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THE

SCIENCE AND ART

OF

MIDWIFERY.

BY

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PROFESSOR OF OBSTETRICS AND THE DISEASES OF WOMEN AND CHILDREN IN THE BELLEVUE HOSPITAL MEDICAL COLLEGE; CONSULTING PHYSICIAN TO THE MATERNITY HOSPITAL; VISITING PHYSICIAN TO THE EMERGENCY HOSPITAL; GYNÆCOLOGIST TO THE BELLEVUE HOSPITAL; FELLOW OF THE AMERICAN GYNÆCOLOGICAL SOCIETY; CORRESPONDING FELLOW OF THE OBSTETRICAL SOCIETIES OF EDINBURGH AND LONDON; ETC., ETC.

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TO

FORDYCE BARKER, M.D., LL.D.,

IN RECOGNITION OF HIS EMINENCE

AS A WRITER, TEACHER, AND PHYSICIAN,

AND IN GRATEFUL ACKNOWLEDGMENT

OF

HIS GENEROSITY TOWARD THE YOUNGER MEMBERS OF HIS PROFESSION,

This Book is Dedicated,

WITH THE AFFECTIONATE REGARD OF HIS FRIEND,

THE AUTHOR.

P1070

PREFACE TO THE THIRD EDITION.

When, three years and a half ago, the first edition of this work was published I stated as follows the principles that had guided me in its preparation:

"My purpose has been to present to the reader a fair statement of the changes which have been made by modern investigation in the views entertained respecting the physiology and pathology of pregnancy, labor, and childbed; and I have endeavored to show that with advancing knowledge the art of midwifery has ceased to rest upon empirical rules, and is already, with rare exceptions, the natural outcome of scientific principles. To insure accuracy, I have spared no pains to subject the doctrines taught to rigorous clinical tests; and I have everywhere sought to supplement and correct my own personal experiences by the recorded observations of others."

The activity that has prevailed in the study of obstetric phenomena, and in the perfecting of obstetric practice in the short space that has intervened since its first appearance, has, however, necessitated many changes in the text, and has led to the nearly complete rewriting of entire subjects. Many statements which three years ago were advanced with diffidence as theoretically probable have recently been shown to be capable of scientific demonstration, whereas a few, with more modern light, have been omitted in the process of revision.

It is with special gratification that I take this opportunity to draw attention to the triumph of the modern doctrines concern-

ing the nature of puerperal fever, and to the wonderful results that have proceeded from the application of Mr. Lister's teachings to the hygiene of lying-in hospitals. The latter have ceased to be pest-houses, and it is now a question whether forlorn women, confined in properly conducted maternities, are not actually safer in childbed than the fortunate classes in their own homes.

To the medical press and the medical profession of this country and Great Britain I owe a debt of gratitude never to be forgotten for the flattering welcome they have extended to this treatise. It has been translated into Spanish by Toledo, into French by Doléris, and a translation into Italian by Dr. Alessandro Camusso is now in the course of preparation.

When I recall the modest expectations with which I first awaited the verdict of the critics, I can not too strongly express my thanks to them not only for the favor they have shown my work, but for the fairness they have exhibited when drawing attention to the statements and teachings with which they were not in agreement.

I have endeavored to make the present edition both a safe guide to the practice of midwifery, and a useful book of reference for those who wish to investigate modern teachings at their source.

For the preparation of the index special thanks are due to my friend Dr. W. H. Flint, whose painstaking accuracy will be evident to those who have occasion to consult these pages.

May 23, 1885.

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THE

SCIENCE AND ART OF MIDWIFERY.

PHYSIOLOGICAL ANATOMY.

CHAPTER I.

FEMALE ORGANS OF GENERATION.

The pudendum.—Labia majora.—Clitoris.—Labia minora.—Vestibule.—The bulbs of the vestibule.—Meatus urethræ.—Sebaceous glands.—Mucous glands.—Vaginal orifice.—Hymen.—Vagina.—Vessels of vagina.—Uterus.—Fallopian tubes.—Ovaries.—Vessels of uterus and its appendages.—Nerves of uterus.—Lymphatics.—Development of the female organs of generation.—Arrests of development.

The female organs of generation may be properly divided as follows : 1. The external parts, or pudendum, and the vagina. 2. The uterus, Fallopian tubes, and ovaries.

The external parts and vagina are chiefly concerned in the act of copulation. As they likewise constitute the channel through which the child passes during parturition, a knowledge of their anatomical structure becomes of importance to those who would practice the obstetric branch of medicine.

The internal organs, i. e., the uterus, Fallopian tubes, and ovaries, assume obstetrical importance in connection with the parts they play in gestation. Thus, the ovary furnishes the germ from which the new being is developed. The Fallopian tube receives the germ, and conveys it to the uterus. In the uterus, the fecundated germ obtains the nutritive materials necessary for its subsequent growth and development.

I. The External Parts of Generation and Vagina.

The Pudendum.—The pudendum comprises all those parts which are perceptible externally. It includes the mons Veneris, the labia, the clitoris, the nymphæ, and the hymen. It is situated at the lower

opening of the pelvis, and has a wedge-shape, whence the term *cunnus*, i. e., *cuneus*. Its base is formed by the *mons Veneris*, a fatty cushion, abundantly supplied with hair, which covers the symphysis pubis. As it follows the curvature of the lower portion of the trunk, in extreme inclination of the pelvis it is sometimes directed so far backward as to render difficult the introduction of the speculum and the accomplishment of the sexual act. It is divided in the median line by the *rima pudendi*, which extends from the mons Veneris to the perinæum. Upon each side of the rima there are two longitudinal, slightly curved, and rounded folds of integument, which rest upon cushions of adipose areolar tissue. These folds constitute the so-called *labia majora*, which, like the mons Veneris, are covered, though to a less extent, with hair. In healthy young women they are firm and full, while in deteriorated constitutions, and in advanced life, they become wrinkled and pendulous, from diminution of the adipose tissue.

