, or vulva which so narrow the birth canal that the healthy uterus is unable to force the normal fetus through it ; systemic and skeletal diseases of the mother interfering with the expulsive forces; diseases of or within the pelvis which induce compression upon the birth canal of a character to prevent the expulsion of the fetus ; or displacements of the uterus which close or interrupt the genital tube at some point. The various displacements of the uterus do not fundamentally cause dystokia, but instead may and frequently do originate some days or weeks prior to the time for parturition. This group, consisting chiefly of rupture of the prepubian tendon, uterine hernia, and uterine torsion, is discussed under "Diseases of the Pregnant Animal", page 187, and the handling of the dystokia they may ultimately cause is discussed there.

Diseases of the Uterus

The Dystokia of Contagious Abortion

Slowly, but none the less surely, it is becoming proven that the chief cause of dystokia in domestic animals is contagious abortion. The term "contagious abortion" is used here in a broad sense. It is meant to include any infection naturally transmitted from animal to animal which has a tendency to invade the uterine cavity and imperil the life of the contained fetus or fetuses. It is freely granted that such a nomenclature is open to very serious objections and that each of such infections might better be known by some distinctive name. Here however the subject of dystokia is being discussed, not the nomenclature of a ruinous group of diseases which largely reveal their evil power by causing the death and expulsion of the immature fetus. Primarily each of the group, so far as now known, affects the uterus, and secondarily involves the fetus. Whenever the pregnant uterus is involved, the course and termination of pregnancy are inevitably disordered, and when the infection invades by contiguity the fetal membranes, fluids, and body the physiologic behavior of the fetus is threatened or interrupted.

The disturbances of pregnancy referable to contagious abortion are manifold. Infection within the utero-chorionic space (in ruminants) or inter-placental area (in solipeds, etc.) inevitably disturbs the orderly expelling powers, and may either abbreviate or extend the period during which the fetus or its cadaver is detained within the uterus. The most fundamental disturbance of intra-uterine infection is **uterine inertia**. The infection represses or destroys the normal reflexes of the organ and depresses the physiologic expulsive powers. If the operator inserts a catheter through the uterine seal of a healthy pregnant uterus and injects into the uterine cavity a neutral fluid to disturb the placental attachments, the uterus reacts and the uterine contents are expelled, usually within twenty-four hours. Intra-uterine infection may long exist with the cervical seal intact or destroyed, but when the uterine seal is mechanically destroyed there is a sharper response to the irritant. Abortion occurs in many cases of intra-uterine infection, but it is a chronic process, however abrupt the final act in the expulsion may appear to be, which has required weeks—usually months—for development. The intra-uterine infections which may cause abortion, so far as known at present, each cause a chronic metritis, which may become acute through the advent of secondary invaders. The most apparent result of a chronic inflammation in any organ or tissue is a disturbance of function. This is best illustrated by the contagious abortion of cattle. The principles are the same in all animals. I have recorded data[1] showing that in a large group of cows the visible duration of the act of parturition runs parallel with the degree of infection with contagious abortion, as shown by serologic tests of both cows and calves. These research observations are in entire harmony with clinical experience. Formerly it was said that, if a cow suffered from dystokia, if parturition were tardy, she would probably suffer from retention of the fetal membranes, or metritis ; now it may be said that if metritis exists in the pregnant cow, perhaps revealing

[1] Annual Report of the New York State Veterinary College at Cornell University, 1914-1915.

its presence after parturition as retained afterbirth, the parturition will be tardy—there will be dystokia. The duration of the pregnancy may have been either curtailed or prolonged, but the duration of parturition is uniformly prolonged. The uterus contracts feebly and tardily. The cervix may be normal and, true to its physiologic office, relax tardily in the presence of the uterine inertia, delaying the expulsion of the fetus. The signs of parturition are evident : the fetal membranes perhaps appear at the vulva ; the cervical canal is perfectly dilatable and is more or less dilated ; the fetus is alive, its presentation, position, and arrangement of extremities are physiologic ; the cow appears robust. Neverthelses parturition drags tediously along hour after hour, without material progress. The simple dystokia of the uterine inertia of contagious abortion is present.

It is freely recognized, clinically, that dystokia, like contagious abortion, is commoner in cows than in other domestic animals. The influence of uterine inertia upon parturition does not consist wholly of the mere delay. Orderly contraction of the uterine walls constitutes one of the two fundamental forces insuring the physiologic position of the fetus and the proper arrangement of its extremities. As uterine inertia increases, the power of the organ to adjust the fetal position decreases. The disordered uterus can not promptly shift a fetus from the dorso-ilial to the dorso-sacral position, nor has it the full physiologic power to favor the proper arrangement of the head and limbs. The abdominal walls, with their enormous power, are helpless in this field. They do their work indirectly by pressing the other abdominal viscera against the gravid uterus ; they compress alike the entire visceral mass.

The second fundamental element in assuring a physiologic position and the proper arrangement of the fetal extremities is the health of the fetus itself. A fetus manipulated through the rectum or vagina reveals very definite reaction against any compression or displacement. If the operator bends the foot or head or shoves it out of place, the fetus resents the disturbance and attempts to replace the member in its physiologic position. A study of the fetus in utero impresses the examiner with the fact that, when parturition comes on, the fetus will not permit, if it can prevent, the displacement, doubling up, or compression of a foot or the head. Instead, it will struggle to extend all its members. In contagious abortion however, the fetus is sick: the infection has penetrated the chorion, invaded the amniotic fluid, been swallowed by the fetus, and impaired its vigor. According to the degree of fetal infection, therefore, the fetus becomes unable to adjust its extremities properly for passage through the birth canal, and dystokia follows. This is called "fetal dystokia", as is the dystokia of the preceding paragraph. For convenience, its handling is discussed under that classification, but it is highly important that the practitioner look beneath the surface and recognize the fundamental nature. Only by such course can he anticipate the impending post-parturient diseases (*e. g.*, metritis) which will probably ensue in the dam and the post-natal diseases (*e. g.*, calf scours) of the fetus.

In a lesser number, and more striking group of cases, contagious abortion, instead of causing dystokia, inhibits the expulsion of the fetus. If inter-placental hemorrhage, due so far as known to the abortion bacillus, occurs, and the uterine seal remains intact, the fetus undergoes aseptic (non-putrid) death. The fetus, the fetal membranes, and the blood clots desiccate to form a "mummy" which remains indefinitely as an inert body in the uterine cavity. Sometime it may, should the uterus contract, induce dystokia, but fundamentally it rather obviates dystokia by causing a perpetual uterine inertia.

In other cases the fetus perishes and undergoes purulent decomposition within the inert uterus. At the same time that the fetus dies, or soon after, the uterus also dies. There is then no expulsive effort, because the gangrenous uterus is absolutely inert. The uterine gangrene and profound sepsis soon destroy the life of the patient. Technically, there has been no dystokia: the patient dies without any effort to expel the uterine contents. Sometimes the dead fetus rapidly becomes intensely emphysematous, the gangrenous uterus bursts asunder, and the uterine contents escape freely into the peritoneal cavity, hastening the amply assured death of the patient.

Sometimes when fetal death and decomposition occur the uterus retains some vitality and pathologic expulsive efforts occur, but progress is tardy or wanting. Perhaps the cervical canal becomes somewhat dilated and the putrid fetal membranes protrude. The veterinarian removes the emphysematous fetus by traction or embryotomy, or in small animals by hysterotomy or hysterectomy. When his disagreeable task is accomplished, he finds the uterus inflamed, inert, and perhaps gangrenous. Should gangrene not be present, the patient may slowly, uncertainly, and unsatisfactorily recover. If she recovers, she is probably permanently sterile. Often it is thought that the emphysematous fetus causes the metritis or uterine gangrene, and the facts, directly the reverse, are not recognized. In other cases, not at all rare, the intra-uterine infection causes fetal death, putrid decomposition, and prolonged uterine inertia. The fetus is not expelled en masse. Instead, the soft parts of the fetus may decompose and, mixed with pus and sometimes with fetal bones, escape through the vagina. Sometimes the inflamed uterus becomes adherent to the rumen, and the fetal debris and pus, escaping into it, are finally expelled per rectum. Such conditions may and do persist for years, piece after piece now and then escaping, but the inertia present so disables the uterus that it can not arouse the force necessary for the final and complete expulsion of the fetal debris.

Finally, when abortion occurs—when the immature fetus dies and the uterus essays its expulsion—dystokia is highly probable. The dead fetus, though small, is very liable to present in a pathologic position (dorso-ilial or dorso-pubic) or there is pathologic arrangement of the extremities (deviation of the head, feet, or limbs). This is designated "fetal dystokia" and the handling is most conveniently discussed under that heading, but in the final analysis the primary disease is the metritis of contagious abortion.

The principles, as traced in the contagious abortion of the cow, apply with equal force to the contagious abortion of other domestic animals. Perhaps the abortion of sheep and swine is identical in etiology with that of the cow. It is essential to intelligent veterinary obstetric practice that the dominating influence of contagious abortion upon the physiology of parturition be clearly recognized. By this means alone can the veterinary practitioner look beyond the superficial, secondary symptom of dystokia and grasp the real significance of the problem presenting. It is of scant use, and indicates restricted vision, to overcome the dystokia of contagious abortion and give no heed to the fundamental disease.

The handling of the dystokia of contagious abortion, in so far as it is dependent upon mal-position or upon the deviation of extremities, is most profitably discussed under *Fetal Dystokia*. Total uterine necrosis, with emphysematous decomposition (including rupture of the gangrenous uterus as a result of extensive emphysema) is so utterly hopeless that its handling calls for no comment. The inhibition of parturition due to fetal mummification is more properly considered in diseases of the genital organs than in obstetrics. Fundamentally, it is overcome by dislodging the corpus luteum of pregnancy from the ovary, thus arousing uterine contractions and the expulsion of the mummy. The process of expulsion rarely precipitates dystokia. Should dystokia occur, it is ordinarily due to the sharply projecting, rigid extremities, which are not subject to adjustment. They must be guided through the birth canal by insinuating the hand between the projecting part and the soft tissues. If this is impracticable, the offending projection must be cut away with the wire saw or the chisel. The handling of chronic putrid decomposition of the fetus falls within the scope of the diseases of the genital organs, rather than of obstetrics. The fundamentals of handling consist of the arousal of the inert uterus by dislodging the corpus luteum of pregnancy (the retained corpus luteum of pyometra) the dilation of the cervical canal, the douching of the uterus, and in case of need laparo-hysterotomy. There remain two clinically important types of dystokia, almost but not always referable to contagious abortion.

1. Emphysematous Decomposition of the Fetus

Emphysematous decomposition of the fetus arises by two somewhat opposite methods. Preëminently it is caused by contagious abortion. The intra-uterine infection causes the death of the fetus without arousing an expulsive reaction in the uterus. The intra-uterine infection causes inertia, instead of so irritating the uterine walls as to cause their contraction. The fetus is detained in the paretic uterus and decomposes. This is in contrast with the usual course, in which the presence of the infection of contagious abortion so irritates the uterus, in spite of the inevitable degree of atony, that it contracts sufficiently to occasion the phenomenon of abortion—the death and expulsion of the immature fetus. In the other group of cases, the uterus and fetus may have been physiologic at the beginning of parturition, but a chance pathologic presentation, position, or location of extremities may bar the expulsion of the fetus, which perishes and soon becomes emphysematous. This type is rare. It can occur only when there has been unwarranted delay in handling dystokia due to physical obstruction. Whatever the fundamental cause, the method of handling is essentially identical and the prognosis is very similar.

The handling demands chiefly, in large animals, the adjustment of mal-presentations, mal-positions, and deviations of extremities; embryotomy; and forced extraction of the torso. The uterus is always partly inert, usually wholly paretic, and affords little or no aid in expelling its contents. The adjustment of presentation, position, or deviation of parts may either precede or follow embryotomy. Thus, if the emphysematous cadaver is in anterior presentation, with deviation of the head, the correction of the deviation may be impossible or imprudent without precedent embryotomy. The embryotomy may be undertaken by two different plans. The head and neck may be amputated, as described on page 394, directly obliterating the obstruction by deviation, or one or both anterior limbs may be amputated subcutaneously (page 395), evisceration (page 408) included if indicated, and the adjustment of the head effected. The question of which of these two courses should be pursued is to be decided by the character of the obstacles offered in each case. If the head and neck are to be amputated, the amputation may be made with either the chisel or the wire saw. The wire saw is best if it can be applied readily.

Usually the subcutaneous amputation of one fore limb, fully described on page 395, is preferable. The fore leg opposite the deviated head is selected for amputation. The emphysematous condition renders the amputation especially easy, as compared with the same operation upon a recently dead fetus. The skin is much easier to detach, the muscles pull apart readily, and the entire operation is facilitated mechanically by the emphysema. Following the amputation of the limb, two or three of the exposed ribs are to be removed, and the thorax and abdomen eviscerated, and in case of need the ribs on one or both sides severed so that the chest may collapse and the gases of decomposition largely escape from the cadaver through the incisions and lacerations. This operation is far more efficient than amputation of the head and neck, because it immediately decreases the size of the chest, which is finally either desirable or necessary. When the fetal cadaver is thus decreased in volume, the deviated head may as a rule be readily brought into the normal position. If this is not practicable, it may yet be amputated, and more readily than before the amputation of the limb and evisceration. In the process of evisceration in emphysematous decomposition, the two objects—the removal of viscera and the liberation of gases—must be kept in mind. The liberation of gases depends upon the extent of mutilation rather than upon the extraction of the tissues. Hence, after evisceration of the pleuro-peritoneal cavity, the ribs, pleura, and peritoneum should be as extensively mutilated as practicable. When the emphysematous hips reach the pelvic inlet, extraordinary resistance is once more encountered. When the evisceration has been completed, an open avenue exists for the destruction of the pelvic girdle, as described upon page 399. Here again, the object to be accomplished is manifold. Breaking down the pelvic girdle upon either side of the coxo-femoral articulation destroys the rigidity of the fetal pelvis, brings about its collapse, and causes the isolated coxo-femoral articulation, with the entire limb, to drop back and follow the other limb through the pelvic canal. The incidental mutilation permits much of the gas to escape.

In the posterior presentation, the same general principles of handling apply. Tissues, viscera, and parts are to be removed, and by extensive mutilation the imprisoned gases liberated. The commest posterior disposition of the fetus is the dorso-sacral position with complete retention of the posterior limbs—the so-called breech presentation. In this complication some obstetrists advise the amputation of the posterior limbs by coxo-femoral dislocation or through the femur. However logical this may be when a non-putrid fetus presents, it is erroneous in principle and practice in emphysema, because after amputation in such a manner the cadaver is still too massive to traverse the birth canal.

The practical course to pursue is the intra-pelvic amputation of both posterior limbs, as described on page 402. It is quite as easy as the other amputation; once completed, the results are far superior. The hind limbs and pelvis have both been removed, the body cavity is wide open and free for evisceration, the mutilation has been extensive, and the liberation of gases important. With the evisceration completed and the body cavity freely accessible to the operator, the mutilation may be extended to the anterior end of the chest, the ribs severed on one or both sides, and in case of need one scapula may be secured through the mutilated chest walls and the fore leg withdrawn reversed.

Once any deviation or mal-position has been corrected, fetal emphysema, with the possible exception of fetal edema, permits the severest traction justifiable in veterinary obstetrics. The gases, by inflating the entire cadaver and moving through the tissues under pressure, maintain a uniformity of pressure at every part of the birth canal not equalled or approached under normal conditions. I have, with the aid of a lever or pulleys, applied traction to emphysematous fetuses in the mare and cow estimated at over one thousand pounds, without having in any case observed any harm therefrom, but I rarely, if ever, permitted five hundred pounds of traction upon a non-putrid fetus. The difference lies in the uniformity of the pressure exerted by the emphysematous cadaver throughout the pelvic canal. Each square inch of the birth canal has an identical pressure. Taking into account the superficial area of the pelvic cavity of the mare and the cow, one thousand pounds of traction represents between four and five pounds of pressure per square inch. The intra-pelvic pressure is not so great as it appears when compared with the pressure in case of a normal fetus in a physiologic uterus. When the uterus and abdominal walls are contracting and traction is being applied to the fetus, the pressure upon the pelvis is the sum of the three forces. When a fetus is emphysematous the uterus is more or less inert, usually wholly inert, and frequently the abdominal contraction is largely in abeyance, so that the sum of the forces causing intra-pelvic pressure is after all not as excessive as it appears. The severe traction is nevertheless undesirable and should be reduced to the minimum by embryotomy.

The prognosis in the mare and the cow is dependent chiefly upon the condition of the uterus. This can not always be determined with any degree of accuracy until the fetal cadaver has been extracted, and even then it may be uncertain. Sometimes the degree of uterine disease can be clearly established in the cow without the removal of the fetus. When, along with fetal emphysema, total uterine gangrene exists, the muzzle is usually dry, the eyes sunken and glassy, there is marked nasal discharge, profuse diarrhea, with thin, black, highly fetid feces, profound depression, sub-normal or supra-normal temperature, feeble pulse, and shallow respiration. Rectal, and sometimes external palpation identifies the enormously enlarged fetus. Vaginal examination probably reveals a dark, fetid discharge from the cervix. Perhaps fetid, necrotic membranes protrude into the vagina, or possibly through the vulva. The cervical canal may be dilated or closed. With such a train of symptoms, the practitioner can know that total uterine gangrene is present and that the condition is hopeless. Clearly he is not justified, from either humane or economic reasons, in operating. When the practitioner can not satisfy himself in advance that uterine necrosis is present, he needs proceed to operate, under a poor prognosis for the life and breeding powers of the patient.

When the fetus has been extracted, the fetal membranes are usually found detached by sloughing and are readily removed. The uterus contains much debris—hair, hoofs, decomposed blood, etc. These should be removed by washing the uterus with physiologic salt solution. There is little call for antiseptics. As a rule they will not be borne by the inflamed organ, and they are utterly powerless to disinfect. The mechanical cleansing must be relied upon instead. Any liquid introduced into the uterus must be removed. Frequently the uterus is too paretic to reject douching fluids, and quarts or gallons may remain in the inert uterine cavity, seriously damaging the organ by their mechanical weight. If they contain antiseptics, these promptly disappear and are quickly replaced by infection, since the water affords increased opportunity for bacterial growth. Fluids introduced should be carefully siphoned out with a single tube, or a double tube may be used so that a constant flow through the uterus may be maintained. Only soft rubber tubes should be introduced into such a uterus, and even they should be handled carefully. The uterine walls are so very friable that any carelessness is a great peril. The force pump should not be used at all, unless the cervical canal is wide open and the reflow is prompt and free. If the cervix is contracted and fluid is pumped into the uterus with an enema pump, fatal uterine rupture occurs long before the uninitiated think possible. It is always safer to use a gravity irrigator with not over two or three feet of pressure.

Emphysematous decomposition of the fetus in the sow and carnivora rarely calls for gastro-hysterotomy, described on page 411, but far more frequently for hysterectomy, described on page 422. Forced extraction offers very scant hope of success. The putrid cadaver frequently parts, leaving the torso beyond the reach of the operator. The progress of the torso through the birth canal abrades, contuses, and lacerates the soft parts, opening up new avenues for the invasion of the virulent infection present. As the genital tube is small, instruments are necessarily applied blindly and with serious danger. Should the forced extraction succeed, there remains the critical intra-uterine infection—the severe metritis—with extensive or total gangrene. The narrow vulva, the narrow, long vagina, the practical absence of a uterine body, and the enormously elongated uterine horns render topical handling of the infection impracticable.

Regardless of the limitations and dangers, there are numerous cases where forced extraction becomes obligatory. When the emphysematous fetus has been forced into the pelvis, there is virtually no alternative. The cadaver needs be grasped with the looped cord (Fig. 99 a, page 331) or the obstetric noose (Fig. 99, e, f, g) or with forceps such as shown in Fig. 101, page 337. Sometimes the sharp hook (Fig. 100, page 335) is used. It is highly dangerous, and in a decomposing fetus tears out very readily. For small animals, hooks may readily be improvised by using heavy wire.

A reasonably safe general line of practice in the dystokia of small animals would be to apply forced extraction in pelvic dystokia and hysterotomy or hysterectomy in abdominal dystokia. Pelvic dystokia in multipara indicates that the uterus is not necrotic and not wholly paretic, and is consequently not in a hopeless state of disease. On the other hand, if the lodgment of the fetus is abdominal, that fact raises the question of uterine gangrene or other form of serious or total uterine inertia. When the fetal cadaver is lodged in the pelvis, it can usually be grasped with reasonable security and facility; when lodged in front of the pelvis, it can not usually be conveniently, safely, or securely grasped.

The arrangement of putrid emphysematous fetuses in the sow and carnivora has not been studied. The obstetrist records that several live fetuses have been born. Then an emphysematous cadaver has become impacted in the pelvic canal. It is removed, more living young are expelled, and then follows another putrid cadaver. Sometimes it is the first, sometimes the last fetus which is emphysematous, becomes impacted, and requires surgical removal. What does it mean? Until the problem is carefully studied, the best that can be done is to view the problem from the standpoint of analogy, and compare the clinical observations in the sow, bitch, and cat with what is known in the cow. Abattoir studies upon the gravid uteri of cows, verified abundantly by clinical experience, show that contagious abortion (by which term is meant any natural bacterial invasion of the gravid uterus which imperils the fetus or uterus, excepting such general infections as tuberculosis and actinomycosis) has three normal bases, or points of rendezvous, in their order of prevalence: (1) the os uteri internum (2) the apex of the non-gravid cornu (3) the apex of the gravid cornu. In the first rendezvous, the supply of infection is constantly supported by the exceedingly common chronic, persistent cervicitis existing at the time of impregnation. During estrum, the infected cervical mucosa is bathed in mucus which blankets the infection and may permit spermatozoa to traverse safely the cervical canal and proceed upon their journey to the apex of the horn, where they encounter another infected area, and may be arrested or may evade the infection, reach the pavilion of the oviduct, and fertilize the ovum. The fertilized ovum in its migration to the uterine cavity must again encounter the rendezvous of infection at the cornual apex and safely evade it before pregnancy may proceed. The basal cavity of the horn and the anterior end of the uterine cavity must be passably free from infection. Otherwise, the migration of the spermatozoa is inhibited, or, if they evade the infection and reach the pavilion of the oviduct, the fertilized ovum can not develop in the infected cavity. Abattoir evidence upon this point is abundant and clear. If the uterine cavity is generally and seriously infected, fertilization does not occur, or the fertilized ovum promptly perishes. The cow is sterile. When the infection is localized, the spermatozoa may evade the infected base in the cervical canal and the os uteri internum, through the aid of the blanket of mucus pass safely through the approximately sterile utero-cornual cavity, and evade the apical base of infection in the horn. The embryo or fetus is later open to bacterial invasion from infection bases existing prior to fertilization, or, in case of the cervical canal, to infection advancing from the vaginal end at any time prior to the completion of the uterine seal. Basing my estimates upon extended abattoir and clinical studies, I should say that the infection of contagious abortion in the cow, when attacking the fetus and its envelopes, advances from the os uteri internum in more than ninety-five per cent. of cases, and from the apex of the gravid horn in less than one per cent. In multipara there is naturally no non-gravid horn.

Pursuing the suggested analogy, in multipara the infection which is to imperil the life of the fetus or fetuses may exist prior to impregnation in the apices of the horns but far more commonly at the os uteri internum, or may invade the uterus from the cervical canal prior to the completion of the uterine seal. As in the cow, the infection radiates from the os uteri internum in an overwhelming majority of cases. It follows that those fetuses perish first which are contiguous to the chief rendezvous of infection. The most frequently and seriously exposed fetus is the first in the base of each horn. The infection may advance along both horns, destroying each fetus successively, or along one horn, while the fetuses in the other horn escape harm. Far less commonly, the infection may advance from the apex of one horn (or both) destroying in turn each fetus reached.

The acceptance of this analogy between the plan of attack in the contagious abortion of cows and of multipara reveals the nature of some of the clinical phenomena in the fetal emphysema in sows and carnivora. According to my abattoir studies of pregnant sows, the sac of the basal fetus in one horn projects into and fills the uterine body. When contagious abortion invades the uterus it is this embryo which first perishes. The infection continues to spread by contiguity, most readily in the basal fetus in the other horn and next in facility to the second fetus in the horn which contained the embryo which first perished. The order in which the embryos have perished is clearly traceable by their size and extent of maceration, the first embryo to perish being in some cases one-fourth the size of the second, and that perhaps one-half the size of the contiguous live embryo. When labor sets in, the dead embryo, whose sac projects into the uterine body must first be expelled. If it has perished early (I have observed dead porcine embryos less than one inch long) it has perhaps been expelled unseen long before the advent of parturition. Pregnancy and the disease each progressing, one or more fetuses may finally die at or near full term and become emphysematous. These cause dystokia. If the embryo whose sac occupies the uterine body reaches full term before perishing, and becomes emphysematous, total dystokia ensues and no fetus can be expelled. If the uterine body has been vacated, a fetus from either horn may then enter for expulsion. Should there be a healthy fetus in one horn and a cadaver in the other, the cadaver offers the greater resistance, owing to the emphysema, and the involved segment of the uterus has less power because of the existing metritis. Under these conditions, the healthy fetus takes precedence and is expelled first. Perhaps several healthy fetuses then follow. If there is but one dead fetus in the diseased horn, it will probably soon be forced into the birth canal, largely because of the contractions of the cornual walls anterior to the segment in which the cadaver lies. The segment of the horn containing the cadaver is more or less inert and incompetent to take the initiative in expulsion. If other cadavers exist in the involved horn, they are naturally contiguous to the first, but, owing to the inertia of the involved uterine segment, are not expelled successively. Instead, the living fetuses from the healthy horn are expelled more promptly, with a cadaver from the diseased horn possibly interspersed now and then.

When the rendezvous of infection is at the apex of a horn and an apical fetus succumbs, the accompanying metritis in the involved segment of the horn destroys its power to expel the cadaver, there is no healthy cornual segment anterior thereto which might force the cadaver out of the inert area, and apical dystokia is established. Accordingly there arise in the contagious abortion of the sow, bitch, and cat three types of dystokia :

(*a*) Pelvic dystokia, in which a fetal cadaver has been forced out of the involved segment and has lodged in the pelvic portion of the genital tube, or just anterior thereto, in the anterior portion of the vagina or in the vestigial uterine body. This blocks the expulsion of all fetuses in either horn.

(*b*) Basal dystokia, when a cadaver is lodged in the base of one horn, and the anterior segment of the horn is unable to push the fetus promptly out of the involved, paretic segment. This blocks the passage of all fetuses in the involved horn, but permits the emptying of the other horn.

(*c*) Apical dystokia, where the cadaver lies in the apex of the horn. This interferes with the expulsion of no other fetus, but, unless there is an efficient vigor in the involved uterine segment to force the cadaver out, it must remain. There is no cornual power in front to push the cadaver onward, and the contraction of the abdominal walls is wholly impotent while the cadaver is in such location. Apical dystokia is most difficult to diagnose, most hopeless of spontaneous correction, can not be reached through the genital tube by the surgeon, and leaves him no course but laparotomy.

2. The Uterine Inertia of Contagious Abortion

Uterine inertia, from whatever cause, necessarily disturbs parturition. On pages 251 and 258, the inertia of the uterus resulting from over-distention in hydrops amnii and in fetal anasarca has already been discussed. When discussing uterine torsion on page 215, it was noted that after the reduction of the torsion the uterus can not as a rule expel its contents, owing to the paralysis following the severe strangulation. Later, in discussing parturient paresis, when occurring at the time of parturition, before the act is advanced, it is stated that parturition is halted by the inertia caused by the disease.

Such maladies as osteomalacie (page 189) and paraplegia (page 191) are frequently accompanied by dystokia. While voluntary recumbency is not inimical to parturition, involuntary decubitis tends to cause dystokia by interfering with uterine vigor. Hence disabling accidents, such as serious fractures and dislocations, by causing decubitis, so disorder the expelling powers as to interfere with the physiologic course of parturition. Far more frequent, and of infinitely greater scientific and economic importance than all the other causes combined, is the uterine inertia of contagious abortion. In the preceding chapter, in discussing the dystokia due to emphysematous decomposition of the fetus, it has been pointed out that the paretic state of the uterus due to inflammation or necrosis plays a fundamental part in the clinical phenomena.

Occupying an area between physiologic birth and the death and putrid decomposition of the fetus, there is an appalling number of cases of disordered birth of every possible gradation, having as their fundamental cause an intra-uterine infection for which no better term is at hand than contagious abortion. Involving every species of domestic animal, the phenomena are best known in the cow. In discussing physiologic parturition in the cow, it was pointed out that, according to the most careful researches I have been able to make, parturition in the cow and heifer, when physiologic, is completed in fifteen to thirty minutes of visible expulsive effort. In recent researches[1] it is shown that, according to the agglutination and complement-fixation tests, there is essential harmony between the intensity of infection and the duration of parturition : that is, upon the average, the higher the reaction to the test for contagious abortion, the longer it will require for a cow to expel her fetus and the fetal membranes. As in the various serologic tests for other diseases, so in contagious abortion, there are recognized important limitations in accuracy. In very intense infection the blood not rarely refuses to respond to the test—far more frequently than reaction to the tuberculin test fails in advanced tuberculosis—but when the average is taken and tests are made at intervals before and after parturition they finally show that, the higher the reaction to serologic tests, the longer the duration of parturition. This is independent of any mal-presentation, mal-position, or vicious

[1] Annual Report of the New York State Veterinary College at Cornell University, 1914-1915.

deviation of an extremity or other mechanical obstacle to the expulsion of the fetus.

The delay in parturition takes on various forms. When placentitis (cotyledonitis) exists during pregnancy so that the fetal membranes are to be retained, the uterine inertia is very marked and parturition drags wearily along hour after hour. Feeble expulsive efforts may be observed twelve, twenty-four, thirty-six, or more hours, and traction finally become necessary though the presentation, position, and arrangement of the extremities are normal, the birth canal dilated or dilatable, and the fetus alive and of normal size. Such tardiness has generally been attributed to various hypothetical causes—debility, nervousness, premature labor pains, etc.—and finally, when traction becomes necessary, the fetus is thought too large or the birth canal too small. Heifers in first calving are usually slow. The hypothesis is that the dilation of the canal for the first parturition requires much time. This is not borne out by careful observation. Healthy heifers calve almost as rapidly as healthy cows, and the act, from the first visible beginning to completion, requires from fifteen to thirty minutes. Most heifers fail to be so prompt. The tardiness can not logically be attributed wholly or largely to the first dilation of the birth canal. The bony pelvis is really the chief obstacle to the passage of the fetus. This unyielding girdle is quite as large comparatively in the heifer as in the adult cow. The fetus is regularly much smaller in the heifer, while the pelvic girdle closely approaches adult size. In a few heifers, chiefly as a family characteristic, the vulva is small, but this rarely offers sufficient opposition to delay birth materially. The vagina and cervix, when sound, dilate freely and quickly to the full dimensions of the pelvic cavity, and immediately disappear as a retarding factor in parturition. Having regard for the fact that the phenomenon of abortion is preëminently common in heifers, it must follow that the infection of contagious abortion is far commoner in them than in adults. This is amply verified by researches. When thirty per cent. of a group of heifers abort, that is not the end of the infection, but is ample assurance that most, if not all the other seventy per cent. are highly infected, will calve tardily, require assistance, and have retained fetal membranes and metritis of varying degree. Other phases of the uterine inertia of contagious abortion have been grossly misinterpreted, especially the non-dilation of the cervical canal. The character of the bovine cervix lends itself admirably to misleading the unwary. As described on page 28, the cervix of the cow is long, its canal tortuous and narrow, and its walls thick and extraordinarily dense. Its anatomic structure is designed for its dilation from the uterine end. While its constriction is active, its dilation is wholly passive. The dilation is brought about, after physiologic relaxation, by the vigorous contraction of the uterine walls upon the uterine contents. The active uterine contractions force the uterine contents (water bag) against the uterine end of the cervical canal, while the walls, stretched over the contents, draw outward and obliquely backwards, dilating the canal. Since the uterine walls are the active agent in the dilation of the canal, whenever they become inert the cervix does not dilate. Accordingly, when the cervix retains its physiologic vigor of contraction and the uterine walls are inert, there is a strong tendency for the superficial observer to conclude that **spasm, stricture, atresia**, or **induration of the cervix** is present, when it is the uterus which is pathologic, while the cervix is physiologic. Another illusion produced by uterine inertia is constriction of the pelvis. This is a favorite diagnosis in dystokia in sows. The constriction of the pelvis is assigned to rachitis, but no material evidence of rachitic pelvic deformity in sows or other quadrupeds has been recorded. I have not seen the pelvis of a domestic animal deformed by rachitis, nor any description of an anatomical specimen of such. The descriptions have all been based upon clinical observations of none too convincing a character. Naturally, pelvic deformity from rachitis ought not to occur in domestic animals. There is almost no weight upon their pelves to deform them. If, as seems almost certain, the rachitic deformation is an illusion, the error is very natural. The fetus lies just anterior to the pelvis, where it has always lain, and the inert uterus can not force it into the pelvis. The abdominal muscles are not brought into vigorous action; even if they were, they are incompetent to assume the fundamental function of the uterus—the propulsion of the fetus through the cervical canal into the vagina.

The handling of the uterine inertia of contagious abortion is to be based upon the general conditions presenting. It is assumed that in this group the inertia is not total. The fetus is living or has but recently perished and has not undergone decomposition. The fetus may be sick. It is commonly infected. Especially, there are bacteria in the meconium, which may precipitate scours in utero or soon after birth. The fetus is perhaps pathologic and the uterus diseased. The disease of the uterus and of the fetus conspire to bring about mal-position of the fetus or of some of its extremities, the handling of which is discussed later under the various displacements. The overcoming of the direct effects of the uterine inertia involves the induction of uterine contractions (the elimination of the inertia), the dilation of the cervical canal, and the application of the necessary traction upon the fetus.

The induction of uterine contractions is difficult and uncertain. When severe metritis exists or the uterus is extensively necrotic, the induction of uterine contractions is essentially hopeless. In the simpler cases, our means for inducing uterine contractions have not been well tested. A few decades ago, ergot was in high repute, though there was little, if any real evidence that it had any effect. Recently the extract of the pituitary gland has come into high favor in human obstetrics, but in veterinary obstetrics no extensive and authoritative researches have been recorded. In very limited researches, it appears to cause very vigorous and highly efficient contractions. It is well deserving of extensive trial. No drug can be expected to stimulate to efficient contraction a critically inflamed uterus with more or less extensive necrosis, such as is usually encountered with a putrid fetus, but in the group of cases here discussed it is assumed that the inflammation is only moderate and that the inertia is perhaps due largely to the presence in the tissues of bacterial products which exert a paralyzing effect upon the uterine muscle. While the abortion bacillus of Bang is generally considered an excitant to the uterine musculosa, this has not been clearly demonstrated. There is strong clinical evidence that it inhibits, rather than excites uterine contractions, and that the real excitant in abortion and premature birth is largely secondary invaders.

Mechanical assistance in uterine inertia is abundantly indicated. Leaving the tardy expulsion of the fetus to the inert uterus is not good obstetrics. Neither is the application of traction to a fetus in a paretic uterus materially more severe upon the birth canal than normal labor pains. If normal expulsive efforts cause in the mare or cow an intra-pelvic pressure of two pounds per square inch in one case, and in another, owing to the inertia of the uterus, one pound per square inch, traction of approximately three hundred pounds will only induce the same intra-pelvic pressure as in the first instance. The only disadvantage of traction lies in its tendency to pull the vagina and cervix along with the fetus. If the fetus is being forced along by uterine contraction, the entire birth canal is kept stretched between the fixed vulvar end and the distal end of the uterus, pressing against the farther end of the fetus. Under these conditions, only very moderate traction is justified, which should be carried out as advised on page 381. There should be no haste : abundant time should be given for each portion of the birth canal to dilate gradually and safely.

The non-dilation of the cervical canal, which has for so long been designated " spasm of the cervix," " atresia of the os uteri," " rigidity " or " induration of the cervix," or other apellations indicating cervical disorder, should be viewed in its proper light. Aside from *very rare* cases of induration or adhesions, the difficulty is uterine, not cervical. The non-dilation of the cervical canal is a common attribute of uterine inertia, not only of contagious abortion, but of hydrops amnii as well.

Non-dilation of the cervical canal is difficult to overcome. If the uterus can be excited to contract with pituitrin or other remedy, dilation of the cervical canal naturally follows. This plan should always be tried unless there are conditions forbidding it. Should uterine excitants (ecbolics) fail, the remaining possibilities are the mechanical dilation of the cervical canal, vaginal hysterotomy, or gastro-hysterotomy. Without vigorous aid from the uterine muscles, the dilation of the cervical canal of the cow is an operation of great difficulty. Uterine dilators such as are used in human obstetrics are efficient when made of appropriate size and operated by means of a sufficiently powerful screw or other mechanical device. The operator should not aim to dilate the cervix immediately by direct force, but to exhaust and fatigue the contractile power of the cervical walls by long-continued pressure. With greater difficulty and less efficiency, the canal may sometimes be dilated manually. When the dilation has progressed far enough that the operator can pass his hand into the uterine cavity, this should be done, the presenting extremities properly arranged, and traction applied carefully to complete the dilation from before backward, simulating the natural manner. The operation now proceeds more rapidly because of the change in the direction of the force. It is this pressure from in front which renders the Palmer or Nelson type of cervical dilator more efficient than the hand of the operator. The dilator is inserted closed. The instrument is then opened, and the jaws, spreading further apart at their uterine than at their vaginal end, form a cone, the apex of which projects into the cervical canal and resembles the natural fetal cone. The operator, by drawing upon the handle of the instrument, counterfeits the advancing cone of the fetus in physiologic birth.

Vaginal hysterotomy, which is described under *Induration of the Cervix*, on page 446, is only of questionable value. Since the chief lesion is in the uterus, the incision of the cervix is an indirect operative procedure, the operation being performed upon a healthy organ to relieve a diseased one. Longitudinal incisions severing the circular muscles of the cervix permit the cervical canal to be readily dilated, but the disease of the uterus remains and the pathologic discharges must flow over the wounds if they escape through the cervical canal. As a rule, gastro-hysterotomy, as described on page 411, is preferable to vaginal hysterotomy in such cases.

The prognosis of uterine inertia of contagious abortion is dependent primarily upon the degree of inertia and the intensity of metritis or other uterine lesions. A common result of the cotyledonitis arising during pregnancy is retained fetal membranes. The inter-cotyledonal metritis of pregnancy continues visibly and more or less seriously, imperilling alike the physical and the sexual life of the dam. The consideration of these diseases logically falls under the diseases of the genital organs. The prognosis for the young is also uncertain. As a broad rule, especially notable in calves, the tendency to dysentery, calf septicaemia, pneumonia, and arthritis of ante-natal origin is parallel to the degree of uterine inertia. The intra-uterine infection passes to the fetus.

The prophylaxis of the uterine inertia of contagious abortion depends necessarily upon the prevention or elimination of serious intra-uterine infection prior to conception.

INDURATION OF THE CERVIX

In the cow, and more rarely in other domestic animals, there occurs an induration of the cervix, the result of a chronic inflammation with a consequent narrowing of the cervical canal. In discussing the anatomy of the cervix, it has been noted that in ruminants—especially in the cow—the cervix is usually highly developed and contains numerous circular muscle fibres, commingled with a large amount of connective tissue, which gives to the part a preëminently rigid character. In the description of the cervix of the cow, on page 28, the annular rings of mucosa with their muscular or connective tissue base have been quite fully noted. These mucous folds and their fibro-muscular bases are the parts chiefly involved in the sclerosis. The induration is the immediate result of cervicitis, which in turn is part and parcel of the complex infection which can at present be no better designated than as contagious abortion. Biologically it is not directly traceable to the Bang organism, but clinically is inseparable. Whenever and wherever abortion rages, severe cervicitis is frequently present. The relationship to abortion is well supported by the serologic tests. Culturally, the evidence is negative. The infection is mixed : the Bang organism is overgrown and screened by others. It has long been taught that induration of the cervix is the result of mechanical injuries, and hence is necessarily a disease of animals which have given birth to young or aborted, and suffered from laceration of the cervix during the expulsion of the fetus, followed by induration and adhesions.

Vague assertions have been made of complete atresia of the cervical canal during pregnancy. This is essentially impossible. Complete atresia of the cervix may, and does occur rarely in the non-gravid uterus. In the gravid uterus, if the uterine seal forms, atresia can not occur. If the cervical canal is heavily infected, so that the seal can not develop, the pregnancy ultimately terminates in fetal death, and almost always in expulsion. Should the vaginal end of the cervical canal become sealed by purulent inflammatory adhesions, infection inevitably exists on the uterine side of the adhesions. This must cause abscessation, with consequent adhesion of the uterus to contiguous organs.

Rupture of the uterine abscess follows, with discharge of the uterine contents. There is no dystokia.

Clinically, I have observed two cases of induration of the cervix. In one, the entire hand could be passed through the cervical canal ; in the other, the canal admitted two or three fingers. During an examination of the cervices of more than two thousand cows and heifers in the abattoir, I observed no cases of induration. Induration of the cervix in non-pregnant heifers is not exceedingly rare as a result of chronic cervicitis. As a rule the cervicitis, with induration, continues indefinitely, accompanied by slight purulent discharge from the cervical canal, and bars fertilization. Should the cervical canal of the non-pregnant animal become closed, the uterus becomes distended with lymph (menstrual debris) or far more frequently with pus (abscessation of the uterus).

Induration of the cervix is preëminently a disease of the non-gravid animal. In the rare instances where it acts as a bar to parturition, induration of the cervix is almost certainly pre-conceptional, but for some very unusual reason fails to prevent conception. In my experience, it has been confined to heifers. In one heifer the cervix was so hard and unyielding that, in forcing the fetus through the narrowed cervical canal, the cervix was torn asunder, leaving a wide rent into the peritoneal cavity. The induration may be of such a degree that the cervical canal will admit of moderate dilation, permitting the fetus to pass with more or less difficulty.

The symptoms of induration of the cervix in the pregnant animal do not appear until parturition sets in and expulsive efforts have become established, when it soon becomes evident that there is some serious obstacle to birth. Although the expulsive efforts may be vigorous, there is little progress. The fetal membranes usually protrude and rupture and some portion of the fetus, especially one or two feet, may advance along the vaginal canal and appear at the vulva, but no further progress is made. Unless surgical relief is given, the placenta decomposes and comes away, leaving the fetus behind. The expulsive efforts cease, and the fetus undergoes putrid decomposition. The animal may largely recover her general condition, or may succumb to septicaemia.

The diagnosis of induration of the cervix must depend primarily upon the revelation of the condition to the sense of touch upon manual exploration. When the veterinarian makes a manual examination per rectum and vagina, he finds that the cervical canal is more or less completely closed and undilatable and that the walls of the cervix are abnormally thickened, hard, dense, and unyielding. The induration may involve any part, or all of the cervix. In many cases the induration is limited to the vaginal portion of the cervix. Perhaps one or more fingers, or even the entire hand, may be passed through the cervical canal, but no further dilation may seem practical, and the parts are exceedingly dense and rigid to the touch.

Induration of the cervix is to be differentiated from the non-dilation of the cervical canal due to the uterine inertia of contagious abortion, dropsy of the amnion, or edema of the fetus, which have already been discussed on pages 439, 251 and 258 respectively. To this end, the actual induration of the tissues of the cervix needs be recognized. The palpation of the cervix per rectum will aid materially. By this means, the veterinarian can recognize the increased volume of the cervix and its sclerotic character. The induration ordinarily involves only a part of the cervix. There is a sharp contrast in density and volume between the diseased and the healthy areas. This aids in diagnosis and prognosis and establishes a guide in operative procedure. Induration is also to be distinguished from malignant or other new formations, such as carcinom, sarcom, actinomycosis, or tuberculosis. These diseases are extremely rare. I have not seen an instance clinically. I have one specimen of tuberculous abscess of the lips of the os uteri externum from a non-pregnant abattoir animal.

The prognosis of induration of the cervix will depend very largely upon its location and extent. When confined to the vaginal portion of the cervix, as is usually the case, the prognosis is distinctly favorable, because this portion admits of the freest possible manipulation and operation without imperiling the integrity of the walls of the organ. When the induration is more extensive, and involves the anterior portion of the cervix or its entire length, the prognosis becomes more serious because any extensive operation or accidental tear during the extraction of the fetus may bring about a perforating wound communicating with the peritoneal cavity, which may lead to the death of the animal.

Handling. Three courses of handling are open for consideration: manual or mechanical dilation, followed by forced extraction of the fetus; dilation by incision or vaginal hysterotomy; and gastro-hysterotomy.

Forced dilation of the cervical canal and extraction of the fetus should be attempted only in those instances where the veterinarian feels confident that it may be accomplished without serious mutilation of the cervix. If it appears that forced extraction would probably cause extensive tears, and perhaps penetrant wounds, it should be abandoned. First the cervical canal is to be gradually dilated with the hand or uterine dilator, until the operator may introduce his hand into the uterine cavity. The fetus is then to be secured by the presenting extremities, each carefully arranged in its proper position, and the cervical canal thoroughly lubricated, after which traction may be applied slowly and judiciously and the fetus forced away. The general directions for the application of traction have been given on page 381.

Vaginal Hysterotomy. The dilation of the cervix by incision, or vaginal hysterotomy, is usually to be preferred to forced extraction. The field for vaginal hysterotomy has not been clearly defined. The reports finding their way into current veterinary literature are not at all conclusive. Obstetric writers have so recommended the operation that their advice is left cloudy. The operation is virtually confined to the cow. It is available, but is rarely or never needed in the mare. In the ewe and smaller domestic animals, it may be needed, but is not available, because of the size of the vulva and vagina. In the cow the need for the operation is rare. I have resorted to it once only, and recall one other case where possibly it would have been more prudent than the forced extraction employed. Many veterinarians with far less experience in obstetrics report very frequent need for, and successful application of the operation. Their reports are not at all clear and convincing regarding the necessity for, the extent, or the prudence of the operation. Many of the reported successful (?) vaginal hysterotomies are possibly successful because the scalpel was used sparingly and other elements overcame the obstacles to parturition. A careful study of Fig. 4 on page 23 and Figs. 6, 7, and 8 on pages 28 and 29, with the accompanying text, will show how restricted is the operative field and how closely it is associated with peril. The vaginal projection of the cervix lends itself freely and safely to operative interference, but the anterior portion offers a very dangerous field for extensive surgical invasion Physiologically, the walls of the cervix are but one-half to one inch in thickness; pathologically, the walls may be doubled in thickness. It is difficult for the operator to determine if the induration involves the entire circumference of the cervix, or only one side. If but one side is involved, it is difficult to learn which side. The diseased cervix is virtually always distorted, and the veterinarian may readily cut through a sharp flexure, into the peritoneal cavity, when he thinks he is cutting through a sclerotic enlargement. It must be remembered that, as the cervical canal dilates, the walls become thinned, and when fully dilated at the time of parturition their diameter is little if at all greater than that of the uterus.

In the one case where I applied vaginal hysterotomy, only the first annular fold of mucosa, the labiae of the os uteri externum, was involved, and the operation was extremely simple and safe. When the operator essays to divide the second annular fold, his field is less clear and the danger is multiplied. Should he attempt to divide the third and fourth rings, the danger has increased geometrically. Fortunately, so far as is known, the induration involves almost wholly the two posterior annular folds and chiefly the first. Whenever it is probable that forced extraction would cause more or less extensive ruptures in the cervix, the veterinarian may often guide and control these injuries by means of proper incisions. If the atresia consequent upon the induration is so great that the canal can not be dilated by ordinary pressure sufficiently to admit the hand, either vagino- or gastro-hysterotomy must be considered. When the induration involves only the vaginal projection of the cervix, and the anterior portion is normal, the operation is simple and readily performed. Preparatory to the operation, a complete examination should be made through both the rectum and the vagina, so that the location and probable extent of the incision required may be prudently estimated in advance.

If the operation has been decided upon, the operator introduces a scalpel or bistoury into the cervical canal and makes one, two, or three incisions in an upward or lateral direction, sufficient to permit the required dilation of the part. The incisions should usually be dorsal or lateral, not ventral. It is better that they should be numerous rather than deep, because if a certain degree of dilation is to be attained and but one incision is made, and the fetus is then forced into the cervical canal, surrounded by the rigid walls, the yielding will take place almost exclusively at the one point weakened by the incision, while the other portions remain undilated. In this way, the peritoneum covering the point of incision may not be able to yield sufficiently to prevent an extensive and dangerous rupture.

After the incisions have been completed, the presenting extremities of the fetus should be secured and properly placed, the cervical canal freely lubricated, and the fetus slowly and cautiously extracted. After the cervical canal has been sufficiently dilated to render it possible, embryotomy may be performed, if deemed prudent.

After the extraction of the fetus, careful examination of the cervix should be made for perforating wounds into the peritoneal cavity. If the organ is intact, it is usually desirable to flush out the uterine cavity with an aseptic solution. If there is a penetrant wound, the introduction of fluids into the uterus is exceedingly dangerous and improper, and other means should be taken for cleansing it. Any liquids present may be drawn off by means of a siphon. The fetal membranes should be removed as promptly as is practicable, and if they cannot be removed with safety they should be kept as nearly antiseptic or aseptic as is possible, by the introduction of powdered antiseptics, such as iodoform and boric acid. If one will carefully mix one-half ounce each of powdered iodoform and boric acid with five or six grains of thymol and introduce into the uterine cavity little or no iodoform odor will escape from the uterus into the dairy stable, and little or no iodoform taint of the milk will occur.

Gastro-Hysterotomy. Finally, if forced extraction and the surgical dilation of the cervix are each impracticable, Caesarian section, as described on page 411, should be performed at a sufficiently early period to give the best opportunity for the saving of the lives of the mother and fetus. The operation leaves the animal worthless for breeding purposes—the common fate in induration of the cervix. It is only in exceptional instances that the veterinarian can properly advise an owner to attempt rebreeding an animal which has required surgical aid in parturition as a result of cervical induration.

Fleming cites a number of recorded instances of induration and atresia of the cervix. I have seen but two instances, both in the cow. The first was in a two-year-old heifer. The cervical canal was sufficiently open to admit the passage of the hand, by which means the two anterior feet and head were secured, and traction cautiously applied. The extraction of the fetus was very gradual, and the traction applied was not severe, consisting of the combined power of two men. The progress was very slow. The two anterior limbs were easily brought through the cervix into the vagina and pelvic canal. Later the head also passed through, but when the chest was reached there seemed to be a halt.

Finally during a vigorous expulsive effort, while traction was being applied, there was a loud tearing sound. The fetus advanced rapidly without severe traction and was quickly delivered. The calf was alive. Upon examination, a great rent was found in the cervical canal, about 10 inches long, which penetrated the peritoneal cavity. Fortunately it was directly at the top, and consequently was advantageously situated in reference to escape of uterine contents into the peritoneal cavity. The heifer recovered without incident.

The second case was in a three-year-old heifer. She was kept at pasture in a place where she was not under close observation. At about the normal time for parturition, the owner noted fetal membranes protruding from her vulva and assumed that she had given birth to a calf. The heifer showed some slight expulsive efforts, which he attributed to a retention of portions of the afterbirth.

In a general way she recovered from the ill effects of fetal retention, and kept in good condition. She was taken from the pasture and was milked, yielding about two gallons per day. Her appetite and general health seemed to be good, except that at intervals she was affected with a fetid diarrhea, which soon passed off. Ten weeks later I was called in consultation, and upon exploration found the os uteri externum constricted, permitting the introduction of but two or three fingers, while through it protruded a portion of the tail of the fetus. The constriction was confined to the vaginal portion of the cervix, so that the fingers entered the fully dilated cervical canal at a short distance from the vaginal end.

With an ordinary bistoury, the os uteri was sufficiently dilated, by cutting, to allow of the ready insertion of the hand. When the hand was introduced into the uterus the remains of the fetus were encountered, there being recognizable the tail and a small fragment of the skin of the buttocks. Beyond lay an inextricable mass of fetal bones, which had separated into their basic parts, the shafts and epiphyses being separated from each other. Deep down in the anterior part of the uterus there was found an accumulation of whole grains of corn and other foods. Along the left side of the uterus there were two openings which would admit of the passage of one or two fingers directed toward the rumen. The uterus had become adherent to the rumen. Portions of the fetus had sloughed into the rumen and, passing out through the intestinal canal, had caused the fetid diarrhea which the owner had observed.

The walls of the uterus were hard, immensely thickened, and wholly devoid of contractile power. Judging from the sense of touch, the walls seemed to be more than one inch thick. Through the fistulous opening between the uterus and the rumen, whole grains of maize and other gross food particles had entered the uterine cavity: there had been comparatively a free exchange in contents between the two cavities.

There was no unfavorable reaction to the operation, and the heifer continued her usual flow of milk. Later she was fatted and sent to market.

Persistent Median Wall of the Muellerian Ducts in the Vagina. I have met, in dealing with sterile cows, several cases of persistence of the median walls of the ducts of Mueller, which should become wholly removed in the formation of the vagina in the embryo. In the cases which I have seen, the persistent embryonic structure consisted of a perpendicular column, stretching from the floor to the roof of the vagina, and located immediately against the vaginal opening of the cervical canal. The column is roundish, frequently more than one inch in diameter, very firm, and apparently quite capable of causing dystokia, because it tends to bind the opening of the cervical canal in a manner to interfere with dilation. It would be especially liable to cause dystokia should one foot pass to the right and the other to the left side of the column. Sometimes the examiner may think at first that he is dealing with the far rarer double uterus, because first he palpates the os uteri from one side of the column and then from the other. The diagnosis is made clear by passing a finger between the column and the vaginal end of the cervix and encircling the column. It is a feint at a double vagina, but most of the median walls of the Muellerian ducts have been resorbed, leaving only the vestige mentioned. When recognized, it is to be caught up by hooking a finger about it, drawn tense, and severed with scalpel or scissors.

Stricture of the Vagina. I have not seen dystokia due to stricture of the vagina, though I have met with several cases of vaginal stricture in sterile cows, which I have advised should be slaughtered, because if by any chance they should become pregnant they could not possibly be delivered of the calf through the birth canal. Usually the vagina is conical; the apex is at the cervical canal and the base at the vulva. In some cases I have been unable to reach and palpate the os uteri externum. Of course, the stricture usually permits copulation, and in itself is not a bar to fertility. Secondarily, it appears that the infection which causes the adhesive vaginitis extends beyond and involves the cervical canal. I have observed these strictures chiefly, but not wholly, in herds where potassium permanganate had been liberally used as a vaginal douche, though no definite connection between the drug and the lesion could be established. It might have been due to carelessness in dissolving the drug, lodging some crystals in the vagina to act as a severe caustic. I have also observed one similar case of vaginal stricture in the mare. The adhesions were so extensive that copulation injured her seriously, causing violent straining, with vagino-cystocele which it was difficult to allay.

Should an animal with severe vaginal stricture become pregnant, or the adhesions occur during pregnancy, it would be difficult to formulate a hopeful plan for delivery through the birth canal. In very mild cases sufficient dilation for the passage of the fetus might be obtained. In severe cases, such as I have met, it is difficult to see how sufficient dilation could occur. Traction applied to the fetus would only tend to force the vagina toward, or even through the vulva, lacerate the peri-vaginal connective tissue, and rupture the vaginal walls. Dilation by incision is virtually excluded. The walls are very thin, and any incision to give relief opens into the peritoneal cavity or into the pelvic areolar tissue, with virtually inevitable serious or fatal infection.

If the lesion is recognized in the non-gravid animal, she should on no account be bred. If first recognized when dystokia is present, prompt gastro-hysterotomy, as described on page 411, would generally offer the greatest hope for success.

Persistent hymen is frequently observed in cases of dystokia, but is usually, probably always, without significance. A complete hymen inhibits copulation. A moderate marginal persistence of the hymen may form an undrained cul-de-sac of the vagina in which retained excretions decompose and cause sterility. While technically persistent hymen might cause dystokia, practically it rarely, if ever, does so. In females which have not given birth to young, there is regularly, especially in the heifer, an unimportant stricture at the vulvo-vaginal line, with palpable remnants of the hymen, which are too frail in structure to constitute a notable barrier to parturition. It is quite common also to find in the vaginae of cows and mares thin muco-fibrous bands stretching from floor to roof at the vulvo-vaginal line, but they are usually, if not always, entirely too frail to require serious attention. Generally they are readily broken in two with the fingers, or can be cut in two with scissors or scalpel.

Intra-Pelvic Hemorrhage. I have met one case of fatal pelvic hemorrhage associated with dystokia in a mare. The mare, nearing full term, with a mate, ran away with a heavy coal wagon and fell into a railroad trestle. Within twenty-four hours she was suffering from dystokia. It was exceedingly difficult to pass the hand through the vagina to the uterus. Embryotomy had to be performed in order to extract the fetus. The mare succumbed. The autopsy revealed extensive hemorrhage in the pelvic connective tissue. Apparently the hemorrhage was due to the accident. The outstanding symptoms were the dulness and weakness of the animal (internal hemorrhage) associated with the extreme compression of the vagina. The compression was uniform throughout, unlike the compression accompanying a pelvic tumor.

Vulvar constriction occurs in both mares and cows, of a degree to cause dystokia. In the cow it is of two types—congenital and pathologic. The congenital type may become prevalent in a family. In one herd which I have attended for sterility, many of the heifers two or three years of age, which have never calved, have vulvar constriction of a severe type. The animals are extra-large Holstein-Friesians of massive frame and weighing twelve to fifteen hundred pounds. The insertion of my hand, though small, required much effort ; in one case it was necessary to dilate the vulva with a scalpel. The defect, so far as I have observed, is confined chiefly to the Holstein-Friesian breed, though it is one of the largest breeds of dairy cattle. The constricting structure appears to be a fibrous band in the vulvar sphincter about one-half to one inch from the margins of the vulvar labiae. Inevitably such a stricture interferes with parturition, but with vigorous expulsive powers the obstacle is usually overcome, though frequently at the expense of the integrity of the vulvar labiae. The rupture of the vulva may be largely obviated by recognizing the cordiform stricture and severing it at one or two points with a small scalpel. The incision, chiefly subcutaneous, may follow a small stab wound through the skin. In one case the vulva of the heifer was so small that, the calf being dead, I performed cephalotomy, as described on page 393. Possibly the head was somewhat enlarged.

Pathologically, the vulva occasionally becomes constricted as a result of disease. In one instance I attended a mare for dystokia due to anterior presentation, with both hind limbs projecting forward beneath the body and into the pelvis. The foal remained impacted in the vulva for several hours. The vulva became necrotic (pressure necrosis) and largely sloughed away. The vulvar opening became too constricted for copulation. Had the stricture been less and permitted copulation, or had the stricture occurred during pregnancy, it would inevitably have caused serious dystokia. In such cases the vulva may be rather freely and safely dilated by cutting.

MALIGNANT AND OTHER NEWGROWTHS INVOLVING THE GENITAL PASSAGES

Veterinary literature records rare cases of malignant and benign newgrowths in the cervix and other portions of the birth canal. They may be carcinomatous, sarcomatous, or, more rarely, actinomycotic or tuberculous. They are very rare, and very diverse in character. The symptoms frequently differ from those of induration or atresia of the cervix by the fact that their presence may be revealed before the end of gestation through the presence of a vulvar discharge, accompanied possibly by some constitutional symptoms of debility, especially in cases of malignant tumors. If not revealed by the presence of discharge during gestation, they may be discovered because of their acting as an impediment to parturition. When the veterinarian is called because of dystokia, and examines the patient, he recognizes the tumor by touch. Naturally they develop chiefly after impregnation. If present and large before breeding, they would tend to prevent fertilization.

The prognosis is highly unfavorable if the tumor is malignant, because, although it may be possible to deliver the fetus, the life of the mother can not usually be greatly prolonged and the disease is generally beyond remedy. The disturbance of parturition is quite inclined to arouse the disease process to renewed activity. Should the tumor be of a benign character, and its anatomical relations permit removal, the prognosis is favorable.

The handling of the dystokia is to be based upon the character of the tumor. If malignant, the chief aim should be to save the life of the fetus, if it is of value. Partial or complete removal of a malignant tumor of the genital canal may be warranted in order to remove the obstruction to birth, and the fetus may then be delivered through the birth canal. If the tumor is irremovable and offers serious obstacle to delivery, gastro-hysterotomy may be performed to save the life of the young.

Benign tumors interfering with parturition should be removed. The practioner should beware however of carelessly removing polypoid or other vaginal tumors. In one case a colleague, removing a benign vaginal tumor arising from the hymeneal ring took with it the mucosa and musculosa. There resulted a vaginal hernia which damaged greatly the appearance of the cow and diminished her value. When she was recumbent, the hernial sac pushed the vulvar lips apart and became visible. The removal of such tumors should be by ligation, not by ecrasement or excision. If the vaginal walls are included in the ligature, the margins of the muscular walls are held in contact until adhesion occurs and the hernia is obviated.

DYSTOKIA DUE TO DISPLACEMENT OF THE UTERUS

Hernia of the Uterus, or Hysterocele, has already been considered amongst the diseases of pregnancy, on pages 196 (Rupture of the Prepubian Tendon) and 205. The various forms ordinarily occur during pregnancy and imperil the lives of mother and young prior to the normal date for parturition. Torsion of the uterus, the commonest type of uterine displacement, has also been described amongst the diseases of the pregnant animal, and the eventual dystokia there discussed.

Deviation of the Uterus. Various writers describe a displacement of the uterus obliquely downward, which they compare with ante-version of the gravid uterus of woman. The exact condition is not very clear. According to Fleming, when the hand is introduced into the vagina it encounters an imperforate culde-sac, consisting of the floor of the uterus pushed up against the floor of the vagina and projecting into the pelvic cavity. The os uteri is situated high up toward the sacrum and is not much dilated. The fetus lies beneath the vaginal floor. Apparently Fleming was dealing with the bi-cornual development of the equine fetus, where its development began in the ventral presentation and later it revolved upon its long axis, through the half of a circle, carrying the uterine cornua with it, thus changing the presentation from ventral to dorsal compound bi-cornual pregnancy.

PELVIC DYSTOKIA

Dystokia referable to diseases and deformities of the pelvis is comparatively rare in domestic animals. It arises from anatomical peculiarities, systemic diseases of the skeleton, and physical injuries.

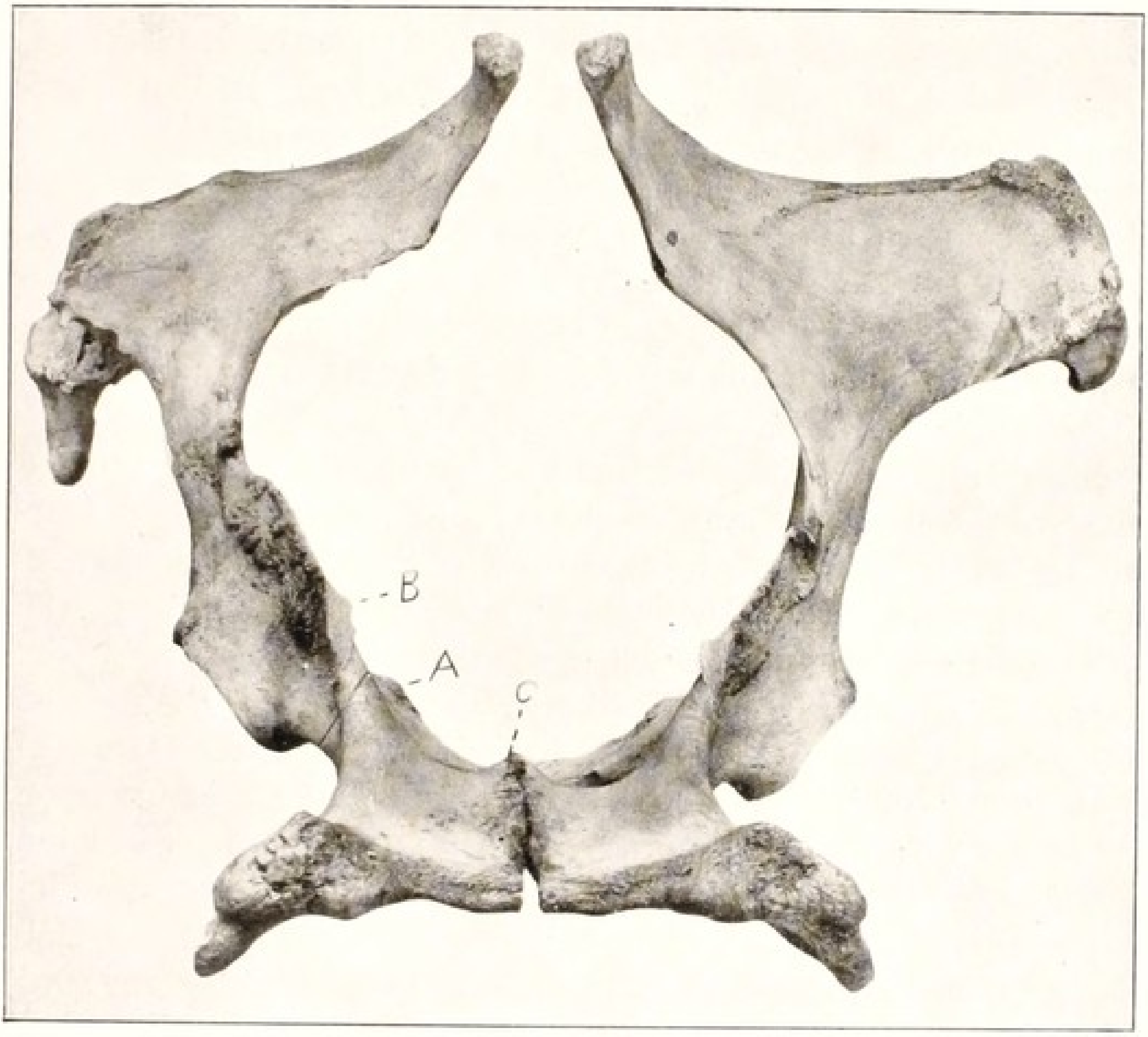


FIG. 117. PELVIS OF MARE.
Showing prominent elevations, A, B and C, on the anterior margin of the pelvic inlet.

Anatomic elevations in the pelvic girdle are common in mares and cows. Their cause is unknown. Usually they present no evidences of pathologic origin, but seem mere deviations from the normal type of development. They occur chiefly upon the median line of the anterior pubic border, near the area of insertion of the prepubian tendon. In heifers there is usually a sharp, conical elevation at the anterior end of the pubic symphysis, projecting upwards sometimes as far as one inch. With age, the cone becomes partly resorbed. Rarely, the elevations occur more posteriorly, along the ischial symphysis and elsewhere.

Whatever their cause, they occasionally induce serious or fatal lesions during parturition. They offer little mechanical impediment to the passage of the fetus. Their chief danger is to the utero-vaginal floor, which, becoming impinged between the conical projection and the fetal body, is contused, lacerated, or perforated, to end finally in septic peritonitis. A heifer suffered from dystokia, apparently due to the uterine inertia of contagious abortion. The dairyman applied traction and removed the calf. The afterbirth was retained, and I was called to attend the cow. She died in a few days. Autopsy revealed a fatal peritonitis arising from a contused perforation in the vaginal floor opposite a sharp, conical projection upon the median line of the pubic brim.

Such injuries during traction upon a fetus are to be avoided chiefly by following the rules already stated on page 383. During the initial stages of the expulsion of the fetus, the advancing part should be drawn upwards and backwards, lifting the fetus over the pubic brim with as little pressure upon that part as possible. When the fetus is well advanced in the pelvis, downward traction upon the fetus presses its ventral surface against the ischial floor and tends to relieve the pressure upon the pubic brim. The practitioner will do well to bear in mind this danger when applying traction to a fetus. When examining an animal after traction has been applied to the fetus, especially by laymen, the veterinarian should look carefully for such injury. If discovered opportunely, the perforation may be disinfected, and possibly successfully closed by sutures, especially by lifting up the wound edges, transfixing with a strong suture, and then firmly ligating the elevated wound margins. It is important for the professional reputation of the veterinarian that such injuries be recognized early and the owner warned of the critical danger. In the cow mentioned above, I failed to diagnose the injury clinically and was bitterly criticised by the owner.

Rachitis. While rachitis is not very rare in domestic animals, it does not as a rule result in serious deformity of the pelvis. The principal weight of the quadrupedal animal falls upon the anterior feet, so that the weight upon the pelvis is comparatively slight, and not apt to cause pelvic deformity. Besides, the bones of most species of domestic animals are well advanced in ossification at the time of birth, and in rachitis tend rather to break than to bend. This is especially true, of horses, cattle, and sheep. In these there is little evidence of serious rachitic deformity of the pelvis. In countries where swine are kept largely in sties and upon a more or less limited diet, it has been claimed that rachitic deformity of the pelvis is common and leads to serious dystokia, rendering it wholly impossible to extract the fetus through the pelvis. In a series of cases of dystokia recorded by deBruin in the sow (B. T. W., January 3, 1907) the pelvis was reported to have been so constricted from rachitis as barely to admit two fingers to pass through it. Hysterotomy became necessary.

The data submitted by de Bruin do not make the question quite clear. In a sow which has not given birth to young, the pelvis may be very narrow posteriorly because its broad ligaments have not relaxed. If there is a general disorder of the uterus, such as the uterine inertia of contagious abortion, the soft structures of the pelvic canal may not become relaxed. In the sow this is the only part of the pelvis which can be examined by digital exploration before the hand can pass the vulva. Apparently the diagnosis of rachitic pelvic deformity was not verified by post-mortem examination. I have not observed such deformity in any animal. If rachitic pelvic deformity occurs in quadrupeds at all, it must be very rare. It is quite different in man, where the bony skeleton is very soft during the chief rachitic age and where the entire body weight is borne by the pelvis, owing to the bipedal position.

In man, the body weight upon the head of the femur is in front of the long axis of the spinal column. The support of the weight upon the legs through the coxo-femoral joints tends to force the pubis toward the diaphragm. In quadrupeds, the coxo-femoral articulation is posterior to the sacro-iliac articulation, and the tendency is to push the ischium toward the tail. Instead of pelvic deformation, the spinal column yields ventralwards, to constitute lordosis. Having regard for all the evidence, it appears highly probable that many diagnoses of rachitic pelvic constriction in animals should be attributed to error. They are probably cases of uterine inertia, usually due to contagious abortion. The delusion is wholly natural. The inert uterus does not possess the force required to push the fetus into the pelvic canal, the abdominal muscles can not yet press effectively upon the fetus, the pelvis seems small to the examiner, and pelvic constriction is diagnosed. I have observed much rachitic disease in colts, with severe lordosis and frequent fractures of the spinal column, but I have not observed pelvic deformity.

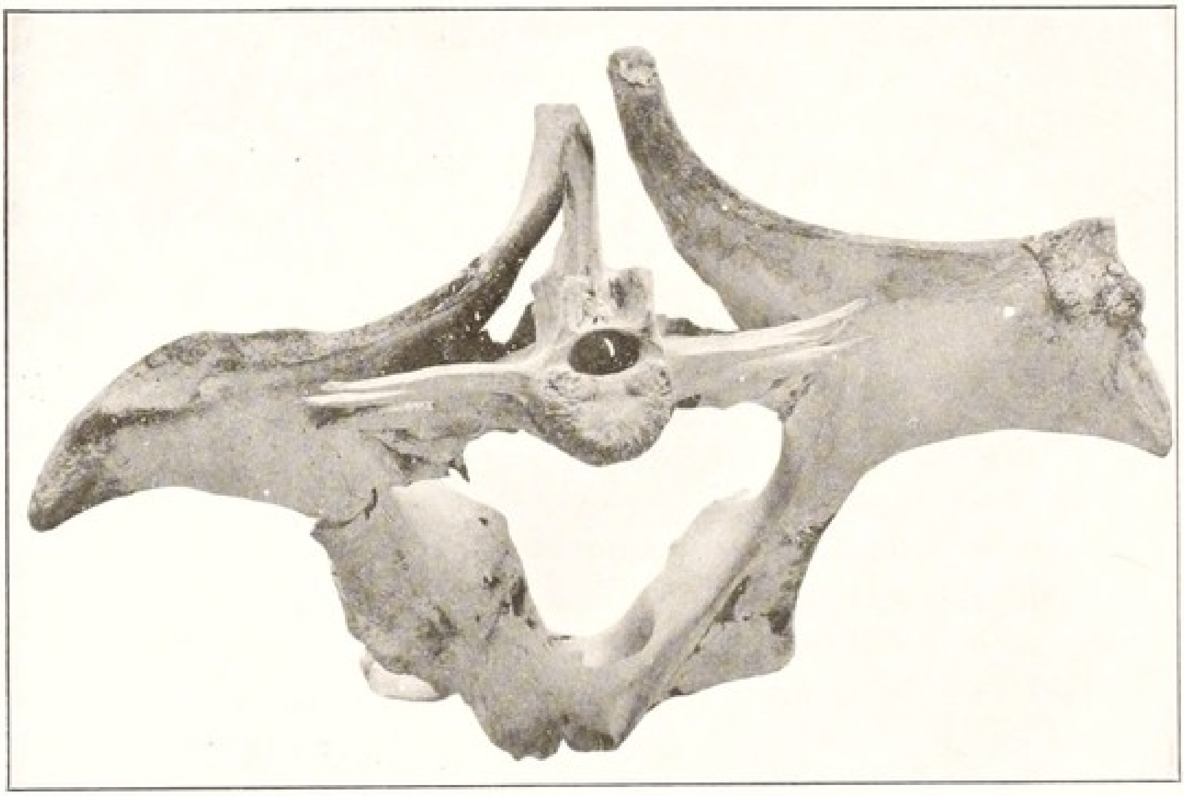


FIG. 118. CONSTRICTED PELVIS OF MARE, INDUCING IRREMEDIABLE DYSTOKIA

Dislocation of right sacro-iliac articulation. Green-stick fracture through right acetabulum. Non-union or fracture of left iliac shaft.

From the standpoint of handling, the question of diagnosis is not vital in the sow or carnivora. Whether due to uterine inertia or pelvic constriction, the logical course is gastro-hysterotomy or hysterectomy as described on pages 411 and 422.

Callus from Pelvic Fractures. It is not rare to meet with fractures of the pelvis in which, when the animal recovers, there remains a large callus, with perhaps some additional deformation by one fractured portion of the pelvic girdle pushing inward, so that it may greatly narrow and obstruct the pelvic canal, rendering birth through it exceedingly difficult or quite impossible. These cases are not very common, but occur in the experience of most veterinary obstetrists, and constantly suggest that a female which has suffered from a fracture of the pelvis should not be used for breeding purposes, except the pelvis has first been examined and found to be sufficiently wide to permit safe birth. Many pelvic fractures are due wholly to accident. In nymphomaniac cows, pelvic fractures are very common. It may be that the general disturbances, due to the cystic degeneration of the ovaries which causes the nymphomania, concurrently render the bones fragile, and make such fractures frequent. The constant riding of other animals, as a part of the nymphomania, evidently contributes to the danger. The relaxation of the sacro-iliac and sacro-sciatic ligaments renders the animal very insecure in her gait, suggesting the locomotor ataxia of man. This insecurity of step certainly increases the peril to the integrity of the pelvis when the nymphomaniac attempts to mount another animal.

Unhealed Fractures of the Pelvis. In one case I observed a fracture of the pelvis of a pregnant mare (Fig. 118), which had occurred when she was a young colt still sucking her dam. A large stallion escaped, mounted the colt, and broke her down. There was a dislocation of the sacro-iliac articulation, a green-stick fracture through the acetabulum, and a fracture through the shaft of the ilium. The latter failed to heal, but the filly recovered sufficiently to get about. She was crippled, but in good flesh and vigorous. Later she was bred without the pelvis having been examined. At foaling time I was called, because of severe dystokia, and found the fetus presenting normally at the pelvic inlet, but the pelvic canal very constricted, so that whenever traction was applied to the fetus it seemed to recede instead of advance. The foal could not possibly be extracted by traction because, on account of the non-united fracture on the one side of the pelvis and the movable sacro-iliac articulation on the other side, whenever traction was applied, the pubis moved toward the coccyx and closed the pelvic channel. Since the fetus was dead and the mare worthless, the animal was at once destroyed.

Exostosis, as a result of dislocation of the femur through the foramen ovale. Fig 119 illustrates the pelvis of a cow, in our collection, in which there has been dislocation of the femur of long standing, through the foramen ovale. As a result of the constant irritation there has developed a large exostosis inside the pelvis, which would naturally cause serious

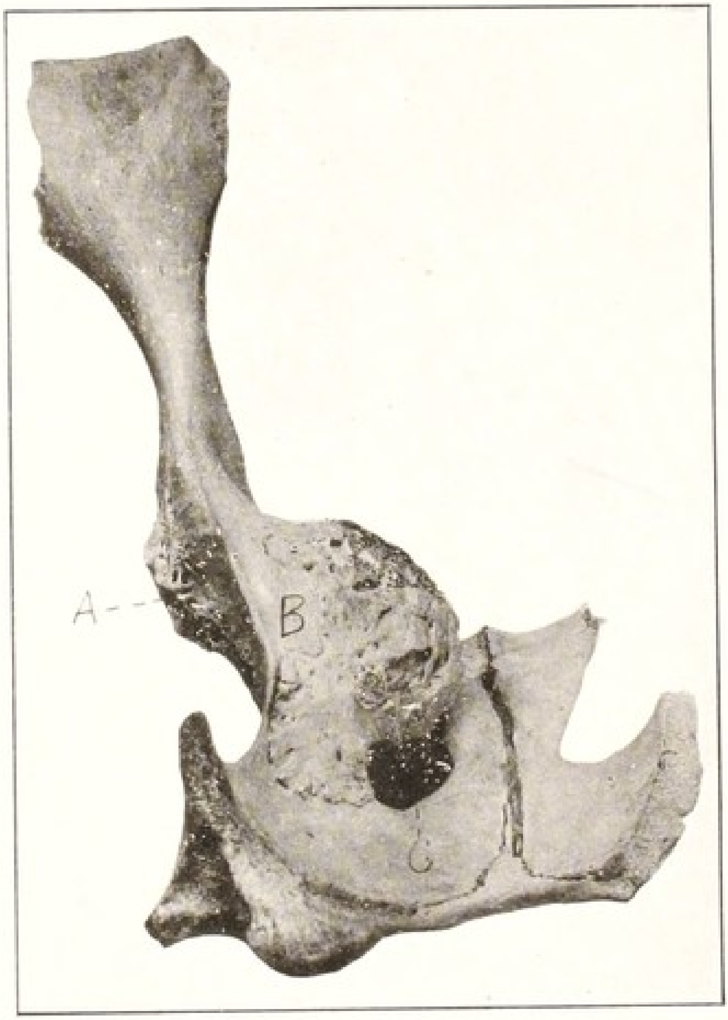


FIG. 119. CALLUS DUE TO DISLOCATION OF THE HEAD OF THE FEMUR OF THE COW THROUGH FORAMEN OVALE

A, acetabulum. B, exostosis from permanent dislocation of femur through foramen ovale.

obstruction in case of parturition. Exostoses, or bone tumors, may arise in the pelvic canal from various causes, and offer more or less serious obstructions to birth.

Handling. In the handling of this group of cases, three distinct possibilities offer to the obstetrist :

1. **Prophylaxis.** Should the veterinarian be consulted regarding pelvic injuries to a female which might be used for

breeding purposes, he should always consider whether the animal may later be safely bred. If the pelvis has been fractured, if there is coxo-femoral dislocation or disease, the possibility of changes in the dimensions of the pelvic canal should be considered, the parts carefully examined, and, if necessary, the owner warned. Should the veterinarian be asked to examine the pelvis of a female with reference to her capability as a breeder, the various impediments should be carefully estimated and a judicious answer given.

2. **Artificial Abortion.** Pelvic deformities of a character to induce dystokia may occur or become known during pregnancy, at a time when the fetus is so small that it might safely pass the pelvic canal. When it is clear that normal birth can not take place, and the mother is prized aside from her power to breed, the question of inducing artificial abortion should be considered. If it seems that the life of the mother can thus be rendered safer than by permitting the fetus to remain and develop until the normal time of parturition, the operation should be performed.

Artificial abortion is best induced by dislodging the corpus luteum of pregnancy, breaking down the uterine seal with a catheter or sound, introducing the catheter into the uterine cavity, and douching with an aseptic or mildly antiseptic solution. The abortion then occurs in twenty-four to forty-eight hours.

3. **Overcoming Dystokia of Pelvic Constriction.** When gestation has passed unheeded until the time for parturition has arrived, and the veterinary obstetrist faces a case of dystokia due to pelvic constriction, the usual plans for the removal of the fetus present themselves.

a. **Forced Extraction.** First to be considered as affecting the lives of both mother and fetus is forced extraction through the narrowed canal. If in the judgment of the veterinarian it is practicable to force the fetus through the canal without serious injury to the mother, this should be done. If forced extraction is decided upon, the operator should properly secure the presenting parts, thoroughly lubricate the passages by means of a warm physiologic salt solution, or otherwise, and proceed with the extraction under the general rules on page 381.

If the fetus has already become advanced in the pelvic canal and is firmly impacted, it is difficult to do otherwise than to attempt the completion of delivery by means of traction. The fact that it has been forced along the passage for a considerable distance should be considered evidence that it may be completely extracted without very great danger.

b. **Embryotomy** may be possible in the larger animals, but is not available in the smaller ones. The embryotomy operations have already been described on page 391. In the anterior presentation and physiologic position, the probable course of embryotomy would be: cephalotomy, page 393; subcutaneous amputation of one anterior limb, page 395; evisceration, page 408; and the destruction of the pelvic girdle, page 399.

Finally, when other means for saving the life of the mother, the fetus, or both are excluded or rendered very doubtful by the conditions which are present, hysterotomy should be employed, under the general plan outlined on page 411, or hysterectomy, described on page 422. The latter operation constitutes the most promising method for overcoming pelvic constriction in the sow, bitch, and cat. When dystokia occurs in these animals from pelvic constriction, the obstetrist should decide early upon the course to pursue. If hysterotomy or hysterectomy is to be performed at all, it should be done at once, without first attempting forced extraction or other manipulations in the genital canal, since the inevitable insult to these parts and the exhaustion of the patient greatly complicate the case and seriously reduce the prospects for recovery should either operation be later decided upon.

FETAL DYSTOKIA.

The fetus may serve as an obstacle to its own expulsion from the uterus, owing to some abnormality due to arrest in development or to disease during its intra-uterine life. The dystokia may be due to the development of the fetus in a pathologic position in the uterus, or to some deviation in its attitude when approaching the birth canal, which may render its passage difficult or impossible.

Fetal dystokia may be outlined synoptically as follows :

A. Abnormalities in the Development of, or Primary Diseases of the Fetus or Its Annexes	Excessive Volume	Hydrocephalus,
	Ascites, and Cystic Degeneration of Fetal Organs	Anasarca Hydramnios
	Hypertrophic Glands	Fetal Tumors
	Campylorrhachis	Schistocormus Reflexus
	Wry-Neck	Anchyloses of Joints
	Double Monstrosities	Twin Dystokia
B. The Development of a Normal Fetus in an Abnormal Position in the Uterus	Bi-Cornual, or Transverse Pregnancy	Dorsal Presentation Ventral Presentation Compound Dorsal Presentation
C. Abnormal Positions and Deviations of the Normal Fetus in Normal (Longitudinal) Presentation	Dorso-Ilial Positions Dorso-Pubic Positions	
	Anterior Presentation	Deviations of the Head and Neck Deviations of the Anterior Limbs Deviations of the Posterior Limbs Interlocking of Fetal and Maternal Pelves
	Posterior Presentation	Retention of the Posterior Limbs

A. ABNORMALITIES IN THE DEVELOPMENT OF, OR PRIMARY DISEASES OF THE FETUS OR ITS ANNEXES.

EXCESS OF VOLUME

Excess in the volume of the fetus is a comparative term. It is the relation existing between the size of the fetus and the dimensions of the birth canal of the mother, rather than definite abnormality in volume. Supposed cases of comparative excess in size are not rare in domestic animals. Whatever their true character, they may prove a more or less serious obstacle to the expulsion of the fetus.

The causes of comparative excess in fetal volume are not clear. Prolonged gestation is sometimes believed to increase the volume of the fetus. In the cow and mare there are great variations in the duration of gestation, ranging from 30 to 90 days or even more. During this period the fetus is presumably constantly growing; if carried for 30 to 60 days beyond the briefest duration of pregnancy, it would be but reasonable to expect that it may be larger because of this longer period of intra-uterine development. Nevertheless it has not been possible to verify this suggestion by clinical observation. Prolonged gestation does not commonly result in such a growth of the fetus as to cause any serious obstacle to its delivery. It is true that those fetuses which are born after a comparatively short duration of gestation—premature births—are usually very small, but they are also correspondingly immature. When fetuses reach the average duration of intra-uterine development they seem to be as large as though carried for a much greater length of time. In one instance which I noted, where the duration of gestation in a mare exceeded twelve months, the foal to which she gave birth was a pigmy about half the size which would naturally have been expected in harmony with the size of the sire and the dam.

Neuman (B. T. W., 1909, p. 702) records having delivered a cow, 413 days pregnant, of a putrid, emphysematous calf, weighing 110 pounds, with long hair—a female, formed like a male. The impression is given that the large size was due to prolonged gestation. The fact that the fetus was dead and emphysematous destroys all evidence of prolonged gestation. The fetus may have perished at 280 days. In 1908, my colleague, Frost, delivered a Holstein-Friesian cow of a calf weighing 147 pounds. The duration of pregnancy was normal, the calf was normal, and was alive, but died during delivery. Calves weighing over 100 pounds are not rare in this breed. It is consequently unwarranted to conclude that, because a fetus is unusually large, the duration of pregnancy has been excessive, or that, because pregnancy is being prolonged, dystokia from excessive volume of the fetus must occur. While rare exceptions may occur, the largest fetuses are usually encountered in those cases in which the normal duration of pregnancy has merely been reached.

It appears, from all that can be learned of the subject clinically, that the retention of the fetus in the uterus beyond the average duration of time is not dangerous from the standpoint of causing dystokia by excess of volume, but rather that other complications may arise which may be more or less dangerous for the well-being of the mother and the fetus. In some cases an abnormality of the fetus or the mother is responsible for the delay in parturition—not the delay in parturition responsible for the abnormality of the fetus. Such being the case, the parturition will perhaps be difficult because of the existing disease. This leads to the erroneous belief that the excessive volume is the cause of the dystokia.

In multiparous animals, like the bitch and sow, it is frequently thought that when the number of fetuses is below the average they tend to grow larger because of the increased nutritive supply, and in this way tend to cause difficult labor. There is probably a better explanation. In multiparous animals, the occurrence of a single fetus or but two or three is highly suggestive of an intra-uterine infection which has killed nearly all embryos early. One or two remain, which finally perish and become greatly enlarged by decomposition. The tumefied cadaver is then looked upon as an overgrown fetus, which plainly it is not.

Excessive size of the male animal, as compared with that of the female, has been alleged to cause an excessive size of the fetus, but it is difficult to verify this clinically. I have had occasion to observe the results of crossing small mares of 700 to 1000 pounds with large draft stallions weighing from 1800 to 2500 pounds, or approximately three times the weight of the mare. Yet I did not observe a case of dystokia in such mares, attributable to excessive volume of the fetus. Fleming cites several authors to show that such crosses do result in difficultlt labor, especially in the ewe and bitch. On the other hand, Saint-Cyr states, in harmony with my personal experience, that he has repeatedly seen large Percheron stallions crossed with small mares, without any resulting difficulty in foaling because of size.

It appears from observation that the size of the female, not that of the male, chiefly fixes the size of the fetus, and that the variation in the size of animals because of cross-breeding occurs chiefly during extra-uterine life, not during gestation.

On the other hand, observations indicate that the male influences the form of the fetus and the comparative volume of certain portions of its body. This variation is noticed chiefly in the size of the head. It has been observed that the crossing of ewes with rams of certain breeds having large heads may lead to dystokia because of the comparatively large size of the lambs' heads. In one instance I observed that many of the cows bred to a certain bull, which had a very heavy head and neck, required assistance in calving because, it was believed, of the voluminous heads and necks of the calves. The dystokia was quite possibly due to other causes, especially to uterine inertia.

When the domestic cow is crossed with the American bison there is almost certainly difficulty in giving birth to the young, not because of the large head and chest of the hybrid fetus, but because of hydrops amnii.

It has been claimed that the breeding of immature females tends to produce dystokia because of the comparatively large size of the fetus. The fetus of such a young mother is actually smaller than the same female would produce later in life. The birth canal, especially the pelvis of the very young female, is not yet fully developed, but, when compared with the dimensions of the fetus, is, so far as known, quite as extensive as in the prime of life. It is a common experience that young heifers may require some degree of assistance in order to expel the fetus. The same is noted in immature sows, and to some extent in other animals. However, these observations are otherwise explainable.

Heifers are notoriously infected severely with contagious abortion, the influence of which has been discussed on page 425. Recent investigations indicate that the heifer gets the infection as a calf, in her milk, and that it persists indefinitely or permanently. The infection is present when she is bred, and the resulting dystokia is wrongly attributed to immaturity.

In one instance which I noted, the owner of a number of fillies allowed a stallion colt to run with them at pasture, and several yearlings became pregnant. Before the end of gestation, contagious abortion broke out, so that they all aborted, and several of them required assistance in order to get rid of the very immature fetuses. One might have thought that, had they carried their fetuses to the normal close of gestation, there might have been difficulty in expelling them. The contagious abortion, however, fully accounted for the dystokia.

Clinical observations apparently show that the fetuses are larger if the mother has been well fed. This does not seem to interfere greatly with birth, because, while the fetus is comparatively large, the expulsive powers of the mother are also greater and the birth as a rule is easier.

Diagnosis. The accurate determination of an excessive volume of the fetus is impossible until it has entered the pelvic canal. When labor sets in, with vigorous expulsive efforts, the fetus normal in form and position, and the birth canal normal, but little or no progress is made in the expulsion of the fetus, excessive volume of the fetus may be suspected. If, under these conditions, the veterinarian examines the patient, he may be enabled to determine that the fetus is comparatively too large to pass readily through the birth canal. However, this opinion does not depend upon any definite measurement which he is able to make of the dimensions of the pelvis or of the fetus.

The principal obstacles to birth, in most cases, are the head and chest. The obstruction caused by the head is especially notable in the bitch and cow. In the bitch the difficulty most frequently occurs in those breeds, like the bulldog, which have short muzzles and consequently present a blunt extremity to pass through the undilated canal. In the mare, the head of the foal, small and elongated, rarely offers any serious obstacle to birth. Generally it is only when the chest or croup arrives at the pelvic inlet that serious difficulty arises because of volume. It has already been noted, in discussing physiologic birth, that the dimensions of the chest of the foal, with the shoulders resting in their normal position, are greater than those of the pelvis of the mother, and that it is only by the forward displacement of the shoulders upon the neck of the foal that the chest is capable of passing through the birth canal. When the dimensions of the fetal chest are such that its diminution by displacement of the shoulders is insufficient to permit the chest to pass through the pelvis, dystokia from excessive size of the fetus ensues.

Prognosis. The prognosis is to be based upon the degree of disparity between the volume of the fetus and the dimensions of the birth canal.

Handling. 1. **Forced extraction** of the fetus should be carried out in all those cases where, in the judgment of the veterinarian, it can be accomplished with reasonable safety to mother. Prior to forced extraction, it should be determined that the fetus is in a correct position and that no harmful deviation of an extremity exists, after which the genital canal should be thoroughly moistened with warm physiologic salt solution, fat, or a warm emulsion of slippery elm bark. In the mare and cow, and to a less extent in the ewe and the goat, the traction may be exerted by means of cords applied to the presenting parts, as described on page 387.

In the sow, bitch, and cat, traction is usually best applied by means of forceps such as shown in Fig. 101 on page 337, or the obstetric noose, f and g, Fig. 99, page 331. Very largely, forced extraction is neither possible nor desirable in small animals, and Caesarian section must be employed.

2. **Embryotomy.** In the larger animals, where forced extraction is impossible or imprudent, the veterinarian should, when practicable, unless the fetus is still living and possesses very high value, diminish its size by embryotomy. In the ewe and goat, embryotomy may be practicable in some cases, depending chiefly upon the comparative dimensions of the genital canal of the patient and the hand of the operator. Embryotomy for excess of volume is very tedious. It involves, in the anterior presentation, usually cephalotomy, the subcutaneous amputation of an anterior limb, evisceration, the severing of the ribs, and de-

struction of the pelvic girdle. In the posterior presentation, similar operations are involved. These are described under "Embryotomy" on page 391.

3. **Hysterotomy or hysterectomy** is generally necessary or advisable in dystokia in the sow and carnivora due to excessive volume of the fetus. Forced extraction is difficult because of the smallness of the genital passages, and frequently unwise because the force which would be required for the extraction of the fetus would produce injuries to the soft parts of a more serious character than would result from gastro-hysterotomy or hysterectomy.

It is unfortunate to postpone the operation. The obstetrist should determine the necessity for the operation early, and carry it out as promptly as possible. If there is delay in operating, and one or more fetuses have perished and become emphysematous and putrid, the operation becomes very grave; when carried out upon a uterus which has not suffered from any previous insult and in which the fetuses are yet alive, it is not highly dangerous. The operation has already been discussed on page 411.

Diseases of the Fetus

Heretofore, many writers have alleged that death of the fetus, and the consequent rigor mortis, emphysema, or other post-mortem changes, were an important cause of fetal dystokia. In discussing the primary diseases of the fetus on page 249, it has been held instead that they rarely or never cause fetal death. Fetal death is secondary to uterine disease, that is, to intra-uterine infection (contagious abortion). Fetal death complicates the dystokia already present, but the fundamental cause is uterine disease, which is discussed on page 439, under maternal dystokia, as a part of the dystokia of contagious abortion.

When discussing primary diseases of the fetus and its annexes on page 249, it was observed that some of them, such as *dropsy of the amnion* and *fetal anasarca*, involved indirectly the health of the mother, because the excessive weight of the pathologic accumulations disable the pregnant female. These conditions were fully considered in that chapter. It is desirable here to consider a second group of primary diseases of the fetus, which have their chief practical interest in the dystokia which they occasion.

Hydrocephalus

Hydrocephalus consists essentially of a distention of the lateral ventricles of the brain with lymph. The fluid may be of any amount. The degree of dystokia depends either upon the amount of fluid or, more definitely, upon the dimensions and degree of ossification of the fetal cranium.

Fig. 120. Hydrocephalus. Foal
(Museum New York State Veterinary College)

In the calf and the foal, the amount of fluid may exceed five gallons. It may constitute a serious impediment to the expulsion of the young.

The cerebral hemispheres are virtually absent, while the cerebellum and medulla oblongata are usually present in an apparently normal condition. The enormous distention of the lateral ventricles, with the prevention of the formation of cerebral matter, leads ordinarily to the death of the fetus as soon as the umbilic circulation is suspended.

The effect upon the skull is interesting, and has an important relation to the question of delivery. The bony skull is usually incomplete. The principal portion of the tumor or enlargement is wholly devoid of any osseous covering, and consists merely of the skin and the meninges of the brain. At the base of the tumor, the bones of the skull spread outward and then upward, to constitute a chalice-like cavity with irregular borders. Somewhat rarely the hydrocephalic cranium is complete, the osseous walls wholly enclosing the abnormal brain.

FIG. 121. HYDROCEPHALUS. FOAL. SKULL FROM FIG. 120.
Measuring transversely 12, and antero-posteriorly 13.5 inches.
(Museum New York State Veterinary College.)

The cause of hydrocephalus is unknown. It is observed in all species, but is most frequently seen in the calf and foal.

The diagnosis is comparatively easy when the fetus presents anteriorly, but may become somewhat difficult in the posterior presentation. When the fetus presents anteriorly, the obstetrist usually finds, upon inserting his hand, that the cranium is abnormally enlarged and soft or fluctuating. At first there may be difficulty in identifying the head, because of the great disproportion and its soft, fluctuating character. The actual diagnosis can be made only by identifying some definite parts of the head, such as the mouth, nostrils, ears, or eyes, and determining that the enlargement has a definite relation to these.

In the posterior presentation, the presence of hydrocephalus is not likely to be suspected until the entire fetus, except the head and neck, has been extracted, when suddenly its progress is checked or completely stopped, and it becomes necessary to make an examination in order to determine the cause.

FIG. 122. HYDROCEPHALUS. CALF.
(Museum New York State Veterinary College.)

Handling. There is a well marked tendency towards spontaneous delivery. When vigorous expulsive efforts become established, the cranial sac tends to rupture at some weak point and the mass of fluid to escape. The rupture may occur through the skin, or more probably through the ethmoid bone into the nostril. In a majority of cases, this renders expulsion possible. The indications in hydrocephalus are the destruction of the tumor by opening the cutaneous sac, permitting the liquid to escape, followed by diminution of the size of the osseous cranium by breaking down the bone with the obstetric chisel. The incision into the tumor is easily made with the scalpel or ring knife, and the cranial bones are so thin and weak that they are easily broken down by means of the chisel, as described on page 393. In one case, in the mare, where neither the anterior limbs nor the head had yet advanced into the pelvic canal, I opened the cranial sac and allowed its contents to escape, broke down the cranial bones, drew the head out and amputated it, after which the neck was repelled, the two anterior limbs secured, and the headless fetus extracted.

When the fetus presents posteriorly, and hydrocephalus has been diagnosed, the handling is analogous to that for the anterior presentation. If practicable, the size of the head should be decreased without amputation. To this end it may be essential to eviscerate, sever all ribs, and remove them, then secure, one after the other, the scapulae, and withdraw the anterior limbs. The spinal column and skin afford a secure hold upon the head, which is then freely available for any necessary reduction.

As a general rule, it is not essential to decrease the size of the bony portions of the head very greatly, or, in some cases, to decrease it at all by artificial means. Fig. 122 represents a hydrocephalic calf, which was expelled without aid, the head sac of which had a capacity of about 5 gallons. I had been called because of the dystokia, but, pending arrival, the calf had been expelled. Upon examination, it appeared that the expulsive efforts had compressed the sac to such a degree that it ruptured through the cribriform plates of the ethmoid bone, allowing the escape of the fluid through the mouth, followed by the collapse of the pouch.

Fetal Ascites

Occasionally the abdominal cavity of the fetus is the seat of very extensive collections of fluid It is said that in rare cases the pleural cavity may suffer similarly. The causes of fetal ascites are unknown. Probably most cases designated ascites are due to cystic distention of the fetal kidneys, ovaries, or other organs.

The symptoms of ascites are ordinarily confined to the resultant dystokia. It occurs almost wholly in the calf. Upon examination it may be found that the fetus is presenting normally and the advancing parts are of normal form and volume. If presenting anteriorly, there is no apparent obstacle to expulsion until the head and neck and part of the chest have passed the vulva, when progress ceases, and, although considerable traction may be applied, the fetus appears immovable. Upon examination the veterinarian finds that the abdomen, enormously enlarged, tense, and fluctuating, constitutes the sole obstacle to parturition. When the fetus presents posteriorly the symptoms are quite analogous : the fetus in normal attitude advances until the hips enter the pelvic canal, where it stops.

Inserting the hand alongside the fetal body, the distended abdomen may be felt and recognized.

The handling of the dystokia consists fundamentally of releasing the fluid from the abdominal cavity. This may be done in a variety of ways. The operator may carry a finger-knife or concealed scalpel into the uterine cavity of the mother, and incise the abdomen of the fetus from without, thus allowing the fluid to escape into the uterine cavity. This plan is not highly efficient because the uterine wall presses against the incision and prevents the free exit of the fluid.

From the standpoint of safety to the mother, efficiency, and convenience to the operator, it is better to liberate the fluid through the chest cavity externally. The head and neck have already passed the vulva. It is the work of but a few minutes to remove one anterior limb subcutaneously, as described on page 395, after which one or two of the exposed fetal ribs may be severed. The operator can then eviscerate, as described on page 408, pass his hand through the chest cavity, and rupture the diaphragm. The ascitic fluid or any collection of fluid within a fetal organ then promptly escapes externally. Delivery readily follows.

In the posterior presentation, the fluid may be caused to escape through the fetal pelvis by an incision through the perineum, followed by severing of the sacro-sciatic ligaments, which affords room for the hand of the operator to pass into the abdomen, releasing the fluid, whether in the peritoneal cavity or in a cystic fetal organ.

Cysts, and Cystic Degeneration of Fetal Organs

Cystic degeneration of various internal organs, which may so increase the size of the fetus as to induce dystokia, are rarely recorded. The liver and kidneys have been found affected with cysts of such dimensions as to constitute an obstacle to the expulsion of the fetus. Naturally these cysts can not be differentiated clinically from ascites, and it is only upon autopsy that the character of the difficulty may be fully recognized. The method of handling is the same as for ascites.

Fleming, citing Ludke, records a cyst, in the subcutaneous connective tissue below the ear of a calf, which was more than a foot in diameter and contained 36 pounds of fluid. The cyst had to be punctured in order to permit the extraction of the fetus, but the exact nature of the disease was not determined. Was it a cystic thyroid or salivary gland? Fleming cites Pflug, who was called to attend a goat in difficult labor and found a large cyst upon each side of the head of the kid, in the region of the parotid gland, which offered considerable impediment to the extraction of the fetus, which, however, was finally accomplished without puncturing the cysts. The same author describes the case of a foal with a cystic distention of the guttural pouch.

The indications in this rare group of anomalies will depend somewhat upon the location and volume of the cyst. When very large, they may generally be easily destroyed by puncture, which allows the contents to escape, or the tumor may be so adjusted in position that the fetus may be extracted without the destruction of the cyst.

Hyperthrophic Glands and Fetal Tumors

It must be very rare that a fetus suffers from a true tumor. Fleming speaks of tumors of the fetus, but includes cysts under this heading. Among the cases which he cites, there is only one which might possibly be regarded as a tumor in the common acceptance of the term. Citing Rossignol, he alludes to a fetus which had, in the neighborhood of the umbilicus, a tumor composed of fibro-adipose tissue which weighed eleven pounds. The description of the tumor is very incomplete, and its nature is not revealed.

Osteo-Chondrom. A colleague, and former student, called to attend a cow for dystokia found that laymen had torn the fetus asunder by traction. The torso, in cephalic presentation, was tightly impacted in the pelvic cavity. The torso was diminished by embryotomy, but the post-abdominal area could not be brought into the pelvis. A large, hard mass could be felt in the fetal abdomen, which could neither be broken down nor extracted. The cow was destroyed. The autopsy revealed a large irregular tumor weighing twenty-four pounds and measuring eleven by sixteen inches in diameter. The mass was attached in the lumbar region by some thin folds of peritoneum, but the exact relation of the tumor to other structures was not determined. The fetus was large, and generally well developed. The tumor lay with its greater diameter transverse to the spinal column, so that the abdomen was greatly bulged laterally. The fetus was apparently hermaphroditic, though circumstances prevented a complete study. It had a normal vulva and vagina. The genital glands, atypical, rested in a well developed scrotum. The tumor (Figs. 123, 124) when sectioned, proved to be an osteo-chondrom. The chief volume consisted of very dense cartilage; the central part was of soft cancellated bone.

FIG. 123. OSTEO-CHONDROM FROM ABDOMINAL CAVITY
(Museum N. Y. State Veterinary College)

While the tumor nonplussed my colleague, and might well have baffled anyone, it would appear, upon study, that the dystokia could have been overcome. With the spinal column intact to serve as a fixation and the tumor lodged securely against the fetal pelvis, it might have been comminuted successfully by driving the chisel (Fig. 111 d) into the tumor repeatedly and forcibly revolving it upon its long axis, gradually comminuting the mass.

Hypertrophy of Wolffian Bodies. A colleague, attending a case of dystokia in a cow, found that the chief obstacle to extraction was two large soft tumors located in the fetal abdomen in the dorso-lumbar region. They were readily removed after other viscera had been cleared away. The tumors, which consisted of soft masses of cystic tubules, weighed 12¾ pounds and measured 7.5 x 11.5 inches each in diameter. Each mass was lobulated like the adult bovine kidney.

Renal Hypertrophy. In the abattoir, I observed, in a bovine fetus about twelve inches long, kidneys measuring four inches in diameter. Had their comparative volume continued up to time of birth, they would have caused dystokia.

FIG. 124. SECTION OF THE TUMOR SHOWN IN FIG. 123

Any fetal organ may undergo hypertrophy. Tumors of great variety may occur. They are all rare, and ordinarily stand quite apart from post-natal tumors.

ANOMALIES IN THE FETAL SKELETON

Any portion of the bony skeleton of the fetus may undergo deformity. Sometimes the anomalous formation appears as a primary disturbance of the skeleton itself, as abnormally bent articulations, without apparent cause. Sometimes an articulation is wanting or its motion is so limited that the condition is designated anchylosis. This is probably incorrect, as it seems more logical to regard these as cases of arrested development of the joint.

In wry-neck, the abrupt curvature of the neck is quite clearly due to the accidental incarceration of the bent neck between the fetal body and the uterine wall, which, persisting, causes a rigid curvature of the cervical vertebrae. In *schistocormus reflexus*, it appears that a contraction of another structure (the amnion) causes an acute doubling of the spinal column.

The aberrations in the anatomic structure of the fetal limbs, especially of the articulations, follow no known law. At times the diagnosis of such deformities is difficult. The foot, and sometimes the carpus or tarsus, depart so far from the normal that direct identification is impossible. It then becomes necessary to pass beyond the deformed part, perhaps to the body of the fetus, in order to identify the member accurately. These aberrations are not rare. As a rule, they cause only moderate dystokia, which is comparatively easy to overcome. In such deformities, as illustrated in Figs. 63, 64, 65, and 128, the aberrations interfere rather by misdirecting the feet than otherwise. Their correction ordinarily offers no formidable problem. If need be, the limb may be amputated or fractured in order to bring it into approximate order.

Wry-neck in the Foal. Dystokia due to wry-neck is comparatively common in the foal. It is unknown in other species. Usually it is described as a contracture, with the implication that the deformation is induced by contraction or abnormal shortening of the cervical muscles of one side. The cervical bones are bent. The one logical explanation is that the hind feet have developed in one horn, the anterior limbs in the other horn, and, in the cramped transverse position, the head and neck have become incarcerated between the fetal body and the uterine walls. The condition is very common in bi-cornual pregnancy, which warrants a strong suspicion that in an anterior presentation, complicated by wry-neck, the basic cause is bi-cornual pregnancy. The neck is bent abruptly backward at its base, and the head lies in the flank of the foal. The deviation has existed throughout a long period of time, as is shown by the curvature of the head upon its long axis. If the neck is curved to the left side of the foal, so that the head rests in its left flank, then the left side of the head and face is concave and moulded to the surface of the fetal body, while the right side is convex.

Wry-necked foals usually present either anteriorly, with the two fore feet more or less extended in the passage and the head out of reach or, more commonly, transversely, with the ventral surface of the body toward the pelvic inlet and some or all four of the feet extended in the vaginal canal.

In the anterior presentation, the operator may not be able to reach the head because of its extreme deviation, favored by the great length of the neck. If he can reach the head, it will be found exceedingly difficult or impossible to extend it. When the fetus is repelled, the head recedes with it, instead of becoming extended as in case of a recent deviation. If the head is secured by means of a hook, cord, or other device, it is still found exceedingly difficult to bring about its extension in the genital passages, because the cervical spine has long been bent and is quite rigid.

When the fetus presents transversely, with all four feet in or near the pelvic inlet, the head is usually undiscoverable; if it can be reached, it is difficult or impossible to bring it into the pelvic inlet. Fortunately it is not desired to advance it into the inlet or otherwise secure it.

The indications in wry-neck vary according to conditions. These will be considered under "Lateral Deviations of the Head in the Anterior Presentation," on page 513, and under "Transverse Ventral Presentation" on page 494.

Campylorrhachis

I have observed one case in the cow, and have known of a second in the practice of a colleague, of a deformity consisting of an abrupt lateral curvature of the spine in the dorsal region, by which the body was doubled upon itself in the middle in such a way that the two posterior feet lay with their ventral surfaces upward, alongside the two anterior feet, with their soles turned downward and the head resting upon them. The cause is unknown. In rare cases, a canine fetus has developed with its cephalic end in one horn and its caudal end in the other, but this can not account for the campylorrhachis in the cow. In the bitch, the bi-cornual development of the fetus causes it to present dorsally, with its ventral surface in contact with the inter-cornual partition of the uterus. The U-shaped fetus affected with campylorrhachis presents simultaneously, by both cephalic and caudal ends, indicating that it has lain in the uterus with its two ends side by side, directed toward the cervix, while the abruptly curved middle of the body must have lain in the body of the uterus or in the base of one horn.

The symptoms of this anomaly are peculiar and confusing. The head end of the fetus offers in the typical anterior presentation and dorso-sacral position, the anterior feet extended and the nose resting upon them. Alongside them, to the right or left, are the two hind feet with their plantar surfaces turned upward. The hocks and buttocks are readily reached. Again the presenting part of the fetus is in the physiologic presentation and position. The condition at once gives the obstetrist the impression of twins. The chief point in diagnosis is to determine whether the symptoms are due to twins or to deformity. In case of twins, one of the fetuses may be repelled while the other is advanced, but in this anomaly both the anterior and posterior portions must advance or recede simultaneously. In confusion, the obstetrist might imagine some strange double monstrosity, but such do not occur. Double monsters are true to a definite plan, and symmetry in the deviation is maintained. When two fetuses are attached, it is through identical parts—head to head, tail to tail, side to side, etc. It may be possible to reach and identify the spinal curvature.

The remedy for campylorrhachis is embryotomy. The most efficient plan is the subcutaneous removal of the two anterior limbs, by the method described on page 395, evisceration of the fetus, as described on page 408, and severing the ribs. This reduces the volume and renders the torso flaccid and pliable. After this has been done, the head and neck are to be repelled far into the flank, the now flaccid body converted into a posterior presentation by traction upon the posterior limbs, and its extraction accomplished. The repulsion of the anterior portion of the fetus should be quite complete, and the operator should continue the process with his hand as long as it is possible to keep his arm in the vaginal canal alongside the advancing posterior portion. The head must be detained in the flank of the mother until the caudal end of the torso has entered the pelvis and the cephalic end is securely detained in the flank.

Schistocormus Reflexus

On page 118, when discussing the development of the embryo, it was stated that under certain conditions the amniotic fold contracts in such a manner that the spinal column is forced down through the abnormally wide vitelline duct, and the somatopleure

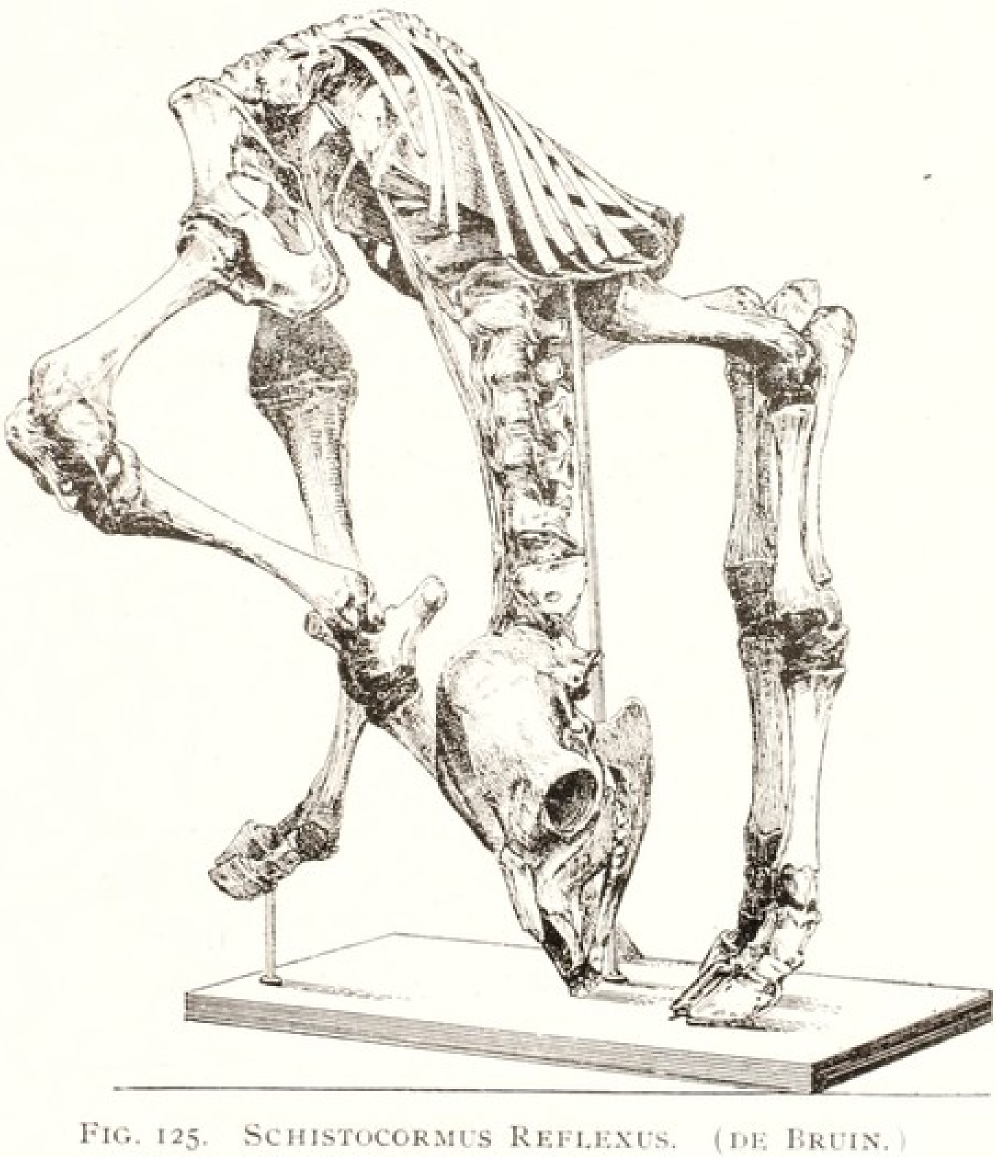


Fig. 125. Schistocormus Reflexus. (de Bruin.)

so reflected that the embryo is virtually everted, as indicated in Figs. 70, 71 and 124. This anomaly occurs almost wholly in the cow, though a few cases have occurred in other ruminants. The viscera lie naked, in the absence of a fetal body cavity. The other portions of the fetus constitute an irregular mass, presenting the pleuro-peritoneal membrane externally in the form of an inverted pouch, open at one end, through which all four limbs, in an inextricable mass, and the nose may more or less protrude. The skin, with its coat of hair, constitutes the lining of the pouch, and lies in contact with the contained limbs, head and neck.

The diagnosis of this anomaly depends upon the anatomical relations above mentioned. Usually—always, so far as I have learned—the monster presents by its four feet and head, and consequently the operator at once comes in contact with several, or all four feet and the head. Following along the fetal extremities, the hand passes into a closely enveloping blind pouch, lined with hair. Examining more externally, the operator's hand passes over the fetal body mass and comes in contact with the fetal viscera lying loose within the chorion. Should the fetus present instead by the bent spine (visceral presentation)—which I have not known to occur—the operator should recognize the viscera lying free, the exposed, bent spinal column, and the ribs, covered only by peritoneum. Usually the condition offers rather serious dystokia. In the cases I have observed, fetal death, putrefaction, and emphysema preceded the symptoms of dystokia.

Forced extraction and embryotomy offer the chief suggestions in delivery. The conglomerate, irregular outline of the fetal mass, with projecting ribs and other bones, renders forced extraction too dangerous in most cases. Unless the pelvis of the cow is very roomy and the fetal mass very small, embryotomy is to be preferred.

In performing embryotomy, the operator should have in mind the anatomical relations of the parts, and should first of all make a longitudinal incision through the skin pouch, so as to lay it freely open and render the limbs available for operation. He should then proceed to diminish the mass to a sufficient degree, preferably first by the subcutaneous amputation of the two anterior limbs, as described on page 395. This may be followed by the removal of the ribs and amputation of one or both hind limbs or of the head, as circumstances may suggest, until the remaining portion may be extracted without serious difficulty or injury to the maternal soft parts.

Dystokia from Double and Triple Monstrosities

Double monstrosities occur chiefly in the cow and somewhat rarely in the smaller ruminants and the sow. In the mare they are almost unknown. They constantly offer more or less serious obstacles to delivery. The symptoms of double monstrosities vary according to the particular abnormality and the presentation.

Commonly, where a fetus is double at one extremity only, it presents by that extremity, and consequently the abnormal portion of the fetus is within reach and the diagnosis can be made by manual exploration. A double face, head, neck, or chest is usually easy to differentiate by palpation. Double monstrosities in which the double condition affects the posterior extremity only, if presenting posteriorly, enable the operator to reach forward a sufficient distance to examine properly the point of bifurcation and diagnose the double character of the fetus.

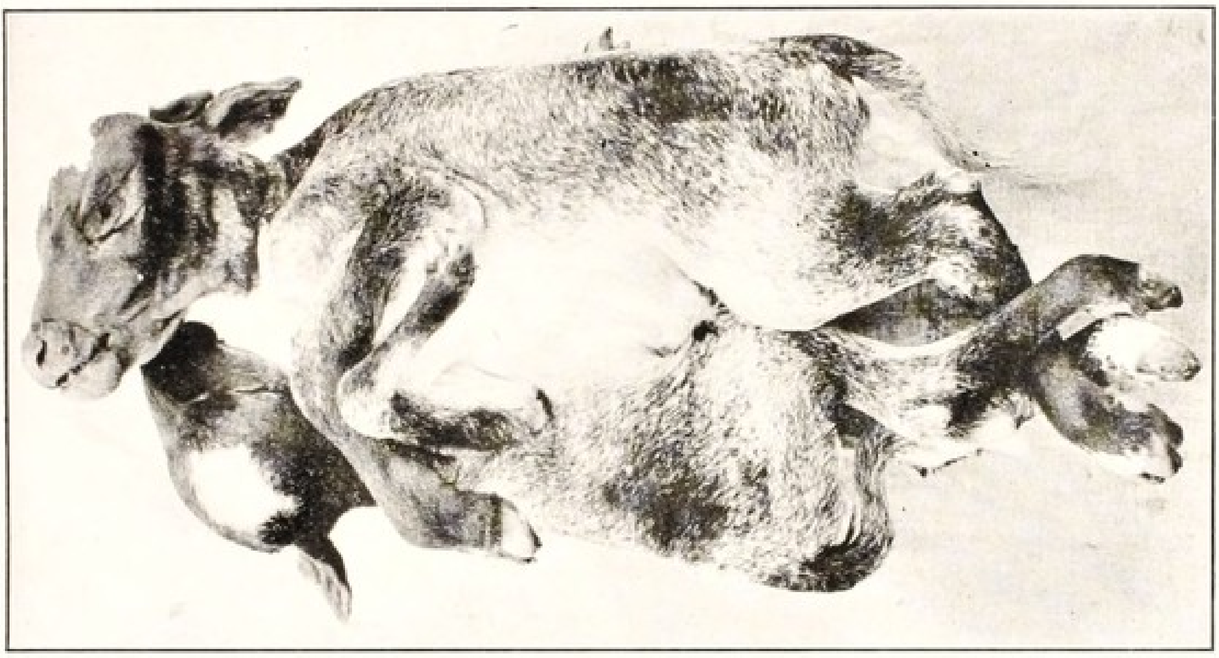


Fig. 126. Gastrodidymus Octipes

(Museum New York State Veterinary College)

In those cases where the single end of the fetus presents and enters the pelvic inlet, the dystokia is not apparent until the double portion reaches the pelvic inlet and its progress is stopped because of the abnormal size. The obstetrist, in making an examination, should be able to pass his hand alongside the single portion of the fetus until he reaches the double portion, the character of which, especially the spinal bifurcation, should be recognized by the sense of touch. Failing in this and finding the delivery by traction impossible or imprudent, the obstetrist may well suspect a monstrosity. He may then amputate a limb, gain access through the amputation wound to the pleuro-peritoneal cavity, and, after evisceration, may recognize the bifurcation of the fetus by manual examination through the body cavity.

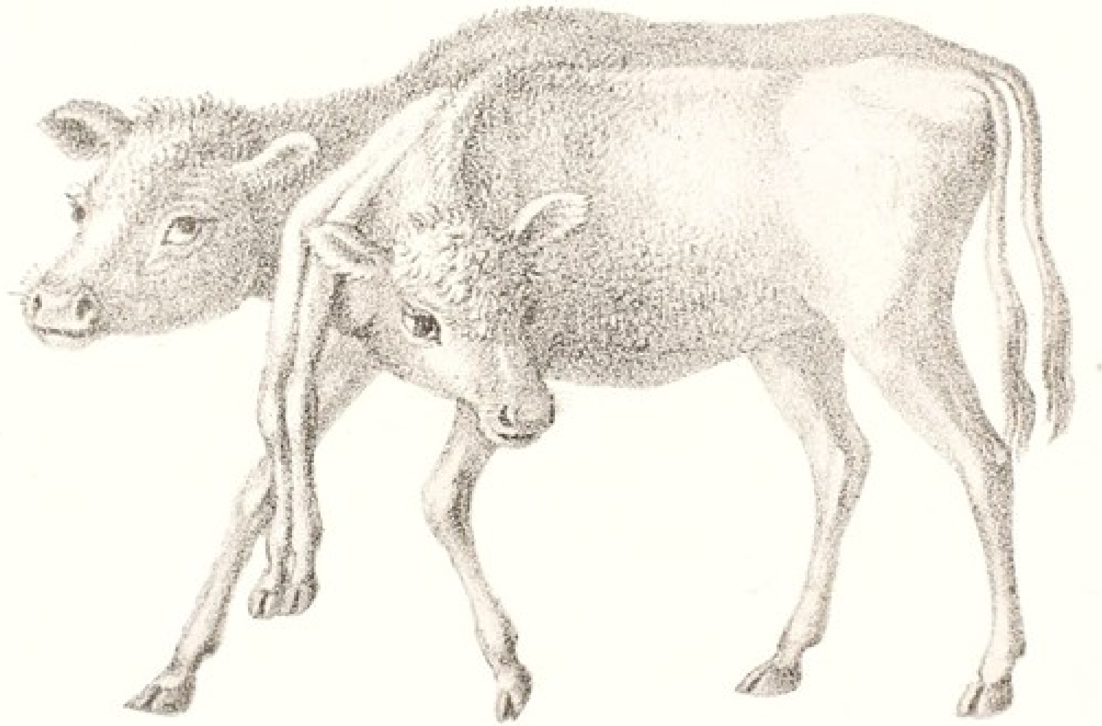


FIG. 127. TETRACHIRUS CHORISTOCEPHALUS. (GURLT.)

When double monsters are manipulated, the obstetrist finds the two corresponding portions of the body moving simultaneously. Here lies the difference between the double monster on the one hand and campylorrhachis and schistocormus reflexus on the other. In the former, the presenting parts are alike—two heads or two tails; in the latter, one part is cephalic and the other caudal. The obstetrist can not repel or advance one without moving the other in the same direction. Moreover, as a general rule he will be able to reach the point where the two bodies are connected, and thus determine the character of the anomaly with which he has to deal.

The very rare pigodidymus aversus (Fig. 129) must be exceedingly difficult or impossible to diagnose. Before the proximal fetus has passed the pelvis, the distal fetus, with both hind limbs inevitably retained and with both hind limbs of the proximal fetus added, becomes jammed against the pelvic girdle. It will then be almost impossible to reach and palpate the union between the two. Partial embryotomy may enable the operator to diagnose the difficulty. After evisceration of the proximal fetus, the operator may be able, by passing his hand between the fetus and the walls of the birth canal, to reach beyond the rump of the proximal fetus to the distal fetus.

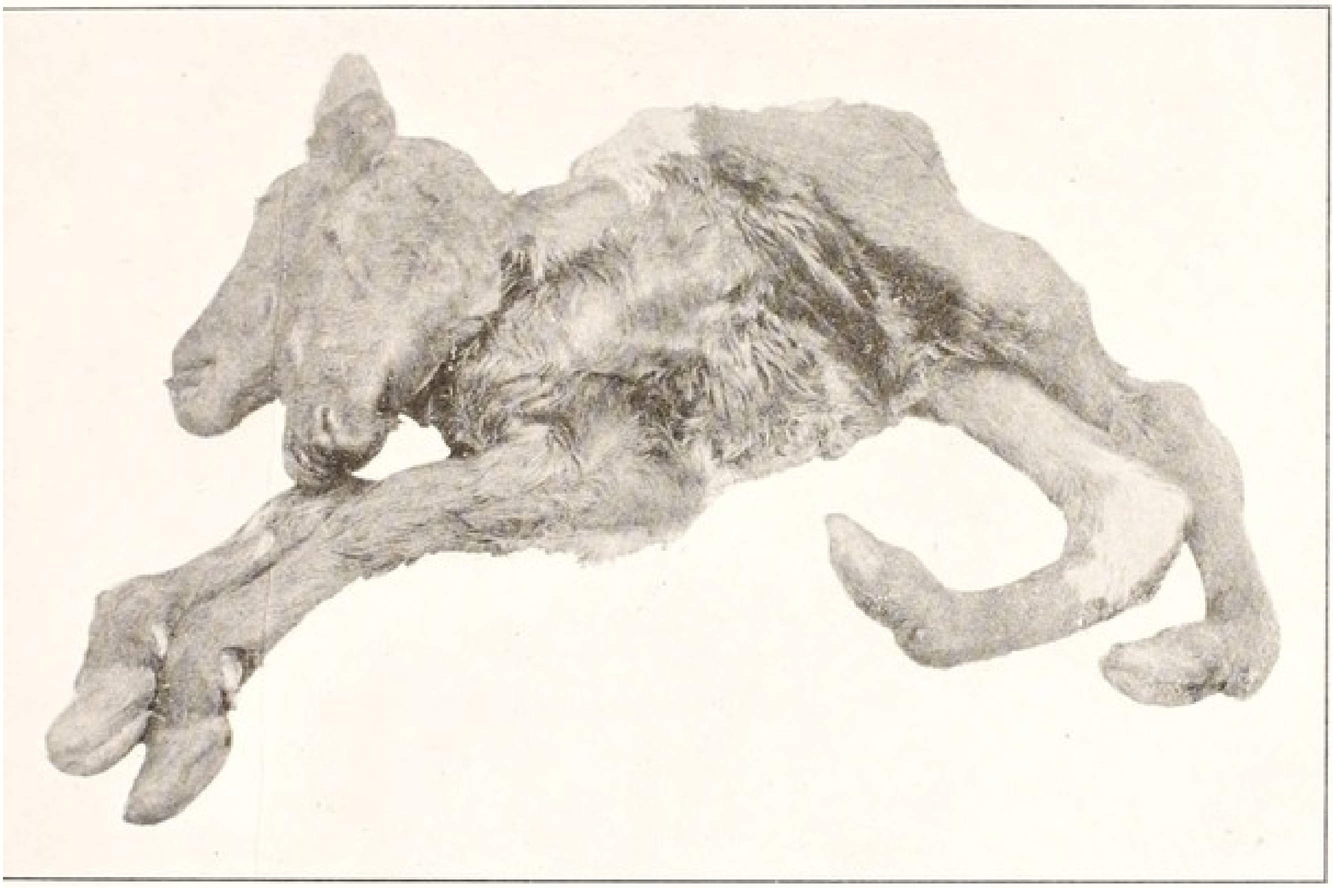


FIG. 128. SCHISTOCEPHALUS
With badly bent posterior limbs.
(Museum New York State Veterinary College.)

Sometimes the double monster is so small that it may be extracted entire without serious difficulty. Sometimes it is necessary to resort to embryotomy in order to bring about delivery with safety to the mother. There are no specific rules for the operation of embryotomy, but the reduction in the size of the monster is to be carried out according to the general suggestions already made on page 391.

It may be well to suggest that it is highly desirable, whenever possible, to divide the double monster into its two halves. That is, if there exists a double head and neck, amputate one of the

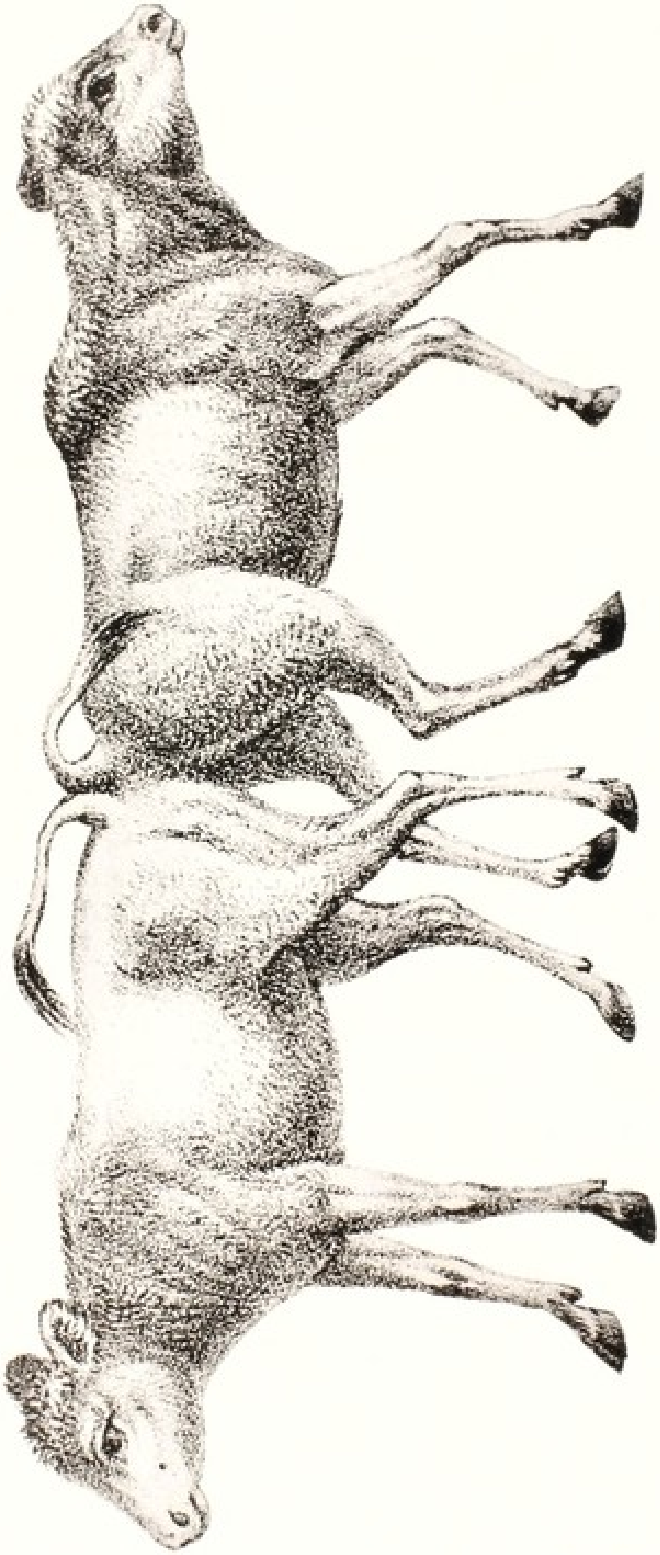


FIG. 129. PIGODIDYMUS AVERSUS. (GURLT)

necks, if possible, with the chisel or by other means, remove it, and then proceed to extract the remaining portion of the fetus. So one might handle a posterior presentation where the posterior extremity of the fetus is double, or might reduce the volume of the double body by evisceration (page 408), by the destruction of the pelvic girdle (page 399), or by the intra-pelvic amputation of the hind limbs (page 402). In such monstrosities as pigodidymus aversus (Fig. 129) the operator would need destroy in turn the pelves of each part before delivery would become possible, assuming that the fetuses are of normal size.

Twin Dystokia

When a uniparous animal becomes pregnant with twins, her tendency toward dystokia becomes multiplied. When discussing twin pregnancy on page 170, it was pointed out that mares and cows, the true uniparous animals in domestication, are preëminently liable to abort twins. The sheep and goat are virtually biparous. It was stated that the abortion of twins in the cow and mare is largely contagious abortion. In discussing the dystokia of contagious abortion on page 425, it has been noted that abortion induces dystokia in several ways, especially by causing uterine inertia and death or disease of the fetus. Each twin may cause independent dystokia, owing to vicious presentation, position, or arrangement of an extremity, or the two together may induce a combined, or twin dystokia by parts of each fetus entering the birth canal simultaneously and becoming wedged there to block further progress.

Living twins, quite independent of the uterine inertia of contagious abortion, show a marked tendency toward compound, or twin dystokia. In unipara there is quite a large uterine body. A single fetus develops partly in the uterine body and partly in the horn corresponding to the functioning ovary. In bicornual twin pregnancy, both ovaries functioning, the vaginal end of each fetus rests in the uterine body, and the ovarian end of each fetus lies in the horn corresponding to the ovary from which the ovum emanated. Their chorions, and sometimes their amnions, fuse. Their extremities (legs, head, and neck) are very long as compared with the extremities of the young of multipara, so that advancing extremities of both fetuses, lying side by side in the uterine body cavity, may well enter the birth canal together. These conditions all combine to render probable the simultaneous entrance of portions of the twins in the birth canal. This is in sharp contrast to the behavior of the fetuses of multipara at the time of birth. The uteri of multipara have no embryos in the uterine body. The fetuses lie normally, not in the uterine, but in the cornual cavities, while the fetal sac of the basal fetus in one horn projects into and occupies the uterine body. Physiologically the fetal sacs of multiparous fetuses do not coalesce. When parturition sets in, the fetal sac of the proximal or basal fetus of one horn completely fills the uterine body. There is no room in the body of the uterus for any portion of another fetus or fetal sac. The fetal sac already occupying the uterine body cavity maintains its priority and blocks the entrance of the chorion of the opposite fetus. This is further assured by the shortness of the limbs of multiparous fetuses, because they can not project far enough beyond the fetal body to become engaged in the birth canal along with the body or limbs of a second fetus. Accordingly, twin or compound dystokia is limited to unipara with a large uterine body.

When discussing twin pregnancy, it was noted that, when bicornual, the fetuses were quite commonly reversed, one presenting by the cephalic and the other by the caudal end. Occasionally they are identical in presentation and position, each presenting by the caudal or cephalic end. Such variability in presentation and position naturally permits a great variability in the details of twin dystokia. There may be found in the birth canal one or more cephalic extremities of each fetus or one or more cephalic extremities of one, with one or both posterior extremities of the other.

Overcoming such compound, or twin dystokia is comparatively simple, largely because, though twin fetuses together are much larger than single fetuses, regularly each is smaller than a single fetus, the uterine cavity is very large, and mutation of the fetuses is therefore comparatively easy. The difficulty of twin dystokia lies in the tendency to err in diagnosis. Time and again, the veterinarian secures and exerts traction simultaneously upon one or more extremities of each of the twins, wedging them thoroughly in the pelvis, where further advancement is impossible and repulsion is exceedingly difficult. The error is beyond concealment from the owner, and does not readily lend itself to explanation or excuse. When discussing the examination of the patient on page 363, great care was urged in this particular. The veterinarian is wholly unjustified in applying traction or other important force to a fetal part until he knows its relationship to other fetal parts. There is no justification for assuming that a head and two feet constitute the anterior extremities of a single fetus until it has been determined that they all join regularly in one fetal body. Whenever the veterinarian violates this principle in diagnosis, he invites humiliating defeat and severe censure.

Once a correct diagnosis has been made, the specific indications in twin or compound dystokia are to repel one twin into the uterus and the abdomen while advancing the other into the pelvic canal. When this has been accomplished, the twin dystokia has been overcome. There may remain the ordinary dystokia of a single fetus due to mal-position or to some deviation of an extremity, etc., but this yields to the general principles of handling dystokia due to a single fetus.

When twins develop in one horn, due to the discharge of two ova from one ovary, as described on page 173, they lie either head to head or tail to tail, as in Fig. 129. While these can not cause twin dystokia in the true sense, the distal fetus may not be at all promptly expelled. For example, in Fig. 129, assuming the two fetuses were separate, the proximal one, with its head toward the vulva, might be promptly expelled. The combined length of the two fetuses is more than double the length of the abdominal cavity of the cow, so that the uterus must double upon itself and the two fetuses lie approximately side by side, the two heads directed toward the vulva, but before the second fetus may approach the pelvic canal the distal end of the uterine horn must undergo version and the fetus finally present posteriorly at the pelvic inlet. The relation of the fetus to the uterus has been constant, but the ovarian end of the uterine horn has undergone version. This arrangement of twins is probably responsible for the long interval sometimes occurring after the expulsion of the first twin before the second appears—a phenomenon which may embarass the veterinarian, who has removed the first twin and failed to discover the second. It was beyond his reach. If however the veterinarian keeps in mind this possibility, while he may be unable to reach the distal fetus after the removal of the proximal one, he may trace as far as he can reach the undiminished uterus, and through its walls detect the second fetus.

B. THE DEVELOPMENT OF A NORMAL FETUS IN AN ABNORMAL POSITION IN THE UTERUS

BI-CORNUAL OR TRANSVERSE PREGNANCY

In uniparous animals, the uterus consists of two horns and a body. In the cow the horns are slightly divergent, as indicated in Fig. 4 on page 23, and the body is very small. A fetus in such a uterus necessarily occupies the body and one horn. If twins are present, each fetus generally rests partly in one horn and partly in the body; it can not lie transversely. If the uterus of the mare (Fig. 3) is examined, a very great change in possibilities is seen at once, and it may be suspected immediately that a fetus could develop transversely in the uterine cornua, and, having done so, present transversely at the time of birth. If the uterus of the bitch (Fig. 5, page 27) is studied, it appears that the two uterine horns are given off at such an angle that the development of a fetus might occur with one end in the right and the other in the left cornu. This would be very rare however, as the location is not propitious for fetal development. The uteri of the mare and bitch are very different. Remembering that the embryo is sharply curved ventralwards, a comparison of the uteri of the mare and bitch would suggest that in the bi-cornual pregnancy of the mare the concave ventral surface of the fetus would present toward the vulva, while in the bitch the position of the fetus would be reversed and its convex dorsal surface would offer toward the vulva.

There are frequent general references in veterinary obstetric writings to transverse presentations, but little or nothing specific. Writers fail to indicate in what animals transverse presentations occur, how frequent such presentations may be, or why they should exist at all. A study of the uteri, as above related, would intimate that bi-cornual pregnancy, and hence transverse presentation, would rarely or never occur in the ruminant, might very rarely occur in carnivora and the sow, and would perhaps be frequent in the mare owing to her cruciform uterus. Clinically, this is what occurs.

Veterinary obstetrists speak freely of ventral and dorsal presentations, as though possible or probable in any species. The reader may be left to assume that the dorsal presentation is just as probable as the ventral, and vice versa: that transverse presentations are mere vagaries subject to no laws or limitations. The cases cited are usually clouded, and poor evidence is submitted of their cause or actual character. Some writers even go so far as to figure a cephalo-sacral position in which the fetus virtually sits upon its haunches just in front of the pubic brim, with the head against the sacrum of the dam. How it could get in such a position in the crucial soliped uterus, as shown in Fig. 3, on page 22, or how it could remain in such a position after having attained it, is difficult to explain.

There is definite clinical proof of three kinds of transverse presentation dependent upon bi-cornual pregnancy:

1. The Primary Dorsal Presentation

This has been definitely recognized in the bitch and sow, but is extremely rare. A colleague observed in the college clinic one case in a bitch, with only one fetus in the genital tract. It had developed with the cephalic end in one cornu, the caudal end in the other, and the middle of the dorsum presenting toward the pelvis. Hysterectomy was successfully performed.

Cuillé (Revue Vet., 1905) records a case of bi-cornual pregnancy in the bitch, which caused insurmountable dystokia. The autopsy showed a fetus lying with its head and fore legs in the right horn and its croup and hind legs in the left. In another case of dystokia, in the bitch, Cuillé extracted the fetus by traction on one fore foot. He believed that this also was a case of bi-cornual pregnancy. Bi-cornual pregnancy has also been recorded in the sow. The experience of a colleague in our clinic, where but a single fetus existed in the genital tract of a bitch, is highly interesting. Details of Cuillé's cases are wanting, but apparently they were also single fetuses. The very interesting suggestion arises that bi-cornual pregnancy in a multiparous animal may depend largely upon the presence of a single fetus and be due to such a fetus dropping into the non-functioning uterine body, because there is no fetus or fetuses in the opposite horn to balance or inhibit such extreme migration or descent. The fetal sac then acquires contact with the functioning bases of the two horns. Various obstetric writers apparently believe that the dorsal presentation occurs in mares, and more rarely in cows. While the correctness of the allegation may well be doubted, the possibility needs be granted. Franck illustrates schematically the presentation in the mare, as shown in Fig. 94, page 284. Should such a presentation be encountered, the dorsum of the fetus offers at the pelvic inlet in the right or left cephalo-ilial position, usually uncomplicated by any further deviation. When the operator inserts his hand, it comes at once into contact with the dorsal surface of the fetus, which is easily recognized. By extending the hand to the right or left, he may palpate and recognize the hips, shoulders, neck, mane, or tail. As a general rule the operator does not come in contact with the head or any of the feet, but only with the body, although in rare cases one or more of the feet may be more or less misplaced in their general relation to the body of the fetus, and project in such a manner that they may be felt or grasped by the operator. In one case in my practice, a hind leg extended backward over the fetus into the pelvic canal, but I am not certain that the case did not belong to the third type, described below.

Should the veterinarian meet with a primary dorsal transverse presentation in the mare or cow—a presentation which rarely if ever occurs—the chief indication in handling is version, converting the transverse into the posterior presentation. The operator usually prefers to convert a transverse into a posterior presentation, because he needs deal with but two extremities—the hind limbs—instead of being forced to handle the head and both anterior limbs should he convert the transverse into the anterior presentation. Version must be accomplished by causing one extremity of the fetus to advance and the other to recede—by exerting traction on one extremity while repelling the other. In the primary dorsal presentation the extremities are not readily available for the application of force. The cephalic end of the fetus is to be repelled by applying force to the withers or back, either with the hand or with a repeller, obliquely forward and toward the head end of the fetus. The application of the force is to be continued until the tail may be reached and grasped and traction applied to it, or a hook may be implanted in the buttocks and traction applied until the hind legs may be secured. When the posterior limbs have been secured and brought into the pelvic canal, the fetus ordinarily needs to be rotated from the dorso-ilial to the dorso-sacral position, completing the adjustment. The fetus is then brought away in the posterior presentation by moderate traction, or, if required, embryotomy is to be performed.

Should version fail, it may be advisable or necessary to perform detruncation in the lumbar region. The operation is to be accomplished chiefly with the chisel, severing first the spinal column and the great dorsal muscles. The soft parts may be most conveniently severed with the finger knife. When the spine has been severed, the cephalic and caudal ends of the fetus tend to approach each other ventralwards and open widely the dorsal wound. Through this wound evisceration should follow. The posterior half of the fetal body may be secured by means of a rope noose about the lumbar vertebrae or by hooks or cords applied inside the pelvis.

It may prove advisable or necessary to extend the embryotomy of the posterior half to include the destruction of the pelvic girdle, as described on page 399. The posterior half of the fetal body may be repelled, turned, and converted into a posterior presentation. The anterior half is to be handled in a similar manner. After evisceration, it may be desirable to sever the ribs, as recommended on page 406, in order to permit the fetal chest to collapse. The remnant may then be extracted by securing the dorsal vertebrae with a cord and applying traction. In some cases it may be practicable or preferable to convert the anterior half into the anterior presentation.

2. Primary Ventral Presentation

So far as can be definitely learned, primary ventral presentation is confined to the mare and is referable to the anatomic disposition of her uterus. A study of the equine uterus (Fig. 3, page 22) shows how readily bi-cornual pregnancy may occur. In my experience, it is one of the commonest types of dystokia in mares. Freely open to investigation, the actual character of the presentation has not been studied. The veterinarian is called to the case, succeeds or fails in relieving the animal, and takes his departure. Judging from the known facts, the most logical conclusion to be reached is that the presentation is caused solely by bi-cornual pregnancy. Apparently the fetus develops approximately as indicated in Fig. 130 and remains in that position to the close of pregnancy. The fetal limbs push out, covered by the chorion, somewhat into the cervical end of the uterine body. The room for the fetus in its transverse disposition is deficient, so that in many cases the neck becomes abruptly bent laterally just in front of the first rib, the head passes back and lodges in the fetal flank, and the pressure of the convex fetal body on one side and the concave uterine wall on the other moulds the head to its environment so that the median cranio-facial line of the fetus forms the segment of a circle.

It is not at all certain how often the wry-neck of the foal in the anterior presentation is referable to bi-cornual pregnancy. It appears quite probable that the deformity is in fact a result of this abnormal disposition of the fetal body early in pregnancy, but the bi-cornual character is less complete than met in transverse presentations, the cephalic end escapes at the time of birth from the cornual base in which it had been lodged, and the foal presents anteriorly with the head and neck deviated sharply and extremely to the right or the left.

When parturition begins, and neither the cephalic nor the caudal end of the fetus becomes disengaged from the horn in which it has rested, the fetus can not offer in the anterior or posterior presentation, but must present transversely, with its ventral surface toward the vulva. The head of the fetus is retained, all the feet are somewhere near the pelvic inlet, and the fetus lies upon its side, more or less transverse to the spinal axis of the mother, with the fetal head resting in the region of one of the maternal ilia—right or left cephalo-ilial position. In typical cases, all the feet appear at or near the vulva, as illustrated by Fig. 95 on page 285, but no essential progress is made, although the animal may make violent expulsive efforts while laymen and empirics attempt to aid by force. Usually wry-neck is present. If the wry-neck is to the right, the fetus usually lies upon its right side; if to the left, upon its left side, so that the head is generally entirely out of reach. In many respects, this is fortunate. Upon inserting the hand, the obstetrist usually meets with, and can identify, all four of the limbs. In so ne cases it may be exceedingly difficult for him to differentiate between the different members, so badly are they entangled with each other, and so tightly impacted in the pelvic canal.

The dystokia is quite favorable for the mare, because the owner or empiric is usually balked at once in any effort to meddle with the case, and must consequently await the arrival of the veterinarian. Even more or less violent traction upon the fetus, as a general rule, produces little harm, because its position is such that any moderate force applied to the feet can not wedge the fetal body in the pelvic inlet or force any hard, projecting portion of the fetus against the soft parts of the mother.

Handling. *a.* **Version** without embryotomy has been advised by some writers, but of this I can not approve. If it is decided to perform version, the two posterior limbs are to be corded at the pastern, and the two anterior limbs pushed forward as far as the operator can reach, while an assistant advances the posterior limbs by exerting traction upon the cords. The operator thus converts a transverse into a posterior presentation, after which the delivery is completed as such.

b. **Embryotomy.** I regard embryotomy, followed by version, as immeasurably simpler and safer than primary version, without generally involving any great amount of labor upon the part of the obstetrist. Embryotomy in these cases consists of the subcutaneous removal of the two anterior limbs, as described on page 395, followed by version of the fetal remnant, which is to be brought about by repelling the chest and applying traction to the two posterior limbs, in order to convert the transverse into a posterior presentation. It is not always practicable to remove both anterior limbs subcutaneously. Usually the uppermost fore leg is quite available, but it may be difficult or impossible to reach the scapula of the under leg. It may then be necessary to amputate at the humero-radial articulation. Some inexperienced operators have imprudently amputated at the carpus. This is a very grave error. The metacarpus and phalanges fold freely against the radius, so that amputation at the carpus does not shorten the obstetric length of the member and leaves, instead of the large rounded surface of the flexed carpus, well padded with skin and tendons, the small, naked, sharp end of the radius, ready to penetrate the uterine walls at any moment. This amputation is always to be condemned as useless and highly dangerous.

Version may be greatly facilitated, if deemed desirable, by eviscerating through the chest at the point where the upper leg has been subcutaneously removed. The operation is described on page 408. Evisceration is generally superfluous, especially in a fetus only recently dead.

The ventral transverse presentation is subject to a variety of complications, which may tax the skill and endurance of the operator. In the typical case, it requires only one to one and one-half hours to perform embryotomy and deliver the fetus as outlined. An expert operator may even accomplish the task in less time. When certain complications are present, it may require very much longer.

In one of my cases all four feet had already passed through the vulva, and the four large, bony limbs were tightly impacted in the pelvic canal, completely filling it, so that it was only with difficulty that the arm could be inserted alongside or between them. I could reach neither of the shoulders to amputate subcutaneously, but was forced to amputate one at the elbow joint, and the other with difficulty at the scapulo-humeral articulation. However, these amputations served my purpose, and permitted delivery after some five or six hours of fatiguing labor. The case was further complicated by the viciousness of the mare, which persistently fought by kicking, striking, or biting at anyone within her reach, so that it became necessary to cast her and securely tie all four feet. The recumbency, with the cramped position of all four feet, induced extraordinary pressure upon the abdomen and greatly restricted the room for the work. Nevertheless she made a good recovery. The work would have been rendered very much easier, had I at once resorted to chloroform anaesthesia. Chloroform anaesthesia in this case would not only have stopped the vicious resistance of the patient, but would have freely permitted the extension of the mare's limbs, obviating the pressure upon the abdomen due to tying all feet together. In communities where veterinarians are numerous, the attendant should call a colleague in such cases to administer chloroform and extend other desired assistance.

In another instance the two anterior limbs were well advanced in the pelvis, with the feet protruding beyond the vulva, and the two hind feet were jammed across the pelvic inlet. The upper hind foot crossed above the upper fore foot in front of the pelvic inlet, the toe was firmly caught in front of the shaft of the maternal ilium, and the hock lay immovably fixed against the illiac shaft on the other side. The lower hind foot passed between the two anterior limbs, and was otherwise engaged in the same way as the upper hind foot. It was impossible to repel the fetus, and equally impossible to reach the uppermost shoulder to amputate the anterior limb, because of its being crossed by the metatarsus. With the chisel I amputated the upper hind foot through the lower part of the tarsus in the manner described on page 401, removed the foot, and secured the stump above the os calcis with a cord. The upper fore leg was then removed subcutaneously. Next the lower hind foot was amputated at the tarsus, in the same manner as the first one, and the stump was secured with a cord. Finally the lower anterior limb was amputated subcutaneously, after which the chest was repelled, while traction was applied to the stumps of the amputated hind limbs, and the remnant of the fetus was converted into a posterior presentation.

In performing direct version, the torso is brought into the dorso-ilial position. In practice however, the version is spiral or combined with rotation, so that when the version is completed the torso usually assumes almost typical dorso-sacral position and is ready at once for extraction.

3. Compound, or Rotated Bi-Cornual Pregnancy

Definite attention was first drawn to this anomaly by me in 1889.[1] Later Tapken[2] described the same condition as a displacement of the uterus.

All available evidence indicates that the condition is purely secondary. The basic deviation from the normal undoubtedly consists of the bi-cornual development fetus described in the preceding section, resulting in a transverse ventral presentation,

[1] "Transverse Development of the Fetus in the Uterus of the Mare," Am. Vet. Rev., Vol. 13, p. 298.

[2] Monatshefte für praktische Tierheilkunde, Vol. 18, p. 148; and Veterinary Journal, Vol. XLIII, p. 148.

approximately as schematically outlined in Fig. 130. Later the uterine horns, with the contained fetus, revolve upon their long axes about 180 degrees, so that the fetus comes to rest in the dorsal instead of the ventral presentation. The equine uterine cornua leave the uterus at right angles or slightly recurved, causing the fetus, when bi-cornual, to develop with its ventral surface facing the cervix, in which position the ventral curvature may best be maintained. Perhaps another element influences the position of the fetus. The vascular supply of the uterus enters through the broad ligament, which is attached to the concave border. The placental structures are more highly developed along the line of entrance of the uterine blood vessels. The umbilic cord passes from the ventral surface of the fetus to the most elaborately developed placental area, and tends to maintain the fetus with its concave or ventral surface in contiguity with the concave vascular line of attachment of the broad ligament of the uterus.

Since the embryo commences to form in the uterine cornua, with its ventral surface directed toward the cervix, and the fetus curves ventrally, it would naturally follow that, as it attains weight, the body would tend to drop downward, while its two extremities would point upward and backward toward the maternal ilia. Later the fetus would tend to descend until the convex dorsal surface would come in contact with the abdominal floor and thereby assume an unstable position. The anatomical relations prevent the uterus and fetus from revolving upon their long axes in the direction of the pelvis. The cornua, with their contained fetus, may acquire stability, once they have begun to revolve, only by the extremities passing forward and downward to come to rest upon the abdominal floor. In accomplishing this movement, the fetus revolves upon its long axis. Its dorsal surface turns downward beneath the vagina and thence backward toward the birth canal, pushing the uterine floor backward beneath the vagina. The fetus must necessarily drop well forward and remain wholly in front of the pubis, thus stretching and elongating the vagina to a remarkable degree. In Figs. 130 and 131, it has been attempted to illustrate schematically this change in the position of the fetus.

Symptoms. The condition naturally passes unobserved until an examination is made in order to determine the cause of the resulting dystokia. The symptoms are then unique and diagnostic. Before the obstetrist is called, the cervical canal usually dilates and portions of the fetal membranes lie in the vagina or protrude from the vulva. The labor pains are weak. The contraction of the walls of one horn pushes the fetus, not towards the cervix, but towards the opposite horn. If the two horns contract simultaneously, they merely counterbalance each other. The fact that no portion of the fetus, or at least no considerable portion of it, can usually be forced into the vagina tends to inhibit any well marked expulsive efforts. Such would necessarily prove futile, and dangerous to the integrity of the uterus.

When the obstetrist inserts his hand, he is first struck by the extremely elongated and narrowed vaginal passage, which is nearly twice its ordinary length, although very much decreased in its transverse diameter. No cervix is distinguishable. If the obstetrist follows the roof of the vagina, the hand glides along it almost as far as the arm can reach ; perhaps he can not reach the anterior end of the roof, where it finally turns down in a gradual curve, without any recognizable line of demarcation between the vagina, cervix, and uterus. If he follows the floor of the vagina and palpates carefully as his hand advances, he will discover to his astonishment a hard body lying beneath, which upon careful manipulation he may recognize as the fetus, lying directly against the vaginal floor, impressing him very strongly at first with the idea of extra-uterine pregnancy. If he follows the floor of the birth canal further, to the extent of nearly the entire length of his arm, his hand suddenly passes downward into the uterine cavity, and he finds that the floor which he has been following bends abruptly backward to constitute the roof of the uterus, immediately beneath which the fetus lies transversely with its dorsal surface presenting toward the pelvic inlet.

In some cases the obstetrist may find one or more feet projecting from the uterus into the vagina, which may readily be reached and grasped. In a large proportion of cases, however, no portion of the fetus projects into the vagina, and before the operator can bring his hand into immediate contact with any portion of the fetus he must reach far forward and, bending the hand downward and backward, touch the ventral portion of the fetus or some of the extremities which are folded along it. In order to accomplish this, he reaches clear over the body of the fetus, passes beyond its ventral line, and then, after passing the point of version where the floor of the vagina ends, turns the hand downward, and more or less backward, into the uterine cavity. These peculiarities serve to differentiate this condition from any other known in veterinary obstetrics.

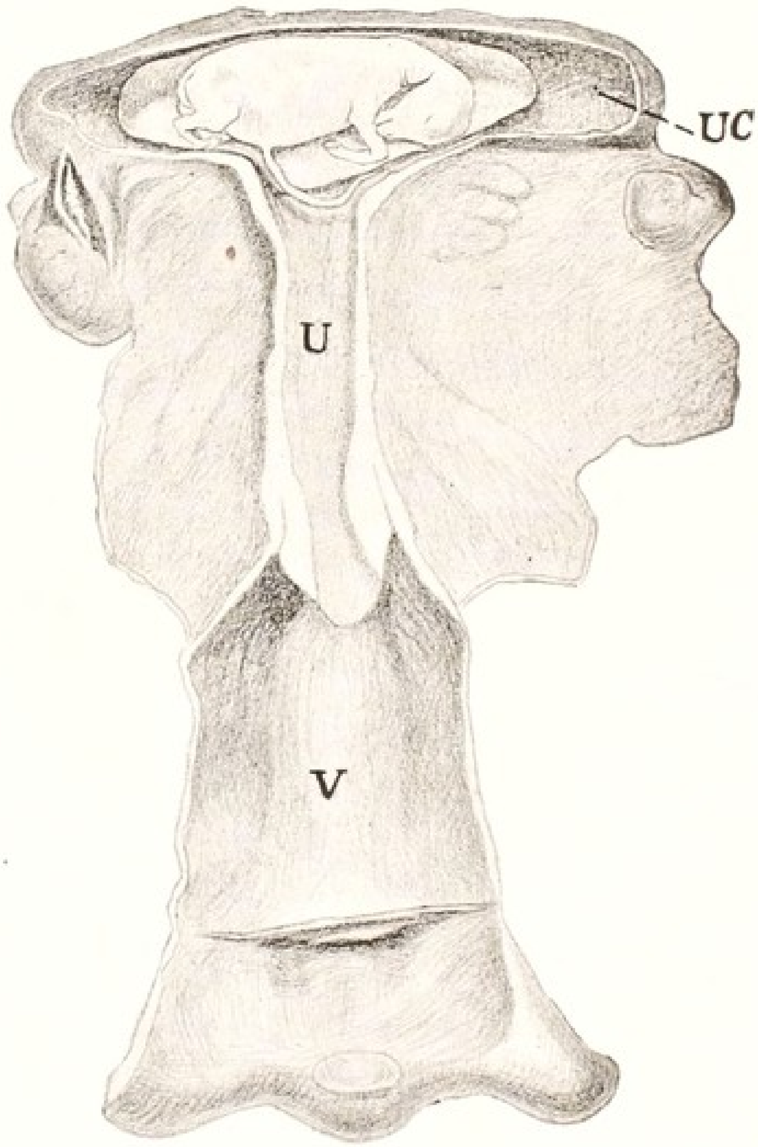


FIG. 130. COMPOUND, OR ROTATED BI-CORNUAL PREGNANCY.

V, vagina. U, uterine cavity, which is later to blend with the vagina to constitute an elongated tube. UC, uterine cornu.

Prognosis. The prognosis is extremely unfavorable. I have neither succeeded in any case nor seen recorded any case in which the life of either mother or fetus has been saved. Tapken says, " Delivery is always difficult. If no part of the fetus can be reached, delivery is evidently impossible. In each of the four cases which I append, the result was fatal for both mother and foal, and also in another case, which, owing to oversight, was not included in the foregoing table. In the latter case of dystokia, two experienced colleagues had, before I had been called, tried in vain to deliver the mare. It was barely possible to touch the metacarpus of one leg with the finger tips, when the arm had been introduced completely to the shoulder." The case of Pauli also ended fatally for both mare and foal, despite the efforts of three veterinarians.

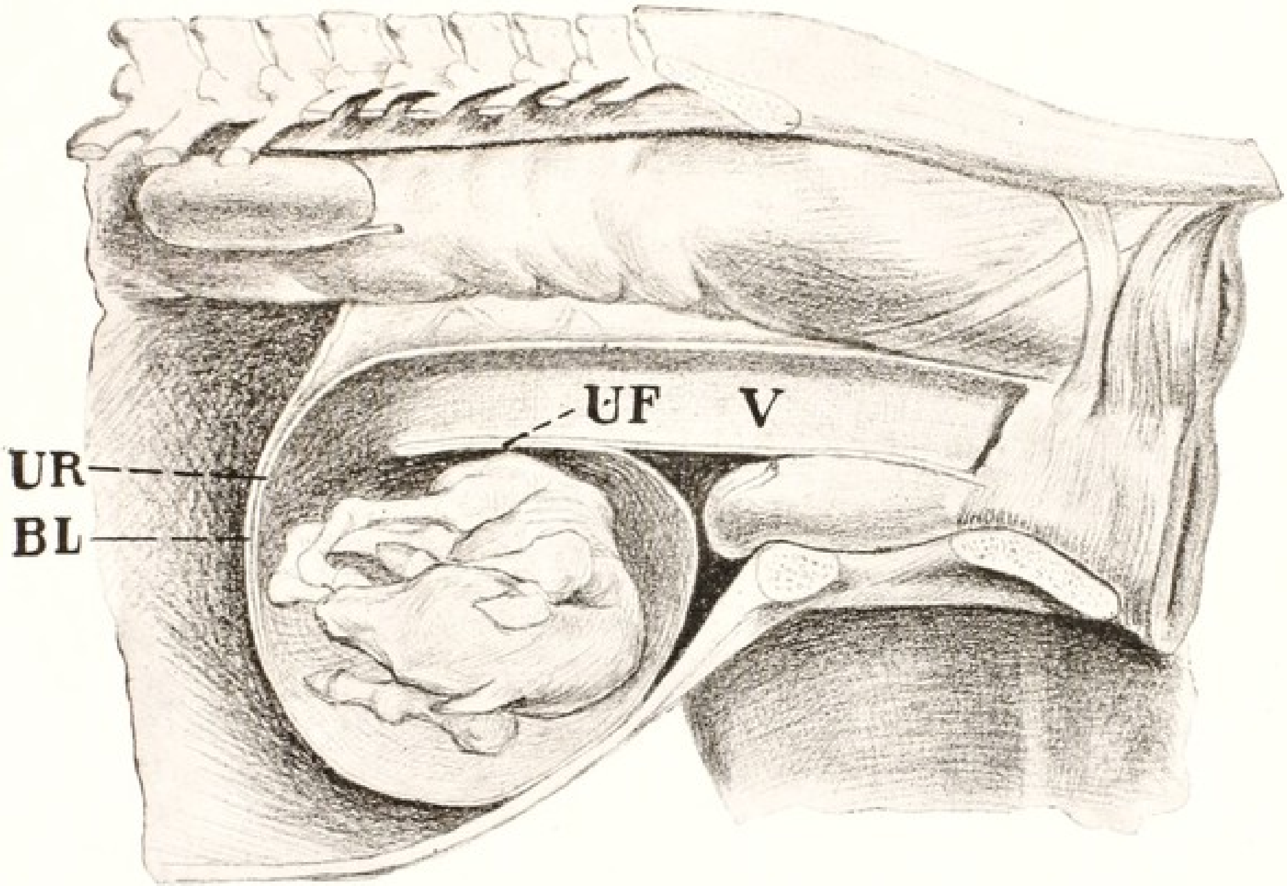


FIG. 131. COMPOUND, OR ROTATED BI-CORNUAL PREGNANCY. Second stage, the fetus having made one-half revolution on its long axis. (Schematic.)

V, elongated vagina and uterine body. UF, floor of uterine cornua, now become the roof. UR, roof of uterine cornua, now become the anterior wall. BL, broad ligament.

I have been equally unsuccessful, and have encountered great and even insurmountable difficulties in delivery. In one case the mare survived the operation some days, but finally succumbed to metritis. In that one it would seem possible that, had I understood the conditions better and given closer attention afterward, she might have been saved. I would not advise the veterinary obstetrist to refrain from attempting to deliver a mare in this condition. However, in undertaking delivery, it would be well to advise the owner of the highly unfavorable prognosis of the case, so that he may be forewarned of the probable outcome. Forensically, professionally, and in the economic interests of the owner, the attending veterinarian should request consultation. A competent and courteous colleague can render very great assistance; a discourteous, fault-finding competitor has his tongue bridled. A Canadian colleague, after losing both mare and foal, sued for his fee, and the owner counter-sued for malpractice. A competitor, who had not seen the case, testified glibly that the operation, which he did not see, was unprofessional, and that the mare could and should have been saved. My colleague won his case, but had his carping competitor been called in consultation there would have been no litigation.

Method of Handling. In detail, each case must be dealt with according to circumstances. In general, it is well to secure any of the extremities which may lie within reach and cord them, so that force may be exerted upon them at any time that it may become desirable. If all four feet can be reached, it is usually advisable to amputate the two anterior limbs, either subcutaneously or at the humero-radial articulation, and then attempt to convert the presentation into a posterior one by drawing carefully upon the hind legs.

The position of the animal is important. Fig. 131 suggests that, if the mare is turned upon her back, the rotation of the uterus will tend to disappear and the fetus will be brought nearer to the operator, so that parts which previously had not been in reach may be grasped. Placing the mare upon her back also relaxes the projecting floor of the vagina, and, by tending to overcome the uterine rotation, renders traction upon the fetus less dangerous to the floor of the vagina and the roof (originally the floor) of the uterus.

Various positions of the mare may be tried in an effort to overcome the difficulty. It must be remembered that it is exceedingly exhausting to the mare to remain for a long time upon her back, and this position should not be continued beyond the absolute necessities of the case. If the work can be done nearly as well with her standing, this position should be preferred until the critical time arrives for extracting the fetus by force, when it would generally be best to turn the mare upon her back for this brief period, thereby relieving the vaginal floor and uterine roof.

The position of the fetus and its relation to the uterus render most forms of embryotomy exceedingly difficult or impossible. I have been able to amputate only the anterior limbs. If evisceration could be accomplished, it would be a very great help by decreasing the size of the fetal body, and still more by rendering it flaccid so that it could be more readily adjusted and extracted.

After the extraction of the fetus, if the obstetrist has been so fortunate as to accomplish this without fatally injuring the uterus, unusual care should be taken to guard against sepsis. Fig. 131 shows that the form of the uterine cavity is extremely unfavorable for adequate drainage, and suggests that this be overcome as far as possible by careful and repeated irrigation of the uterus and siphoning out of the contents.

In view of the fact that no one, so far as recorded, has been able in any case to save the life of either mare or foal, it would seem that the veterinary obstetrist is fully warranted in resorting early to gastro-hysterotomy in a way possibly to save the life of his patient. I believe that it offers the greatest hope for success in these cases. Evidently there is nothing to lose. In one of my cases, as in one of those recorded by Tapken, delivery through the birth canal was wholly impossible. Under such conditions, clearly the only plan remaining is hysterotomy.

Presumably there is never an opportunity to save the life of the foal; it is ordinarily dead before the obstetrist is called. The technic of hysterotomy has been outlined on page 411.

The following cases illustrate the variations and difficulties to be overcome, and suggest, more forcibly than anything else well can, the seriousness of the anomaly. Cases 1 to 3 are quoted from the contribution by Tapken; cases 4 to 6 are from my personal experience.

1. An old mare, which had already foaled regularly a number of times, showed symptoms of colic, after the normal duration of pregnancy. Later, mild labor pains appeared and some of the fetal waters were expelled. Upon examination, twelve hours later, the mare was comfortable, ate some, no labor pains recognizable. At times there was a discharge of fetal fluids. The cervix uteri was dilated. Portions of the ruptured chorion extended into the vagina. The uterine walls were stretched and thrown into

folds similar to torsion of the uterus, but nearer to the body of the uterus. The fetus could barely be reached with the finger tips, after the arm had been introduced up to the shoulder. During the exploration there were only feeble labor pains.

An attempt to modify the position of the uterus, by rolling the mare, failed. While in the recumbent position, however, strong labor pains appeared. As a consequence of these violent pains, the tightly stretched uterine wall was pressed into the pelvis to such an extent as to threaten rupture. The neck of the bladder was also dilated to such a degree that four fingers could be introduced into it. During the violent pains, the urinary bladder was from time to time forced out into the vulva, where it was visible as a whitish mass about the size of a man's fist.

A second veterinarian was called in consultation. At 4 P.M. the further handling of the case was undertaken by Tapken, in company with his colleague K. After a prolonged effort, the lower end of the tibia was grasped, and a cord attached above the hock.

By means of a vigorous pull by four persons, the tarsus was brought to the pelvic inlet, and the tendo-Achilles divided, partly with a knife and partly with shears. Both arms were inserted in the genital canal, and finally the leg was drawn out so far that it could be amputated at the hock. The second leg could not be grasped. Traction was applied by six men to the stump of the amputated leg, the skin and muscles torn asunder without any incisions having been made, and the leg torn away at the hip joint and drawn out. The other tarsus could then be grasped, and was handled in the same way. Upon the application of powerful traction by six persons, the fetus was extracted. It was large, but normally formed.

In the uterus, near the neck, there was a perforation. The mare died a few hours later.

2. An eight-year-old mare, which had repeatedly foaled in a normal manner, showed, after eleven months pregnancy, weak labor pains and unrest for a period of two and one-half hours. An examination revealed one fore leg, presenting in the normal position and direction, in the pelvis. Beneath the advanced limb, the uterus and vagina formed a projection, under which one could distinguish parts of the fetus, especially the head. During the labor pains, these parts were forced time and again to the middle of the pelvic cavity. Beneath the presented fore leg one could feel, through the uterine wall, other parts of the foal, which later were found to be the second anterior limb flexed at the carpus.

After mounting a stool, so that the arm could be inserted as far as possible, Tapken succeeded in reaching the point of flexure of the uterus. It was impossible to grasp any other part of the fetus. The anterior limb was corded and drawn out by three persons, until the forearm was visible. The other anterior limb was then released from the folds in the uterus and brought into the genital canal, but it could not be extended. In order to secure room, the extended limb was detached. The division of the skin was incomplete, and could be extended only to the elbow joint. As a result of this, the combined power of six or seven persons was required to draw the limb away.

The head, which was clearly recognizable at the beginning of the operation, became displaced in such a way that it could no longer be reached. Consequently there remained no recourse but a forcible extraction of the fetus, which was accomplished by the traction of six or seven persons.

The mare lay exhausted and listless. After half an hour the pulse was 60, strong and regular, indicating that no great amount of internal hemorrhage was occurring. A small amount of blood flowed from the vulva. By a manual exploration of the uterus, no labor pains were induced. After three and one-half hours the mare arose, staggering somewhat at first, but soon partook of food. In the following days the appetite was fairly good, then failed.

Four days later the mare was again examined. The pulse was 70, the appetite poor, and now and then there were expulsive efforts. Upon examination of the parts, there was found a great gaping rent in the superior wall of the uterus, so that it was easy to introduce the hand directly into the peritoneal cavity. The animal died on the sixth day. The autopsy revealed a rent in the uterus about 25 cm. long, and diffuse peritonitis.

3. A young mare, at full term, had shown labor pains for several hours. Fetal waters had appeared. Upon inserting the hand as far as possible, only fetal membranes and the uterine wall could be felt. Through these walls, however, in the reflexed uterus, parts of the fetus could be recognized. An empiric, with the consent of the owner, had made an examination and had torn through the wall of the uterus, which he had mistaken for the fetal membranes. The mare was destroyed.

4. In 1887 the writer was called to attend an imported Percheron mare, because the keeper believed her to be in labor, although in some way the symptoms appeared to him unusual.

Upon examination no expulsive efforts could be observed, and when manual exploration of the vagina was made there was marked narrowness of the passage at the usual location of the os uteri, which was mistaken for it. Lying beneath the vagina, a fetus was felt, apparently with all its membranes intact. Non-interference, with close watching, was advised.

The mare continued fairly well and quiet for about 48 hours, when I was recalled and, upon making a second examination, found the fetal membranes protruding from the vulva. Upon careful examination it was found that the part, which was previously supposed to be the os uteri, was merely the narrow vagina, beneath which the fetus lay. The presence of the membranes permitted one to follow them along their course until the opening into the uterus was reached, when it was found that nothing resembling the normal os uteri was present. The vagina was extremely long and narrow. Far forward, barely within reach, the canal opened abruptly downwards and backwards into the uterus. Posterior to this opening, and beneath the vagina, lay the body of the foal, in a transverse position, readily felt through the vaginal and uterine walls. Though beyond reach through the genital canal so long as the mare was standing, when she was recumbent the hind limbs could with difficulty be reached.

After patient and exhausting work, the hind legs were secured at the tarsus by means of cords, but it was impossible to bring them into the passage until the feet were amputated through the lower tarsal articulation. I had then the two hocks presenting with the ossa calces directed upwards, while beneath the vagina could still be felt the main volume of the fetus. Firm traction applied to the hind limbs finally brought the fetus into a posterior presentation, and accomplished its extraction after about five hours of very trying labor.

Examination immediately after delivery revealed an enormous rupture of the uterus and inferior wall of the vagina. The animal was destroyed, but no autopsy made.

5. A large French draft mare in excellent condition, which had previously bred successfully. The fetal membranes were found protruding, but no well-marked labor pains. Exploration revealed an exceedingly long, narrow vagina, which, at its anterior extremity, barely within reach, opened abruptly downwards and backwards. The usual conformation of the os uteri was wanting. While the mare was standing, no portion of the fetus could be touched by passing the hand into the uterus. There seemed to be a great cavity posteriorly. By following the superior wall of the vagina up to the uterus, I found it bent abruptly downward to become the anterior wall, which could be followed as far as the hand could reach without coming in contact with any portion of the foal. Posterior to this opening, beneath the floor of the vagina, the fetus could be plainly felt. By passing the hand through the uterine opening, drawing its posterior margin firmly backwards, and then reaching downward and backward as far as possible, a portion of the fetus could be barely touched, but not grasped.

After casting the mare and placing her upon her back, one hock was secured, corded, and with great difficulty brought into the passage. Then one anterior limb was secured and amputated. Later the other hind leg was secured, and with strong traction the fetus was brought away after eight hours of exhausting labor. The mare succumbed twenty-four hours later, and no autopsy was made.

6. I was called in consultation in a case of dystokia in a large draft mare which had previously foaled several times without difficulty. The vagina was abnormally elongated and narrow, and its anterior end opened abruptly downward and backward without resemblance to the usual os uteri. The fetus could be felt plainly through the floor of the vagina, posterior to the opening into the uterus. It lay with its back against the pubis of the mare. By passing the hand through the opening into the uterus, and then downwards and backwards, the elbow of one fore leg could be touched with difficulty. After long and arduous labor, this one limb was secured and brought into the passage, but we were wholly unable to secure any other limbs or parts of the foal, either by raising the abdomen with a sling or by casting the mare and turning her upon her back. Though my colleague was an experienced obstetrist and a large and powerful man with very long arms, it was impossible for either of us to secure other parts of the fetus. The one limb which we had succeeded in cording was in such a position, in relation to the uterus and vagina, that traction could not be applied with

any safety or efficiency. After a long and fruitless effort, the mare was destroyed, and a post-mortem examination made immediately.

The foal, very large and well matured in every respect, was lying upon its right side with its dorsum against the pubis of the mare. The head was located in the right uterine cornu; the hind legs and buttocks in the left. The body lay in a thoroughly transverse position across the abdominal cavity, beneath and posterior to the opening between the vagina and uterus. One fore leg was flexed at the carpus, and the other, which we had secured, was drawn backward over the neck of the fetus, into the vagina. The two cornua were developed equally, and their long axes were perpendicular to that of the mare. The vagina, because of the transverse position of the fetus and the peculiar rotation of the uterus, was much elongated and narrow. The opening from the vagina into the uterus was abruptly downwards. The line of demarcation between the superior vaginal and uterine walls had become wholly effaced. Far forward, the undifferentiated superior wall of the birth canal suddenly turned downwards, to become the anterior uterine wall. Thus that portion of the uterus which had originally constituted the roof, or superior wall, had now become its anterior wall. The inferior wall of the vagina, or floor, terminated anteriorly abruptly, in a thin margin; what had been the *floor* of the uterus was turned abruptly backwards and upwards against the vagina, thus becoming the *superior* uterine wall.

C. ABNORMAL POSITIONS AND DEVIATIONS OF THE NORMAL FETUS IN NORMAL PRESENTATION

I. Dorso-Ilial and Dorso-Pubic Positions

In the larger domestic animals, where the fetus normally lies *en arc*, the ventral surface concave and the dorsal convex, it is essential to the easiest delivery that the fetus should be in the dorso-sacral position. The body does not readily bend dorsalwards. Since the ventral wall of the fetus is comparatively short and inextensible and the body cavity is distended by the viscera, the rigidity of the fetal body is maintained. A further obstruction to its passage, in other position than the dorso-sacral, is that the greater diameter of its body does not correspond with the greater diameter of the pelvic canal. It is possible in some cases to bring about the extraction of a fetus in the dorso-ilial or dorso-pubic position, but this is chiefly in those cases where the fetus is comparatively small as related to the genital passages of the mother. When the fetus is so small that it can be brought out in this unfavorable position, its diminutive size permits the easy correction of the position. The dorso-ilial and dorso-pubic positions are virtually confined to the mare and the cow. The fetus in such position is usually dead. The position is encountered most frequently in the posterior presentation.

The indications are to rotate the fetus upon its long axis and convert the dorso-ilial, or dorso-pubic, into the dorso-sacral position. Under special conditions, it may be advisable or practicable to resort to forced extraction. The technic of rotation has been fully described on page 375, and forced extraction on page 381. If each of these fails it may be necessary to resort to embryotomy, consisting, when in the anterior presentation, of the subcutaneous amputation of one anterior limb (page 395) and evisceration (page 408) followed by rotation.

II. ANTERIOR PRESENTATIONS

a. Deviations of the Head and Neck

In domestic animals, the tendency for the head to become more or less deviated at the time of birth varies greatly because of the differences in the length of the neck as compared to its transverse diameter. In the pig, where the diameter of the neck is greater than its length, it is very difficult for the head to become deviated, in marked contrast to the foal, with the very long and slender neck, in which these deviations are among the commonest and most serious forms of dystokia. Not only is the head of the foal very liable to deviation at the time of birth, but frequently the head and neck have become bent laterally at a very early date in gestation and have remained so throughout the development of the fetus, constituting a serious deformity—wry-neck.

1. Lateral Deviation of the Head

The commonest form of deviation of the head is the lateral, as it is in this direction that the neck is most flexible and the head most readily displaced. The deviation may occur with equal facility to the right or the left.

The causes of lateral deviation of the head are two. In the foal the deviation frequently occurs during an early period of gestation, to constitute wry-neck, so that when the end of gestation arrives the head and neck have already been doubled back along the side of the foal for weeks or months, the parts have become thoroughly adapted to this position, and the head lies in the flank of the foal, where it is molded to the convex surface of its body. That side of the head in contact with the body of the foal is concave ; the opposite side convex. When a foal in anterior presentation is affected with wry-neck, the deformity is probably generally, if not always, a result of bi-cornual development which has not been so complete as to prevent the cephalic end from gliding out of its cornu and entering the birth canal. This is more fully discussed when considering bi-cornual pregnancy, on page 494.

The second, and save in the foal perhaps the only cause of deviation, and the one which is most subject to remedy by mutation, is an accidental misdirection of the head at the time of parturition. As the fetus, in an anterior presentation, is being forced along the genital canal, the nose or other portion of the head becomes somewhat deflected to the right or the left, and, becoming impacted against some projecting portion of the pelvis or genital canal or entangled in some way in the fetal membranes, is drawn to one side, and becomes caught between the side of the fetal body and the wall of the uterus or vagina. When this occurs it is highly improbable that delivery can proceed spontaneously. Instead, the head tends to become farther and farther

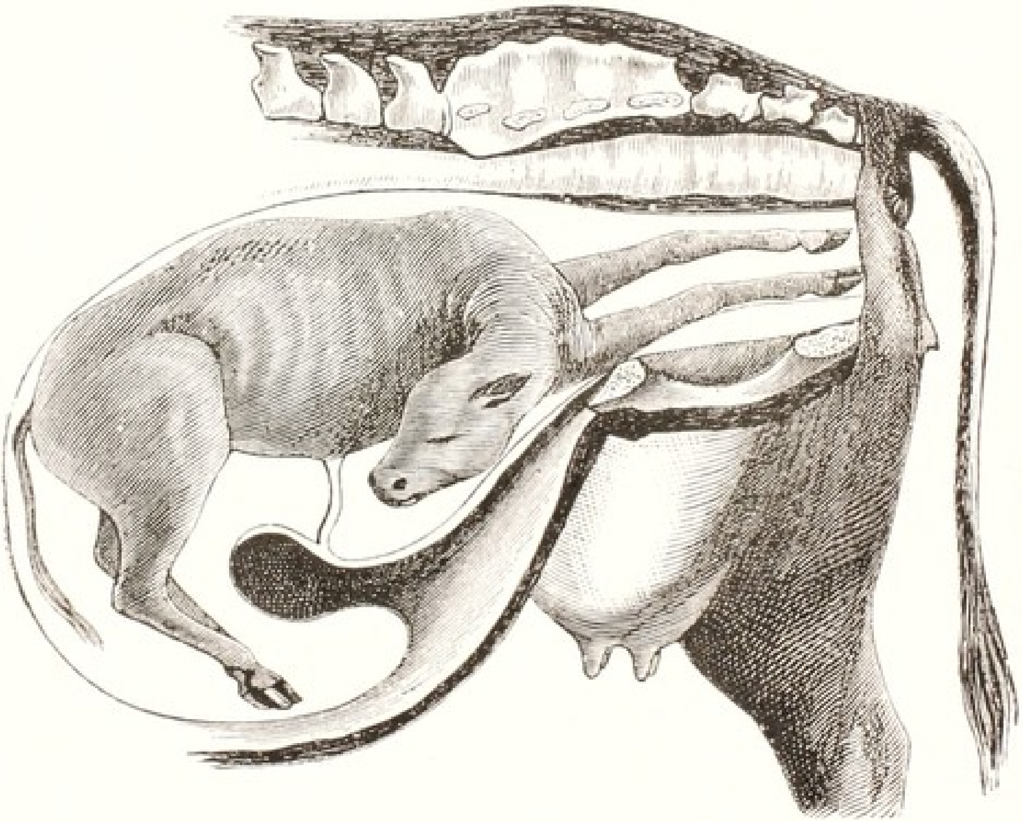


FIG. 132. LATERAL DEVIATION OF THE HEAD. (ST. CYR.)

deviated as the body of the fetus advances. Finally the neck is doubled directly backward as far as possible and the head lies in the flank.

The diagnosis usually offers little difficulty. Generally it needs to be differentiated from only the two succeeding forms of deviation—the downward and upward displacements of the head. The operator must identify the two anterior limbs, one or both of which are ordinarily in the birth canal. Next it must be determined whether the head is deviated upward or downward, or, if laterally, whether it be to the right or to the left. The determination of the direction is not always easy. If the head can be reached, that decides the question. When the head can not be reached with the hand, the diagnosis becomes more difficult. As a general rule it is only in the foal that the head can not be reached and examined with the hand, and here one is aided by the presence of the somewhat prominent mane. If the head is bent laterally and the operator passes his hand as far as possible along the presenting portion of the fetus, he will usually be able to identify the withers. From this point, turning either to the left or to the right and then backwards, he may trace the top of the neck by the mane. At the lower margin of the neck, the operator will usually be able to identify the trachea. In one direction he can trace this to its point of disappearance within the fetal chest between the two anterior limbs, and in the other may follow it across the right or left anterior limb, where it later turns backward toward the patient's head.

In the upward and downward deviations of the head, the relations of the trachea and the superior border of the neck or mane are wholly different. In the upward deviation, the top of the neck or the mane is out of reach, whereas the lower margin of the neck or the trachea is quite fully exposed, curving upward and thence backward above the withers, to disappear. When the deviation is downward, the trachea cannot be discovered, but the superior portion of the neck or the mane disappears downward, usually between the two anterior limbs.

The indications in lateral deviations of the head will vary greatly according to species and individual cases.

1. **Mutation.** In those cases where the deviation is recent, where wry-neck is not present, where the fetus is not emphysematous, or there are no other insurmountable obstacles to the correction of the deviation, this is the conservative and proper course. The cow or mare should be operated upon in the standing position, with the hind parts elevated, or, if recumbent, should be placed in lateral recumbency on the side opposite to that to which the fetal head is bent—that is, with the fetal head *above*, not underneath the fetal body. The mother should be secured with her hind quarters elevated.

The operation consists first of repulsion (page 373) which is to be applied to the chest of the fetus, directed obliquely backward and away from the misdirected head. If the head is deviated to the right side of the mother, the repulsion should be obliquely toward her left side, so as to tend to release the head and cause it to advance toward the pelvic inlet. During the operation of repulsion, the operator must keep constantly in mind the great fundamental value of keeping the posterior part of the body of the mother decidedly elevated, whether she be standing or recumbent. The means for bringing this about have been discussed on page 355. While attempting repulsion, severe expulsive efforts need be controlled by some of the means advised on page 359.

After repulsion has been accomplished, the operator should secure and extend the head of the fetus by those means most available in the particular case, under the rules laid down on page 377. In many instances it is merely necessary to grasp some portion of the head with the hand or fingers, and give it a sharp pull, by which it is brought into its normal position. When the nose is pointing backward—that is, toward the anterior part of the mother—the nostrils and commissure of the lips offer a secure hold for the fingers of the operator or for the insertion of a blunt hook. This may prove of value until the head has turned somewhat.

In the correction of this deviation, it will often prove highly advantageous to place a repeller securely against the chest of the fetus and have an assistant maintain constant repulsion, thus keeping the body pushed away from the pelvic inlet in a manner to insure to the operator the greatest amount of room for manipulating the head.

The bitch, cat, or ewe may be more or less suspended by the hind legs, the vagina filled with a warm, unctuous fluid, and the fetus repelled, partly by gravity, partly by the pressure of the fluids, aided by shaking the animal, by pushing upon the fetal limbs, or by means of a finger tip placed against the chest. When repulsion has been accomplished, the operator may locate the fetal head through the abdominal wall, and by external manipulations push it upward (the patient being suspended by the hind feet) toward the vulva, while a finger or fingers inserted in the vulva aid in adjusting the head in proper position. Traction may then be applied.

2. **Forced extraction** has been advised in the mare by some veterinary obstetrists, with the idea that by this means it is possible to save a foal. I have been unable to find a record of so fortunate an occurrence. Only rarely has the mare survived. The plan of forced extraction in this deviation has already been described, and unsparingly condemned, on page 381.

A mare was entered in our clinic from which a fetus in this position had been extracted by force. Her perineum was completely ruptured, the afterbirth was retained, she was very weak and exhausted, and presented a repulsive and pitiable sight. The afterbirth was removed, and the ruptured perineum was disinfected. In a few days she succumbed. Upon post-mortem examination there was found a small perforation upon the floor of the cervix, which had caused a septic peritonitis. Forced extraction in the mare or the cow is unnecessary, unsurgical, and brutal.

3. **Embryotomy** constitutes the one practical method for overcoming dystokia due to the lateral deviation of the head in the mare and cow, if the displacement cannot be readily corrected. Nowhere in obstetrics has embryotomy a more favorable application than in this deviation, especially in those cases of foals where wry-neck is present, which renders it extremely difficult, if not impossible, to bring about a correction of the vicious position. In all those cases where the fetus is dead and the head is deviated laterally to so great an extent that it can not be readily adjusted, or even if the fetus is alive and of comparatively little value, or if it is evident that its life can not be saved, embryotomy should be proceeded with at once.

While the veterinarian should not undertake embryotomy when the deviation can readily be corrected, he should be equally careful not to exhaust the strength of his patient and subject her to all the dangers of prolonged manipulation in a useless and ill-considered effort at mutation. Neither should he exhaust his physical powers in a vain endeavor to bring about a correction of the deviation before he resorts to embryotomy. Embryotomy may be carried out by either of two plans. One may resort with convenience and confidence to the subcutaneous removal of one anterior limb, as described on page 395. The limb on the side opposite to which the head is bent, and which is thereby fully exposed, is the one to be selected for amputation. After the removal of the anterior limb, the chest should be opened at the exposed point and evisceration carried out, as described on page 408. When this has been accomplished, and the fetal ribs have been severed, the size of the presenting portion of the fetus is reduced to such a degree that it is now no greater with the head turned back than it would have been had it presented normally. It may then be drawn away with the head deviated, or still better, since the torso has now become very flaccid and much room is gained, it may be very readily repelled and the head brought into position, and the extraction finally takes place in a somewhat normal manner.

Some operators advise, instead of subcutaneous amputation of the limb, the amputation of the head and neck, which has been described on page 394. The amputation of the limb is easy, quick, and safe. Should the fetus be emphysematous, the amputation of the limb is infinitely better, because it opens the way for necessary further diminution by evisceration and other procedures. If the fetal body is normal, either operation is efficient.

4. **Hysterotomy or hysterectomy** is not called for in the larger domestic animals, nor usually in the sheep and goat. In the smaller animals, where the correction of the deviation fails and embryotomy is not available because of the small size of the birth canal, one of these operations, as described on pages 411 and 422, is the only recourse, and offers a fair prognosis if undertaken at the proper time and under proper conditions.

2. Downward Deviation of the Head Between the Anterior Limbs

The lateral deviation of the head described in the preceding section may not be direct, but may be obliquely upward or downward. Such deviations from the direct lateral line are not materially important, and offer nothing unusual for consideration. Occasionally the obstetrist encounters a downward deviation, in which the head passes downwards between the two anterior limbs.

It was stated, when considering the normal attitude of the fetus in the uterus, that it rests with its head and neck bent ventralwards, with its chin in close proximity to the sternum.

It is easy to understand that in some cases the head may remain in this position, and one or both anterior limbs become extended and enter the pelvic canal. The head drops down between the anterior limbs and is held tightly in that position after the limbs have entered the pelvis, because they are firmly pressed together over the back of the neck.

Variations occur in the degree of the deviation, as in other cases, but they largely arrange themselves into two groups. The first group includes those of a minor character, in which, when the fetus advances along the birth canal, its nose catches against the pubic brim. As the fetus is pushed along, there is a constant tendency for the nose to turn more and more downward and backward, while the head becomes sharply flexed upon the neck and the poll passes into the pelvis, to constitute what is sometimes known as the poll presentation. In such cases the head, or at least the poll, ordinarily remains above the anterior limbs. From this position it has been assumed by some that the deviation may become more and more accentuated until it reaches that degree where the head passes completely downward between the legs. A study of the circumstances under which the deviation occurs tends to throw serious doubt upon this view. When the limbs are advanced in the pelvic canal, they are necessarily confined quite closely to each other, and it is only during the early stages of advancement, before the feet have yet approached the vulva, that the muzzle of the foal or calf can well drop down between the two anterior feet and become jammed against the pubic brim. As the two limbs advance further and further, they become applied more and more closely to each other, so that it would be highly improbable for the head of the fetus to pass completely down between them. The two positions are not differences of degree, but are fundamentally different in origin. The one does not pass into the other by imperceptible gradations.

The diagnosis by manual exploration is comparatively easy. In the first instance the head is found lying upon the anterior limbs, with the poll directed more or less upward and toward the vulva, while the nose projects down between or alongside of the limbs and is caught against the pubic brim. In the second instance the head at first can not be felt, but the limbs seem to be pushed somewhat apart as they near the chest. Careful manipulation will reveal the fact that the top of the neck or the mane disappears almost straight downward from the top of the withers, finally recurving backward. By reaching around underneath the anterior limbs and fetal chest, some portion of the head will probably be reached and identified.

The handling of the downward deviation of the head offers some variations according to type.

1. **Mutation** is usually applicable in those cases where the nose is caught against the pubic brim. The correction of the deviation then constitutes the most rational and economic procedure. It is not difficult to repel the fetal poll and permit the muzzle to be lifted over the pubic brim. The operator should insert his hand between the pubic brim and the muzzle of the fetus, and, grasping the latter in the palm of his hand, lift and extend it in the pelvis.

When the head has passed completely down between the legs, correction of the deviation may prove highly difficult or impossible. It is essential, before the deviation can be corrected, to repel the fetus far enough that the carpal joints pass into the abdomen, permitting the limbs to part sufficiently to allow the head to pass up between them and resume its normal position. When this has been accomplished, the lower jaw may be corded, or secured with the hand or with a hook in the orbit, and lifted upwards between the legs.

In the smaller animals the correction of the displacement is to be undertaken in the manner already advised for the lateral deviation. As a rule, it will not succeed.

2. **Forced Extraction.** Tapken strongly advises forced extraction in those cases in the mare where the nose of the foal is caught against the pubic brim, if there is any hope that the fetus is alive. He believes that this greatly advances the interests of the foal without materially injuring those of the mother. However, it is very rare that the foal is alive when the veterinarian reaches the case, and there is rarely, if ever, any reason for precipitancy. Tapken does not state that he has thus saved the life of a foal, but merely thinks it possible to do so.

3. **Embryotomy.** Where the head is completely deviated downward, the two anterior limbs are closed over above it, and a reasonable effort demonstrates that the replacement of the head

is improbable, or will apparently prove very difficult, and the fetus is dead or comparatively valueless, one should proceed at once with embryotomy. It is best to remove one anterior limb subcutaneously, according to the technic described on page 395, by which process the incarcerated head is released and permitted to be brought into position, after which the extraction occurs in the ordinary way.

3. Upward Deviation of the Head

Upward deviation of the head, which is exceedingly rare in practice, is due to some accidental misdirection while the fetus is passing along the birth canal. In most animals—especially in the foal—a primary upward deviation is so unstable that the head is very liable to drop off to one side and, revolving somewhat upon its long axis, assume a more or less lateral displacement. Owing to the anatomical peculiarities of the head and neck, this displacement is perhaps most frequently observed in carnivora, where it may constitute a very serious obstruction to birth.

The diagnosis is not readily made in the smaller domestic animals. In the larger ones, where manipulation is practicable, the obstetrist finds upon the insertion of his hand that, though the position is dorso-sacral, the head is not readily grasped or touched, and that the trachea of the fetus, freely exposed and presenting toward the pelvic inlet, emerges from the chest and turns upward and then backward to disappear along the sacrum of the mother.

The indications are analogous to those already related under lateral deviation. Repulsion and the correction of the deviation by the methods already described should first be considered. Before exhausting the strength of the operator or of the patient, if the replacement is difficult or threatens to be futile, embryotomy is to be recommended, and should be carried out upon the same basis as in the lateral deviation.

In the small animals, mutation and embryotomy are not ordinarily available, and forced extraction is generally inadvisable except the fetus has entered the pelvis. In these, hysterotomy or hysterectomy, as described on pages 411 and 422, usually offers the best opportunity for both the mother and the fetus. Whichever operation is decided upon should be undertaken early, before the patient has become exhausted or the fetuses have perished and become emphysematous, and especially before the genital passages have been lacerated and infected in a vain effort to bring about extraction by other means.

b. Deviations of the Limbs in the Anterior Presentation

Deviations of the Anterior Limbs

The anterior extremities of the fetus are subject to greatly varying deviations. While these may sometimes be unimportant in the smaller species, they cause very serious dystokia in the larger animals. The long, rigid limbs make it essential that each extremity should be fully extended in its proper place to pass readily through the pelvic canal. Any deviation from this normal attitude is liable to result in more or less serious difficulty in the expulsion of the young animal.

1. Flexion of the Anterior Limbs at the Elbow

It is not very rare to meet with instances in the calf and foal in which the two anterior feet present in their normal position and appear at the vulva, accompanied generally by the nose, which is advanced to nearly the same degree as the feet themselves. At first glance the position seems to be essentially normal, but when the fetus has reached the point where the feet and nose are visible its advance becomes checked and the expulsive efforts of the mother are quite unavailing to cause any further progress.

The interpretation of this condition varies somewhat with different writers. Fleming says: "It is usually due to the shoulders not being closely applied to the chest of the fetus, and the elbows, consequently, thrown widely apart, coming in contact with the brim of the pelvis, thus proving an obstacle to the progress of the young creature." On the contrary, the dystokia occurs because the shoulders *are* closely applied upon the chest instead of being displaced forward upon the neck, where they belong, during parturition. The condition is fundamentally a flexion of the humero-radial articulation, which pushes the shoulders backward upon the sides of the chest and impacts the olecranon against the pubic brim. The transverse diameter of the chest of the fetus is greatly increased by the retention upon its sides of the entire volume of the fetal shoulders, including the scapula and scapular muscles, the humerus, and the bulky anconean group of muscles. The perpendicular diameter of the fetus is also greatly increased, because it must represent the distance from the top of the spinous processes of the dorsal verte-

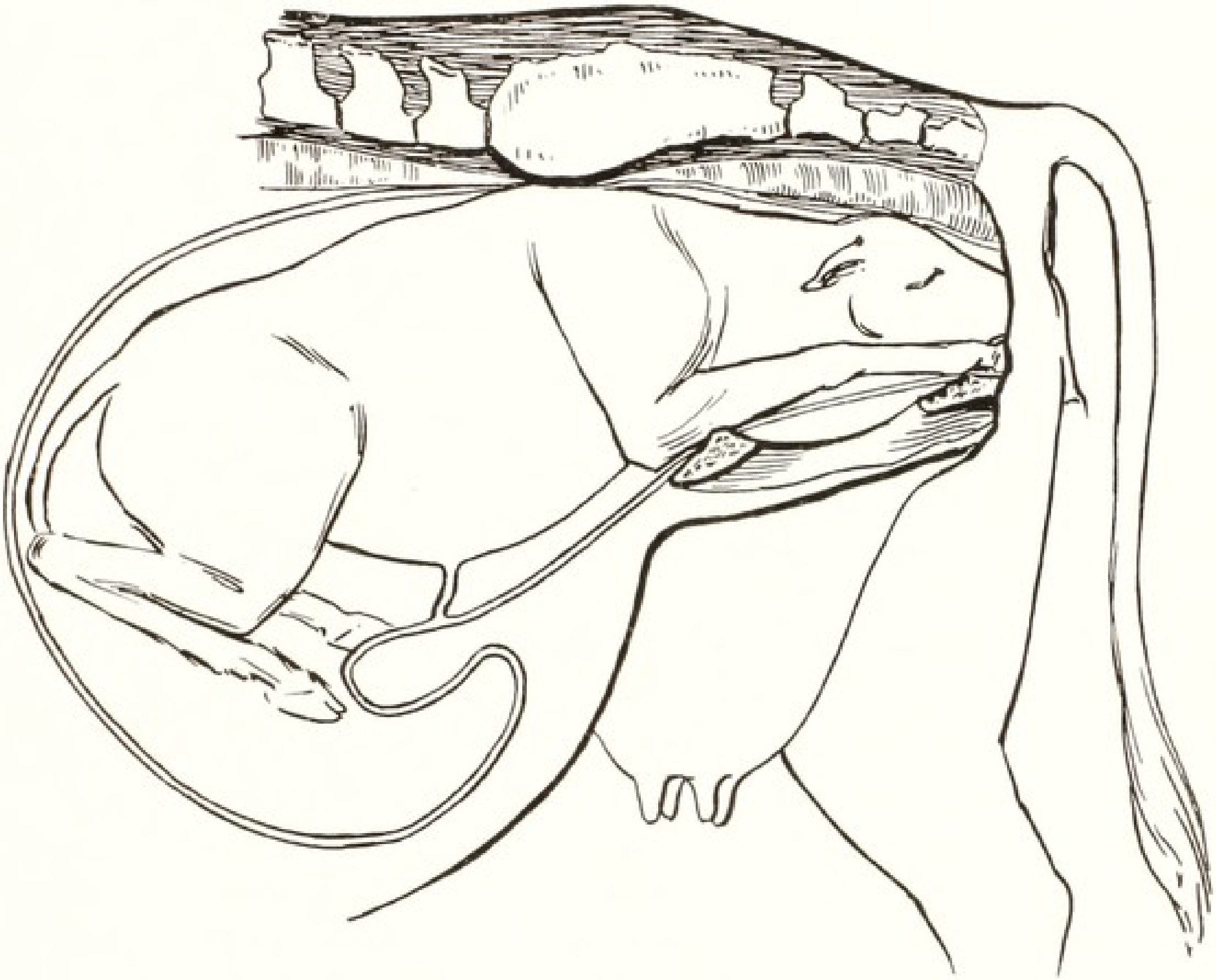


FIG. 133. INCOMPLETE EXTENSION OF ANTERIOR LIMBS

brae down to and including the olecranon. The latter projects obliquely downward, constituting an unyielding obstacle which becomes lodged against the pubic brim. The condition naturally belongs to the dorso-sacral position.

The diagnosis depends fundamentally upon two facts. While the two fore feet present normally and the nose is resting on top of them in a normal position, so far as it is independently concerned, there is an abnormal relation between the degree of advancement of the feet and the nose. While normally the nose of the fetus rests about the middle of the metacarpus, in these cases it is advanced to the fetlock or even further. Under these conditions, if the obstetrist will introduce his hand along the anterior limbs until he reaches the brim of the pubis, he will find the olecranon tightly impacted against it.

The indications are simple and obvious. They consist of releasing the olecranon from its incarceration in front of the pubis and extending the limb in the birth canal. Little, if any repulsion is required. When both limbs are retained, each should be handled separately. The operator should insert his hand along the inferior surface of the limb, with the palm turned upward, until it has been forced between the pubis and the olecranon, so that the latter rests in the hollow of the hand. Then an assistant should exert traction sharply upward and backward, while the operator causes the olecranon to glide over the pubic brim. The shoulder glides forward from the chest and rests alongside the neck, and the anterior limb becomes extended in the pelvic canal. The same operation is carried out upon the other limb, after which the fetus is delivered under ordinary precautions in the dorso-sacral position.

2. The Fore Limbs Crossed Over the Neck

Except in the mare, it is very rare that an anterior limb of a fetus becomes crossed over its head or neck while passing through the birth canal. Even in the mare, it is not very common. The length of the neck and limbs in the foal favors this displacement. It is closely akin to the downward displacement of the head, differing from it merely in the fact that, in the former, the head and neck present normally with the anterior limb displaced, while in the latter the anterior limbs present normally with the head entirely out of line and dropped down between the two limbs. Such displacement in the foal offers a considerable obstacle to parturition, owing partly to the obstruction of the carpus lying on top of the fetal poll or neck, largely because it induces the position of the shoulder and elbow already described in the flexion of the anterior limbs at the elbow. The diameter of the chest is greatly increased and the olecranon, instead of being in a horizontal position, projects downward almost perpendicularly, becomes caught against the pubic brim, and constitutes a very serious obstacle to the advancement of the fetus along the birth canal.

There is the further very important danger that, when a foot is so misdirected, it is liable to become engaged in the roof of vagina and, perforating it, cause a rupture of the rectum or of the perineum. The false position of the deviated foot or feet is readily recognized upon examination.

Handling. It is not difficult ordinarily to seize the misdirected foot with the hand and, while exerting some traction upon it, push it toward the side where it belongs, first somewhat upward to cause it to glide over the poll, thence in a lateral direction and downward, and finally toward the central line to bring it beneath the head and neck. If both feet are crossed over the head, that one which is uppermost—the one which is crossed over the other foot as well as over the head—should first be brought into position, after which the other is to be similarly handled. It is not essential to repel the fetus, unless the fore foot has become engaged in the roof of the vagina and has pushed its way into it so far that the repulsion is necessary for its disengagement. In such cases the repulsion should be merely sufficient to enable the operator to bring about the necessary replacement of the foot.

Should the replacement of the limb prove difficult, it is advisable to cord the foot and have an assistant exert traction upon it in such direction as the operator may indicate, while he guides and aids the reposition directly with his hand. After completing the replacement of the foot into its normal position, the operator should take the further precaution to see that the elbow is disengaged from the pubic brim and completely extended, before any traction is applied to other portions of the fetus, because, until this is done, expulsion can not readily occur.

3. Flexion of the Anterior Limbs at the Carpus

This obstacle to birth occurs chiefly in the calf and the foal, where it is somewhat common. It is less frequent, and of less significance, in the lamb and kid. In carnivora and the sow, the condition is not present, or not of moment as a cause of dystokia, because the short limbs readily fold backward and permit the head to present alone.

In this deviation, the metacarpus is flexed upon the radius, the radius upon the humerus, and the humerus upon the scapula, so that the entire limb is folded and the shoulders are pushed back upon the chest, thus greatly increasing the perpendicular and transverse diameters of the region.

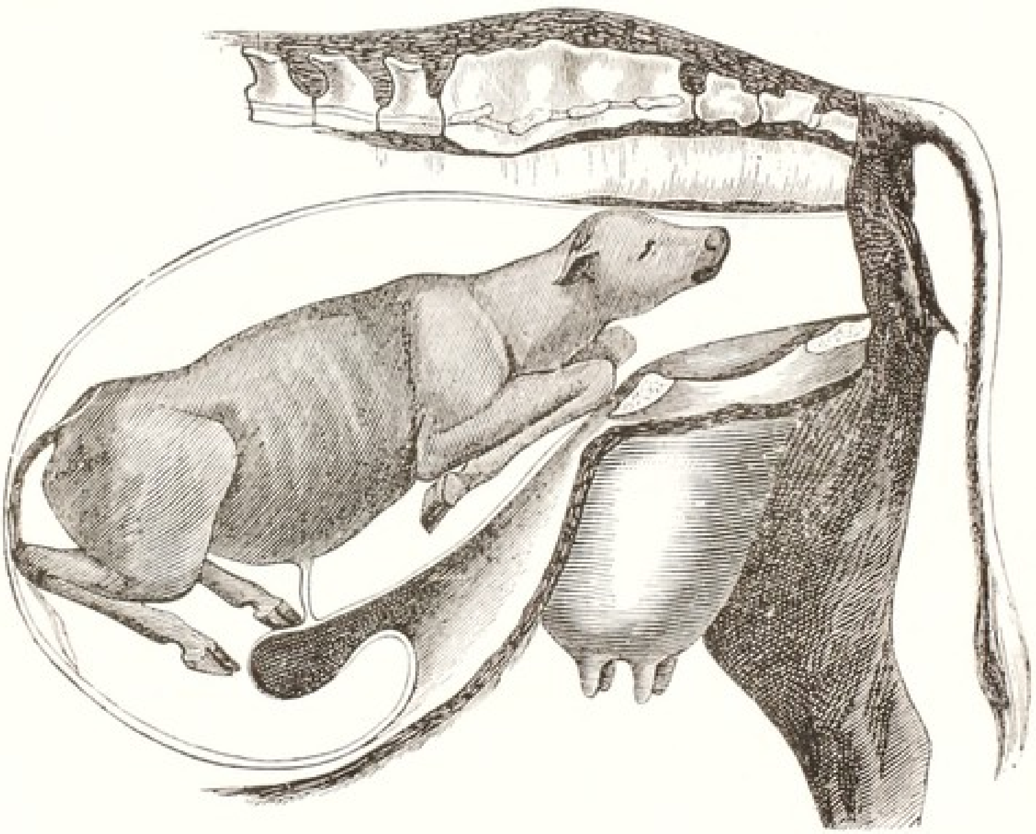


FIG. 134. FLEXURE OF THE ANTERIOR LIMBS AT THE CARPUS. (ST. CYR.)

Normally the fetus, until just before birth, lies with all limbs loosely flexed along the ventral surface of its body, in such a way that they are comfortably adjusted within the available room. When expulsive efforts set in, should the uterus be diseased owing to intra-uterine infection, it does not contract physiologically, and may fail to adjust the limb properly for birth. When the uterus is diseased, the contained fetus is almost certainly secondarily involved, and if not dead is probably sick, so that the pain caused by the close compression and folding of the feet and limbs arouses no efficient corrective struggles on the part of the fetus. When both the uterus and the fetus are healthy, a slight accident at the critical moment may cause the deviation ; once begun, there is little hope of spontaneous correction. It is quite possible that, because of close investment by the fetal membranes, owing to a small amount of amniotic fluid, the foot may not become extended upon the carpus. Consequently the fetus approaches the pelvic inlet with the limbs still flexed and they become impacted in the pelvic cavity or against or beneath the pubic brim, to constitute a more or less serious obstacle to delivery. It has been alleged that the displacement may begin by the toe becoming caught against the pelvic girdle. Once caught, as the fetal body advances and the radius is pushed towards the vulva the toe bends downwards, then backwards, and the metacarpus becomes flexed upon the radius. Under such a mechanism, when the parts become folded the carpus would be far advanced in the pelvis along the side of the neck of the fetus. This, as every obstetrist knows, is rarely the case, but instead the flexed carpus projects into the pelvis only a very short distance or is engaged against or beneath the pubic brim—a position which it could readily acquire only before the toe has reached the pelvis.

Another objection to the theory that the flexion of the carpus occurs during parturition may be realized by the obstetrist when he attempts to extend the flexed member so as to bring about the extraction of the fetus. He finds at once that the length of the metacarpus exceeds the diameter of the pelvis and that the limb has to be pushed completely back into the abdomen in order to be extended.

Usually the deviation should be attributed to an exaggeration of the pre-parturient flexion of the limb—not to an acquired deviation of the part. Consequently one finds frequently both anterior limbs flexed ventralward, with the chin resting on the sternum. This is especially common in abortion, where the dead fetus quite frequently presents by the poll and carpi.

Sometimes one foot, with the head, presents normally ; sometimes the head only ; and sometimes one anterior foot only. The diagnosis is to be made by manual exploration.

In the mare and cow the retention of the anterior limbs at the carpus usually constitutes an insurmountable obstacle to parturition, except artificial assistance is given. Saint-Cyr properly suggests that the dystokia does not result so much from the flexion of the carpus as it does because all the long bones of the anterior limb are flexed upon each other and the entire mass of the shoulder and limb is pushed backward upon the chest walls, to increase abnormally the transverse and perpendicular diameters of this portion of the body and render it so gross that it can not pass through the birth canal until the deviation has been corrected.

The indications are to secure the deviated limb or limbs and bring them into their normal position. Should the fetus be in the dorso-ilial or dorso-pubic position, this may be adjusted as described on page 375, either before or after the adjustments of the limbs, as circumstances may indicate.

1. **Mutation.** In order to bring about the extension of the limb or limbs, repulsion of the fetus is necessary. If the head of the fetus, with or without one anterior limb, has advanced only a short distance along the pelvic canal, it may be quite practicable to push it into the uterus and acquire room for the correction of the deviation in the abdominal cavity. If the fetus is very small, or the pelvis of the mother quite roomy, it may be possible to repel the fetus after its head has passed completely beyond the vulva, but this generally proves very difficult, and sometimes impossible. If the fetus is dead, which is generally the case with the foal, and the head has passed beyond the vulva or can readily be brought beyond it, the most desirable method of procedure is to resort at once to decapitation, as described on page 392, and then repel. Decapitation, a very simple procedure under these conditions, decreases very greatly the amount of labor required for repulsion and the time necessary for the correction of the deviation. It increases greatly the favorable outlook for the mother.

When the head of the calf has passed beyond the vulva, its prominent blunt poll makes its repulsion more difficult than that of the foal. Hence, if the head has protruded beyond the vulva and the calf is dead or is of little or no value to the owner, or if the conditions are such that the life of the mother will be greatly jeopardized by tedious repulsion, the obstetrist, as in the foal, should proceed at once with decapitation.

Pronounced elevation of the posterior parts of the mother's body greatly facilitates repulsion. In the ewe and other small animals, the patient may be almost or quite suspended by the hind legs in order to favor repulsion. Tepid unctuous fluids may then be introduced by gravity through the vulva into the vagina. The fluid lubricates the walls, rendering fetal movements easier, and the weight of the liquid contributes toward repulsion. The repulsion may be aided by manual force.

Having accomplished repulsion, with or without decapitation, the obstetrist should secure the anterior limb, or limbs, with the hand or by means of cords. The bent carpus should be lifted from beneath the pubis, a cord placed upon the pastern as described on page 332, and the limb extended as described on page 377.

As soon as the foot has been brought into the birth canal, the limb is quickly extended by traction. The other fore foot, if retained, is handled in the same manner. If the head is deviated, it is to be handled according to the directions given on page 377. After proper adjustment of the relations between the two anterior limbs and the head, delivery is proceeded with.

2. **Forced Extraction.** Under certain conditions forced extraction may be advisable. Some obstetrists recommend it highly, especially in the case of a living foal. Naturally, it is practicable only in those cases where the bent carpus is already in, or may be secured and brought into the pelvic canal. The flexed carpus may be grasped with the hand, or a cord applied to it, traction exerted, the shoulder, arm, and forearm drawn forward off the chest alongside the neck, the body advanced, and the fetus delivered.

3. **Embryotomy** is rarely demanded except to the extent of the preliminary decapitation, which is desirable in order to facilitate repulsion. It is rarely, if ever, essential or advisable to amputate the anterior limbs at the carpus. Should amputation be found necessary or desirable, it is readily performed with either the chisel or the wire saw.

4. Complete Retention of the Anterior Limbs

In complete retention of the anterior limbs, instead of being flexed at the carpus, one or both carpi project down deeply into

34

the uterine cavity in front of the pubis of the mother, with the radius fully extended upon the humerus. The olecranon becomes lodged in the condyloid fossa of the humerus, and the arm and forearm constitute a long, rigid column. There can be no flexion at the elbow in a posterior direction. As a consequence of this deviation, the shoulders of the fetus are pushed far back upon the sides of the chest so as to increase greatly its transverse diameter, while the perpendicular diameter is still more profoundly increased by the rigidity of the limb, and now equals the distance from the fetal withers or back to the carpus.

The causes of this deviation are two. When a fetus presents at the pelvic inlet with one or both carpal joints flexed, these become impacted against the pubis, and, as the fetus con-

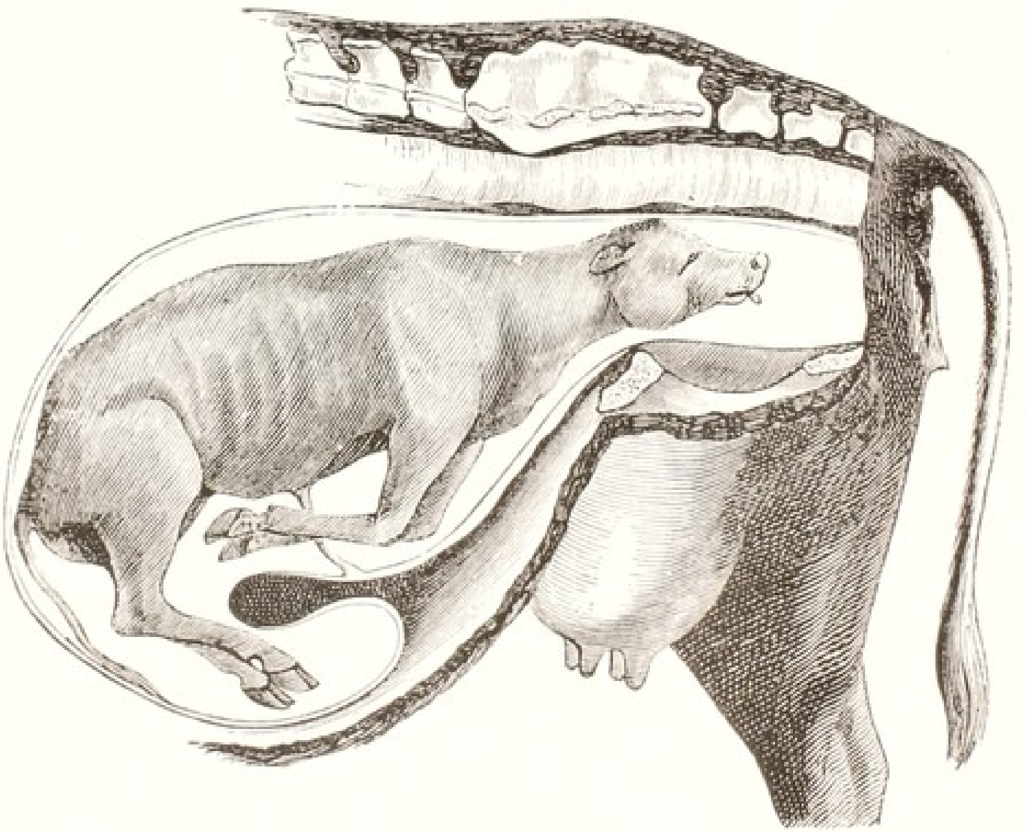


FIG. 135. COMPLETE RETENTION OF THE ANTERIOR LIMBS (SAINT-CYR)

tinues to be advanced by the expulsive efforts of the mother or by traction, tend to glide downward, and finally backward, in a way to convert the flexed carpus into complete retention of the limb.

It is quite possible that the fetus sometimes approaches the pelvic inlet with the limbs extended backwards. With the anterior limbs of the fetus folded loosely beneath the ventral surface of its body, a small amount of force, applied to the lower end of the radius, pushes it backward, and causes the fetus to offer at the inlet with the entire forelimb retained. The position is not abnormal for the smaller domestic animals. For the carnivora the position is more favorable for easy delivery than though the anterior limbs were extended beneath the head. It is only in the larger domestic animals that this position becomes abnormal and interferes seriously with parturition.

The diagnosis is comparatively easy. The condition permits the head and neck to advance further than when the limbs are flexed at the carpus. As a rule, when the veterinarian is called, the head has passed beyond the vulva and manual exploration promptly reveals the nature of the deviation.

Handling. 1. **Mutation.** The indications are to correct the deviation of the anterior limb or limbs. The fetus must be repelled as described on page 373. Before this can be accomplished, it is best, unless the fetus is living, to decapitate, as described on page 392. With or without decapitation, the repulsion should be made obliquely backward and upward, assuming that the fetus has presented in the dorso-sacral position. As the fetus is repelled, the forearm tends to advance towards the pelvis and come within reach, so that it may be grasped.

The beginner should bear in mind especially that, the further upward and backward the fetus is repelled, the nearer the radius approaches to the pubis, and consequently the more readily it is reached. Without repulsion, it is frequently quite impossible to reach the radius at all. As repulsion progresses and the radius comes within reach, a cord should be passed around it and a running noose applied as low down toward the carpus as is possible. Drawing from time to time upon the cord, the operator should continue the repulsion and, with the aid of the cord and his hand, bring the limb into the position of carpal flexion, described in the preceding section. He should then proceed with delivery in the manner there advised.

2. **Forced extraction** has been suggested. It is frequently practicable in the sheep and goat. In the mare and cow it is wholly unwarranted. Some veterinary obstetrists have reported success with forced extraction, but the records are not sufficiently lucid to enable the reader to determine whether they were dealing

with an average sized fetus or with an abortion at a comparatively early period in gestation. When a fetus is not fully developed and its limbs are comparatively much shorter and more pliable, it may be forced through the passage in almost any conceivable position, dependent upon its size. When the fetus has reached its normal dimensions and attained the degree of rigidity regularly possessed at the time of birth, the correct position of each extremity becomes one of fundamental importance. Whenever forced extraction is attempted under these conditions, the operator must assume an extraordinary risk. If a fetus can be drawn away by forced extraction when an anterior limb is completely retained, it must be because it is very small, in which instance there is no necessity for forced extraction, because the deviation is easily corrected.

3. **Embryotomy.** Except for the amputation of the head, which is generally advisable, embryotomy is rarely demanded in this deviation. Fleming states: "Amputation of the head will not always prove advantageous in retropulsion; indeed, it will often be found to be a disadvantage." Upon what clinical facts such an opinion is based, is difficult to understand. It is possible that sometimes further embryotomy may prove desirable. If the head has been removed, and, after repulsion, it is still impossible or impracticable to correct the deviation, especially in cases of emphysema of the fetus, the removal of one or both of the shoulders may become desirable. If one limb be extended it may be amputated subcutaneously, but this method can not be applied to a completely retained limb. It is then necessary instead to divide and detach the skin over the region of the shoulder, and follow with a division of the muscles which attach the scapula to the chest. The first muscles to be encountered and divided are the trapezius and rhomboideus, which would free the superior end of the scapula and permit it to be secured by means of a cord with a running noose. Then should follow the division of the latissimus dorsi, serratus, and pectoral muscles, after which the limb may be drawn out by the scapula, the skin covering it becoming inverted. After one limb has been removed, the chest of the fetus may be opened, and evisceration, as described on page 408, employed. Further diminution in the size of the fetus may be prosecuted to any desired extent, and the remnant finally drawn away.

5. Interlocking of the Maternal and Fetal Pelves

Not infrequently, especially in the cow, birth has proceeded with more or less facility, with the fetus and each of its extremities in an apparently normal position, until the hips have reached the pelvic inlet, when the progress is interrupted and the fetus refuses to move, even under vigorous traction. The interpretation of this condition varies with different obstetrists.

Some hold that the dystokia occurs because the two stifles are in a state of abduction and thus, standing apart, catch upon the pelvic margin and stop the progress of the fetus. It is difficult to conceive of the possibility of such a condition, because there is nothing to maintain such abduction, but all the expulsive forces tend to overcome it promptly and effectively.

The actual conditions, depicted in Fig. 114, on page 400, consist essentially of the interlocking of the pelves of the fetus and mother in such a way that, if traction is applied directly backwards or somewhat upwards, the incarceration is emphasized instead of being overcome.

During its development, the embryo lies in the form of the segment of a circle, and the ventral surface of the body is maintained in a somewhat concave form. When the fetus begins its passage through the birth canal, it maintains this curved form until it has been completely expelled from the vulva. If this direction becomes interrupted, the pelvis of the fetus may become interlocked with that of the mother.

If, when the chest of the fetus is passing through, or has passed beyond the vulva, traction is directed backward or upward instead of downward, the tension is concentrated upon the prepubic tendon, which advances the fetal pubis and increases greatly and dangerously the perpendicular (pubio-sacral) diameter of the fetal pelvis, and also the transverse diameter between the supero-external tuberosities of the fetal ilia. Normally, the fetal pelvis leaves the spinal column at an acute angle, downward and backward ; if traction is exerted on the spine in a downward direction, this angle is increased, the ilial tuberosities are lowered, and the ischia and pubis pass backwards and upwards. If the traction is applied to the pubis through the prepubian tendon, the angle is changed and the iliac shafts approach the perpendicular to the fetal spine. The error in the direction of traction causes the fetal ilia to become firmly lodged against the anterior border of the maternal ilia ; the more violent the traction, the firmer the interlocking. When the fetal pelvis is large and the external iliac tuberosities prominent, the hips may offer serious resistance in passing the pelvic inlet, even without the complication of misdirected traction. I have not encountered the interlocking of the pelves in animals which I have attended prior to the application of injudicious traction. It is doubtful that it occurs except in conjunction with misdirected traction. I have twice attended cows which had been tied firmly by the head to a post, with one or two horses hitched to the fetus and pulling their utmost in the wrong direction, in an attempt to bring away the calf, but without avail.

The symptoms and diagnosis of this form of dystokia require but little consideration. The fetus, possibly rather large, generally offers in the normal anterior presentation, and advances somewhat slowly until the hips have reached the pelvic inlet, when the progress is stopped and the fetus can not be advanced by traction so long as it is applied in a direct line, parallel to the long axis of the body of the mother or somewhat upwards. If the operator can succeed in inserting his hand along the fetus into the uterus, he will find that everything is apparently normal, except that the pelvis of the fetus is firmly wedged against that of the mother and seems immovable. There is but one condition from which it needs be differentiated—the double monstrosity known as pigodidymus aversus, Fig. 129.

The indications in this form of dystokia are :

1. **The Application of Traction in the Proper Direction.** When a fetus has advanced without serious difficulty until it has reached the hips, and is in every way normal, there is no good reason why its extraction should not be readily completed, if care is taken to apply the traction directly downward toward the feet of the mother, according to the technic given on page 381.

2. **Embryotomy.** Failing to bring about extraction under moderate force, the obstetrist should at once resort to embryotomy, consisting of the destruction of the pelvic girdle, as already described on page 399.

6. Forward Extension of the Hind Limbs Beneath the Fetal Body

In the mare, and possibly in other animals, a fetus sometimes presents anteriorly, with the anterior limbs and head in an approximately normal position, and the two posterior limbs thrust forward in extreme extension beneath the body of the fetus, so that the two hind feet are lodged just in front of the maternal pubic brim, or have passed some distance along the pelvic canal. This places the fetal body in such a position that its progress becomes blocked when the neck or chest has appeared at the vulva.

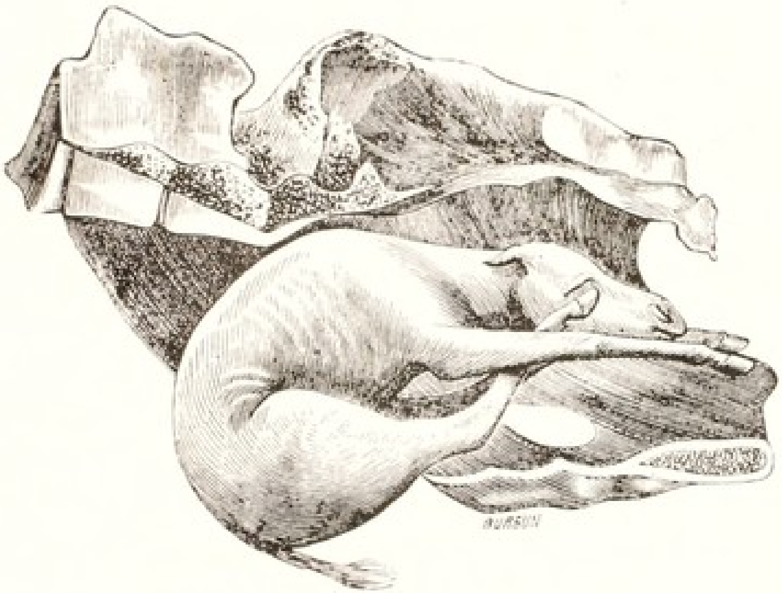


Fig. 136. Forward Deviation of Posterior Limbs in Anterior Presentation (Saint Cyr.)

The cause of this presentation is unknown. The fetus is ordinarily—always, so far as I have seen—in the dorso-sacral position, with the proper relations existing between the two anterior limbs and the head and neck. When it has advanced sufficiently for the fore feet and nose to show at the vulva, its further progress becomes arrested. Inserting the hand beneath the body of the fetus, the operator encounters one or both posterior feet, either in the pelvic canal or just anterior to the brim of the pubis, where they are easily recognized, their soles directed downwards. The spinal column is jammed hard against the maternal sacrum.

The prognosis is extremely unfavorable. Next to bi-cornual pregnancy, this is one of the most dangerous positions of the fetus encountered in the mare. The fetus is doubled up in such a manner as to cause very severe pain and violent straining, constantly threatening serious or fatal injury to the mother. The position offers unusual opportunity for damage by empirics, and invites violent traction by laymen without knowledge of the serious results which are almost sure to follow. When the two posterior feet are lodged against the brim of the pubis, the danger is perhaps greater than when the hind feet are well advanced in the pelvis, because the expulsive efforts of the mare, or traction applied by attendants, tend to force the two posterior feet through the floor of the uterus. It is also a position in which the layman and empiric may undertake embryotomy. In one case I attended, detruncation had been performed through the dorsal region, but the genital organs had not been protected from the sharp bones which had been left exposed. As a consequence, the vagina was very badly lacerated and a chronic vagino-cystitis followed, from which the mare never recovered, although she survived.

The method of handling varies greatly in the hands of different obstetrists.

1. **Mutation.** Some advise the adjustment of the misplaced members, but I find no data to show in what proportion of cases, if at all, such a plan may succeed. The directions given are to repel the two hind feet as far as possible into the uterine cavity and abdomen, and then by traction to bring the fetus away. It must be evident that it is only in very favorable cases that such an operation can succeed. With the anterior portion of the fetus impacted firmly in the pelvic canal, the operator can not reach very far into the abdominal cavity, and can not expect to repel the two posterior feet to any very great degree.

The character of the position generally excludes all possibility of repelling the head and body of the fetus, and if the hind limbs are very far advanced in the pelvic canal it would seem impossible to repel them. Even when repulsion has succeeded to a degree, it is impossible for the operator to know whether the two hind feet rest in a safe position where they may turn backward as the fetus moves forward. It seems to me, from clinical observation, that there would be constant danger of the hind feet being thrust through the floor of the uterus while traction is being applied to the anterior portion and the hips are advancing and passing over the bent limbs.

I do not consider adjustment of the deviated posterior limbs safe, practicable, or advisable. Such an operation may be wholly feasible in the cow, but I have not observed dystokia of this form in the cow.

2. **Forced Extraction.** Some obstetrists advise forced extraction. What success they have attained can not be determined from the literature, but it would appear that the position is one which renders this operation especially dangerous. The plan of forced extraction is to secure the two hind feet with cords, advance them well under the body of the fetus, and then, applying powerful traction simultaneously upon the two hind limbs and the head, bring the fetus away entire. Such a plan of delivery necessarily draws the pubis forward, forces the fetal pelvis into that unfavorable position already described as *Interlocking of the Fetal and Maternal Pelves*, and adds the thighs to the diameter of the buttocks.

3. **Embryotomy** is the most desirable and rational method for handling. It consists essentially of detruncation (page 398) repulsion of the hips, and conversion of the fragment into the posterior presentation.

In all cases of dystokia in this position, an unfavorable prognosis should be given, whatever the method of handling. Before beginning his operation, the veterinarian should determine as far as possible if any rupture of the uterus has been caused by the two posterior feet, or if they have wounded the large uterine vessels of this part, causing serious hemorrhage.

In my practice, one mare died from uterine hemorrhage while I was preparing to attempt delivery, although the case was a very recent one and had not been greatly tampered with.

In another case, to which I have already alluded, the owner and his neighbors had bisected the fetus through the thorax, left the vertebrae and ribs freely exposed, and lacerated and torn the vulva and vagina in a very repulsive manner, so that, although I succeeded in detruncation at the proper point and the removal of the fetus, the lacerations caused by the owner were followed by a severe and chronic infection, which involved not only the vagina and vulva, but also the bladder, causing a severe chronic purulent cystitis, from which recovery was very tardy and incomplete.

I was called to attend a vigorous young mare suffering from this form of dystokia. The case was recent and had not been meddled with. Delivery by detruncation was prompt and easy. The mare died two days later from gangrene of the vulva and vagina.

In a fourth case a foal was found one morning incarcerated in this position. Apparently the dystokia had existed much of the night. The delivery was easy. Gangrene of the vulva with sloughing occurred, followed by vulvar constriction of such a degree that copulation was not possible.

I have not had a satisfactory recovery in this form of dystokia.

III. DEVIATIONS IN THE POSTERIOR PRESENTATION

1. Flexion at the Tarsus

Dystokia in the mare and cow, due to the tarsal articulations becoming flexed and either entering the pelvic canal or becoming caught just in front of the pubis, is comparatively common. This displacement constitutes a formidable obstacle to the expulsion of the fetus, because it necessarily involves the flexion of all the articulations of the limb, and consequently increases greatly the diameter as measured from the fetal sacrum down through the folded limb, as indicated in Fig. 137. The femur is flexed upon the pelvis, the tibia upon the femur, the metatarsus

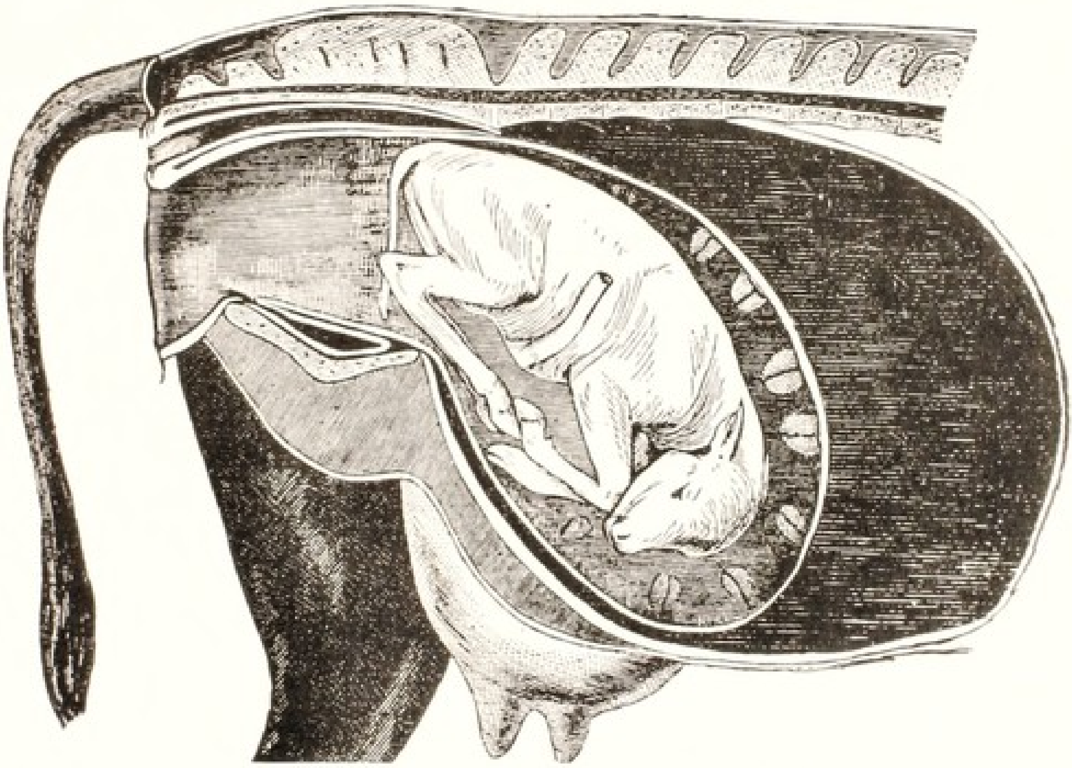


Fig. 137. Retention of Posterior Limbs at the Tarsus. (Franck.)

upon the tibia, and the phalanges upon the metatarsus. One of these articulations can not be completely extended until the others are ready to be simultaneously extended. The folding of the limbs in this manner quite effectively prevents the passage of a fetus of normal dimensions through the pelvic canal.

The diagnosis is easy. Upon inserting the hand, the operator may first touch the tail, or the ischiatic tuberosities. Lying in the pelvic canal or just beneath and in front of the pubic border, there is recognized the summit of one or both hocks. The fetus is thus lying in the position of ordinary sternal recumbency, with the hind feet closely doubled immediately beneath the body.

The cause of this displacement is not far to seek. In discussing the normal position of the fetus in the uterus, it has been noted that usually it lies with its hind legs loosely folded beneath its abdomen. When parturition occurs, the limbs should under normal conditions become extended, so that in a posterior presentation the most advanced part should be the two hind feet. When this extension fails to take place, and the fetus is forced toward the pelvic inlet in the position in which it has previously lain, the points of the ossa calces naturally become caught against the pubic brim, or advance for a short distance in the pelvic canal, and stop further progress in the expulsion of the fetus, In discussing the dystokia of contagious abortion, it has been pointed out that when a healthy uterus contracts upon a healthy fetus the latter reacts by struggling and normally so places its extremities that painful doubling will be avoided. Struggles always tend toward extension.

Handling. 1. **The correction of the deviation** should in all cases be undertaken if, in the judgment of the obstetrist, it can be properly accomplished. The overcoming of the deviation consists first of the repulsion of the fetus obliquely forward and upward, as described on page 373. The mother should preferably be in the standing position, with the hind parts elevated. If unable to rise, she should be placed in lateral recumbency, or—sometimes still better—in the dorsal position, still applying the rule of keeping the posterior portions of the mother elevated. When the repulsion has been accomplished, the extension of the limbs is to be carried out as described on page 377.

2. **Forced Extraction** has been advocated by some operators, although neither its advantages nor its safety has been demonstrated. As a general rule the so-called forced extraction involves partial embryotomy by the severing of the tendo-Achilles, which, by permitting dorsal flexion at the fetlock, ameliorates the dystokia. Forced extraction is never necessary, and rarely if ever justifiable, even with the severing of the tendo-Achilles.

3. **Embryotomy** occasionally becomes necessary or desirable.

In case of a very large foal, or when the foal or calf is dead and emphysematous, and especially in those cases where the patient is unable or unwilling to stand, it may be impossible, or at least impracticable, to adjust the position. Consequently embryotomy must be performed.

Embryotomy in these cases is very simple, consisting merely of the amputation of the foot with the chisel, or the wire saw, through the lower portion of the tarsus, as described on page 401.

4. **Hysterotomy or Hysterectomy**, as described on pages 411 and 422, may become necessary in the smaller domestic animals, where the adjustment of the deviated limbs or embryotomy is not available.

2. Complete Retention of the Posterior Limbs. Breech Presentation

The breech presentation may occur in any domestic animal. It acquires its greatest significance in the mare, where it constitutes a very formidable cause of dystokia. It differs from the preceding deviation in that, instead of the limbs being flexed at the tarsus, they are extended forward upon the pelvis, beneath the abdomen and chest of the fetus, each joint in rigid extension. The causes are essentially identical with those of the preceding deviation. Probably in many cases complete retention originates from flexion at the tarsus. The flexed tarsus becomes caught against the brim of the pubis. The expulsive efforts of the mother, pushing the fetal body toward the vulva, cause the ossa calces to glide downward and then forward, and the tarsus to become extended, until finally the entire limb is pushed forward beneath the body. The operator, upon examining the case, usually meets first with the tail or buttocks of the fetus, and in many cases can touch the tibia or other portion of the limb only with very great difficulty. Sometimes no part of the hind limb can be grasped or recognized until after repulsion has taken place.

1. **The adjustment of the deviated limbs** is indicated first of all. The fetus should be repelled, as described on page 373, after which the tibia or metatarsus, as may be available, should be secured by means of cords, as described on page 377. By

continuing repulsion, the position is to be converted into a hock presentation, after which the further handling of the case is identical with that described above for retention of the posterior limbs at the tarsus.

2. **Forced extraction** has been advised by some operators. How successful they have been, veterinary literature does not make clear. While forced extraction may be somewhat easier it is not warranted by modern surgical principles and is quite unnecessary.

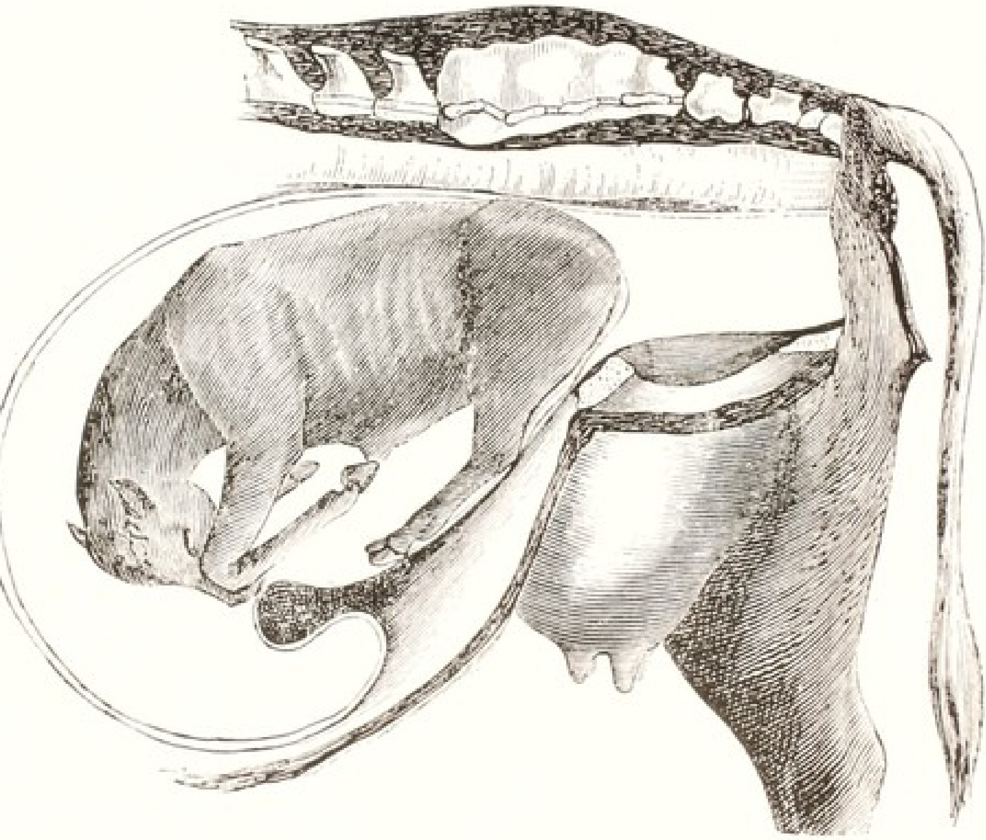


FIG. 138. BREECH PRESENTATION. (SAINT CYR.)

3. **Embryotomy** offers the most valuable method for overcoming this form of dystokia, especially in the mare, in all those cases where adjustment is impossible or difficult. Whenever the fetus is comparatively large or is dry or emphysematous, or for any other reason it is exceedingly difficult or impracticable to bring about a prompt adjustment of the position, embryotomy is highly efficient. It should be undertaken promptly, before the operator and patient have become exhausted in fruitless endeavors at mutation. Various forms of embryotomy have been recommended by different writers. I prefer the intra-fetal

amputation of the two posterior limbs, as described on page 402. Others prefer to amputate the limbs extra-fetally, with the knife, Persson's saw, or the Pflanz embryotom, or—better than either of these—with the wire saw. The intra-pelvic amputation of the limbs is however the most efficient plan. It destroys the pelvis and buttocks, one of the chief obstacles to delivery, and permits ready evisceration and other operations for decreasing the size of the torso.

4. **Gastro-hysterotomy or hysterectomy**, pages 411 and 422, is frequently necessary or advisable in swine and carnivora, but is uncalled for in the cow and the mare, because embryotomy is always readily available.

WOUNDS AND INJURIES OF THE GENITAL AND NEIGHBORING ORGANS.

1. Post-partum Hemorrhage.

Post-partum hemorrhage may be placental—that is, capillary—or it may be traumatic. Serious placental hemorrhage occurs very rarely. Insignificant hemorrhage from the placenta is common in the mare and the cow, and to a lesser degree in other domestic animals.

Amongst domestic animals, severe placental hemorrhage is virtually confined to the cow, and apparently constitutes one of the phenomena of contagious abortion. In the abattoir I observed one case of extensive inter-placental hemorrhage. Between each maternal and fetal cotyledon, there existed a well-marked hematom. When the inter-placental hemorrhage becomes excessive, it detaches the fetal placenta, the blood escapes into the utero-chorionic space, envelops completely the fetal sac, and causes mummification. The same causes continue to operate after parturition and expulsion of the fetal membranes. Occasionally there appears suddenly severe placental hemorrhage at from two to four or five days after the expulsion of the fetus. The hemorrhage is usually very profuse : the uterine cavity is quickly distended with two to five gallons of coagulated blood, and large quantities of liquid blood escape from the vulva. The blood is bright scarlet, coagulates promptly, and shows little tendency to decompose. So much is this true that in the abattoir it is not rare to find, in the uterus of a cow, an old mummified hematom, black in color, tough, and highly adhesive. The hematom may remain in the uterus indefinitely as an inert body. The inter-placental hemorrhage, the mummification of the fetus, the severe puerperal hemorrhage, and the mummified hematom appear to be a connected series of hemorrhages, occurring at different epochs, due to a common cause. These hemorrhages are seen, so far as observed clinically, in herds where contagious abortion is prevalent and severe. They appear to be intimately related to the hemorrhagic metritis of contagious abortion. In the latter disease, hemorrhages into the uterine mucosa and uterine cavity constitutes one of the most striking clinical phemomena.

The common hemorrhage in this metritis has no direct significance simply as hemorrhage, as the amount is too small to induce anemia.

In the severe cases under consideration, the hemorrhage immediately assumes importance because of its volume, and later offers a menace from bacterial decomposition of the immense intra-uterine hematom. The hemorrhage sets in abruptly without warning. The cow has suffered from the dystokia of contagious abortion, but the cause of the dystokia has not been recognized. Perhaps the parturition has been very tardy, dragging along hour after hour, and the afterbirth has come away slowly, but this is too common in cows to create anxiety. The uterus does not involute, but the owner fails to see that. Perhaps there is the scarlet-gray genital discharge, but the owner calls it lochia and dismisses the matter. Then, without warning, the storm breaks. The uterus fills quickly with blood—one, two, four, or five gallons—and then the bright scarlet blood can no longer be contained and gushes from the vulva. The cow is uneasy, gets up and lies down frequently, and moves restlessly about her stall. The bedding and the stall partitions are soon covered with blood : the entire room looks more like a shambles than a box stall. I do not know how fatal such hemorrhage is. The two cases which I have observed recovered, though the animals were exceedingly weak from the hemorrhage.

Prompt and free subcutaneous administration of adrenalin chloride appears to be highly beneficial and to constitute the best known method of handling. The clotted blood in the uterus should be left absolutely undisturbed. One can not, as in woman, empty the uterine cavity and pack it. The great, flabby, tubular organ is so long that its end can not be reached, and its walls are so flaccid that it is capable of well-nigh endless distention. When the hemorrhage has been brought under control, the obstetrist may begin, after twenty-four hours, cautiously and gradually to break down the hematom and wash it out with warm physiologic salt solution. No attempt should be made to wash it all out at once. Since it does not as a rule decompose rapidly, no haste is required. I have worked for three or four days, once daily, to break down the clot and remove it. Finally, it should all be washed out. If it is not, the blood clot may undergo putrid decomposition and intensify the metritis, or may undergo non-putrid desiccation (mummification) to inhibit estrum and induce prolonged or permanent sterility.

The hemorrhages which occur during or immediately subsequent to parturition are generally due to traumatic injury of the uterine walls which is more or less independent of the placenta.

During the birth act, serious and fatal hemorrhage occurs sometimes from a rupture of the uterine walls involving some of the great vessels. Necessarily in the mare it involves in the lesion the placenta itself, since this is distributed over the entire organ.

After the fetus has been expelled, the rude removal of the fetal membranes by laymen or empirics frequently induces profuse hemorrhage, which may end fatally. In the cow, when the placenta is retained and involution of the uterus has not yet occurred, and the layman or empiric attempts to detach the membrane, profuse and fatal hemorrhage is liable to result, especially if the cotyledons are rudely torn away.

In one instance an empiric, attempting to remove the membranes from a cow immediately after calving, by tearing the uterine cotyledons away, brought on a hemorrhage which proved fatal to the patient in the course of a few hours. When I arrived, the entire uterine cavity was filled with a great mass of blood; much blood had already escaped from the vulva; the cow was down, and unable to rise; the mucous membranes were blanched; the animal was pulseless, and in a dying condition.

Hemorrhage from the uterus, of the two types, occurs also in cases of prolapse or inversion.

Symptoms. Generally there is an escape of blood from the vulva. The blood may, however, be largely retained within the uterus, and coagulate promptly. In case of rupture of the uterine walls, and especially of the uterine floor, when involving large vessels, a profuse and even fatal hemorrhage may occur into the peritoneal cavity, without any appreciable amount of blood escaping from the vulva. In these instances of intra-uterine or intra-peritoneal hemorrhage, the symptoms, in general, are those of internal hemorrhage, such as the blanching of the mucous membranes, weakness of the animal, pain, anxiety, and sweating.

Death frequently follows quickly. The diagnosis must be made by these symptoms, in conjunction with a manual exploration of the uterine cavity.

The indications in uterine hemorrhage will depend largely upon the cause and origin. When due to extensive wounds of the uterine walls, involving the large vessels, and the uterus is in position, it is well-nigh beyond the obstetrist's control, though possibly in some cases the wounded vessel might be secured if it could be identified. In the milder form of hemorrhage, where the quantity of blood is not great, it may not be necessary or even advisable to interfere, especially if the uterine cavity is apparently in an aseptic condition. When the hemorrhage is dependent upon a want of involution, contraction should be encouraged by the use of pituitrin, combined with adrenalin.

If the uterus is intact, involution may be hastened by injecting into it a tepid physiologic salt solution.

In hemorrhage from the prolapsed uterus, one can not hope to check that of a capillary character except by the reposition of the organ; that from any torn vessels of importance can be readily controlled by forceps, ligation, or other means in common use.

2. Rupture of the Uterus and Vagina

Rupture of the uterus or vagina is liable to occur at any time during labor, and especially toward the close of the act, as the fetus is being forced along the genital passages. The accident occurs in a great variety of ways. Frequently it occurs through the projection of an extremity of the fetus in an improper direction, so that it is forced through the wall of the organ because of a concentration of pressure upon a small area. Ruptures from this cause naturally occur most frequently in the mare and cow, where the fetus has long and rigid extremities, which are capable of inducing great injury when they become misdirected.

In transverse presentations in the mare, when version is attempted without embryotomy, there is always danger of an extremity becoming so misdirected that, during the expulsive efforts of the mother, it may be forced through the uterine wall and bring about a perforating wound of the peritoneal cavity.

In the anterior presentation, with the two posterior limbs extended beneath the body of the fetus and lodged just in front of the pubic brim upon the uterine floor, forcing the fetus into the passage brings about a great concentration of pressure upon the uterine floor by the feet. The croup and thighs are rigidly and firmly pressed against the sacrum and lumbar vertebrae, and the extended limbs are forced, under enormous pressure, downward and forward against the floor of the uterus. Such pressure is constantly liable to cause the toes of the fetus to force their way through the uterine floor.

When the fetus presents anteriorly in the dorso-sacral position, with a foot crossed over the head, or a foot misdirected upward from other cause, the misplaced toe tends constantly to push upward and force its way through the roof of the vagina.

In the bi-cornual development of the fetus, as already described on page 494, extensive and fatal rupture of the uterus is very liable to occur when traction is applied in order to bring about delivery.

In torsion of the uterus, as already related on page 215, transverse rupture is a common result of the displacement, and follows regularly when the torsion has become extreme.

A further, and not uncommon cause of uterine rupture is the attempt of the veterinarian to force a normal fetus through a constricted passage, or a fetus which presents improperly through a normal passage. In discussing induration of the cervix on page 446, a case was related in which, in a heifer, an attempt to force the fetus, normal in size and position, through a very narrow cervical canal, ruptured the cervix for its entire length.

Another, and highly important way by which rupture of the uterus may be caused during traction consists of contusing and perforating the walls by forcing the uterus against some projecting portion of the pelvis, as described on page 459.

In other cases, when forced extraction is attempted with a fetus in an improper position, such as a deviation of the head, the uterine wall may be caught by some projecting portion of the fetus and dragged along in such a way that it doubles upon itself and tends to bring about its rupture.

Of all the ruptures of the uterus, the most embarrassing and unfortunate are those which are brought about by improper manipulation by the obstetrist himself or by the meddling of laymen or empirics. In discussing the general subject of obstetric work upon page 361, the suggestion has been made that it is to the professional and legal interest of the veterinary obstetrist to examine very carefully each case of dystokia to which he is called, determine whether the animal has been subjected to injurious meddling before his arrival, and discover, if possible, any important injuries which may have taken place, before he attempts to handle the case.

Again, in discussing the method or plan for overcoming dystokia or accomplishing obstetric work, it has been urged on page 368 that the veterinarian should always use care and judgment and especially that he should husband his strength to conserve his efficiency. In one instance I had labored long and ineffectively to correct a lateral deviation of the head, in a case of wryneck, when I should have resorted at once to embryotomy. Finally, after becoming exhausted, I made an attempt to secure the head by means of a long, blunt hook, failed to control properly the direction of the instrument, caught it in the uterine wall, and tore a large opening, which necessitated the destruction of the patient.

Sometimes, a prolapsed uterus becomes caught upon objects of various kinds and, dragging upon them, brings about a more or less serious rupture. It is not very rare for the prolapsed uterus to be torn and lacerated by other animals. Especially is this true of the cow when she suffers from eversion of the uterus in an enclosure where swine can get to her, as these animals at once pounce upon the prolapsed organ and begin to devour it, if it is within reach. In one case cited by Fleming, almost the entire organ had been devoured. Just as the condition was discovered the cow got up, and the remnant of the organ suddenly returned to its place. The animal recovered. It has been claimed that rupture of the uterus is sometimes caused by hydrops amnii. Uterine rupture from acute emphysematous decomposition of the fetus is not rare.

The symptoms of rupture of the uterus are perfectly obvious in the prolapsed organ. When the organ in its normal position becomes ruptured, the symptoms will vary according to the position and extent of the rupture, the degree of hemorrhage, and the character and volume of substance which may escape from the uterine into the peritoneal cavity. If the rupture is very extensive, and a large amount of liquids, especially if infected, escape into the peritoneal cavity, there is at once a profound collapse, under which the animal is liable to die very suddenly. If the rupture is extensive, and immediately after the extraction of the fetus the veterinarian is so unfortunate as to inject into the uterine cavity a large volume of antiseptics for the purpose of irrigating the organ, and these escape instead into the peritoneal cavity, the collapse is sudden and death may ensue in the course of an hour or two.

When the rupture involves the division of voluminous blood vessels, the chief symptoms may be due to the hemorrhage, as already described in the preceding chapter. If the rupture occurs in the roof of the organ, or so high along the sides that it does not readily permit the escape of large volumes of liquids into the peritoneal cavity, there may be no symptoms at first, and it may pass undiscovered except through manual exploration. Later, infection may gain admission into the peritoneal cavity, through the rupture, and bring about a septic peritonitis, with all the symptoms of that disease.

When the rupture is very small, amounting to a mere perforation, or when a small area of the organ is so contused that it loses its vitality and later becomes necrotic, and the peritoneal cavity becomes secondarily opened, the definite symptoms—septic peritonitis and its accompaniments—are slow to become established. It may be several days after parturition before they become apparent, and when the rupture is very small the definite diagnosis may be made only upon post-mortem examination.

In one instance the owner of a mare had inhumanly drawn away a foal while the head was completely deviated to the side, and in doing so had caused a complete rupture of the perineum. When the mare was presented at our clinic because of this injury, the afterbirth was still retained. This was removed, and the ruptured perineum was regularly cleansed and disinfected. Although I examined the uterus carefully, I failed to find any injury to its walls and concluded that the retained placenta and the ruptured perineum were the only lesions, but this was an error. The mare perished three days after entering our clinic, under symptoms of septic peritonitis. Upon post-mortem examination there was revealed a small rupture of the uterus along the floor just anterior to the pubic brim, upon the median line. The opening was barely sufficient to admit the passage of a pencil. Its edges were necrotic. From appearances it could not be determined whether the rupture had occurred during the time of dystokia. Probably it had at first consisted of a contusion, the result of impingement of a uterine fold between the fetus and a bony prominence of the maternal pelvis, during the inhuman forced extraction.

In another instance some stablemen had delivered a cow, and the delivery was followed by retention of the placenta. Although this was removed carefully, the cow exhibited the general symptoms of peritonitis, to which she succumbed. A post-mortem examination revealed a small perforation of the uterine floor, just in front of the pubic brim, in the same position essentially as in the preceding case of the mare. Again it was impossible to determine whether the perforation was immediate or secondary. In each case I was severely criticised because of the death of the patient.

These cases emphasize the importance of care in examining the uterus in all instances where there has possibly been tampering before the veterinarian has been called, and should clearly impress the practitioner with the importance of taking all due precautions in any manipulations which he undertakes. It must be evident to him that, when he is attempting to adjust a retained foot, he should be careful not to bring excessive pressure upon the point of danger at the pubic brim, because of the constant possibility of causing a small perforation of the uterine floor. It has been advised (page 377) that, in the extension of a foot which has been retained, the operator should always grasp the toe in the palm of his hand, and cause it to glide over the pubic brim without coming in contact with the uterine floor. This is highly important, not only because it actually facilitates the operation, but also because it affords a highly necessary security against serious or fatal injury to the uterus.

The handling of rupture of the uterus must be adapted to each individual case. It should always be remembered that the involution of the uterus brings about a great decrease in the size of a rupture in its walls. When the rupture is in the roof of the uterus or well up on its side, there is always a possibility of spontaneous recovery, and every opportunity should be allowed for its occurrence. When the uterus is in position, it is possible to close a rupture by means of sutures. In the large uterus of the mare or the cow, a rupture may be closed by sutures without disturbing the position of the uterus or, in some cases, the uterus may be so displaced as to bring the wound into the vagina or even outside the vulva. When the uterus is left in position, the operator may use a short half-circle needle with a very long suture. The needle can be manipulated with one hand. The suture may be tied by grasping one end at the wound and the other end outside the vulva.

When the organ is prolapsed and ruptured, it is comparatively simple to close the opening by means of sutures under proper aseptic precautions. The sutures should be of silk, and of the intestinal type: that is, the peritoneal surfaces should be brought in contact with each other while the wound margins project into the uterine cavity.

In all cases of uterine rupture it is clearly inadvisable to inject liquid antiseptics or other fluids into the uterus, and take the risk of their escaping into the peritoneal cavity. It is essential to remove blood clots, fetal envelopes, or disease excretions, but this should be accomplished without irrigating the organ. The operator may largely remove these with the hand, used as a scoop, and the cleansing may be completed by means of pieces of gauze saturated with an antiseptic.

When the ruptured organ is prolapsed, and the rupture is so extensive that recovery is very doubtful, the organ should be amputated. This operation is described under "Prolapse of the Uterus."

3. Rupture of the Bladder

Rupture of the bladder during parturition is a very rare accident. Fleming cites two cases. In one, related by Furnivall (Veterinarian, Vol. 33, page 377) a mare died very quickly after the expulsion of the fetus. A post-mortem examination revealed nothing pathologic except rupture of the bladder. In the other, recorded by Overed, the mare was not seriously unwell after foaling, but it was noted that she urinated more frequently than usual and the act was accompanied by pain. However, she was well enough that she was bred on the ninth day, and it was only after four weeks that Overed was called to examine the animal. She died later with symptoms of peritonitis. Upon opening the abdomen, a large quantity of fluid, said to be 12 gallons, escaped, which was supposed to be urine. Diffuse peritonitis was present, and a rupture existed in the bladder, which communicated with the peritoneal cavity. It was assumed that the fundus of the bladder was injured during parturition, and that later the contused parts became necrotic and sloughed.

In herbivora, with normal alkaline urine, rupture of the bladder does not induce the profound and fatal collapse observed in man. In sharp contrast, cattle may live for days and weeks after rupture of the bladder, and carry in the peritoneal cavity many gallons of urine.

4. Rupture of the Intestines

Fleming cites Schaack as having observed one instance of a rupture of the intestine by its becoming compressed between the fetus and the pelvic bones. The symptoms of such an injury, especially in the mare, are those common to rupture of the intestine, chiefly collapse, with very feeble or indistinguishable pulse, trembling, and cold sweats. It is well-nigh impossible to make a positive diagnosis of this condition during the life of the animal, unless in the rectum, where it may be palpated, and it can merely be suspected from the general symptoms. It is not possible to apply any effective method of treatment.

5. Rupture of the Diaphragm

It has been claimed that rupture of the diaphragm occurs rarely as a complication or accident of parturition, in some cases of dropsy of the amnion or allantois, or from other causes which may induce extraordinary weight or volume of the gravid uterus. The few cases which are recorded are not very significant, and exhibit no definite symptoms by which the accident is to be diagnosed. The diagnosis has been made post mortem. It is quite possible that some of the cases diagnosed as rupture of the diaphragm as a parturient accident may have been post mortem, such as frequently occur an hour or two after death.

6. Prolapse of the Intestine through the Ruptured Walls of the Uterus or Vagina

When a perforating wound or rupture of the walls of the uterus or vagina occurs at any point, it is possible for a protrusion of the intestines to follow. When spaying the mare or cow through the vagina, the veterinarian habitually makes a more or less extensive wound, large enough in the mare to admit the entire hand, but there is virtually no danger of the protrusion of the intestine. When uterine or vaginal rupture occurs during difficult parturition and the intra-abdominal pressure is enormously increased by the straining, a portion of the intestine is liable to prolapse into the uterus or the vagina, and finally beyond the vulva.

It has already been noted that in some cases a rupture of the uterus is caused by the meddling of empirics. In one instance an effort had been made to catch some portion of the fetus by means of a hooked stick, and in so doing a large rent had been caused in the wall of the vagina. The fetus was retained within the uterine cavity because of bad position. The expulsive efforts of the mare forced the floating colon through the rent in the vagina. At the time of my arrival the intestine had protruded beyond the vulva so far that it dragged upon the ground.

The indications usually are to destroy the patient at once, since the prognosis must necessarily be extremely bad. The protrusion generally occurs before the expulsion of the fetus, and it then becomes almost impossible to extract the fetus without incidental injury to the intestine and infection of the peritoneal cavity. If it be possible to return the intestines with hope of saving the life of the patient, this should be done, and sutures applied or other measures taken to keep the intestines out of the way until the fetus has passed beyond the point of injury. After the fetus has been removed, if the utero-vaginal wound has not been previously sutured, or the sutures have torn out during birth, it may in some cases be practicable to suture the wound in a manner to guard against further prolapse and decrease the danger of infection.

7. Prolapse of the Bladder through a Rupture in the Floor of the Vagina

When the floor of the vagina becomes ruptured during parturition, there is a somewhat remote possibility that the urinary bladder may be forced through the rupture into the vagina. Necessarily, such a prolapse involves the bending of the organ upon itself to an extent which tends to cause an obstruction to the passage of urine through the urethra, and thereby favors distention of the bladder. The accident is an exceedingly rare one, and has occurred only with sufficient frequency to establish the possibility.

The symptoms consist of the presence of the prolapsed organ in the vagina or vulva, with its fundus turned toward the vulvar opening, or protruding through it, according to the degree of distention. The bladder is right side out, and shows the peritoneum upon its surface. A careful examination of the floor of the vagina will reveal the presence of the rupture, through which the organ protrudes. In the mare or cow, a further test of the character of the injury may be made by inserting a finger into the urethra and passing it along that canal until it turns upward, to reappear again in the vagina inside the prolapsed organ. The rupture must be anterior to the urethral opening to permit the prolapse.

The indications in such cases are to return the bladder to its proper position, under aseptic precautions, and suture the wound, bringing the peritoneal surfaces in contact. If the bladder should be so greatly distended that it is exceedingly difficult or impossible to return it through the rupture, the urine may be drawn off by passing a small trocar or hypodermic needle into the distended organ.

8. Uterine Intussusception and Prolapse

Intussusception, or eversion, and prolapse of the uterus is a common and formidable obstetric accident, especially liable to occur in cows, chiefly in large dairies where abortion infection is severe.

Usually the accident consists at first of an invagination of the anterior extremity of a cornu into the succeeding portion, essentially in the same manner as intussusception of an intestine. Should the invagination continue, the invaginated portion finally appears at the vulva, and, passing beyond, constitutes a prolapse or evagination. When the eversion becomes complete, there is necessarily involved with it a prolapse of the cervix, the vagina, and sometimes the bladder. In the incomplete forms, and in the beginning of the displacement, there exists merely an intussusception or invagination of one of the horns to a limited degree, and it is only by the extension of this that the accident becomes complete. In uniparous animals only the gravid cornu becomes everted, but the non-gravid cornu is prolapsed within the everted gravid one, hidden from view and recognizable only as a diverticulum opening upon the exterior of the mass. In multipara but one horn is usually involved, because its prolapse through the body of the uterus bars the eversion of the other. The chief cause of uterine prolapse is uterine inertia. It has been stated that in the cow, where uterine prolapse is commonest, physiologic parturition, including the expulsion of the fetal membranes, requires but one and one-half to two hours for completion. The involution of the uterus follows so rapidly that in forty-eight hours the obstetrist may grasp the uterus per rectum and hold the organ in the hollow of his hand. Such a uterus does not prolapse; it is the inert uterus which suffers from this displacement. Generally the inertia is referable to intra-uterine infection—the infection of contagious abortion. Rarely it is due to milk fever. The inertia permits the flaccid uterus to follow a fetus to which traction is applied and to become everted as the fetus is being extracted. If the uterus is vigorous, it contracts upon and behind the fetus and maintains its relations; if inert, it is pressed against the fetus by surrounding viscera, air is excluded, and the fetus, as it progresses, carries with it by suction the surrounding flaccid walls. After the expulsion or extraction of the fetus, the flaccid uterus again invites prolapse whenever the intra-abdominal tension is high (bloating, decubitis, etc.) and the inert organ is mechanically pushed out.

Since the accident necessarily demands the presence of a freely dilated cervical canal, it occurs soon after parturition. Prior to parturition, the foundation is laid by the intra-uterine infection for the eventual prolapse. During parturition, the second important step, the intussusception of the apex of the horn, occurs. The completion of the prolapse may occur after hours or days, or the intussusception may persist and the patient die without the prolapse becoming complete.

Anatomical peculiarities are believed to exert some influence upon the probability of inversion of the uterus. It has been pointed out, on page 25, that the anterior border of the broad ligaments of the uterus of the cow are attached far posteriorly to the abdominal walls, and as a result the uterus is not held so far forward in the peritoneal cavity. When pregnancy occurs, the broad ligaments become greatly amplified. At the time of parturition these bands are so greatly elongated that the uterus can readily become prolapsed, so far as these attachments are concerned, without their becoming ruptured or even very greatly stretched. This is believed to render the cow more liable to prolapse than the mare.

Retained fetal membranes are frequently charged with causing uterine prolapse. The hypothesis is not well expressed. The placentitis causing the retention of the membranes is due to an infection which develops in the utero-chorionic space during pregnancy. The infection induces uterine paresis, intensified by the presence of the decomposing membranes. Eversion is further facilitated by the fact that, in the presence of the membranes, the cervix does not undergo its normal constriction. Very naturally, any injudicious traction upon retained membranes favors prolapse.

Not rarely, parturient paresis acts as a distinct cause of prolapse of the uterus. Apparently this cause has been overlooked by many veterinary obstetrists. The ordinary symptoms of parturient paresis, such as coma and sub-normal temperature, are complicated by the uterine prolapse. In the cases I have observed, three in all, it could not be determined from the history whether the ordinary symptoms of paresis occurred first or the prolapse. Naturally, when uterine prolapse complicates parturient paresis the animal is recumbent, usually prone upon her side. This induces tympany, by which the paresis is aggravated and the replacement of the prolapsed organ is prevented.

Symptoms. When the displacement has only begun, the chief symptom is expulsive efforts, indicative of intra-uterine irritation. The animal is more or less uneasy. When the intussusception becomes halted in the apex of the horn, there may be merely symptoms of metritis.

In the larger domestic animals, where the uterus can be readily examined with the hand, a careful search may reveal the gravid cornu occluded at some point in its length by a hard projection in its canal. Upon examining this projection, an opening will be found in its center. The fingers may be passed around between the tumor and the direct wall of the cornu. A further study of the conditions present will show the obstetrist that he is dealing with inversion of the cornu. In the cow, the obsteterist may be able to palpate the intussuscepted horn per rectum. The involved portion is hard ; the free portion posterior to it is soft and flaccid. In the unicornual twins of the cow, as described on page 174, the intussuscepted apex can not be palpated through the genital tract but may be recognized per rectum.

If measures are not taken at once to remedy the displacement, the tendency is for the intussusception to extend toward and involve the body of the uterus and the vagina, and later appear at the vulva, to pass beyond and project as a large bleeding mass. Sometimes the invaginated portion is permanently arrested in the horn. The prolapsed uterus is characteristic in appearance, and should not be mistaken for any other organ. It may still be covered by retained fetal membranes. In ruminants the cotyledons, which are very conspicuous, reveal fully the character of the disease.

In the mare the mucous surface of the uterus has a dark red, velvety appearance, and is thickly studded with the placental villi. To the inexperienced, the appearance of the chorion may cause confusion between the membrane and the mucous surface of the uterus. They are well-nigh identical in their general appearance, and can be distinguished only by a careful examination. Especially is this true when the chorion is being expelled right side out, instead of being everted, as is usual, during its expulsion.

When the eversion is extensive and complete, it forms a characteristic tumor, varying in its appearance somewhat according to species. In the mare and cow it constitutes an immense pear-shaped tumor, which, when the animal is standing, hangs down in the neighborhood of the tarsus. The mucous surface has become external, and capillary hemorrhage occurs upon its surface. Litter and other foreign substances may be adherent to its exterior.

If the eversion has existed for some time, the organ becomes dark, and occasionally covered with an exudate, or, if it is of very long standing, with pus. It may be badly torn, abraded, or gangrenous. The position of the uterus causes an intense mechanical congestion and an enormous increase in size.

The general symptoms are by no means uniform. Occasionally a cow is observed, with her uterus completely prolapsed, grazing or ruminating. In some instances the condition produces such debility that the animal is unable to rise. Perhaps more frequently prolapse of the uterus occurs in animals so weak that, with this additional disturbance, they can no longer rise. In other cases the animal is recumbent because the displacement constitutes one of the symptoms of parturient paresis, and not because of the presence of the prolapsed organ. When gangrene of the organ occurs, the extreme debility and collapse from the septicaemia may bring about a paralysis which prevents the animal from standing.

The symptoms may be modified and complicated by the relations of neighboring organs, which tend also to become displaced. The vagina has necessarily been involved in each case of complete prolapse, and even the vulva is involved to a degree because of the great weight of the protruding organ dragging upon it, so that in many cases in the mare or cow, if the hand is inserted into the vulva, it can scarcely reach the boundary line of the vagina until it comes in contact with the recurved wall of the prolapsed organ. Naturally the bladder becomes partly or completely prolapsed through the vulva, within the vagina. The urethra becomes doubled upon itself in such a way as to interfere with the escape of urine. As a result, the bladder becomes distended with urine. Inside the uterus, one or more loops of intestine may pass out through the vulva and extend down to the fundus of the prolapsed organ.

The interference with the circulation in the organ, and the irritating effect of the air upon the uterus, constantly accentuate the tendency to engorgement. Its denuded surface offers an excellent avenue for the introduction of infection. Thus, uterine prolapse may lead to gangrene, abscesses, or tetanus. Fleming, citing Funk, records an instance where, in the bitch, the prolapse of one cornu prevented the expulsion of fetuses which still remained in the other horn, necessitating Caesarian section for their removal.

The prognosis of prolapse of the uterus is exceedingly variable, and must always be highly unfavorable except artificial assistance is given, since there is no possibility of spontaneous reduction. Fleming cites one case in a cow in which the organ was devoured by swine, after which she recovered. Generally speaking, death is inevitable, unless the case has judicious attention. Even then the mortality is high. The rapidity with which death occurs will vary according to circumstances and complications. In ordinary cases the animal may live for several days; in special instances, as in parturient paresis, death may ensue within a very few hours, rather because of the paresis than of the prolapse.

The prognosis depends very largely upon the promptness with which competent assistance is given. It is always unfavorable in neglected cases, and very much more favorable where prompt attention is given.

The prognosis is very greatly influenced by species; it is very much more favorable in the cow than in the mare. Fleming, citing Deneubourg, states that in an extensive experience he had not lost a case in the cow. The same author cites Moens as having had 27 cases without a fatality. Other writers have lost as high as 25 to 30 per cent. of cases in the cow. The statistics regarding fatalities are not reliable because, as in too many other reports of cases, there is a tendency for veterinarians to record their successful experiences and remain silent regarding those where the termination has been fatal. In the mare the accident is highly fatal. Saint-Cyr, from statistics given, records a mortality of 74 per cent., and Zundel of 50 per cent. These figures are probably misleading, due to the fact that the successful, and not the fatal cases, have been recorded.

In my experience, prolapse of the uterus in the mare has been very rare. One or two instances occurred where the prolapse appeared immediately upon the expulsion of the fetus, when the mare was in a dying condition, and when death followed within a few minutes. In only one instance, in the mare, did prolapse of the uterus occur in such a way as to call for definite treatment, and this animal survived. She was unable to stand after the reduction of the prolapse, and required slings. Before she had become strong enough to warrant their removal, tetanus set in, and the slings were retained until she recovered from that disease.

It is my regular practice to search for beginning inversion in each case of dystokia in the cow and the mare. Repeatedly I have recognized a beginning inversion of the gravid cornu in the mare. Having given it immediate attention, I have been able to correct the position of the organ promptly, and the animal has remained well.

In the cow my experience on the whole has been unfavorable, because I have encountered a number of cases as a complication of parturient paresis, which have proven universally fatal. In other instances the results have been more satisfactory, with recovery in more than 80 per cent. of cases. When I have attended a cow for dystokia I have not seen prolapse of the uterus follow, probably because I regularly searched for, and corrected any beginning intussusception. In the smaller animals, inversion of the uterus is highly unfavorable, in so far as replacement is concerned, but the animals very largely recover after amputation of the organ.

The relation of prolapse of the uterus to the future breeding powers of the animal has not been very carefully studied. It is generally held that if the organ is returned promptly the displacement has little or no influence upon the fecundity of the patient. This is not logical. It has been stated above that the prolapse occurs as a result of intra-uterine infection. The prolapse of the organ, the serious engorgement, the befouling of the naked placental areas, all conspire to render the existing infection more severe.

Once the accident has occurred, its recurrence is claimed to be probable at the next parturition. Writers advise that when such animals are rebred they should be watched the next time they give birth to young. I have not observed a recurrence.

Handling. In all cases of dystokia, the obstetrist should examine the uterus after the extraction of the fetus, in order to determine whether the organ has assumed its proper position and relations, and especially whether any inversion of the organ has begun. If such beginning inversion is present, as has repeatedly been observed by the writer, the obstetrist should reduce the intussusception at once, by applying pressure upon the advancing portion of the organ, either with the clenched fist or with the ventral surface of the fingers, taking care at all times not to wound or otherwise injure the organ. After the replacement of the organ, unless there are reasons to the contrary, such as a rupture of the uterus, the obstetrist should inject into the uterine cavity a large volume of warm physiologic salt solution. The uterus tends to become accurately replaced by the weight of the water and is cleansed from any irritants which may be present. The solution also stimulates energetic contractions of the uterus, favoring normal involution.

Complete prolapse or inversion of the uterus is ordinarily handled, especially in the larger animals, by replacement. Rarely in the larger animals, frequently in the smaller, the uterus is amputated. When it is desired to replace the prolapsed uterus, it is of primary importance that the animal should be placed in the most favorable position available. In the larger animals, where the prolapse has not existed very long, the standing position is frequently preferred. In many cases the patient, especially the cow, will not stand. Sometimes she can be induced to stand until the replacement is well advanced, when she obstinately throws herself down and undoes all that has been accomplished. Whether the animal is standing or lying, the posterior part of her body should be sharply elevated. This throws the weight of the abdominal viscera against the diaphragm and away from the pelvis, and tends to produce a vacuum in the pelvic cavity, favoring the replacement of the prolapsed uterus.

Though some veterinarians prefer to have the animal standing, those who have had extensive experience in very severe and difficult cases prefer that the animal be placed in lateral recumbency. When recumbent and the extremities are fully extended and secured, the patient is quite under control and can not undo the work by sudden movements. If the animal is to be handled in the recumbent position, it is essential that she be placed upon her side. Some hold that it is even better to place her upon her back. The attitude of the patient should be borne in mind, in every case of uterine prolapse, because it modifies the difficulties to be overcome, to a degree almost beyond belief. With a cow in the standing position, I had worked long and hard to return the prolapsed organ. Several times the operation had progressed far enough that almost the entire organ had been returned through the vulva, when expulsive efforts would come on and the cow would throw herself upon the ground and undo all. After this had occurred several times and I was completely discouraged, she again threw herself violently, fell into an excavation, and lay with her head down hill upon as steep a bank as would permit her to retain her position without sliding downward. She was then held down. When I attempted again to return the uterus, it fairly fell back into place after one or two minutes of work. The operation at which I had worked in vain for an hour or two was completed in a few minutes. Smaller animals, when suffering from prolapse of the uterus, are regularly to be more or less completely suspended by the hind legs. Where extreme difficulty is encountered in the mare or the cow, they too may be partially suspended with ropes and pulleys from a beam. The means for elevating the posterior end of the patient have been considered on page 359.

Having secured the animal in a proper position for the return of the organ, or having made the necessary arrangements for placing the patient in the proper position, the obstetrist should proceed to put the organ in proper condition for its replacement.

If the placenta remains attached, this should be removed if at all practicable. In the everted state, removal of the placenta is undertaken under the very best possible conditions, so that it is nearly, if not always, perfectly practicable and easy. It is needless to say that this should be done with very great caution, since any abrasions or lacerations of the uterus tends to produce very profuse hemorrhage.

In almost all cases of prolapse of the uterus, the organ has become more or less befouled with dirt of various kinds, and especially with manure and bedding, bearing abundant and serious infection, which it is the province of the veterinarian to overcome as far as possible. In order properly to cleanse the uterus, the organ must first be protected from further contamination by being placed upon a clean sheet, tray, or other suitable apparatus. Having provided ample protection, the operator should proceed to cleanse the organ, chiefly by irrigating it with a tepid physiologic saline solution, removing most of the dirt by mechanical washing, without irritating. The washing should be abundant and should be accompanied by gentle massage, which will tend to overcome the congestion of the organ, thereby decreasing its volume.

It should constantly be borne in mind by the obstetrist that the position of the organ, as related to the body of the patient, affects its size, and that, if the organ can be held somewhat above the level of the vulva, or at least as high as that organ, the blood tends to gravitate into the body, thus relieving the engorgement to an appreciable degree, and rendering the replacement more practicable.

If the uterus has been torn or abraded, the wounds should be given proper attention. If any perforations have occurred, they should be closed by means of sutures, in such a manner that the two peritoneal surfaces of the organ are brought in contact. Should any blood vessels be wounded, the hemorrhage should be controlled before it is attempted to return the organ to its position.

The chief obstacles to be overcome in the replacement of the organ are (a) the intra-abdominal pressure, (b) the engorgement of the uterus, and (c) the prolapse of the bladder through the vulva within the uterus, its distention with urine, and the prolapse of the intestines through the vulva, within the uterus.

(a) The intra-abdominal pressure is best overcome and a negative pressure (suction) established by placing the patient in the inclined position with the posterior parts elevated, as already advised.

(b) The engorgement of the uterus is best overcome by compression, massage, and elevation, combined. The compression is best exerted, in the mare and the cow, by means of a broad sheet of strong, smooth cloth, such as heavy muslin—a bed sheet in case of emergency. As a stock bandage, it is advised to use a piece of heavy muslin or light duck (8 ounces) 3 feet wide by 8 feet long. Slit each end on the middle line to within one foot of the centre, thus converting the piece into a four-tailed bandage, with a solid central area two by three feet. In the centre of this area make a circular opening large enough to admit the operator's arm and bind it in a manner to prevent its tearing. Entrust the bandage to two assistants. If the cow or mare is standing, one assistant takes his place on each side of the patient; if in lateral recumbency, one stands or kneels at the patient's back and the other at her hind feet. The operator adjusts the bandage with the circular arm-opening corresponding to the opening into the non-everted apex of the gravid horn. The two assistants compress the prolapsed uterus by exerting traction upon the tails of the bandage. By crossing the tails at either end, the central area is converted into a bag or pouch which envelops the uterus. According to conditions, any one of the tails may be drawn in any desired direction, so that the compression may be modified to suit the needs. One or more of the tails may be passed completely around the uterus and any degree of compression desired thus obtained. The operator should be careful to keep the uterus elevated above the vulva so that the blood will tend to gravitate into the body. The obstetrist should aid in the compression, applying at the same time judicious massage. Under this handling, the engorgement decreases rapidly.

(c) After the engorgement has been effectively diminished, any intra-uterine prolapse of the urinary bladder or the intestine is to be overcome. The operator introduces his clenched fist through the circular opening in the centre of the bandage and into or against the mouth of the non-everted portion of the gravid horn. The non-everted apex of the horn is then to be pushed forward cautiously toward and through the vulva, pelvis, and pelvic inlet, into the abdomen. While the operator is pushing the apex of the horn forward, he should carefully palpate for intestines, and for the urinary bladder which may be enclosed within the uterus. If the prolapse is recent, the urinary bladder will not be greatly distended nor constitute a very formidable obstacle. In any case, the operator needs press carefully upon the viscus and try to push it through the vulva. If he succeeds, the bladder resumes its normal position at once, and the urine may then escape. If the distention is too great to permit the bladder to be pressed through the vulva without danger of rupture, the obstetrist should draw off the urine with the catheter or a trocar.

A large hypodermic needle, pushed through the uterus into the bladder, will permit the urine to escape safely, but slowly. An ordinary intestinal trocar for the horse is far more convenient. The passage of a catheter through the reflexed urethra is especially difficult in the cow. The operator may insert one finger through the urethra, dilate the canal somewhat, then insert two fingers, and, holding the fingers apart, permit the urine to flow out between them. As soon as the bladder is well reduced in size, it is readily pushed through the vulva. The intestines, which may be prolapsed into the uterus, rarely, if ever, offer serious difficulty, but are readily pushed forward into the abdomen.

The preliminary search for the prolapsed urinary bladder and intestines, and their replacement, has incidentally accomplished the first step in the reduction of the uterine prolapse. After the obstetrist has pushed the non-everted apex of the gravid horn into the abdominal cavity, a considerable segment of the everted portion of the horn has necessarily followed. It is necessary to withdraw his hand, and in so doing to prevent as far as possible the replaced portion of the horn from following the hand and again becoming everted. This is to be accomplished largely by especially firm pressure exerted upon the prolapsed mass by the two assistants with the bandage. The efficiency of this part of the operation requires that the central arm hole in the bandage shall be as small as will freely admit the arm. The operator, with his free hand, should, while withdrawing the engaged arm, exert pressure against the margins of the cornual mouth. For this purpose, the thumb of the free hand may be inserted alongside the engaged arm, while the palm of the hand and the fingers are applied against the exterior of the prolapsed mass. As soon as the hand first inserted has been disengaged, it or the other hand is to be engaged in the margin of the non-everted portion, and again carefully pushed forwards into the abdominal cavity, carrying a second section of the horn into position.

The procedure is to be repeated as often as necessary, until finally the entire organ has been replaced. During replacement, the operator should constantly compress and massage the prolapsed mass. If desirable, assistants, in addition to those manipulating the bandage, may aid in the compression and massage of the prolapsed uterus. With the prolapsed uterus enclosed in the bandage, as advised, lay assistants are not very liable to do serious injury to the uterus in aiding with compression and massage under the supervision of the obstetrist.

It is essential in this operation that great care be taken not to lacerate or abrade the organ with the finger nails, push a projecting finger through the walls of the organ, or otherwise injure it. Throughout the operation, the prolapsed organ should be kept soft and pliable by frequent irrigation with warm physiologic salt solution.

Some advise that, instead of returning the apex of the gravid or everted horn first, the obstetrist should begin at that part of the organ which is nearest the vulva, and by this means press the uterus back through the vulvar opening. The assistants hold the organ in the same position as in the preceding plan. The operator, acting upon the proximal portion of the prolapsed mass, presses his hands on either side of the tumor between it and the lips of the vulva, and thus replaces first the vagina, then the cervix and body of the uterus, and finally the everted cornu, until the replacement becomes complete.

Another method of replacement is that of Coquelet, consisting essentially of applying a special pressure bandage until the organ is considerably reduced in size, when one of the two preceding methods is applied for replacing the mass. Coquelet passes beneath the prolapsed organ, close to the vulva, a clean piece of cloth about one yard in length and 28 to 30 inches in width. Its lower border is carried up over the distal end of the organ, and the ends are then carried up over the sides of the organ, until all are folded together on top of the uterus, completely enveloping it. While tepid water is kept constantly applied to the bandage, it is gradually tightened by pressing upon the mass underneath and pulling the corners of the bandage tighter and tighter until the desired amount of reduction has been brought about. The prolapsed organ is then replaced by the method described above, or otherwise.

After the uterus has been returned through the vulva, it is essential that the operation should immediately be completed. Otherwise, expulsive efforts recur and the organ is almost certain to become prolapsed again. When the uterus returns into the vagina, the operator's hand should follow it and should trace out each part of the cavity. Especially should he clearly distinguish the two cornua of the organ and make a careful search of the gravid horn to see that the invagination of that part has been completely overcome. If the replacement has been carried out as advised—the apex replaced first, and the base last—once the prolapsed mass is pushed through the vulva the replacement is probably complete. If the replacement is commenced at the base of the organ (which I oppose) when the prolapsed mass is pushed through the vulva the gravid horn is naturally still intussuscepted and the existing invagination must be overcome by placing the clenched fist or the open hand against the mass and pushing upon it until the intussusception has been completely overcome.

When the complete replacement has been accomplished, it is well to keep the hand in the cavity of the organ for a few minutes, until straining and uneasiness cease, and the organ has undergone some contraction and begins to recover its tone. Sometimes severe straining continues, with the probability of a recurrence of the prolapse. The most efficient means for overcoming the expulsive efforts is the introduction into the uterine cavity of a large volume of a warm physiologic salt solution or a one-fourth per cent. solution of carbolic acid, which not only completes the replacement but also soothes the organ, washes away any blood clots or extraneous matter, and favors a normal involution of the organ. As soon as the uterine cavity is well filled, the fluid excites expulsive efforts, by which the solution is thrown out. The contractions aroused in the uterine walls cause each part to become properly replaced in detail.

If the straining is very persistent, after the organ has been replaced as well as possible, and the measures above suggested have been carried out, it may be necessary to resort to the use of narcotics or anaesthetics. Among the various remedies to overcome the straining, the obstetrist should not forget those which may act locally. The tepid saline solution or the very weak solution of carbolic acid tends to decrease the irritation and overcome the straining. Iodoform acts well as a local anaesthetic, tends to guard against infection of the uterus, and consequently becomes of very great importance in retaining the organ in position. The powdered iodoform should be introduced into the uterine cavity in a gelatin capsule, the capsule opened, and the powder scattered thoroughly.

Among the remedies which have a powerful influence in controlling the straining, chloral hydrate occupies an important place. It may be administered in draught or in enema. Some obstetrists have advised the use of ether as a general anaesthetic; others have advised the use of opium as a narcotic. Opium and morphine are not reliable agents in ruminants and solipeds, and may excite rather than soothe.

As a general rule, there is no call for the use of either narcotics or anaesthetics. If the uterus has been properly cleansed, without the use of irritants, and has been properly replaced in every detail, expulsive efforts are rare. If the patient is very weak and unable to stand, displacement is probable and an anaesthetic, by relaxing the entire body and rendering tympany highly probable, may favor the displacement instead of preventing it.

In the smaller animals, where the uterus is so small that the hand can not be introduced, the reposition of the prolapsed organ is rendered difficult and somewhat dangerous. It frequently fails. To a certain degree, the finger may be used to replace the organ, but can not follow the uterus to assure complete replacement. In order to bring this about, it may be necessary to use a sound, which needs be of large size and well rounded at the end in order to guard against puncture of the organ. A horse catheter or a similar instrument may be used to push the organ into position, or, as Fleming suggests, a candle, properly rounded at one end. If the small animal is suspended by its hind legs, and warm water poured into the vagina by means of a hospital irrigator, the weight of the water, with the position of the patient, tends to complete the replacement. In the sow it must be remembered that, since the narrow tubular horn may be 24 to 36 inches long, several times longer than the greatest diameter of the abdominal cavity, complete replacement with a sound is impossible.

Since in most cases, when the prolapsed uterus has been promptly reduced and properly replaced, the animal becomes calm and ceases to strain, a recurrence of the prolapse is not probable. This holds true especially in all cases where the animal can stand. Many obstetrists deem it essential, nevertheless, that some mechanical appliance should be used to prevent a recurrence. However advisable this may be, it should not tend in any way to decrease the attention of the obstetrist to the measures which have been advised for bringing about a thorough replacement of the organ in every detail, its proper cleansing and soothing by irrigation, and the stimulation of the uterus to normal involution. When these are done, and thoroughly done, it is only in a minority of cases that any mechanical appliances for the retention of the organ are essential or desirable. Admittedly, however, it is very unfortunate to leave an animal without adequate protection, and permit the prolapse to recur after the obstetrist has left the premises. A variety of appliances for the retention of the uterus in position have been recommended or condemned by this or that veterinary obstretrist, largely according to his personal experience or prejudice.

Pessaries have long been used for the purpose of retaining in position a uterus which has once been prolapsed. They consist essentially of an elongated, rigid shaft, which may be passed through the vulva and vagina into the uterus, and retained there by some form of external bandage or other mechanism. The end inserted into the uterus is fitted with a large, round head of metal, wood, cloth, or glass. The vulvar end is fitted with a ring, perforation, or other means for securing it to the external bandage. When properly placed and secured, pessaries prevent displacements. The uterine end needs be large and smooth, in order to avoid possible injury to the uterus.

The pad pessary is made of a stick of wood 20 or 25 inches in length, with a pad as large as can readily be introduced through the vulva, fixed to the uterine end. This is firmly secured to the wooden stem, so that it cannot become dislodged; through the other end of the shaft a cord is passed by which it can be fastened to a bandage, so that the instrument cannot be forced out of the organ.

Some veterinarians construct a pessary of metal, with a small ring upon the uterine end. Laymen sometimes take a large wine or beer bottle, fasten a stick in its mouth, introduce the large end of the bottle into the uterus, and retain it there with a bandage.

The value of the pessary in veterinary obstetrics is very questionable. Almost inevitably it causes discomfort to the patient, and tends to induce expulsive efforts. If for any reason the pessary becomes disconnected—if the pad slips off the end of the shaft—

the naked stem is liable to be forced through the uterine wall and cause serious injury. The most formidable objection to the pessary is from the standpoint of inducing uterine infection. It exerts a concentrated pressure upon a small area of the organ, weakening the tissues and rendering them more susceptible to infection. The stalk of the instrument constitutes a highway from the exterior to the cavity of the organ, along which bacteria may pass freely. The pessary is rarely used, and still more rarely advisable.

Sutures, in great variety, have been recommended. They are usually passed directly through the lips of the vulva. It is better to insert them through the skin and aponeurosis upon either side of the vulva, thus avoiding the wounding of the vulvar mucosa. Necessarily, they must be strong and deeply inserted, in order to afford that amount of security which the obstetrist desires. Usually two sutures will suffice. A very good plan, with the cow or the mare, is to insert a long, heavy needle, armed with silver wire or silk tape at a point one or two inches below the superior vulvar commissure, and an equal distance laterally from the median line. Insert the suture deeply through the skin and aponeurosis, and bring it out one or two inches above the inferior vulvar commissure and an equal distance laterally from the median line. Tie the two ends of tape together. Insert a second suture of similar character in the tissues upon the opposite side of the vulva. Then take two pieces of tape and tie them across the vulva from one suture to the other, one at the upper ends and the other at the lower ends of the sutures described. These should be so tied that they may be readily untied and readjusted.

The efficiency of sutures in preventing a recurrence of prolapse of the uterus is high, but not perfect. If the straining of the animal is very violent, the sutures may be torn out by the great force. When there is little or no straining, they remain in position, and are effective. At least the prolapse does not recur. This may be because the sutures do not readily permit it, or because the animal does not strain and the prolapse would not occur anyway. The labial sutures have the further disadvantage that they produce wounds in the birth canal at a time when it is highly susceptible to infection.

Sutures necessarily cause pain, and suture infection inevitably ensues. Consequently it must be confessed that sutures, like the pessary, have objections, but not the same in each case.

The bandage, or truss, is usually constructed of ropes (Fig. 139) and is so arranged that it may compress the vulvar opening,

FIG. 139. ROPE TRUSS OF RAINARD. (de Bruin.)

offering thereby a more or less effective obstacle to the protrusion of the uterus. The truss is conveniently made from two pieces of cord about one-half inch in diameter and twelve to fifteen feet long. Each is doubled in the centre, and the two are united by a loop in their middle, in a way to leave an oval space somewhat in the form of a ring, which will surround and include the vulvar opening, but not completely close it. The two ends of one of these cords are then passed downwards between the hind legs, on either side of the udder, and thence forwards and upwards, to meet and be tied together at the region of the dorso-lumbar articulation. Thence the ends are continued downwards and forwards, to pass between the two fore legs, there to be attached to, or concur in the formation of a collar. The free ends of the other cord are to be carried upwards on either side of the tail and tied together over the loins, thence carried downwards and forwards beneath the sternum, tied together, and turned upwards and forwards to reach the withers, where they are to be tied to the collar or contribute to its formation. When so applied, the ropes tend to continue their compression when the patient arches her back to strain. If the cords are carried straight forwards, from the vulva along the back and belly, they are immediately loosened whenever she arches her back. Some obstetrists prefer a metallic loop, through which compression is to be exerted upon the vulva. It is maintained in position by cords arranged the same as the rope truss.

With many veterinary obstetrists, the truss holds first place as a means for retaining the uterus, after it has been replaced. It is exceedingly difficult so to apply a truss that the patient can not force the uterus out if she strains persistently and vigorously. Trusses generally become relaxed and loosened when the patient arches her back to strain. The truss can not prevent the inversion of the organ and its passage into the vagina and vulva, but can only tend to prevent its prolapse through the vulvar opening. This is equally true of sutures. While this truss is recommended by one and that truss by another, the best one always is that one which is best applied. The scientific value of the truss is not so great as many suppose, but after all it has an important influence from a sentimental standpoint, and has none or few of the objections which can be raised against sutures and pessaries. Since the owner of an animal which has suffered from prolapse of the uterus is constantly afraid of its recurrence, it is good practice to apply the truss in the majority of cases simply to allay his fears, if it accomplishes nothing else. Should the truss become displaced somewhat, and the prolapse recur, the owner still considers that the veterinarian has at least attempted the retention of the organ. It is preferable to show the owner how to apply the truss, should it become necessary, and then have him watch the patient and care for her so that the truss will not be needed. This applies to the patient which is able to stand. With a recumbent patient the case is graver, and retention apparatus may be imperative. She should be kept with her hind parts slightly elevated. The abdominal pressure should be reduced to a minimum.

The handling of prolapse of the uterus, after the organ has been replaced and the precautions against a recurrence taken as suggested, demands little except caring for the general well-being of the animal. It is well to bear in mind that any increase of the intra-abdominal pressure tends constantly to force the organ backward. This may be largely avoided by unloading the alimentary canal with one of the hypodermic cathartics, as eserine or arecoline. The alimentary canal should be kept nearly empty, by allowing a concentrated and laxative diet.

If the weather is suitable, the animal will be quieter, and will not show the same tendency to strain, if given her freedom in pasture, where she can constantly move about in search of food. In many cases when the animal seems to be very much irritated and shows a great tendency to strain, if she is led about gently for a time and her attention attracted, the irritation may soon abate. The exercise tends to bring about a more thorough adjustment of the organ, and stimulates the normal circulation and involution of the uterus.

It is needless to say that any food which may tend to cause tympany should be carefully avoided, and that constipation should not be permitted to occur. If an animal becomes tympanitic, that alone may suffice to bring about the prolapse of the organ, simply as a result of the increased intra-abdominal pressure.

When there is reason to fear metritis following prolapse, its avoidance should be attempted by frequent irrigations with mild antiseptics or physiologic salt solution and the liberal application of powdered iodoform in the uterine cavity. When metritis follows replacement and retention of the prolapsed organ, it should be handled according to the general directions for that malady.

The truss or sutures may be retained in position for one to three days, according to conditions, or, if straining continues, possibly for even a longer period of time.

Amputation of the uterus may be advisable when it is impossible to bring about a reposition of the organ. In nearly all cases of prolapse in large animals, it is possible to return the organ and retain it in place. It is claimed however that cases do occur in which reposition can not be attained. This is especially true in the smaller domestic animals with very long uterine horns.

In some cases of prolapse of the uterus, when the organ has remained extruded for some time, it may have become more or less necrotic and seriously infected. The replacement of such a uterus is often followed by serious and even fatal consequences to the patient. If the uterus has been prolapsed for a few hours only, it is not gangrenous as a rule, because the eversion of the organ does not wholly cut off the circulation, but only interferes somewhat by doubling the vessels in their course, so that the blood supply may be maintained for a long time, and in some cases almost indefinitely. As soon as the organ hangs down from the vulva in a complete state of prolapse, the interruption to the circulation is intensified by the force of gravity. If the organ has been seriously injured by rough handling during dystokia, has been bruised or crushed against the floor or wall, or has for a long time been greatly soiled by highly infectious manure, gangrene is frequently inevitable. It is inadvisable to return such a uterus into position. The condition may cause a recurrence of the prolapse, in spite of any precautions to the contrary ; if the organ is retained in its position, it may induce sepsis and cause the death of the animal.

Usually extensive wounds of the uterus call for amputation, especially when penetrant and complicated by severe peritoneal infection. When only a small wound, or even a large one which is moderately clean occurs, amputation is not necessary. It is better in such cases to suture the wound and retain the uterus. It is by no means essential that the entire uterus should be amputated because a portion has been damaged beyond recovery. It is just as safe to amputate one-fourth or one-half as to amputate all of the organ, and sometimes it may be of fundamental importance to save a portion of the uterus, if the power of breeding may be retained. When a wound is present, which can be closed accurately by means of sutures, the operation is as safe as the ablation of the organ.

The prognosis of amputation of the uterus varies in different animals, and under different conditions. In the mare it is usually unsuccessful. In the cow it is a fairly successful operation, if undertaken in due season and carried out with proper care. In the smaller domestic animals it is usually quite successful, especially in the sow and carnivora.

Technic. Before proceeding with amputation, the entire prolapsed organ is to be carefully cleansed, and placed upon a sheet of sterile gauze or other material, where it may be well protected during the operation. The uterus, except at the operative area, should be carefully covered or wrapped with sterile or antiseptic gauze, in order to prevent contamination of the operative wound from the infected surface. If the condition of the uterus warrants, the blood accumulated in it should be forced back into the circulatory system, so far as practicable, by compression with the bandage of Coquelet, described on page 567, or by other means.

Great care should be taken that other viscera are not included in the operation. The bladder may extend into the prolapsed organ, and be caught or damaged in the operation. Very frequently a loop of intestine projects into the peritoneal sac of the prolapsed organ. Numerous instances have occurred where veterinarians have carelessly ligated the organ and included the intestine, causing the death of the patient. In order to determine whether any viscera extend into the cavity of the prolapsed organ, the veterinarian should always open the peritoneal cavity of the reversed uterus, and make a careful manual exploration of its interior. The amputation is to be carried out by ligating or suturing the uterus, cervix, or vagina upon the vulvar side of the point of excision. In small animals, where frequently one horn only is prolapsed, the prolapsed horn may be ligated at its base, and the other horn not disturbed. Ligation has been the rule of practice. The layman and the crude veterinarian of the early days of the profession established so firmly the idea of ligation that it still holds sway. In the small animals, ligation is fairly surgical, because the calibre of the genital tube is so small that it may be brought into close approximation and its circulation blocked without complex foldings of the walls of the tract. In the mare and cow, the immense size of the genital tube makes it impossible to apply a ligature smoothly with equal pressure upon each part. The application of the ligature inevitably throws the thick walls of the genital canal into many folds. The compression can not be alike upon each part of each fold. The mass is so great that the ligature can not well be effectively applied. It should produce immediate ligation-necrosis upon the peripheral side, but it does not. Instead, the blocking of the circulation is incomplete, and, as the engorgement of the tissues yields to the ligature, the latter becomes loosened. Then the margins of one or more folds may slip out and the stability of the entire ligature be disturbed or destroyed. For these reasons, the ligature should be discarded in the large animals and the more surgical and accurate sutures employed.

Some operators advise that the uterus be ligated in parts; others that it be ligated in toto. The latter is the usual custom. The material for the ligature may vary according to availability in a given case. One of the best and most satisfactory materials is silk tape, which is soft and very strong, so that it will admit of being drawn very tight. Some veterinary obstetrists use a heavy cord of almost any character, and some advise the use of a moderately thick and strong pure gum tubing. In default of other more suitable material, a pure gum horse catheter will answer admirably. The elastic ligature has the advantage of automatic tightening as the engorgement of the ligated tissues gives way. The ligature must be applied so tightly as to cause immediate necrosis on the distal side. For this purpose powerful traction is required. In applying the elastic ligature, a piece of stout cord should be laid upon the uterus, parallel to its long axis, and the ligature applied tightly around the uterus, over the cord. The cord is then tied over the ligature to hold it. The ligature may be passed two or more times around the organ, according to its strength in comparison to the size of the uterus.

The stability of the elastic ligature may be increased if the operator will leave the ends of the fixation cord quite long; after tying them firmly about the elastic ligature, thread the two ends of the cord into sufficiently large needles; carry them through the ligated organ to the opposite side, one in front of the elastic ligature and the other behind it; and tie them firmly over the elastic ligature opposite to the first tie.

When the ligature has been securely applied, the uterus may be cut off at a safe distance beyond it—in the cow usually about three to four inches. Care should be taken to leave a sufficiently large stump to insure the ligature against slipping when the vagina returns into its position. It is inadvisable to leave an unnecessary amount of tissue, which must inevitably undergo decomposition and consequently add to the volume of infection.

The ligature should come away ordinarily after five to ten days, along with the necrotic stump of the uterus. Pending this time, the vagina should be irrigated daily with antiseptics.

In the amputation of the uterus, the veterinarian should aim, in all cases where it is practicable, to include the ovaries in order to eliminate the annoyance of estrum in the permanently sterile animal.

Amputation by means of sutures is more surgical and safer than the ligature. After the thorough cleansing of the prolapsed organ and the careful manual exploration of its peritoneal cavity, to make sure that it does not contain the bladder or the intestines, it should be grasped and extended by an assistant.

The row of sutures should be placed horizontally—that is, the suture line should be parallel to the broad ligaments of the uterus and vagina. In healing, this will tend to leave a flat vulvo-vaginal floor, without interference with the ureters, bladder, or urethra. The assistant should therefore hold the uterus spread out flat from side to side. This plan may be facilitated by constructing rude clamps from two pieces of wood of sufficient length (approximately twelve inches) tying them together at one end with a stout cord, passing the free ends over the prolapsed organ, pressing the ends together, and tying them securely with a cord. An assistant holds the uterus by grasping the clamps. The suturing may then occur immediately against the distal side of the clamps. If the precautions advised regarding prolapse of the bladder or intestines into the uterine sac have been taken, the sutures can be applied without any possibility of wounding other viscera. The clamps should be so adjusted that, while completely controlling hemorrhage and adequately securing the uterus, they shall not press so severely upon any portion of the tissues as to imperil their life.

The sutures should be of heavy braided silk, and should be interrupted and overlapping. That is, in the cow or the mare the initial suture should be inserted three-fourths to one inch from the margin and the margin included within the suture when tied. The second suture is to be begun either upon the vulvar or the ovarian side of the first, about one-fourth inch nearer the margin of the uterus than the median end of the first suture. The median end of the second suture is to be brought out one-half to three-fourths of an inch on the median side of the first suture. Each suture is to be drawn tightly and tied securely. Having each suture slightly overlap the preceding suture insures the final engagement of all parts of the genital canal, obviates hemorrhage, and causes immediate necrosis of the distal parts.

After the sutures have been properly applied, the uterus is to be excised one to two inches upon the ovarian side. The cut margins are then to be carefully disinfected. This is to be followed by a continuous suture of silk applied deeply to the cut margins, as in overcasting a seam. The suture area should next be carefully dried with sterile gauze, dressed with tincture of iodine, the alcohol permitted to evaporate, and the stump released and returned through the vulva. Iodoform ointment or iodoform suspended in oil may be introduced into the canal to allay irritation. The vulvo-vaginal canal should be cleansed and disinfected once or twice daily by douching.

II. Prolapse of the Rectum

Prolapse of the rectum occurs rarely as a result of expulsive efforts during or immediately after the act of parturition. In the horse the anus becomes somewhat everted normally with each defecation, but returns at once to its position when the act has been completed. This peculiarity is regarded as a predisposing cause of rectal prolapse.

Slight eversion of the rectum is not uncommon in the mare, on account of the violent expulsive efforts. In some cases of difficult parturition, where the animal is not attended constantly, the prolapse of the rectum may become extensive and imperil the animal's life.

In one case occurring in my practice, a valuable mare, suffering from dystokia, was found with the rectum prolapsed to the extent of three feet, involving about six feet of the organ. With some difficulty it was replaced, and the extraction of the foal accomplished without material delay or visible injury to the rectum or genital organs, but the patient perished a few hours later. Extreme prolapse of the rectum is sometimes observed during parturition in the sow.

During labor the obstetrist should make note of any threatened eversion of the rectum, especially in the mare, and should take all necessary precautions against its occurrence. This may be best accomplished by having an assistant press upon the anus with a towel or other cloth. When the organ has already become prolapsed, it should be replaced as promptly as possible, and retained in position. It should be carefully cleansed by bathing with physiologic salt solution, but does not ordinarily call for disinfection, since it must again become infected as soon as feces pass back into the portion which has been prolapsed. As the organ returns it should be followed by the hand to make sure that all parts of the walls are straightened out.

The prognosis of prolapse of the rectum in the mare during parturition is highly unfavorable. In other animals the prognosis is more favorable.

12. Prolapse, or Eversion of the Bladder

Eversion of the bladder may occur in any animal. It has been noted chiefly in the mare, though it has been recorded in the cow and sow. The very wide urethral opening of the mare tends to make the eversion more probable, because more room is afforded through which the organ may pass.

The eversion of the bladder may occur at any time immediately prior to, during, or following labor. The accident, when occurring before or during parturition, does not constitute any great impediment to the expulsion of the fetus, but the integrity of the organ and the life of the patient may be endangered during the passage of the fetus through the vulva. When eversion occurs after the passage of the fetus, the danger to the patient is less.

The causes of eversion of the bladder are chiefly the exalted intra-pelvic pressure due to expulsive efforts, and, in the mare, the very large urethral opening.

The symptoms of eversion of the bladder are such as to render diagnosis easy and clear in the majority of cases. A tumor appears, which is somewhat pear-shaped and has its attachment on the median line of the floor of the vulva, at the point where the urethra normally exists. The urethral opening has disappeared, and its place has been taken by the everted organ. The tumor varies in size, according to its degree of congestion, which is largely dependent upon the duration of the eversion. If the eversion is recent, or if the bladder has not protruded beyond the vulva to any great extent, or has not been seriously abraded or injured, it presents a fresh mucous surface. Upon either side, near the neck of the tumor, may be observed the two uretral openings, from which urine escapes drop by drop, or sometimes in small jets during an expulsive effort. If not much swollen, the bladder may remain almost or completely hidden, especially when the animal is standing, to become exposed when she is lying down or straining.

Eversion of the bladder is to be differentiated chiefly from *hernia* of the bladder, through a rent in the vaginal floor, and from hematoma or tumors in the vagina or vulva. In rupture of the vaginal floor with *hernia* of the bladder, the *peritoneal* surface of the bladder remains external, and the ureters, still emptying inside the organ, may cause it to become distended with urine. The rupture in the vaginal floor is recognizable. The urethra is present in its normal position on the vulvar floor. Through it the finger or a catheter may be passed into the herniated organ. The *mucous* surface of the *everted* bladder is external, and the ureters open upon the external surface. The viscus does not become dilated with urine. The meatus urinarius is absent.

In the handling of eversion of the bladder, the organ should first be thoroughly cleansed by washing with a non-irritant fluid, such as a physiologic saline solution. The organ should be examined and proper attention given to any injuries. If any perforations of the walls exist, these should be carefully closed by means of sutures, so applied that the peritoneal surfaces of the lips of the wounds are brought into contact. If a portion of the wall of the organ has been severely lacerated or contused or has become so badly infected or otherwise damaged that its recovery cannot well be expected, the damaged portion should be removed and the edges of the wound brought together, thus amputating as much of the organ as may be necessary. In such an operation it is essential to preserve the outlet of each ureter.

After due preparation, the organ is to be returned into its normal position, through the urethral opening. Usually the operation is not difficult, especially if the organ has not been long everted. Grasping the organ in the hollow of one or both hands, the operator should press firmly and evenly over the entire mass until it gradually returns into its position. Generally the operation cannot be carried out hastily. Firm and evenly applied pressure with the hands gradually forces the blood out of the organ, and reduces its volume, until finally, when the engorgement has largely disappeared, the organ returns through the urethral opening. General anaesthetics or narcotics, such as chloral and morphine, may be used in order to overcome the expulsive efforts, by which the replacement or retention of the organ is made difficult.

After replacement, any irritation present may be ameliorated to some extent by irrigating the cavity with a warm saline solution. If this does not suffice, local anaesthetics may be applied, such as cocaine with adrenalin chloride.

The prognosis in prolapse of the bladder is usually favorable, if it is handled early and properly.

13. Rupture of the Perineum

Owing to certain anatomo-physiologic facts, perineal injuries from parturition are confined almost wholly to the mare except in the third type enumerated below. The expulsive efforts of the mare are preëminently violent, the limbs of the foal are very long and rigid, and the peritoneal infundibuli surrounding the rectum and vagina are extensive, permitting the vulvo-anal sphincters to be pushed far backward in response to intrapelvic pressure.

Perineal injuries are chiefly of three forms:

(1) Vagino-rectal or vulvo-anal perforations producing a fistulous opening between the digestive and the genital tracts.

(2) The extension of the preceding injury to include the entire vulvo-anal partition.

(3) Lacerations of the vulva without penetrating the ano-rectal cavity.

The long and rigid feet and limbs of the foal predispose them to deviation. When deviated upwards, especially when a foot of the foal is crossed over its head, the toe may be directed upwards against the roof of the vagina and the floor of the rectum, which, being flaccid, the toe pushes upwards into the rectum, and probably through the anus. If the veterinarian or owner observes the disaster early, he may be able to force the foot back, out of the rectum and into the vagina, leaving an extensive communicating wound between the vagina and the rectum. If the accident is not observed and remedied at the critical moment, the foal is forced rapidly along, the one foot protruding from the anus, the other foot and the head from the vulva. The injury renders the expulsive efforts of the mare more violent, the fetus is thrust forward with great force, and the entire ano-vulvar partition is torn asunder, causing a vast cloaca into which empty the rectum, vagina, and urethra. The disaster may occur otherwise. In one case, related on page 517, the owner tore away a fetus in the anterior presentation with lateral deviation of the head and completely ruptured the perineum. The principle of the injury was somewhat analogous. Apparently the prominent curvature of the neck, or possibly the poll, pushed the vaginal floor upward, the projecting bent neck or the poll caught in front of the anus, the anal sphincter yielded, the neck or poll protruded through the anus, and the vulvo-anal partition was torn asunder. In each case the tear is from before backward and from above (anus) downward.

The third group of injuries is fundamentally different in cause and character. The vulva is too small, the fetus is comparatively large, or there is present some disturbing deviation, and the vulvar sphincter ruptures. The tear is usually directed obliquely upward and outward from the superior commissure of the vulva, and tends to pass alongside the anal sphincter, between it and the sacro-sciatic ligament. It is a centrifugal tear from the vulvar opening outward, due to a body which is too large being forced through the vulva. Rarely, if ever, does it involve a rupture of the anal sphincter.

The symptoms of a rupture extending from the vulva or vagina into the anus or rectum, without involving the sphincter muscles, are not well marked externally at first, but may be followed soon by swelling. At the time of the accident the obstetrist or attendant may observe that some portion of the fetus has passed from the vulva or vagina upward into the anus or rectum. Later, feces drop occasionally from the vulva. The relative amount of feces which may escape from the vulva and anus respectively will depend upon the size of the opening. Sometimes but small quantities of feces escape from the vulva; sometimes most of the feces escape thus. There is frequently an involuntary passage of flatus, especially when the animal is driven at a trot.

When the rupture of the perineum is complete, the symptoms are well defined and very evident. At first there is more or less hemorrhage from the lacerated tissues. The tissues are greatly frayed and befouled with feces, which drop into the wound, and thence into the vulva. There is intense infection, followed by extensive swelling and suppuration, with necrosis of the lacerated tissues. After a time the lacerated wounds heal, with cicatricial deformity. There is no reunion of the divided parts, but each portion separately granulates and heals, leaving the perineum divided. The feces fall constantly into the vagina, from which they drop involuntarily, after causing chronic irritation, thickening, and suppuration of the mucous membrane. If the animal is moved at a rapid pace, there is an involuntary passage of air in and out of the cloaca, which causes a repulsive sound. When the air is involuntarily forced out in gusts it usually carries with it particles of fecal matter. Complete rupture of the perineum is one of the most repulsive injuries met in veterinary practice.

The prognosis of rupture of the perineum depends chiefly upon the character and degree of the lesion. When the rupture results in a recto-vaginal fistula, the prognosis is favorable as to the life of the animal, and moderately favorable as to her usefulness, but as a general rule the animal makes an objectionable noise when being trotted, owing to the involuntary escape of flatus from the rectum through the vulva. It is possible for such animals to breed, providing the fistula is of such a character that the penis of the stallion will not become engaged in the opening during coition. The probability of bringing about a complete recovery by obliteration of the fistula has always been remote. I have made repeated efforts in two cases to bring about a closure of the fistula, and in each instance not only failed absolutely, but left the fistula larger instead of smaller. A few cases of complete recovery from this injury appear to be recorded; the failures are apparently left unpublished.

When the rupture involves the complete destruction of the sphincters of the anus and vulva, and includes the floor of the rectum and roof of the vagina for some inches forward, the prognosis is highly favorable for the life of the animal. There have appeared from time to time records of complete recovery following sutures, but there has been ominous silence regarding the failures. How great the proportion of failures is not known, but it must certainly be very, very high, probably more than 90 per cent. Personally, I have never obtained a recovery nor had the privilege of observing one in the hands of other veterinarians.

In almost all cases the wounds granulate and finally cicatrize, but the lips of the wound do not unite, and the anal and vulvar cavities remain one, with the feces dropping into the vulva. An animal with complete perineal rupture, which has failed to unite, is usually sterile. The conditions are such that successful copulation can not readily occur, because the penis of the stallion becomes deflected upward into the rectum. As work animals they are worthless, because of the repulsive sound of the involuntary passages of air in and out of the cloaca and the fragments of feces accompanying the expelled air, which scatter in every direction. Unless complete recovery can be obtained, the value of the animal is virtually ruined except for the temporary purpose of nursing the foal, should it be born alive. After this service has been rendered, the mare usually passes into the hands of low dealers. Unless complete recovery can be attained, it is usually better for sentimental and humane reasons to destroy the animal.

In the third group of lesions, which consists chiefly of the tearing of the lips of the vulva at or near the superior commissure or elsewhere, without involving extensively the sphincter of the anus, the prognosis is highly favorable. Under proper surgical attention, the animal should be completely restored to usefulness in the vast majority of cases.

Handling. In the two first groups, in spite of the very unfavorable prognosis, attempts should be made to bring about complete recovery, always giving an unfavorable prognosis, and thus placing the operator in a proper position before the operation is undertaken. There is nothing to lose, and if success follows the effort, the gain is the value of the animal.

Views vary as to the most opportune time at which an operation should be undertaken. Some veterinarians recommend operating immediately after the injury; others counsel delay until the lacerated tissues have sloughed away and granulation is established over the entire wound surface. In this the operator should be guided somewhat by circumstances. If he is called immediately, before a serious infection of the wound accompanied by great swelling has taken place, it would appear preferable to operate at once. If the operation has been delayed until the wound margins have healed, it becomes necessary to denude them entirely of epithelium.

Prior to undertaking the operation, the alimentary tract should be thoroughly and completely evacuated, so that the necessity for the passage of feces over the freshly closed wound may be reduced to the minimum. Such unloading is best accomplished with repeated small doses of eserine or arecoline. A mare of medium size may take 0.75 to 1 grain of either alkaloid, which should be repeated every forty-five to sixty minutes until the intestines are apparently empty.

The vulva, anus, perineum, buttocks, and tail should be thoroughly disinfected.

The animal is to be placed in lateral recumbency, for which purpose the operating table furnishes by far the best means and places the patient in the best possible position for the convenience and efficiency of the operator. If a table is not available, the patient may be secured upon an improvised platform of boards or straw, and sufficient elevation acquired to render the operative field available.

The patient is then to be placed under complete general anaesthesia with chloroform or chloral. Local anaesthesia does not answer fully, because the animal will resist the confinement and interfere with the operation even in the absence of surgical pain.

The vagina and rectum are to be thoroughly washed. They can not be disinfected. Concentrated disinfectants applied to the rectal and vaginal mucosa induce an irritation which will later cause swelling and straining. The operator should accordingly do much of the cleansing by means of irrigations with warm physiologic salt solution, followed, if thought best, by copious irrigations with a very weak solution of carbolic acid, creolin, or lysol.

The tail should be completely enclosed in an antiseptic bandage, and securely tied out of the operator's way. Antiseptic towels or cloths should be spread in abundance over the buttocks and thighs, and secured in position by means of safety-pins. The table or floor just beneath the field of operation should also be carefully covered with antiseptic towels or gauze. After these precautions have been taken, the vagina and rectum are to be carefully wiped dry with sterile gauze. If the wound is recent, any necrotic or maimed tissue fragments are to be carefully excised with scissors. If the wound margins are covered with epithelium, this must be carefully and completely removed.

The recto-vaginal cloaca is to be widely dilated by means of retractors, and the recto-vaginal walls upon either side of the wound grasped with double tenaculum forceps and drawn backwards as far as possible, bringing them essentially external to the vulvar lips.

There has been no generally standardized or accepted method for applying sutures. There can be no standard method until greater success is attained. The sutures may be applied by any reliable method. A good plan is to take heavy braided silk sutures about two feet in length, armed at either end with a full-curved needle. Carry one of the needles into the rectum and, if the operator is right-handed, insert the needle into the right side of the recto-vaginal partition at the anterior end of the wound and one-half inch from its lateral margin. Pass the needle to, but not through the vaginal mucosa, carry it across, insert it in the opposite margin of the wound between the vaginal mucosa and muscular tissue, carry it up into the rectum at a point opposite the entrance on the left side, and remove the needle. Insert the other needle in the same manner about one-quarter inch posterior to the first, and pass through the tissues and back into the rectum in the same way. Tie the free ends of the suture together, to keep them from being pulled out of the wound, and have an assistant hold it upward out of the way.

Apply a second suture further back, in the same manner, and repeat until the posterior or external end of the wound is reached. Drop all the sutures, except the first one, along the floor of the rectum, or have an assistant hold them aside. Divide the first suture by clipping away the knot, and then close the engaged portion of the wound by drawing the sutures gently and tying. Do not draw the sutures too tightly, lest they cause necrosis, infection, and swelling, and tear out prematurely. Repeat the process with each succeeding suture.

After the sutures have all been tied, and the ends clipped away, begin at the anterior end of the wound, and apply a continuous suture close to the margins, to secure accurate apposition. The wound margins on the vaginal side should be closed by accurate continuous sutures in the same manner as the second suture in the rectum.

The external wounds are then to be closed by appropriate deep interrupted sutures. Because of the great danger from suture infection in this part, the sutures, before introduction, should be thoroughly saturated with a disinfectant, preferably by their immersion for a time in tincture of iodine. The external sutures may be rendered safer by applying to each, after insertion, a drop of tincture of iodine.

When the suturing has been completed, the rectum and vagina should be carefully wiped with sterile cotton or gauze, and the wound line, especially in the rectum, liberally sprinkled with iodoform.

When a recto-vaginal fistula exists, the operation is analogous. The sutures are to be made in the same manner. The anus should be widely dilated with retractors, and the margins of the fistula grasped and drawn out through the anus.

The after-handling of the wound is highly important. The chief concern of the operator is the prevention of the befouling of the wound by means of contact with fecal matter, followed by swelling, infection, and tearing out of the sutures. The animal should not be allowed any solid food, but may have gruels or liquid foods, especially milk. The bowels may be largely blocked up, and the passage of feces into the rectum decreased, by small doses, ½ to 1 gr., of morphia, repeated every three or four hours. The expulsion of such feces as may gain the rectum should be facilitated by injections of warm physiologic salt solution After the feces have been expelled, there may, with advantage, be introduced into the rectum iodoform suspended in a bland oil.

Recently a new plan has been recommended for operating upon rupture of the perineum, which appears hopeful and logical. The plan of sutures is not essentially different from the above. Professor Schmidt of Vienna advises that two parallel incisions be made, one on each side of the ruptured vulva and anus, beginning near the level of the superior border of the anal sphincter above and continued downward half-way along the vulvar opening. Carry these incisions through the skin, aponeurosis, and radiating muscle fibres passing from the sphincters to the ischal tuberosities and margins of the broad ligaments of the pelvis. From the superior end of each of these incisions, carry a second one obliquely upwards and medianwards, the two to meet above the anal sphincter. These incisions free the ano-vulvar sphincters from their pelvic attachments except on the pelvic floor and leave the anus and vulva lying comparatively free. The radiating muscles and other tissues can no longer drag upon the sutures in the wound. The plan appears to be a distinct advance over previous methods, and is well worthy of trial.

The handling of the third group of injuries to the perineum, the external lacerations which do not divide the sphincters, offers nothing special, and consists of the closure of the wound by means of sutures, in accordance with general surgical principles.

14. Vesico-Vaginal Fistula

Fleming, citing Dupont, records an instance of vesico-vaginal fistula, but fails to give exact data in regard to it. Rupture of the bladder in an ordinary case of birth, due to the passage of the fetus over it, is improbable, since normally the bladder is completely emptied before the fetus enters the birth canal, and the empty organ lies in a depressed and smooth area upon the pelvic floor, covered over by the floor of the vagina. Should there be present, within the bladder, a calculus or tumor, the danger to the viscus would be very great. Should the floor of the vagina and the upper wall of the bladder become very severely contused, and the two adhere, there may follow a sloughing of the injured portions, and eventually an artificial communication become established between the bladder and the vagina. Chronic purulent cystitis, which is not a very rare disease in the mare following vaginitis, should not be mistaken for vesico-vaginal fistula.

The handling of vesico-vaginal fistula should be based upon general surgical principles, adjusted to each individual case. The fistula can not be overcome unless the urethra remains open. In such a lesion, as a general rule, there would be, in addition, a chronic, purulent cystitis, with an accompanying precipitation of the urinary salts upon the walls of the bladder, causing the latter to become very greatly thickened and paretic and give to the finger the sensation of the walls being covered with fine sand which has formed into crusts. This condition needs be overcome by repeated irrigations with warm water, with possibly very mild antiseptics.

15. Hematoma of the Vulva

During or about the period of parturition, there occasionally appear in the vulva more or less extensive hematoma, due to the rupture of blood vessels, causing a hemorrhage beneath the mucous membrane in the loose connective tissue.

The date of their appearance varies. In one instance I noted a hematom of considerable size in a mare, following parturition, in which no dystokia had occurred so far as was known. In a second instance, in a mare not yet due to foal, a hematom occurred which contained about one-half pound of coagulated blood. In this animal there had been rather severe colic, which had continued for eighteen or twenty hours, with some tympany, but she had not rolled violently and it was not known that she had received any injury. The owner had made a manual exploration of the vagina, but apparently had done nothing which might cause the hematom to form. The great vascularity of the part just prior to parturition tends to favor such lesions upon very slight provocation. In one of these cases the hematom occurred along the floor of the vulva near the median line ; in the other it was well up in the vulvar lip.

The symptoms are very characteristic when the blood has become collected in a large mass, because it pushes the mucous membrane outward into the cavity of the vulva, so that the tumor projects beyond the surface of the surrounding tissues and may become pedunculated or pear-shaped. It may project quite beyond the lips of the vulva, especially when the animal is lying down, and may usually be seen very well by parting the lips of the vulva with the hands. Upon palpation the tumor is comparatively soft and painless. When so situated that it can be seen, it is observed to be of very dark color, which indicates its character.

It is important to make a clear differential diagnosis of hematoma. In one case the tumor was distinctly pedunculated, and so extensive that it protruded beyond the lips of the vulva whenever the animal was lying down. It was so near to the median line, immediately in the neighborhood of the meatus urinarius, that it was mistaken at first for the everted bladder. Further examination revealed the meatus urinarius, and established the fact that the bladder was in its normal position.

In some cases there is a very general extravasation of the blood into the tissues, over a large area. This is frequently met in practice, where dystokia has existed, especially if rudely handled by laymen or empirics. In such circumstances the vulva and vagina become greatly abraded and irritated by rough hands and apparatus, or by hard, rough cords. Such extravasations are not of a character generally to cause serious trouble, but are after a time absorbed.

The handling of hematoma usually consists of making a free opening through the mucous membrane and pressing out the blood clots, after which the vulva should be cleansed with an antiseptic solution. It is generally easy to thrust a finger through the mucous membrane, producing an extensive opening, which will not adhere and retain discharges later. This method of evacuating the blood coagula has an element of safety in it, because there is no danger of wounding any blood vessels which by chance may be displaced because of the lesion.

Fleming advises scarifications in cases of extensive extravasations, though he admits that Cartwright had an unfortunate experience through the wounding of a large vein. Apparently Cartwright was dealing with a general extravasation of blood in the connective tissue, where a single puncture or division of the mucous membrane would not permit the blood to escape. As a general rule the extravasated blood will be safely resorbed by the tissues, if given the opportunity. Scarifications, on the other hand, open an inviting avenue for serious infection. They had best be omitted and, in their stead, careful cleansing and disinfection maintained until resorption occurs.

16. Relaxation of the Pelvic Symphysis

Gillis records one instance of what was diagnosed as relaxation of the symphysis of the pelvis, as a consequence of parturition, but the diagnosis was not verified by any conclusive data. A cow had some difficulty in expelling a calf, after which she could scarcely rise when down, or walk when upon her feet. Her hind quarters swayed from side to side. The sacro-iliac articulations appeared to be tender. When the animal was moved, there seemed to be some motion in the ischio-pubic symphysis. The condition remained permanent, and the animal was prepared for the butcher.

17. Contusions of the Lumbo-Sacral Nerves

The lumbo-sacral plexus of nerves (Fig. 1, p. 4) is so disposed, in domestic animals, that certain trunks are somewhat subject to impingement between the bony walls of the pelvis and prominent, unyielding portions of the fetus, by which they may become more or less seriously contused and their functions interrupted. The probability of these nerves becoming injured during parturition is not alike for all the trunks: the gluteal and obturator nerves are especially exposed, where they pass over the articular eminence between the last lumbar and the first sacral vertebrae; the obturator nerve again becomes exposed to injury as it rounds the margin of the obturator foramen.

a. Contusion of the Gluteal Nerves. Gluteal Paralysis

In two draft mares, I observed paralysis of the gluteal muscles, followed by atrophy consequent upon parturition. The difficulty was not referable to dystokia, in the ordinary acceptation of the term, since birth occurred without aid and, so far as known, without difficulty. The mares were in prime condition: no injury or infection was recognizable; there was no fever, loss of appetitite, or loss of flesh. When the mares were down it was difficult for them to get up; when up they walked with an unsteady gait. In one case, where the paralysis was unilateral, the difficulty in rising was not great. When moved, the animal had a very distinct paralytic limp in the affected limb. After a few days the muscles of the gluteal region commenced to atrophy rapidly to an extreme degree, but most of the paralysis soon subsided, although there was a certain deficiency in the strength of the part. After several weeks, the muscles began to recover their volume, but the recovery was very slow, and nearly a year elapsed before the parts resumed their normal appearance.

In a second patient the paralysis was very profound and notable, because both hind limbs were involved and it was necessary for a time to aid the mare somewhat when she attempted to get up. Once she had gained her feet, she could walk with some difficulty. The paralytic symptoms subsided in the course of two or three weeks, but the atrophy was extreme and the restoration of the muscles was very slow, though eventually complete.

The handling of contusion of the gluteal nerves must depend fundamentally upon the general care of the animal, since there is nothing very direct to be accomplished. It is not necessary as a rule that anything definite should be done. The animal should not be permitted to struggle in getting up, or otherwise exert herself violently in a manner to increase the injury to the nerves and muscles, but should be watched closely and guarded against further injury. To this end she should have comfortable quarters, and her stall should be so managed that she will have the best footing possible in order to avoid any slipping in attempting to rise. Furthermore, it is desirable, as far as practicable, to aid the animal by lifting upon the tail whenever she wishes to get up, unless she can rise unaided with comparative ease and safety. Slings may be applied, should conditions require, but it is preferable to avoid them. Should indications warrant, the veterinarian may apply electricity, in the later stages, by placing one of the poles of the battery over the lumbar region and moving the other over the surface of the atrophied gluteal muscles.

According to my observations, the prognosis is highly favorable. The paralysis disappears in a few days to two or three weeks. At the same time atrophy is increasing, but from this the animal tends to recover completely in from six to eighteen months, and in the meantime may do light work if desired.

b. Contusion of the Obturator Nerves. Obturator Paralysis

The obturator nerve is subject to injury from the fetus, at its point of passage over the eminence of the lumbo-sacral articulation, and again at the point where it rounds the lip of the obturator foramen.

The symptoms are acute and unique. They consist essentially of a loss of power in the obturator group of muscles, which include all of the adductors of the limb—the obturator externus, the adductors of the thigh, the pectineus, and the short adductor of the leg.

It matters not, so far as symptoms are concerned, if the nerve is injured at its point of passage over the lumbo-sacral eminence or of its disappearance through the obturator foramen. If one nerve only is contused, the animal is able to progress with some difficulty, but the affected limb is carried in extreme abduction, though the power of bearing weight or of advancement is not interrupted. In advancing the limb, it is brought forward in extreme abduction, and is placed upon the ground some inches laterally from the normal point.

If both obturator nerves are injured simultaneously, the symptoms assume an entirely different phase. Both limbs now become sharply abducted, the hind feet slip apart, the animal is unable to support her weight and drops upon her pubis. If assisted to her feet, and the hind limbs are held in adduction, the animal can stand without difficulty, but the moment she raises one foot the two slip apart again and she falls.

In one case occurring in the clinic of the New York State Veterinary College, a mare had foaled apparently naturally, but immediately afterward it was seen that in walking she carried the leg in extreme abduction, so that it was exceedingly difficult for her to walk. The condition had existed for about a year before she was presented at our clinic. Injury to the obturator nerve upon the affected side was promptly diagnosed. She still walked with the affected limb in extreme abduction. The muscles of the inside of the thigh were greatly atrophied. Believing her incurable, we destroyed her. Post-mortem examination showed all the muscles supplied by the injured obturator nerve to be very pale and greatly atrophied, so that their volume was only about one-third that of the corresponding muscles of the opposite side.

The other muscles of the limb were normal. The obturator nerve was apparently normal except at its point of disappearance in the obturator foramen, where there existed a very distinct enlargement, consisting chiefly of connective tissue, as shown at 1 in Fig. 140.

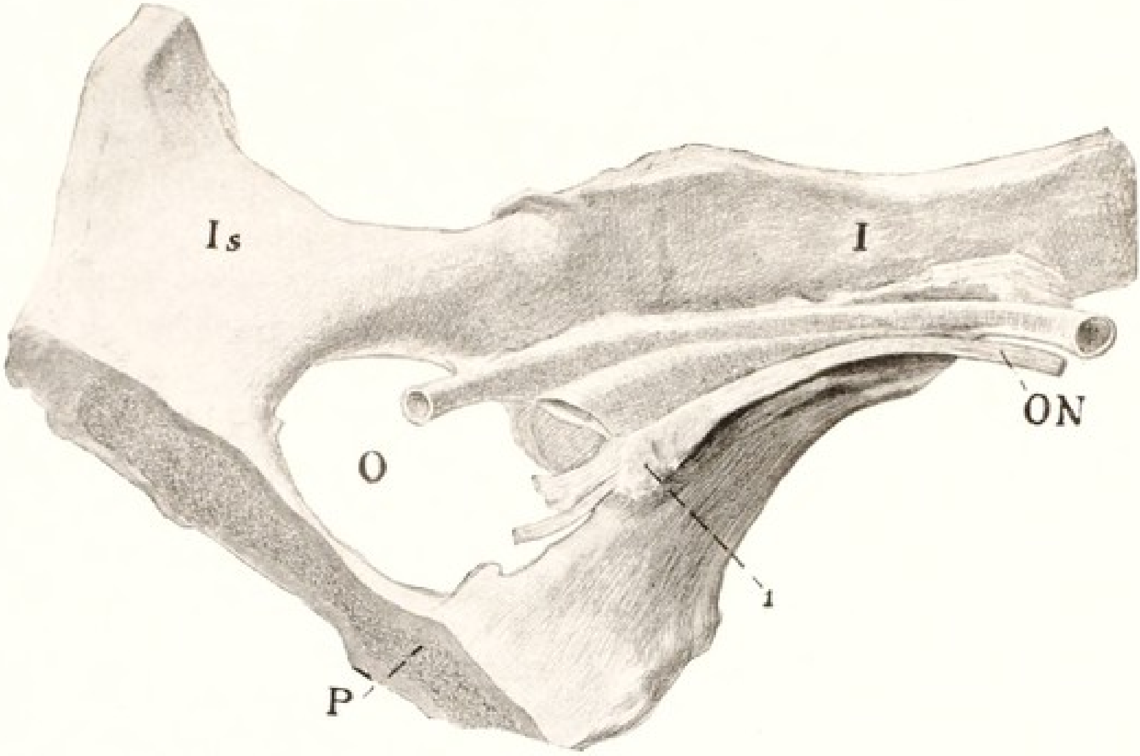


FIG. 140. CONTUSION OF OBTURATOR NERVE.
I, ilium. Is, ischium. P, pubis. ON, obturator nerve. O, obturator foramen. I, inflammatory induration of obturator nerve.

In a second case, observed in private practice, an imported four-year-old French draft mare had given birth to her first foal without difficulty, but was unable to get up. I placed slings under the patient and helped her to her feet, but she could not stand on the hind limbs because they parted immediately and she tended to drop upon her pubis. If a man would hold the feet in adduction, she could stand without difficulty. After the slings were properly adjusted and the two hind feet tied together, she stood comfortably and without difficulty. After three days, upon the removal of the slings, it was found that she could walk with but little difficulty. She made a rapid and complete recovery.

The handling of contusions of the obturator nerve should consist of the application of slings. The feet should be tied together to prevent abduction. Later, electricity may prove useful, one electrode being applied over the loins and the other to the inside the thigh.

Coxo-Femoral Dislocation

Coxo-femoral dislocation is not rare in cows. I have seen it most frequently in stanchioned animals, but have seen it also in cows at pasture. It seems to occur during parturition only, though possibly sometimes just prior to calving. I have observed it most frequently in heifers in first pregnancy and in poor or indifferent physical condition, but have seen it also in adult cows in good condition. In most cases the dislocation has been associated with dystokia. It could not be determined that indirectly the dystokia caused the dislocation, but this appeared probable. It has appeared that, in the agony and exhaustion of difficult birth, the animal has slipped in lying down or rising, which has caused the dislocation. The weight of the uterine contents, at this time at its maximum, adds materially to the danger of falling. Another element possibly enters into the causation of the dislocation. In cows, far beyond other animals, when parturition approaches, the pelvic ligaments relax, and as a corollary the rigidity of the pelvic skeleton becomes materially reduced. There follows an uncertainty of step, which, added to the above causes, may abet the accident.

The symptoms are obscure. The veterinarian is called because the patient is unable to rise. No clinical history is available except that she went down in calving and has not been able to stand. Sometimes—and this appears to be most common—the veterinarian is called because of the dystokia. When he arrives, the dystokia is present and the patient is down, unable to rise, and, with the extra weight of the gravid uterus, unable to stand if helped up. The dystokia must be overcome with the patient in decubitis. After the fetus has been removed, the patient is still unable to rise. The chief body functions—pulse, temperature, and respiration—are not materially abnormal. There are no marked evidences of pain or suffering. After the uterus has been unloaded, the patient can possibly stand when lifted up. Usually she will not do so. Apparently she does not try to stand, possibly because of the pain, to which she gives no other expression.

At best, the diagnosis is not easy, and in many cases is made difficult or impossible by the unfavorable environment. When the patient is in a dark stanchion or stall where there is little room for handling, a safe diagnosis is virtually impossible. When the patient is moved into the open, with abundant light and room, the diagnosis can be made without serious difficulty. For examination, the cow should be placed in lateral recumbency. An assistant should grasp the upper hind foot, and, while the veterinarian manipulates the hip joint and examines carefully the location and movements of the trochanter major, the assistant should move the limb in harmony with the orders of the operator. The limb should be flexed and extended, abducted and adducted, extended backwards and forwards, and moved in any other way which may reveal important data. After the one hip has been thoroughly examined, the patient should be rolled over and the other hip examined comparatively. It is essential to measure or otherwise note the position of the trochanter major of the femur as related to the external tuberosities of the ilium and ischium. Whenever dislocation occurs, the distances between the trochanter major and neighboring bony prominences are inevitably changed. Sometimes the ligamentum teres is ruptured without dislocation following, or at least the dislocation does not persist. There is then no disturbance of location of the trochanter, but, as in dislocation, there is a marked change in the mobility of the limb, especially in abduction. There may be some evidences of pain, but the cow is too stoical to give definite expression thereto. Careful comparisons between the normal and the dislocated hip constitute the chief ground for a safe diagnosis. In one case, in which the dislocation was bilateral, this basis of diagnosis failed. There remained however the great mobility of the hip joints and a definite change in the position of the trochanter when compared with that of healthy cows.

The prognosis is hopeless. It is difficult or impossible to reduce the dislocation, because the annular cartilage on the brim of the acetabulum dislocates and pushes into the cavity in front of the head of the femur. Even if the replacement could be accomplished, there is no way to retain the femur in position. The animal need not die. Fig. 119 on page 464 indicates that a false joint may form and the animal survive indefinitely, as a worthless cripple. In the one case of bilateral dislocation which I observed, the cow made a partial recovery. After she had lost nearly all her flesh she was able to get up and walk about slowly with a rolling, uncertain gait. Apparently she could survive year after year, but she was absolutely worthless.

The best course to pursue, when the accident is diagnosed early, is to slaughter the cow at once, and, if in at all proper condition, use her meat for food. In America there is so strong a prejudice against eating meat from a recently parturient cow that it is officially excluded from the market. The exclusion of such meat is not based upon scientific grounds.

PUERPERAL INFECTIONS

When discussing the care of the female during her puerperium, the preventon of the infection of the genital organs was considered. These infections are so closely bound up with those which exist in the uterus before parturition that they are best considered together, as a part of the diseases of the genital organs. These will be considered in a companion volume.

It seems justifiable to include here two diseases of the puerperal animal—laminitis and tetanus—each of which may, and usually does, originate independently of reproduction, but which in a small number of cases is dependent upon parturition for its origin.

1. Puerperal Laminitis

Puerperal laminitis occurs chiefly in the mare. Occasionally it is seen in the cow, and presumably occurs in other ruminants. Puerperal laminitis in the mare is a well-nigh constant accompaniment of endometritis, associated with retained fetal membranes. In the cow, I have not seen puerperal laminitis except in association with retained fetal membranes. In both the mare and the cow, the disease seems to be necessarily bound up with a placentitis of ante-parturient origin. Parturient laminitis is so common in the mare that it may be regarded as an essential part of that type of endometritis complicated by placental retention. It is probably overlooked sometimes because there are present, in the endometritis of the mare, two areas of pain—the abdominal pain due to the metritis and the pain in the feet from the laminitis—both of which induce a stiffness in the gait, and show about the same symptoms.

The nature of puerperal laminitis, as observed clinically, does not differ in any essential respect from the laminitis due to irritation of the intestinal tract from indigestion. It appears to be a purely metastatic inflammation, dependent directly upon the endometritis and the absorption of the products of bacterial decomposition.

The symptoms of puerperal laminitis are identical with the symptoms of the laminitis following indigestion. Usually it occurs in those cases of endometritis in the mare which have their origin in a retention of the placenta in the non-gravid horn of the uterus. As a rule it follows an apparently normal birth, in which the placenta has been expelled promptly and, so far as the owner observes, completely, but that portion of it which has occupied the non-gravid cornu has been broken off and retained. In the course of forty-eight to seventy-two hours after parturition, the general symptoms of endometritis appear. Upon examination, the fragment of placenta may still be found in the non-gravid cornu.

At the same time that the symptoms of endometritis are first observed, well-marked laminitis usually appears. The disease may involve the two anterior feet, or all four feet. As in ordinary cases of laminitis, the animal moves with great difficulty, and places her weight upon her heels so as to relieve from pressure, as far as possible, the sensitive laminae upon the anterior walls of the feet. If the disease is very severe, the animal tends to persistent recumbency, or stands riveted to the spot and can hardly be induced to move.

Examination of the hoofs reveals a distinct elevation in their temperature, varying of course according to the intensity of the attack. Throbbing of the arteries of the feet is very evident.

The prognosis of the disease is generally favorable. The laminitis and endometritis are inseparably bound up together, so that their prognosis and handling are essentially identical. Like laminitis from other causes, so puerperal laminitis is largely a disease of the draft animal. The prognosis will depend to a degree upon the size of the patient. The gravity of the disease increases with the weight of the animal.

Fundamentally, the laminitis is to be handled as a complication of the metritis. The fetal membranes need be removed as promptly and completely as practicable, and the uterine cavity cleansed by repeated douchings with warm physiologic salt solution or other neutral aseptic or mildly antiseptic fluids. The handling of puerperal laminitis calls for attention to the uterus parallel to the attention demanded for the digestive tract in the ordinary type of laminitis. There arecolin is given to evacuate the alimentary tract ; in puerperal laminitis attention is diverted to the genital tract, and the accumulations within the uterus are washed out mechanically by douching. There are two plans for handling the inflammation of the feet—hot and cold applications—each of which has its devotees. I prefer continuous and ample application of cold, either in the form of water or of ice. If the animal is recumbent or can be induced to remain recumbent, so much the better, because the feet are thus relieved of the weight of the patient. In the recumbent animal, cold water is not readily applicable. It is then best to apply broken ice in packs, renewing frequently in order to maintain constant refrigeration. If the animal can readily stand, and will do so, she should be placed in a bath of ice water. The cold water bath should extend up to or above the fetlocks. The floor of the bath should be of some yielding substance, so that the entire plantar surfaces of the feet may contribute to the support of the weight. The shoes should be removed in order to prevent sinking of the os pedis. The dropping of the sole may also be prevented by the application of special padded shoes, by which the weight is distributed equally over the entire plantar surface of the hoof.

2. Puerperal Tetanus

During the puerperium tetanus infection may gain entrance into the genital tract in a variety of ways. The denuded placental areas suffice as an avenue of invasion and the depth of the uterus limits the oxygen supply to the degree required for the growth of the tetanus bacilli. The obstetrist, or other persons, may readily introduce the bacilli into the genital tract while handling dystokia or retained fetal membranes. When portions of the fetal membranes protrude from the vulva, they may act as a passive carrier. When the cow lies down, the fetal membranes protrude an increased distance, become contaminated, and, when she rises, drop back partly and draw the infection into the tract. Prolapse of the uterus also furnishes an opportunity for the invasion of tetanus bacilli. Accordingly, puerperal tetanus is observed chiefly, in both the mare and the cow, following retention of the fetal membranes and prolapse of the uterus. Having gained the susceptible genital tract, the organisms may multiply there and induce the disease.

The period of incubation, symptoms, pathology, and treatment are identical with those of cases of tetanus in which the bacillus has entered by other avenues. Since the number of cases of puerperal tetanus is small, the comparative prognosis is uncertain. In the case of prolapse of the uterus mentioned on page 561, the mare recovered successively from uterine prolapse and from tetanus.

PUERPERAL ECLAMPTIC DISEASES

In domestic animals there occurs with considerable frequency a group of diseases characterized chiefly by a profound disturbance of the central nervous system, which usually express themselves either by tonic and clonic spasms or by coma. These diseases generally appear soon after parturition, but may occur during or shortly prior to that event. They all run a very rapid and stormy course, with a high mortality, unless their progress is interrupted by prompt and judicious treatment.

The pathology of these diseases is unknown. Various theories have been propounded to account for their occurrence, but none of them have met with general acceptance, and the correctness of none of them has been shown. Post-mortem examinations have revealed various lesions or alleged lesions, which may be regarded as results of, rather than the cause of the malady. They fail to reveal the true character of the disease. For example, there is frequently found in parturient paresis of the cow a well-marked pneumonia, which is not a part of the disease, but an intercurrent complication due to the inhalation of food particles or medicines. Hemorrhages upon the brain have been found, but this is not strange if an animal has thrown herself about violently for a number of hours, striking her horns with great force against the wall, floor, or ground, and thus causing more or less injury by concussion of the brain. Similar violence induces cerebral or meningeal hemorrhages in healthy animals. In a similar way, other lesions discovered upon post-mortem examination may be accounted for. In many instances the post-mortem revelations are nil. It would appear from such knowledge as has been gained up to the present time that, since no lesion has been discovered which constitutes an essential part of the malady, its true pathology is unknown. It is difficult to arrive at a general conclusion, because various reasons are assigned, and there is no exact agreement as to what maladies should be included in the group.

In woman there occurs a rather common disease, known as parturient eclampsia, which is highly fatal. Some authors consider this identical with the parturient paresis of the cow; others deny the identity or analogy of the two.

The eclampsia of woman occurs most frequently—in approximately fifty per cent. of the cases—during birth. About twenty-five per cent. of the cases occur before parturition, and the other twenty-five per cent. after childbirth. The histories of the date of attack of eclampsia in woman and of parturient paresis in the cow are somewhat alike in so far as the occurrence of cases before, during, and after birth are concerned, but the percentages of cases during these various epochs are not at all alike. Very few attacks of parturient paresis occur in the cow during pregnancy or labor, but almost all of them during the puerperal state.

Eclampsia in woman is characterized by sudden and severe spasms, which endure for a few minutes, to be followed by a pause and later a recurrence of the spasms. The pause is sometimes characterized by deep coma. The disease usually appears very suddenly, without warning, though in some cases there may be premonitory symptoms of unrest, headache, and nervous twitchings. Then follows dilation of the pupil, with loss of consciousness accompanied by clonic and tonic spasms. The jaws are tightly closed, sometimes severely wounding the tongue. Usually the temperature is high, and tends to become more elevated as the spasms are more severe. Upon post-mortem examination, the changes which are observed can scarcely be considered as characteristic of the disease, or as indicating the essential pathology of it.

Admittedly, the symptoms of parturient paresis in the cow differ widely in a general way from those seen in the eclampsia of woman. This leads Harms to remark that a comparison of the symptoms of eclampsia in woman with those of parturient paresis in the cow would cause anyone who had ever seen a case of milk fever in the cow to conclude at once that they were two wholly distinct maladies. Other veterinary obstetrists believe that the two maladies are essentially identical. In this opinion I concur. The two maladies appear at a similar date as related to parturition, the true pathology of neither has been satisfactorily determined, and post-mortem changes which can properly be considered as the basic lesions of the disease are wanting.

In some domestic animals, especially in the mare, bitch, and sow, it is not rare to observe a parturient eclampsia which, in history, symptoms, course, and termination, is quite parallel to that observed in woman. There are present similar tonic and clonic spasms, the well marked trismus, the pirouetting of the eyes, the elevation of temperature, the stormy course of the disease, and the high mortality.

Although in parturient paresis of the cow profound coma is usually observed, instead of spasms, this does not prove its non-identity with the eclampsia of woman. Tonic and clonic spasms are common in woman, and in some domestic animals, from a variety of causes. Coma in some animals, as the horse, is exceedingly rare. In the cow coma is a common symptom of disease, and occurs in many maladies. It is seen in indigestion, especially from over-feeding. In the horse, man, and carnivora, the same causes more probably lead to spasms. Coma is observed in the cow as a result of infections in the uterus or udder, and is accompanied by sub-normal temperature, just as in parturient paresis. In the eclampsia of woman, coma appears at intervals. In the parturient paresis of the cow, there are sometimes tonic and clonic spasms. The difference in symptoms is not basic, but rather a question of preponderance of spasms as related to coma, or vice versa, in the different species of patients.

In one instance I observed a cow in which the general symptoms of eclampsia were present a few hours after easy parturition. The pupils were dilated, the eyes rolled, there was grinding of the teeth, frothing at the mouth, clonic spasms, especially of the head and neck, and a general disturbance of consciousness, so that the animal looked and acted as if temporarily insane. The condition lasted for about two hours, when the symptoms passed into those of ordinary parturient paresis, with profound coma and sub-normal temperature.

In other instances of parturient paresis there are observed in the earlier stages, somewhat similar, though less marked eclamptic symptoms, which usually pass quickly into the characteristic symptoms of paresis.

While the knowledge of eclampsia in woman and in the domestic animals remains so imperfect, with equal want of knowledge as to the nature of parturient paresis in the cow, it is impossible to determine precisely what relation they bear to each other. It would appear from the foregoing that, until some positive knowledge as to the actual causes of these diseases is obtained, they should be considered as constituting one great group dependent upon the same general causes. The disease is expressed somewhat differently by the various species of animals. Here and there are cases presenting symptoms which occupy a middle ground between two different members of the group, constituting connecting links which serve to bind them more or less closely together into a highly interesting class of diseases.

a. Parturient Eclampsia in the Mare

Parturient eclampsia in the mare is closely related to the parturient state, and is expressed chiefly by violent tonic and clonic spasms, which run a very rapid course, and quickly terminate in recovery or death, without producing any lesions yet discovered which may properly be considered as fundamental.

The first definite description of this disease was a contribution by the author.[1] My first case occurred in an adult grade draft mare, which had at her side a healthy, vigorous foal, some ten days old. The mare had foaled naturally and easily at the ordinary time. The very apparent vigor of the foal showed clearly that she had been furnishing an abundant supply of milk. The owner reported that a few hours prior to my arrival the mare suddenly became strangely nervous, assuming a wild look, with staring eyes, restlessness, stiffness of gait, twitching of the muscles, occasionally lying down and getting up. The disease progressed very rapidly, until upon my arrival she lay prostrate on her side, unable to rise. In this position I found her, with the whole muscular system exceedingly rigid, breathing labored, convulsions constant, pupils greatly dilated, mucous membrane livid, firm trismus, and the muscles of her limbs so rigid that they could not be flexed sufficiently to raise her upon her chest.

The second case was a high grade draft mare aged six years, used exclusively for breeding purposes. The mare was quite large, very robust, and had foaled ten days previously without difficulty. The foal at her side was very vigorous and well nourished. I found the mare lying quietly on her sternum, showing no evidence of suffering, and looking quite bright and healthy. Upon approaching her, however, she showed marked nervousness, and tried at once to get up, but appeared

[1] American Veterinary Review, Vol. 14, page 559.

to have lost the power of co-ordination. Her efforts brought on clonic spasms of a severe character. Her hind legs knuckled at the pasterns, much as in azoturia. During my stay she became more nervous and uneasy. She made repeated unsuccessful attempts to rise. Respiration was rapid and laborious, and there were constant and severe cramps of the entire body, trembling, and profuse perspiration, all of which appeared to decrease in intensity when we withdrew and permitted her to become more tranquil. The passage of the catheter increased the convulsions quite markedly. There was apparently hyperaesthesia of the vulva, and of the body generally. I diagnosed azoturia, and prognosticated a favorable termination. Later observations have shown me that mares with young foals do not contract azoturia. Moreover, the fact that the mare had been running constantly at grass precluded the possibility of that disease. She died a few hours later.

During the summer of 1889 an unusual number of cases occurred in rapid succession, showing every degree of intensity. At this date, since the rapidly developing horse-breeding interests in my locality had about reached their maximum, large numbers of mares were kept solely for breeding purposes. Favorable weather during the season furnished exceedingly luxuriant pasturage. During that year I observed seven well-marked cases, several of which offered favorable opportunities for observation throughout a greater part of the course of the disease.

A well-bred road mare, in high condition, with a vigorous, well-nourished foal, eight to ten days old, at her side, was brought from the pasture preparatory to being bred. Soon after her arrival at the owner's stable, it was noticed that the mare was restless and nervous, her eyes somewhat staring, and there were occasional muscular twitchings. Most noticeable of all was a peculiar, well-marked throbbing of the chest, which shook the entire body. It seemed like an exaggerated heart-beat, and was quite regular in rhythm and force, but was not rhythmical with the heart-beat. The disturbance seemed greatest along the line of attachment of the diaphragm to the ribs. The phenomenon could be attributed to no other cause than clonic spasm of the diaphragm. There was some trismus, but not enough to prevent the patient from eating with relish and comparative ease. With quiet and moderate doses of belladonna and cannabis Indica, she made a good recovery in a few hours.

I was called to attend a half-blood draft mare, aged seven years, in prime condition and perfect health prior to the date of my visit. She had foaled ten days before without trouble. The foal was vigorous and well nourished. She was then brought from the pasture for the first time, and placed in the stable. Within a few hours, symptoms of disease were manifested. I found the animal in great pain, very nervous, and easily disturbed by any movements or noise. She lay down quite frequently. While lying, she became more tranquil, and all the symptoms abated. She lay on her sternum, and did not attempt to roll. She rose with apparent ease. While standing there were constant clonic twitchings of the muscles of the entire body, spasmodic movements of the limbs, frequent changes in posture, trembling, profuse sweating, distention of the nostrils, and stiff movements as in tetanus. There was no protrusion of the membrana nictatans over the eyeballs, but the eyes were staring, the pupils dilated, and the conjunctivae dark livid in color. There was severe trismus: the jaws were wholly immovable. As in the preceding case, there was violent spasm of the diaphragm. She was bled freely from the jugular, and given large and repeated doses of belladonna and cannabis Indica. For nearly thirty-six hours the symptoms remained about the same, when they began to abate rapidly, and in forty-eight hours after the beginning of the attack the mare was in her usual health.

On the same day, on a neighboring farm, I attended another grade draft mare with a similar history of recent easy parturition, healthy foal at her side, etc. Prior to my arrival, she had shown a train of symptoms similar to those noted above, but, as the owner delayed calling me, upon my arrival I found the animal prostrate on her side, the whole muscular system thoroughly tetanized, the eyes set and insensible to light, firm trismus, well-marked opisthotonos, and repeated severe convulsions of the entire body, readily increased by any sudden noise. Barring the want of protrusion of the membrana nictatans and the greater nervousness, the case closely simulated recumbent tetanus. The animal succumbed after about twenty-four hours.

I was called to attend a full-blood draft foal, five or six days old, which was suffering from lameness. In order that the foal might be well attended, the mare was brought from the pasture and placed in the stable. The next morning I was called hurriedly to attend the mare, which I had seen the previous day in apparently perfect health and unusually robust and vigorous. Upon my arrival at the farm I found her greatly agitated, the whole body tetanized, with constant clonic twitchings, spasmodic movements of the limbs, hurried, labored respirations, nostrils widely dilated, visible mucous membranes of a dark livid hue, firm trismus, and profuse sweating. When on her feet she could not stand still, but continually moved about involuntarily, and so very uncertainly that she could scarcely be approached with safety. The perspiration was so profuse that it streamed from the dependent parts of her body, the nose was poked out, the head elevated, the back arched, the tail erected, giving the entire body the posture assumed in severe tetanus, but the well-marked protrusion of the membrana nictatans seen in the latter disease was wanting. The animal lay down frequently, usually on the sternum, in which position she became more tranquil and apparently obtained some relief. Sometimes she lay prostrate on her side, in severe convulsions, the legs all rigid, so that the upper feet did not touch the ground, but projected in a straight line from the body. The spasm of the diaphragm was so violent that even when the mare was lying on her sternum her whole body shook violently at each contraction. When she was standing fifteen or twenty feet away, a loud thumping noise could be heard, emanating from the chest, like violent palpitation of the heart, but upon close examination it was found that the disturbance was not synchronous with the heart-beat. With great difficulty, owing to the uncertain convulsive movements of the animal, I drew about three gallons of blood from the jugular. This was followed by heavy and repeated doses of fluid extract of belladonna and cannabis Indica every hour. My prognosis was very unfavorable, as death seemed imminent. After twelve to fifteen hours the symptoms rapidly abated, and within twenty-four hours after my visit she was apparently in her usual health.

A high-grade draft mare of vigorous constitution, with a well-nourished healthy foal about fifteen days old at her side, was taken from the pasture for the first time since foaling and put to light farm work. In a few hours she had developed all the symptoms enumerated in the preceding cases, and when I arrived she was unable to regain her feet. She grew worse rapidly, and died the same day, within twelve hours from the time she was brought from the pasture in prime condition, and only five to eight hours after the beginning of the attack.

An imported pony mare in high condition, with a well nourished foal at her side, six or eight weeks old, was brought from the pasture for the first time since foaling, saddled, and placed in the hands of children, who used her for a few hours in the morning. At noon the stableman found some difficulty in removing the bit from her mouth. This attracted no particular attention, but when the owner attempted to bridle her again after dinner, and failed on account of firm trismus, it was evident that something serious was wrong. A veterinarian was at hand in a few hours. The pony rapidly developed all the symptoms enumerated in the preceding cases. She was bled from one jugular on the first, and the other on the second day. In about forty hours after the beginning of the attack, the symptoms suddenly abated, and within forty-eight hours the pony was apparently as well as ever.

I have recorded briefly here a series of cases presenting symptoms no more varied than would be expected in different individuals in various stages of the disease. The separate clinical pictures pass from one into the other by imperceptible gradations, and are all apparently due to the same cause.

In the earlier stages, and in the very mild cases throughout, all showed the restlessness, the staring, pirouetting eyes, and the clonic spasms, especially marked in the diaphragm. In proportion to the nervousness, the pulse and temperature are little altered. If unchecked, the clonic spasms are largely succeeded by those of a more tonic nature, trismus becomes a marked symptom early in the malady, the restlessness and convulsions increase in intensity, the respiration becomes more labored, the mucous membranes are livid from partial asphyxia, and the whole muscular system is extremely tetanized. Finally the animal becomes unable to stand, or to find relief in lying on the sternum, but lies prostrate on the side in constant convulsions, until she succumbs from asphyxia.

The history is quite uniform. The disease occurs exclusively in vigorous mares, in high condition, of mature age, but not old. They have recently foaled naturally and easily, and have healthy, well nourished foals at their sides. The mammary glands are well developed and active in all cases. In nearly, if not all the cases I have related, the mares had been enjoying unrestricted freedom at pasture constantly since foaling, until taken up a few hours prior to the attack, which was suddenly ushered in without warning. It seems that a sudden change of surroundings, a change from freedom to the stable or harness, probably by causing maternal anxiety for the foal, has an essential influence in the immediate causation of the disease. The symptoms indicate a grave disturbance of the central nervous system, expressed for the most part in convulsions and spasms of the striated muscles. The symptoms enumerated in the mare bear a close resemblance to those of eclampsia of other lower animals and of woman, as well as to the early stages of parturient apoplexy of the cow.

The disease in the mare is ushered in suddenly, runs a rapid course of twenty-four to forty-eight hours, and terminates as abruptly as it began, in complete recovery or in death.

The diagnosis should apparently be quite easy in all cases. The history of the case, so far as observed, seems of special value. The clonic and tonic spasms, the extreme trismus, and the peculiar spasms of the diaphragm are quite characteristic. The disease may be confounded with:

(a) Tetanus, from which it is distinguished by the sudden onset, the earlier and more complete trismus, the peculiar spasm of the diaphragm, the greater nervous irritability and greater tendency to clonic spasms, the greater tendency to lie down, the dilation of the pupil and pirouetting of the eyes, the absence of the protrusion of the membrana nictatans, the absence of any antecedent wound, the far more rapid course, and the usually more favorable termination.

(b) Cerebro-spinal meningitis, from which it is distinguished by its history, its more sudden onset, its cramp unaccompanied by paralysis, its well marked trismus, rapid course and more favorable termination.

(c) Azoturia, from which it differs essentially in attacking animals not subject to that affection—that is, mares enjoying unrestrained liberty and having young foals. Aside from the fact that azoturia cannot be induced in such animals, the spasms are more general over the entire body, the trismus is characteristic, and the urine neither abundant nor highly colored.

Evidently, the treatment should consist first of quiet and comfort. The foal should be allowed with the mare. In my cases, free blood-letting apparently alleviated the symptoms, if resorted to early. Fluid extract of belladonna and of cannabis Indica, in large and repeated doses, apparently allayed the excitability, and exerted a favorable influence upon the course of the disease.

b. Parturient Paresis in the Cow. Milk Fever Parturient Apoplexy

Parturient paresis has long been known as an exceedingly common, and until recently highly fatal malady of dairy cows. Apparently it has been known as long as dairying has been followed as a scientific pursuit and cows have been bred especially for dairying purposes. Somewhat rarely it may attack cows belonging to the distinctively beef breeds, but even then it is usually in those which are heavy milkers. The disease occurs usually in adult cows, rarely in the young or aged. Harms, citing Bavarian statistics, gives the following table of the ages at which 127 cows were attacked by milk fever.

At the age of	3	years	------------------	1
" "	4	"	------------------	4
" "	5	"	------------------	20
" "	6	"	------------------	14
" "	7	"	------------------	22
" "	8	"	------------------	18
" "	9	"	------------------	22
" "	10	"	------------------	12
" "	11	"	------------------	3
" "	12	"	------------------	6
" "	13	"	------------------	2
" "	14	"	------------------	1
" "	15	"	------------------	2

Harms, quoting Haycock, gives the following duration of time after parturition at which parturient paresis made its appearance.

5	times	immediately	after	calving.
8	"	20 hours	"	"
5	"	23 "	"	"
5	"	24 "	"	"
3	"	30 "	"	"
2	"	36 "	"	"
1	"	42 "	"	"

Parturient paresis occurs also before and during parturition. In these cases, all the cardinal symptoms of the malady present themselves, and the course and termination are the same as observed in cows attacked after parturition.

Harms, early in his career, diagnosed cases of milk fever before birth, during the act, and as long after parturition as thirty days; later he concluded that he had been in error and had been dealing with spinal meningitis or hydrocephalus, two diseases which he regarded as very difficult to differentiate from milk fever. According to his view, parturient paresis in the cow does not occur at all before the fetal membranes have been expelled. He cites other practitioners, however, among whom is Thomsen of Flemsbury, who had a cow fall with paresis while he was removing the afterbirth manually, and Kohler, who found the detached membranes in the uterus in cases of paresis.

Other observers have seen cases in which the malady has occurred under other conditions. I was called to attend a cow because of dystokia, and found her standing with portions of the membranes hanging from the vulva. Upon examination it was found that the fetus was in its normal position and alive, and that the cervix was fully dilated. All that appeared to be wanting was a moderate expulsive effort on the part of the cow, but this did not occur. She seemed well in a general way, except that she was unsteady upon her feet. The fetus was extracted under very moderate traction, without any aid from the mother. Some two hours later she fell, exhibiting all the symptoms of parturient paresis, and perished therefrom a few hours later.

In another instance I saw a typical case of paresis, where the animal was down and comatose and the placenta was still retained in the uterus.

The disease is one of well-nourished animals. It does not occur in those cows which have been starved or have been kept upon food of very bad quality. On the other hand, the excessively fat cow does not show so great a tendency to the disease as the one which is in good flesh. It is a disease belonging to the highly-nourished animal, not to the obese or the emaciated.

In all those cases of parturient paresis occurring subsequent to parturition, the disease follows an easy birth. In almost every case, there is prompt expulsion of the fetal membranes.

Symptoms. When the animal is under close observation, preceding the full development of the symptoms of parturient paresis there is usually noted first a staring expression of the eyes, with dilation of the pupil and a wild look. The eyes may be pirouetted or rolled in their orbits. There may be occasional muscular twitchings or contractions, and a condition of unrest. In rare cases there are very distinct clonic spasms, especially of the neck, with grinding of the teeth and slabbering. The animal acts as if affected with mania, and executes various movements with the head. In one case I observed that the cow would bite at her shoulder. If the cow is caused to move, she does so with a more or less unsteady gait. She seems especially weak and uncertain in her hind limbs, and sways somewhat from side to side or knuckles over. She may show considerable uneasiness and nervousness, and lie down, only to get up again in a few minutes, perhaps with some difficulty.

As the disease progresses the animal goes down and is unable to rise. At first she lies upon her sternum, usually upon the left side, in a somewhat natural attitude, with the head up. Later she shows a tendency to extend the head and rest the muzzle on the ground or to drop the head in the right flank with the nose lying upon the ground. Still later, she tends to lie prone upon the side.

Early in the disease coma sets in and the animal becomes more or less insensible. Convulsive struggles occur for a time, in which the patient throws herself about violently. She may make unsuccessful and unconscious efforts to arise, and may succeed in getting upon her knees and floundering about violently. She may throw the head from side to side with great violence, may shift from sternal to lateral recumbency, and from time to time may resume sternal decubitis. As the disease advances, there is a constantly increasing tendency to lie flat upon the side.

At first the pupils are dilated and the eyes have a wild and glaring look. The normal movements of the eyelids soon cease, the eye remains open, and the surface of the cornea becomes dry and listless, probably because the eyelids are not closed frequently to distribute the tears over the cornea and keep it moist. Early in the disease, there may be an abundance of tears, which may flow down over the cheeks and keep them wet. There is an involuntary flow of saliva, due rather to the failure of the animal to swallow it than to any increase in the amount secreted.

The temperature is sub-normal. Rarely in the earlier stages of the disease, when accompanied by more or less violent muscular twitchings, there may be elevation of temperature. Later, when the disease has existed for some hours and there has been partial improvement, and a relapse occurs, not of paresis, but of inhalation pneumonia or other inflammatory complication, the temperature may become elevated. The respiration is deep and slow as a general rule, though in some cases it may be rapid and shallow. There is sometimes a moan during expiration.

The disturbances in the alimentary tract consist essentially of a profound paralysis. There is difficulty and uncertainty in deglutition. In former times many cows were killed in attempting to drench them. Instead of being swallowed, the liquids passed into the lungs, causing fatal strangling or bringing about an equally fatal foreign-body pneumonia. The rumen is paralyzed, and as a consequence tends to become filled with gas owing to the decomposition of contained food. This is especially marked if the animal lies upon her side. This symptom is one of great danger for the animal, because the tympany tends to press the food up through the esophagus into the pharynx, whence it drops into the larynx and is inhaled, to cause either fatal strangling or, later, a fatal foreign-body pneumonia. The intestines are likewise paralyzed, and little or no defecation occurs. If the hand is introduced into the rectum, a small amount of dry feces is found.

The kidneys cease to function, and little or no urine is emptied into the bladder. Some veterinarians have urged that it is essential in the treatment of the disease for the catheter to be passed frequently in order to prevent rupture of the bladder. As a matter of fact, unless the bladder is distended when the disease comes on, it does not become so until after the malady has ceased.

The secretion of milk is wholly in abeyance. There may be a small amount of milk in the udder at the time that the cow goes down, and this may remain for a time, but there appears to be some tendency for it to be resorbed and the udder to become very flaccid.

The pulse at first may be slow and weak, becoming later more frequent and irregular.

The general sensation is much depressed. Early in the disease the eye seems somewhat sensitive to light or touch, but later the cornea may be touched without causing any reaction, and the skin may be pricked at any point with a pin or other sharp object, without producing any evidence of feeling.

As the disease progresses, the coma and paralysis become more and more profound, and death may occur at any time without warning, or the coma may gradually deepen and the animal appear almost lifeless for hours before death occurs. As the fatal termination approaches, the breathing becomes shallower, the pulse becomes weaker and more irregular, and the temperature continues to sink.

The course of the disease is rapid. Generally, the earlier the advent of the malady after parturition, the more rapid its course. The animal may die within six or eight hours from the beginning of the attack, or the disease may be prolonged to two or three days.

Complications of great variety may occur. In some especially stormy cases, there is complete prolapse of the uterus as one of the earliest symptoms, and death usually ensues very quickly. In two cases in my experience, the animals perished within two or three hours after the advent of the first symptoms of the disease.

One of the commonest and most serious complications observed in the course of the disease is strangling owing to the inhalation of solids or liquids. This may cause immediate death, or may cause foreign-body pneumonia. A few years ago it was common to attempt drenching a cow with large volumes of oil or of solutions of saline cathartics or other medicines, which in many cases flowed directly into the lungs because of the unconsciousness of the animal and the paralysis of the pharynx. In other instances in the comatose animal, there is an involuntary passage of food from the rumen through the esophagus into the pharynx, from which it is inhaled into the lungs. In either case the animal may be quickly strangled by the blocking of the bronchial tubes from the food or medicines. Formerly it was a common experience for the veterinarian to give a large dose of medicine and have the animal perish before he could get off the premises.

When immediate death from the inhalation of food or drugs does not ensue, the paralysis and coma may continue, and the symptoms of parturient paresis pass imperceptibly into those of pneumonia. Sometimes the animal partially recovers, seems brighter, and may even recover so far as to regain her feet and possibly take some food. After some hours, or even a day or more, she may show signs of pneumonia with elevation of temperature, and go down again, to perish finally from the complication.

Diagnosis. The diagnosis is usually rendered clear by the period of the occurrence of the disease, the condition and character of the animal, and the symptoms. In some cases, however, the differential diagnosis may be exceedingly difficult, and afford abundant room for a conflict of opinion between practitioners.

Harms very properly points out that the peculiar attitude of the cow does not always indicate parturient paresis, but that other diseases, like acute hydrocephalus, spinal myelitis, and meningitis, may cause the animal to assume the same position. Harms considers these the only diseases which may be mistaken for parturient paresis, and suggests that puerperal mania, puerperal fever, simple lumbar paralysis, and fracture of the pelvis can not deceive the scientific veterinarian. He points out that in his experience the diagnosis of milk fever may be excluded in those cows which have not calved recently, which show loss of sensation in the hind parts of the body only, or have a normal or elevated rectal temperature. Cows which retain an appetite until they fall, or even after they are down and unable to rise, he does not regard as being affected with parturient paresis. On the other hand, he claims that hydrocephalus may be excluded and milk fever diagnosed if the cow has calved within a few days, if the loss of sensation involves the entire body, if the rectal temperature is sub-normal, and if the paralysis is so profound that the animal can not rise even with assistance.

I can not agree with Harms that a cow must have calved recently in order to justify a diagnosis of parturient paresis. In several instances I have observed all the cardinal symptoms of milk fever just before or during parturition. The history, the susceptibility, the symptoms, and the course and termination of the disease pointed unerringly to parturient paresis. While milk fever occurs almost wholly very soon after calving, there are notable and clear exceptions where the cow is attacked just before, or during parturition. The fact that a cow has calved recently does not prevent the occurrence of other diseases which may simulate parturient paresis. Schmidt[1] draws attention to the fact that indigestion in the cow may simulate parturient paresis very closely.

In one case which I observed, a cow went down in the pasture with what strongly resembled parturient paresis in almost all essential respects, including paralysis, coma, and subnormal temperature, but she had calved six weeks previously. The disease was apparently due to a slight purulent mammitis. It is interesting to note, in connection with this case, that the injection of oxygen into the udder apparently led to a complete recovery. This would lead many to believe that the malady was really parturient paresis. I cannot subscribe to this view. The coma and the associated subnormal temperature could occur as readily in other diseases. The inflation of the mammae with oxygen or air acts as a powerful stimulant in coma in the cow and may thereby favorably influence it regardless of its cause. The effect of the inflation of the mammae of normal cows with oxygen is not known. It is not known why udder inflation cures parturient paresis nor why it may not cure other diseases, especially if coma is the chief symptom.

Causes. While we do not comprehend the fundamental nature of milk fever in the cow, nevertheless we know fairly well the conditions which lead up to the disease.

1. Chief among the causes, stands the quality of the cow as a deep or profuse milker. Milk fever is pre-eminently a disease of the high-class dairy cow, and until recently has existed as a perpetual menace to the improvement of dairy breeds, because, the more excellent the individual as a dairy animal, the more vulnerable to the disease. On the other hand, cows belonging to the beef breeds, and poor milkers among dairy cows are virtually immune.

[1] American Veterinary Review, Vol. 22, 1898.

2. The state of nutrition has a very marked and well known influence upon the occurrence of parturient paresis. This is a disease of the cow in excellent condition, not of the emaciated or excessively fat. It occurs in those animals which are in the highest possible condition, and apparently in perfect health up to the hour of attack.

3. Food and housing have been claimed to influence the tendency of the cow to parturient paresis. This is in many respects very true. The malady is seen much more frequently in some seasons and in some communities than in others, and is variously attributed to the food or weather. These are inseparable from nutrition. If the weather is bad, the food may be bad. Undue exposure may lower the vitality of the animal, and thus prevent the high condition which predisposes to milk fever.

The disease is seen in the stable and in the pasture. The relative frequency will vary according to conditions. Parturient paresis may occur chiefly during the spring or early summer, in cows which are upon very rich pastures; it may be seen most frequently in those animals which are kept in the stable. This will vary according to the comparative excellency of the pastures or of the food and feeding in the stable.

4. Abrupt changes in food, housing, or other conditions may apparently influence the tendency to the disease. In the other members of this group of diseases, we recognize very clearly the effect of psychic influences, such as removing the young from the mother or bringing the mother and her young into the presence of strange animals or into new surroundings, thereby causing maternal anxiety. This apparently has an effect in some cases in causing parturient paresis of the cow.

5. It is quite universally recognized that, when parturient paresis occurs soon after calving, as almost all cases do, the malady uniformly follows a very prompt and easy birth. No case has been recorded, so far as we can find, where parturient paresis in the cow has followed dystokia.

Pathology. As already stated, the pathology of the disease is unknown. Post-mortem examination reveals changes of an interesting character, which tend to throw some light upon the symptoms and course of the disease, without, however, making clear its exact character.

Because of the well-marked coma and the general disturbance of the nervous system, the condition of the brain and the spinal cord become of great interest. The dura mater is apparently sound, though in some cases a serous exudate exists beneath it. The pia mater is said to be somewhat congested: the veins, especially, are distended with blood. The interpretation of the conditions in the brain varies with different observers. Some have found the brain substance anaemic; others have considered it congested. Sometimes hemorrhages are found upon the surface of the brain. Harms found emphysema beneath the pia mater and in the veins of the canal of the spinal cord.

The heart is usually pale and distended with blood, and occasionally shows ecchymoses of varying size.

The condition of the lungs is exceedingly variable. Harms found them edematous or emphysematous, but observed no foreign bodies in them. I have repeatedly discovered particles of food far down in the bronchial tubes, and in some cases of sudden death have found the larger bronchii completely occluded by food masses. In other instances I have been able to recognize the presence of drugs in the bronchial tubes, which had been forced upon the cow in the form of a drench some hours previously.

The alimentary tract, liver, spleen, and urinary organs are usually comparatively normal. In the uterus there are no very remarkable changes. In harmony with the history of the disease, the uterus is not normally contracted. Like other organs of the body, the uterus is anaemic.

The theories regarding the nature of parturient paresis are innumerable, and difficult of classification. These may be divided into four great classes, according to the beliefs which veterinarians hold as to the organ or system from which the disease takes its origin.

1. Many hold that the disease has its origin in some essential change in the brain or spinal cord. They believe it consists of a congestion of the entire central nervous system, with overfilling of the veins of the brain and spinal cord. Other veterinarians hold that the disease consists of anaemia and paralysis of the central nervous system.

2. Another group of veterinarians believes that the disease has

its essential origin in the uterus. In this group, each individual has an opinion of his own, which differs somewhat from that of each of his colleagues. Some believe that, from the uterine mucosa, there is absorbed into the system an amount of infectious material or the products of bacterial activity within the uterine cavity, which, acting upon the central nervous system, produces the disease. The character of this toxic substance has not been revealed, nor has any clear evidence been adduced to show that such exists. It has not been shown why, if the disease consists of the absorption of toxic substances from the uterus, cows which are very thin in flesh, are poor milkers, or have suffered from dystokia should not just as readily suffer from milk fever as deep milkers which are in high condition and have calved easily. Others, like Stockfleth, hold that milk fever is the result of embolism of the veins of the uterus, the emboli escaping to other portions of the body.

3. A third group of veterinarians, including Schmidt of Kolding, holds that the disease arises from the mammary gland, and consists of a toxaemia due to the absorption of colostrum, perhaps incompletely formed, or other secretions which possess a highly deleterious character.

4. Harms holds that the disease is a form of aeraemia, or air in the blood. In his post-mortem examinations, he found air in the veins of the brain, spinal cord, lungs, and other organs.

Neither of these views has been generally accepted. As already stated, post-mortem examination has virtually failed to reveal anything definite regarding the actual cause or character of the malady. This and that lesion has been recorded, only to have its existence or importance disputed by other writers of equal authority. One finds hyperaemia of the brain, and another anaemia, with the possibility that either or both may be correct.[1]

Handling. 1. **The essential therapeutics of parturient paresis consists of the inflation of the udder with air or oxygen.** So far as clinical experience reveals, it is not material which of these is used. As soon as the patient can be reached,

[1] For a full resumé and discussion of the various theories of the nature of parturient paresis, the reader is referred to the contribution of J. Schmidt, Kolding, (Monatshefte für praktische Thierheilkunde. Bd. IX., S. 241,) a translation of which appears in the Am. Vet. Review, Vol. 22, p. 392, Sept.

and a definite diagnosis of parturient paresis made, a sufficient volume of oxygen or air should be introduced into each quarter of the udder to distend quite thoroughly all parts of the gland. In order to avoid the escape of the air through the teat canal, it may sometimes be desirable to apply temporarily to the teat a soft ligature, which is to be removed after the expiration of three or four hours.

The ligature should consist preferably of a soft piece of tape, which should be tied around the teat tightly enough barely to prevent the injected air from escaping through the teat orifice. If tied too tightly, and allowed to remain for several hours, necrosis of the teat follows. The teat is to be closely watched, and the ligature removed promptly whenever serious injury is threatened.

The broader the ligature and the more evenly applied, the less the danger to the teat.

The ligation of the teat is not always necessary. The necessity for ligation in order to retain the gas in the udder is largely dependent upon the character of the teat sphincters. In those cows which leak their milk, there will naturally be greater necessity for ligatures than in hard milkers. The amount of gas injected is subject to no fixed rule. The udder should be firmly distended. Usually the sphincters of the teats will retain sufficient gas and permit any excess to escape. Some believe that, the greater the distention of the udder with air, the more prompt and effective the treatment. This has not been clearly shown. Occasionally the distention is overdone, and extensive emphysema of the udder, thighs, and croup follows from rupture of the milk acini. No harm ensues. If the distention seems insufficient, if the response is tardy or feeble, more air or oxygen may be introduced at any time.

Should the first inflation fail to produce the desired results after an interval of three to six hours, a second distention of the gland should be made. There is no evidence that any harm may occur from repeated inflations of the udder with air or oxygen, so long as no infection is carried into the gland.

Since the mammae are at this stage highly vunerable, it is essential to safety that due precautions be taken against introducing infection into the gland upon the portion of the apparatus inserted into the teat, or forcing it into the gland with the oxygen or air which is being introduced.

The precautions to be taken are analogous to those for any surgical operation. They include the disinfection of the operator's hands; the disinfection of the cow's udder, especially the teats; the sterilization of the injection apparatus, especially the tube which is to be introduced into the teats; and the protection of the udder from infection during the operation. The patient needs be placed in such position that all four quarters of her udder are readily available. Usually it is best to place her in lateral or oblique recumbency.

The udder should be carefully placed upon a clean cloth saturated with a reliable disinfectant, or upon a clean tray, after which the entire gland, especially the teats, is to be thoroughly washed and disinfected. The apparatus to be used for injecting the air or oxygen, especially the tube to be inserted into the teat, should be sterilized by boiling.

Before inserting the tube into the teat, all antiseptics should be carefully washed away from the tube and from the end of the teat, with sterile water. **The introduction of antiseptics into the milk gland upon a tube or other instrument is as dangerous as the introduction of ordinary forms of bacteria.** The operation is to be **aseptic**, not **antiseptic.**

The mechanism by which the inflation is brought about is not essential, so long as the general rules of asepsis are maintained. Various forms of apparatus have been introduced for the purpose of avoiding infection, but few, if any of them are free from objection. No difference what the particular type of apparatus, the general rules of aseptic surgery must be carefully applied by the veterinarian; the apparatus is not sufficient in itself. Many of these devices consist of a rubber bulb, attached to an elongated tube, into which is inserted a filter of asbestos, cotton, or other substance. Beyond this, the rubber tubing ends with an ordinary milk or teat tube, which is inserted into the milk canal. This form of apparatus is probably the most objectionable of any that has been devised, because the filter is difficult to sterilize and, becoming befouled, acts as a constant menace to the udder of the patient. The simplest apparatus, the one which can be most readily sterilized by boiling, is the best. There is no great danger of the introduction of infection with the air, if moderate care is taken not to stir up dust in the stall while the operation is in progress. This danger may be eliminated in a variety of ways which are very simple. If a wash-bottle is constructed, and the air forced through the water, and thence into the udder, any floating particles of dirt will be retained in the water, leaving the air free from infection.

Laymen have used the ordinary bicycle pump for injecting air into the udder. This process has been bitterly criticised by some veterinarians. Such a pump, or one on a similar plan, with very ordinary precautions, is safer than the apparatus usually sold for the purpose. A sterilizable pump of this type can be made a very convenient and safe appliance. It may be enclosed in a sterilizable metal case, and kept sterilized ready for use. At the time of use, a few layers of sterile gauze over the intake will effectively filter the air.

The safest and most convenient apparatus for the work is the oxygen, or compressed air, tank. The tank may be charged by the veterinarian, with a small force pump. The air should be filtered through sterile gauze as it enters the pump. Thus charged, under suitable precautions, the apparatus is always ready, compact, light, easily applied, and workably free from the danger of causing infection. The milk tube or other tube inserted into the teat should be short, barely long enough to freely enter the milk cistern. A longer tube may wound the parts during unexpected struggles. The tubes may be sterilized in advance, and enclosed in a hermetically sealed container, so that they are ready for use. The oxygen tank is most convenient if small. Two or more tanks could be kept on hand, so that one could always be charged and ready for use. The detached tube may be enclosed in a sterilizable metal container and quickly prepared for use. It is apparently immaterial whether any milk which may be in the udder is withdrawn before the injection or not.

Some practitioners advise treatment supplementary to the inflation of the udder, but they have not yet clearly shown by clinical data that any good has come from such additions. Generally those who desire to add something to the udder inflation prescribe powerful heart stimulants, such as strychnine or caffein.

As a remnant of by-gone days, some veterinarians still advise and practice catheterization. The secretion of urine ceases with the advent of the disease. Over-distention could not have existed in the healthy cow, and can not occur in the paresis patient. A pint or a gallon of urine in the bladder can do no harm; catheterization may do much.

The attitude of the patient is of very great importance. Except when it is necessary for a few minutes while inflating the udder, the cow should from the first be carefully and zealously guarded against assuming lateral recumbency, or this position promptly corrected if already attained. The cow, like other ruminants, promptly suffers from tympany of the rumen whenever ever lateral recumbency is maintained for a prolonged period. The distention of the rumen, by its pressure upon the diaphragm, interfer esseriously with respiration and with the action of the heart and other organs. The most serious danger from this position is that, in the paretic state of the animal, there is imminent risk of the involuntary passage of food from the rumen into the pharynx, and its inhalation into the lungs, to cause fatal strangling or foreign-body pneumonia. Consequently it is essential to keepthe animal in sternal recumbency. This may be facilitated by packing bundles of straw about the animal. When the patient is very violent it may be desirable to secure the two anterior feet in such a way that the limbs can not be extended. This is best accomplished by attaching a short strap or cord to each anterior foot, carrying them upward over the withers, and tying them together in such a manner as to keep the anterior feet completely flexed upon the carpus against the chest.

When parturient paresis occurs before or during parturition, the fetus should not be primarily disturbed, but the udder inflated. The dystokia, or rather atokia, due to uterine paresis from the disease, vanishes after the inflation of the udder. I have seen cases where parturition was due, the cervical canal dilated, the calf alive and presenting normally, but the uterus inert. They respond promptly to the inflation of the udder, get up quickly, and parturition comes on and is completed with alacrity.

In those cases of parturient paresis complicated by prolapse of the uterus, the inflation of the udder is the urgent primary duty of the veterinarian. Upon no account should he meddle with the prolapse until the basic treatment has been applied. When that has been done, the uterus should be cleansed, placed in favorable position for the circulation of its blood, compressed, and guarded until the paresis abates, when the prolapsed organ is to be replaced as advised on page 555.

It is quite unnecessary to suggest that the animal be well bedded and otherwise made comfortable.

The practitioner should be on his guard against the dangers of moving the recumbent animal from place to place. If the patient has fallen in a bad situation, out of doors or elsewhere, it may appear desirable that she should be conveyed to a stable or other suitable place for handling. In bringing about this transfer it is well-nigh unavoidable that she be placed in lateral recumbency and undergo a form of handling which will tend strongly to cause the regurgitation and inhalation of some of the contents of the rumen. Therefore it is best in all cases to make the patient comfortable, if possible, where she falls. Abundant bedding, and blankets if the weather is cold or rainy, usually suffices as well as a stable and avoids the danger of transfer. When moving the recumbent animal is imperative, she should be kept on her chest until all is in readiness, the transfer then made promptly and carefully, and the patient quickly replaced upon her sternum.

When the practitioner is called to attend a case of parturient paresis, he should rigidly abstain from drenching the patient, and carefully enquire, before he takes charge, whether any drugs or medicines have been given by the mouth. If cows suffering from parturient paresis are drenched, the mortality is exceedingly high, because portions of the drench usually pass down the trachea into the lungs. It does not matter at what stage of the disease the attempt to drench the animal occurs. While she is still upon her feet, and merely beginning to stagger, she is nevertheless very liable to become strangled. There appears to be from the first an anaesthesia or paresis of the larynx, pharynx, and other parts, which prevents coughing or any other signs of strangling. If the animal has received a drench, especially one which would be highly irritant to the lungs or could not be absorbed from the respiratory mucous membrane, an unfavorable prognosis should be given at once, and the handling begun with a definite understanding that the animal will probably die from inhalation pneumonia.

The history of the origin of the present plan for handling parturient paresis dates back to the investigations of Schmidt of Denmark, in 1897, when he introduced his plan of handling the disease by the introduction into the udder of a solution of iodide of potassium, commingled with air. Later, various practitioners found that, failing to have the potassium iodide at hand, the distention of the udder with other liquids, such as very weak disinfecting solutions or normal salt solution, possessed a similar efficiency. Then oxygen was substituted for the potassium iodide solution, and its efficiency was found to be even greater. From this experience it was readily surmised that, in default of pure oxygen, the mixture of oxygen and nitrogen of the air might answer the purpose. Clinical experience early demonstrated this to be a fact. To-day oxygen and air are used indifferently, with very great success.

The discovery of Schmidt, with its gradual development, leading to the now universally accepted mode of handling parturient paresis, constitutes one of the most remarkable and beneficent advances in therapeutics in the history of veterinary medicine. It has transformed one of the most fatal of diseases into one which, when promptly handled, is almost robbed of its mortality.

Prior to the investigations of Schmidt, parturient paresis was a great obstacle to the advancement of efficiency in dairy cows. As soon as a cow showed high efficiency, imminent danger to her life from parturient paresis at once arose, and the ranks of the best dairy cows annually suffered appalling losses.

Under the treatment with air or oxygen, the mortality in parturient paresis in the cow has dropped from 60–75 per cent. to less than 5 per cent., in those cases which are promptly attended and in which there has been no meddling by the administration of medicines by the mouth.

From the standpoint of prophylaxis, the attitude of the profession has been quite generally modified by the advent of the present method of handling. Formerly it was advised in many cases to withdraw a portion of the milk from the udder before the cow calved, and to keep her well milked immediately after calving, but this rule has been reversed, and it is now advised to leave the udder fully distended with colostrum or milk.

It was formerly advised, also, that a purgative be given, immediately before or after parturition, in order to prevent parturient paresis, but this has been generally discarded since the advent of the inflation treatment.

It is now uniformly advised, in case there appears to be any danger of an attack of parturient paresis, that the udder be inflated at once with oxygen or air as a prophylactic measure.

The history of the therapeutics of parturient paresis is extensive and interesting. Almost every form and character of treatment possible has been advised, and favorable reports of the use of each have been made. Purgatives long held a very high place, in spite of the fact that they were generally poured into the lungs instead of the rumen, and quite generally hastened the fatal termination. Stimulants, narcotics, sedatives, in endless profusion, were recommended by one, only to be condemned by others and finally to be discarded. Blood-letting was advised and abandoned. Hypodermic injections of strychnine, eserine, pilocarpine, and many other drugs were advised, with the great advantage that they did not get into the lungs and strangle the animal, but the results from their use were not satisfactory. External applications were used, such as stimulating liniments on the spine and ice on the head. Intra-uterine injections of a solution of alum or other substances were advised. In spite of all these innumerable methods, recommended by this or that practitioner, the high mortality of the disease still held its sway.

Puerperal Eclampsia in the Sow

Hegel (Repertorium, Vol. 46), de Bruin (Geburtshilfe bei den kleineren Haustieren), and others describe puerperal eclampsia in the sow. The malady is characterized, according to Hegel, by spasmodic movements of the neck, grinding of the teeth, convulsive movements of the facial muscles, inability to stand, and elevation of temperature.

De Bruin has usually observed the disease two to five days after farrowing and expulsion of the fetal membranes. Usually the birth has been easy. The symptoms are chiefly a more or less complete suspension of lactation, with paresis, coma, and intestinal torpidity.

The prognosis is good, and most cases tend to spontaneous recovery after a few days.

Hegel advises bleeding from the tail, cold poultices to head and back, purgatives, tobacco clysters, etc., and, if trismus persists, the application of chloroform and oil to the masseter region.

De Bruin warns the practitioner against drenches, always dangerous for swine because of strangling. He advises the use of electuaries composed of 10 grammes sulphate of magnesia, 50 grammes powdered anise seed, and common syrup sufficient to make a paste. This is placed upon the tongue with a wooden spatula, and the entire quantity used during one day. He also advises the application of tincture of camphor over the body to arouse the skin secretions.

The Milk Disease of Sheep. Parturient Paresis in Sheep and Goats

De Bruin describes a malady of ewes, closely resembling the parturient paresis of the cow, under the designation of milk disease. It occurs chiefly in ewes from which the sucking lambs have been removed after having lambed normally some six weeks previously. The disease appears usually 2-24 hours after the removal of the lambs from the ewes.

The symptoms are absence of appetite, rumination, or other digestive functions. The ewe ceases to bleat or hunt for her lamb, becomes paretic, with glassy eyes, loss of corneal reflex, coma, and the general symptoms of parturient paresis of cows.

The prognosis is good, and the method of handling is the same as for parturient paresis in the cow.

De Bruin describes, under a separate heading, a parturient eclampsia of sheep, goats, and swine, regarding this malady as essentially different in etiology and pathology from the milk disease described above.

The real ground for differentiation is not clear. In these cases the animals show definite tonic and clonic spasms. The disease is usually acute and stormy. It appears ordinarly soon after giving birth, though it may occur ante-partum. There are present trismus, opisthotonos, and general convulsions, with pirouetting of the eyes, followed by coma.

Chloral hydrate in enemas, and hypodermic injections of morphine, are recommended for handling, and good results are reported. De Bruin does not mention inflation of the mammae with air or oxygen, nor does he intimate why this should not be quite as successful in the eclampsia of the sheep and goat as in the paresis of the cow.

Puerperal Eclampsia of the Bitch

Next to the cow, probably the bitch suffers most frequently from puerperal eclampsia or paresis. The malady has rarely been observed prior to, or immediately following parturition. Usually it occurs from 2—8 days after giving birth to young. Occasionally it occurs 10—14 days after parturition, and rarely as late as 30 days. Ordinarily it follows easy parturition. It is most frequently observed in highly bred nervous animals, and occasionally follows the psychic disturbance incident to removal of the puppies from the patient.

The symptoms are analogous to those of the eclampsia already described in the mare, ewe, goat, and sow. The first symptoms are anxiety, restlessness, and uncertain gait. The patient falls in convulsions. The voluntary muscles are affected with severe tonic and clonic spasms. As in other eclamptic diseases, the body excretions are largely in abeyance, the bowels are torpid, the urinary secretions are suspended, and the mammae are flaccid and devoid of milk. During the convulsions, the patient at first remains conscious. Later the convulsions may be followed by coma and unconsciousness. While in the convulsions, the visible mucosa are cyanotic. The affection greatly resembles strychnine poisoning, but De Bruin points out the important difference that in strychnine poisoning the patient is easily excited, while in eclampsia no hypersensitiveness is apparent.

The course of the disease, as in other members of the eclamptic group, is usually stormy. Unless it is energetically handled, it ends fatally in 24 to 48 hours. **The prognosis** is good when the disease is promptly handled.

De Bruin strongly recommends 20–40 mg. (0.3–0.6 grains) of morphia hydrochlorate, hypodermically, repeated in a few hours if necessary. Some advise chloroform inhalations or chloral hydrate enemas. Some have recommended the administration of ether or chloroform syrup by the mouth, but, as in all diseases of this group, the powers of deglutition are uncertain, and there is constant danger, from the introduction of medicines through the mouth, that they will get into the lungs.

INDEX

Abdominal Ballottement, 158.
Aberhalden's Test for Pregnancy, 161.
Abnormalities in the Development of the Fetus. Dystokia from, 468.
Abortion, Artificial, 465.
Abortion, The Dystokia of Contagious, 425.
Abortion, The Uterine Inertia of Contagious, 439.
Acardia, 55.
Adjustment of Deviated Extremities, 377.
Afterbirth, 122.
After-pains, 304.
Allantois, Dropsy of, 251.
Allantois, The, 120.
Amnion, Dropsy of, 251.
Amnion, The, 115.
Amaurosis, 196.
Amorphus, 55.
Amputation at Tarsus, 401.
Amputation at the Humero-Radial Articulation, 398.
Amputation of Anterior Limbs, 395.
Amputation of Posterior Limbs. Intra-Pelvic, 402.
Amputation of the Head, 392.
Amputation of Head and Neck, 394.
Amputation of Uterus, 574.
Anasarca, Fetal, 259.
Anatomic Elevations in Pelvis, 459.
Anatomy, Obstetric, 3.
Anomalies in Fecundation, 176.
Anomalies in Fetal Skeleton, 481.
Anterior Limbs, Amputation of, 395
Anterior Limbs. Flexion of at Elbow, 522
Anterior Presentation, Dystokia in, 512.
Anus, Atresia of, in embryo, 71.
Apical Dystokia in Multipara, 438.
Apoplexy, Parturient in Cow, 611.
Appliances for Traction, 330.
Arrangement of Fetuses in Twin Pregnancy, 173.
Arteries, Formation of in the Embryo, 86.
Arteries, Uterine, Palpation of in Pregnancy, 157.
Artificial Abortion, 465.
Ascites, Fetal, 477.
Atresia of Anus in Embryo, 71.
Auricles, The, 85.
Ausculation of Fetal Heart, 158.

Ballottement, Abdominal, 158.
Basal Dystokia in Multipara, 438.
Bi-Cornual Pregnancy, 494.
Bi-Cornual Pregnancy, Rotated, 501.
Bitch, Parturient Eclampsia of, 629.
Bladder, Eversion of, 580.
Bladder, Formation of the, 100.
Bladder, Prolapse of, 580.
Bladder, Prolapse of through Vaginal Rupture, 555.
Bladder, Rupture of the, 552.
Blastodermic Vesicle, 51.
Brain, Hernia of, 61.
Brain, The Formation of, 57.
"Breech Presentation," 541.
Broad Ligaments of Uterus, 24.

Callus from Pelvic Fracture, 462.
Campylorrhachis, 483.
Care of the New Born, The, 309.
Care of the Puerperal Animal, 303.
Care of Umbilic Cord at Birth, 311.
Caudal Presentation, 284.
Celom, 53.
Cephalotomy, 393.
Cervix, Induration of, 446.
Cervix, The, 28.
Cervix, Uteri, Prolapse of, 240.
Cesarian Section, 411.
Cessation of Estrum in Pregnancy, 151.
Chisels, Obstetric, 348.
Chorion, The, 122.
Choroidal Fissure, 65.
Circulation, The Fetal, 93.
Circulatory System of the Embryo, 85.
Cleft Palate, 64.
Clitoris, Formation of, 105.
Coition, 43.
Complete Retention of Fore Limbs, 529.
Complete Retention of Posterior Limbs, 541.
Compound Bi-Cornual Pregnancy, 501.
Concealed Knives, 242.
Constriction of Vulva, 455.
Construction of Obstetric Instruments, 350.
Contagious Abortion, The Dystokia of, 425.
Contagious Abortion, Uterine Inertia of, 439.
Control of the Patient, 355.

Contusion of the Gluteal Nerves, 592.
Contusions of Lumbo-Sacral Nerves, 592.
Contusion of the Obturator Nerves, 594.
Copulation, 43.
Cords and Bands, Obstetric, 330.
Cord, Spinal, 60.
Cornea, 65.
Cornua, Uterine, 17.
Corpus Luteum of Pregnancy, 155.
Coxae, The, 5.
Coxo-Femoral Dislocation, 596.
Crystalline Lens, 65.
Cyclops, 58.
Cysts, Dentigerous of Ear, 67.
Cysts of Fetal Organs, 478.

Decapitation, 392.
Destruction of Pelvic Girdle, 399.
Detruncation in Anterior Presentation, 398.
Deviations in Posterior Presentation, 539.
Deviations of Fetal Extremities, 512.
Deviations of Head and Neck, 513.
Deviations of Limbs in Anterior Presentation, 522.
Deviations of Uterus, 458.
Diagnosis of Multiple Pregnancy, 173.
Diagnosis of Pregnancy, 150.
Diaphragm, Rupture of, 553.
Differential Diagnosis of Pregnancy, 162.
Digestive Apparatus, Formation of, 70.
Discus, Proligerus, 42.
Diseases of Fetus, Primary, as a cause of Dystokia, 468.
Diseases of Pregnant Animal, 187.
Diseases of Pregnancy, 187.
Diseases of the Uterus, Dystokia due to, 425.
Dislocation, Coxo-Femoral, 596.
Dislocation of Femur as cause of Dystokia, 463.
Dislocation of Hip Joint, 596.
Displacements of Uterus, 458.
Dorsal Presentation, 284
Dorsal Presentation, Primary, 495.
Dorso Ilial Position, 512.
Dorso-Pubic Position, 512.
Downward Deviation of Head, 518.
Dress, The, of the Obstetrist, 354.
Dropsy of Allantois, 251.
Dropsy of Amnion, 251.
Dropsy of Uterine Walls, 190.
Dropsy of the Utero-Choriomic Space, 191.
Ducts of Mueller, 17.
Duration of Pregnancy. The, 165.
Dystokia, 323.
Dystokia due to abnormalities in Development of Fetus, 468.
Dystokia due to crossing of Fore Limbs over the Neck.
Dystokia due to the Development of a Normal Fetus in Abnormal Position in the Uterus, 494.
Dystokia due to Diseases of the Uterus, 425.
Dystokia due to displacement of Uterus, 458.
Dystokia due to Flexion of Fore Limbs at Carpus, 526.
Dystokia due to Primary Diseases of Fetus, 468.
Dystokia, Fetal, 323.
Dystokia from Abnormal Positions of Fetus, 512.
Dystokia from Anomalies in Fetal Skeleton, 481.
Dystokia from Bi-Cornual Pregnancy, 494.
Dystokia from "Breech Presentation," 541.
Dystokia from Campylorrhachis, 483.
Dystokia from Complete Retention of Fore Limbs, 529
Dystokia from complete Retention of Posterior Limbs, 541.
Dystokia from Compound or Rotated Bi-cornual Pregnancy, 501.
Dystokia from Cysts of Fetal Organs, 478.
Dystokia from Deviations of Fetal Extremities, 512.
Dystokia from Dislocation of Femur, 464.
Dystokia from Double Monstrosities, 487.
Dystokia from Excess of Volume, 468.
Dystokia from Fetal Ascites, 477.
Dystokia from Fetal Osteo-Chondrom, 479.
Dystokia from Fetal Tumors, 479.
Dystokia from Flexion at the Tarsus, 539.
Dystokia from Forward Extension of Hind Limbs, 535
Dystokia from Hydrocephalus, 474.
Dystokia from Hyperthrophic Fetal Glands, 479.
Dystokia from Hypertrophy of Wollffian Bodies, 481.
Dystokia from Interlocking of Fetal and Maternal Pelves, 533.

Dystokia from Intra-Pelvic Hemorrhage, 455.
Dystokia from Pelvic Rachitis, 462.
Dystokia from Persistence of Muellerian Ducts in Vagina, 453.
Dystokia from Primary Dorsal Presentation, 495.
Dystokia from Primary Ventral Presentation, 497.
Dystokia from Renal Hypertrophy, 481.
Dystokia from Schistocormus Reflexus, 485.
Dystokia from Transverse Pregnancy, 494.
Dystokia from Tumors in Genital Canal, 457.
Dystokia in Anterior Presentation, 513.
Dystokia in Multipara, 438.
Dystokia in Posterior Presentation, 539.
Dystokia in Contagious Abortion, The, 425.
Dystokia of Uterine Inertia, 439.
Dystokia, Pelvic, 459.
Dystokia, Synopsis of Fetal, 467.
Dystokia, The General Handling of, 368.
Dystokia, Maternal, 323, 425.
Dystokia, Twin, 491.

Ear, Formation of, 66.
Ear Teeth, Formation of, 67.
Eclampsia, Parturient of the Bitch, 629.
Eclampsia, Parturient in the Mare, 605.
Eclampsia, Puerperal in Sow, 627.
Eclamptic Diseases, Puerperal, 602.
Ectopia cordis, 89.
Egg, Segmentation of the, 48.
Embryo, Formation of, 53.
Embryology, 47.
Embryotomes, 344.
Embryotomy, 391.
Embryotomy in Posterior Presentations, 401.
Embryotomy Operations, Miscellaneous, 410.
Emphysematous Decomposition of the Fetus, 430.
Epididymis, 103.
Epispadias, 105.
Equipment for Obstetric Work, 330.
Estrum, 43.
Estrum, Cessation of in Pregnancy, 151.
Eustachian Tube, Formation of, 66.
Evagination of Uterus, 555.
Eversion of the Bladder, 580.
Eversion of Uterus, 555.
Evisceration, 408.
Ewe, Milk Disease of, 628.
Examination of the Patient, 361.
Excessive Size of Fetus as cause of Dystokia, 468.
Expulsion of Fetal Membranes, 280.
Expulsive Efforts, Control of, 359.
Extension of Extremities, 377.
Extra-Uterine Pregnancy, 209.
Extraction, Forced, 381.
Extremities, The Extension and Adjustment of, 377.
Eyes, Formation of the, 64.

Fallopian Tubes. (See Oviducts), 17.
Fecundation, Anomalies in, 176.
Feeding the New Born, 317.
Femur, Dislocation of, 596.
Fertilization, 46.
Fetal Anasarca, 259.
Fetal Ascites, 477.
Fetal Circulation, The, 93.
Fetal Dystokia, 323.
Fetal Dystokia, Synopsis of, 467.
Fetal Heart, Ausculation of, 158.
Fetal Membranes, 122.
Fetal Membranes, Expulsion of, 280.
Fetal Membranes. The, 114.
Fetal Skeleton, Anomalies in, 481.
Fetal Tumors, Dystokia from, 479.
Fetus, Emphysematous Decomposition of, 430.
Fetüs, Palpation of, per Rectum et Vaginam, 157.
Fetus, Position of the, in Uterus, 145.
Fetus, Presentations and Positions of, 283.
Fetus, Primary Diseases of, 249.
Fetuses, Arrangement of in Twin Pregnancy, 173.
Fetuses, the Number of, 169.
Finger-Knives, 340.
Fissicollis, 89.
Fistula, Vesico-Vaginal, 589.
Flexion of Anterior Limbs at Elbow, 522.
Flexion of Fore Limbs at Carpus, 526.
Flexion of the Tarsus,
Forced Extraction, 381.
Forceps, Obstetric, 337.
Fore Limbs, Complete Retention of, 529.
Fore Limbs Crossed Over the Neck, 524.
Form of the Pregnant Uterus, 139.
Formation of Nervous System, 54.

Formation of the Brain, 57.
Formation of the Embryo, 53.
Forward Extension of Hind Limbs, 535.

Gastrodidymus Octipes, 487.
Gastro-Hysterotomy, 411.
General Handling of Dystokia, 368.
Generative Organs, The, 14.
Genital Cells, Wandering, 177.
Genital Organs, Wounds of, 544.
Genital Tract, The, 17.
Germinal Spot, 42.
Gestation, 134.
Gluteal Nerves, Contusion of the, 592.
Gluteal Paralysis, 592.
Goat, Parturient Paresis of, 628.
Graffian Follicle. (See Ovisac), 40.
Graffian Follicle, Rupture of. (See Ovulation), 44.
Groove, Neural, 54.
Groove, Primitive, 52.
Gubernaculum Testis, 102.

Head, Amputation of, 392.
Head and Neck, Deviations of, 513.
Heart, Auscultation of Fetal, 158.
Heart, The, 85.
Hematoma of the Vulva, 590.
Hemorrhage from Gravid Uterus, 238.
Hemorrhage, Intra-Pelvic, 455.
Hemorrhage, Post-Partum, 544.
Hermaphroditism, 106.
Hernia Cerebri, 61.
Hernia of Brain, 61.
Hernia of Uterus, 458, 205.
Hooks, Obstetric, 334.
Horns of Uterus, 17.
Humero-Radial Articulation, Amputation at, 398.
Hydrallantois, 251.
Hydrocephalus, Dystokia of, 474.
Hydrocephalus, Nature of, 60.
Hydrometra, Parietal, 190.
Hydrometra, Visceral, 191.
Hydrops Amnii, 251.
Hygiene of Pregnant Animals, 179.
Hypertrophic Fetal Glands, 479.
Hypertrophy of Wolffiian Bodies, 481.
Hypertrophy, Renal, 481.
Hypospadias, 105.
Hysterectomy, 422.
Hysterocele, 458.
Hysterocele, 205.

Ilium, The, 5.
Induration of the Cervix, 446.
Infection, The Prevention of during Obstetric Operations, 364.
Infections, Puerperal, 599.
Innominate Bones, 5.
Instruments for Section, 339.
Interlocking of Fetal and Maternal Pelves, 533.
Intestines, Rupture of, 553.
Intra-Pelvic Amputation of Posterior Limbs, 402.
Intra-Pelvic Hemorrhage, 455.
Intussusception, Uterine, 555.
Involution of Uterus, 280.
Ischium, The, 6.

Knives, Concealed, 242.
Knives, Finger, 340.
Kidneys, Formation of the, 100.
Lacrymal Duct, Formation of, 65.
Laminitis, Puerperal, 599.
Lateral Deviation of Head, 513.
Lens, Crystalline, 65.
Ligament, Broad of Uterus, 24.
Ligament, Round, of Testicle, 102.
Ligament, Round of Uterus, 24.
Ligament, Sacro-Sciatic, 7.
Ligamentum Teres, Rupture of (See Coxo-Femoral Dislocation), 596.
Limbs, The Formation of, 107.
Liver, Formation of, 84.
Lumbo-Sacral Nerves, Contusions of, 592.
Lungs, Formation of the, 77.

Male Reproductive Organs, The, 102.
Malignant Tumors as Cause of Dystokia, 457.
Management of Normal Parturition, 290.
Maternal Dystokia, 323.
Maternal Dystokia, 425.
Maturation of the Ovisac, 40.
Meconium, Discharge of by the New Born, 317.
Megalomelus Perissodactylus, 111.
Membrana Nictatans, Formation of, 65.
Menstruation, 46.
Menstruation, Cessation of in Pregnancy, 151.
Metrorrhagia, 238.
Milk Disease of Ewe, 628.
Milk Fever, 611.
Milk Fever of Sheep and Goat, 628.
Milk, General Composition of, 321.
Miscellaneous Embryotomy Operations, 410.
Muellerian Ducts, 17.
Muellerian Ducts, Persistence of in Vagina, 453.
Multiple Pregnancy, The Diagnosis of, 173.

Mutation, 372.

Navel Cord, The 131.
Necrosis of Apices of Fetal Sac, 123.
Nerves, Gluteal, Contusion of, 592.
Nerves, Obturator. Contusion of, 594.
Nervous System, Formation of, 54.
Necrotic Tip of Fetal Sac, 123.
Neural Groove, 54.
New Born, Feeding of the, 317.
New Born, The Care of the, 309.
Normal Parturition, Management of, 290.
Number of Fetuses, The, 169.

Obstetric Anatomy, 3.
Obstetric Chisels, 348.
Obstetric Forceps, 337.
Obstetric Hooks, 334.
Obstetric Instruments, Construction of, 350.
Obstetric Operations, 372.
Obstetric Outfits, 352.
Obstetric Physiology, 35.
Obstetric Saws, 346.
Obstetric Work, Equipment for, 330.
Obturator Nerves, Contusion of, 594.
Obturator Paralysis, 594.
Olfactory Organs, 62.
Operations, Obstetric, 372.
Ossa Innominata, 5.
Osteo-Chondrom, Fetal, 479.
Osteomalacie, 189.
Ova, Permanent, 40.
Ova, Primitive, 40.
Ovaries, The, 14.
Oviducts, The, 19.
Ovisac, Maturation of, 40.
Ovulation, 44.
Ovum, Segmentation of the, 48.

Palate, Cleft, 64.
Palpation of the Fetus per rectum et Vaginam, 157.
Palpation of Uterine Arteries in Pregnancy, 157.
Pancreas, Formation of, 84.
Paralysis, Gluteal, 592.
Paralysis, Obturator, 594.
Paraplegia, 191.
Parietal Hydrometra, 190.
Paresis, Parturient, in the Cow, 611.
Parturient Appoplexy, Cow, 611.
Parturient Eclampsia of the Bitch, 629.
Parturient Eclampsia in the Mare, 605.
Parturient Eclampsia of Sheep and Goat, 628.
Parturient Eclampsia in Sow, 627.
Parturient Paresis in the Cow, 611.
Parturient Paresis of Goat, 628.
Parturition, Management of Normal, 290.
Parturition, Physiologic, 261.
Parturition, Symptoms of, 268.
Patient, The Position and Control of, 355.
Pelves, Interlocking of Fetal and Maternal as Cause of Dystokia, 533.
Pelvic Dystokia, 459.
Pelvic Dystokia in Multipara, 438.
Pelvic Fracture, Dystokia from, 462.
Pelvic Symphysis, Relaxation of, 592.
Pelvis, The, 3.
Penis, Formation of, 105.
Perineum, Rupture of the, 582.
Permanent Ova, 40.
Peromelus, Achirus, 109.
Peromelus, Apus, 109.
Persistent Median Wall of Muellerian Ducts, 453.
Physiologic Parturition, 260.
Physiologic Presentation and Position of Fetus, 283.
Physiology, Obstetric, 35.
Placenta, 114.
Placenta, The, 126.
Placental Tufts, 123.
Polyspermia, 178.
Position, Dorso-Sacral, 284.
Position of the Fetus in Uterus, 145.
Position of the Patient, 355.
Positions of Fetus 283.
Positions of Fetus, Abnormal, 512.
Posterior Limbs, Intra-Pelvic Amputation of, 402
Posterior Presentation, 284.
Posterior Presentation, Dystokia in the, 539.
Posterior Presentation, Embryotomy in, 401.
Post-Partum Hemorrhage, 544.
Pregnancy, 134.
Pregnancy, Corpus Luteum of, 155.
Pregnancy, Diseases of, 187.
Pregnancy, Diagnosis of, 150.
Pregnancy, Diagnosis of Multiple, 172.
Pregnancy, Differentation of, from various diseases, 162.
Pregnancy, The Duration of, 165.
Pregnancy, Extra-Uterine, 209.
Pregnancy, Twin, 170.
Pregnant Animal, Diseases of, 187.
Pregnant Animals, The Hygiene of, 179.
Pregnant Uterus, form of, 139.

Prepubian Tendon, Rupture of the, 196.
Prepuce, 105.
Presentation, Dorsal, 284.
Presentations of the Fetus, 283.
Presentation, Posterior, 284.
Presentation, Ventral, 285.
Prevention of Infection during Obstetric Operations, 364.
Primary Diseases of Fetus as a cause of Dystokia 468.
Primary Diseases of the Fetus and its Membranes, 249.
Primary Dorsal Presentation, 495.
Primitive Groove, 52.
Primitive Ova, 40.
Primitive Streak, 52.
Primary Ventral Presentation, 497.
Prolapse of Bladder through Rupture in Vagina, 555.
Prolapse of the Bladder, 580.
Prolapse of the Rectum, 579.
Prolapse of Intestine through Rupture in Uterus, 554.
Prolapse of Uterus, 555.
Prolapse of the Vagina, 240.
Pubis, The, 7.
Puerperal Animal, Care of the, 303.
Puerperal Eclamptic Diseases 602.
Puerperal Eclampsia in Sow, 627.
Puerperal Infections, 599.
Puerperal Laminitis, 599.
Puerperal Tetanus, 601.

Rachitis, Dystokia from, 460.
Rectum, Prolapse of the, 579.
Relaxation of the Pelvic Symphysis, 592.
Removal of the Meconium from the New Born, 317.
Renal Hypertrophy, 481.
Repellers, 338.
Reproduction, 35.
Reproductive Organs, Male, 102.
Repulsion, 373.
Retropulsion, 373.
Rotation, 375.
Round Ligament of Testicle, 102.
Round Ligament of Uterus, 24.
Rupture of Diaphragm, 553.
Rupture of Gravid Uterus, 207.
Rupture of Intestines, 553.
Rupture of Prepubian Tendon, 196.
Rupture of the Bladder, 552.
Rupture of the Perineum, 582.
Rupture of Uterus and Vagina, 547.
Rupture of Uterus with Prolapse of Intestine, 554.

Sacro-Sciatic Ligament, 7.
Sacrum, The, 3.
Saws, Obstetric, 346.
Saws, Wire, 347.
Schistocephalus Bifidus, 63.
Schistocormus Fissidornalis, 71.
Schistocormus Reflexus, 119.
Schistocormus Reflexus, 485.
Seal, The Uterine, 152.
Section, Instruments for, 339.
Sectors, Obstetric, 346.
Segmentation of the Egg, 48.
Sheep, Milk Disease of, 628.
Sinus Venosus, 85.
Smell, Organs of, 62.
Somites, 107.
Sow, Puerperal Eclampsia in, 627.
Spatulas, Obstetric, 349.
Spina Bifida, 56.
Spinal Cord, Formation of, 60.
Streak, Primitive, 52.
Stricture of Vagina, 453.
Superfecundation, 176.
Superfetation, 176.
Symptoms of Parturition, 268.
Tarsus, Amputation at, 401.
Tarsus, Flexion of as a Cause of Dystokia, 539.
Teeth, Formation of the, 77.
Teratology, 47.
Testicles, 102.
Tetanus, Puerperal, 601.
Torsion of the Uterus, 215.
Traction, Appliances for, 330.
Transverse Pregnancy, 494.
Tumors in Genital Canal, 457.
Tunica Granulosa, 42.
Twin Dystokia, 491.
Twin Pregnancy, 170.
Twin Pregnancy, Arrangement of Fetuses in, 173.

Umbilic Cord, Care of at birth, 311.
Umbilic Cord, The, 131.
Upward Deviation of Head, 521.
Ureters, Formation of the, 100.
Uterine Arteries, Palpation of, in Pregnancy, 157.
Uterine Cornua, 17.
Uterine Inertia of Contagious Abortion, 439.
Uterine Intussusception, 555.
Uterine Seal, The, 152.
Uterine Walls, Dropsy of, 190.
Utero-Chorionic Space, Dropsy of the, 191.
Uterus, The, 21.
Uterus and Vagina, Rupture of, 547.
Uterus, Deviations of, 458.

Uterus, Displacements of, 458.
Uterus, Dystokia due to Diseases of, 425.
Uterus, Eversion of, 555.
Uterus, Form of the Pregnant, 139.
Uterus, Hemorrhage from the Gravid, 238.
Uterus, Hernia of, 205.
Uterus, Hernia of, 458.
Uterus, Horns of, 17.
Uterus, Invagination of, 555.
Uterus, Involution of, 280.
Uterus, Position of Fetus in, 145.
Uterus, Prolapse of, 555.
Uterus. Prolapse of, 574.
Uterus, Rupture of the Gravid, 207.
Uterus, Torsion of, 215.

Vagina, The, 30.
Vagino-Cystocele, 240.
Vagina, Prolapse of, 240.
Vagina, Rupture of, 547.
Vagina, Stricture of the, 453.
Vas Deferens, 102.
Veins, The formation of in Embryo, 91.
Ventral Presentation, 285.
Ventral Presentation, Primary, 497.
Ventricles, The, 85.
Version, 376.
Vesicle, Blastodermic, 51.
Vesico-Vaginal Fistula, 589.
Visceral Hydrometra, 191.
Vitelline Membrane, 42.
Vitelline Sac, 114.
Vitreous Body, 65.
Vulva, The, 32.
Vulva, Hematoma of, 590.
Vulvar Constriction, 455.

Wandering of Genital Cells, The, 177.
Wire Saws, 347.
Wolffian Bodies, Hyperthrophy of, 481.
Wolffian Body, 102.
Wolffian Ducts, 105.
Wounds and Injuries of Genital Organs, 544.
Wry-Neck in the Foal, 482.

Yolk Sac, 114.

Zona Radiata, 43.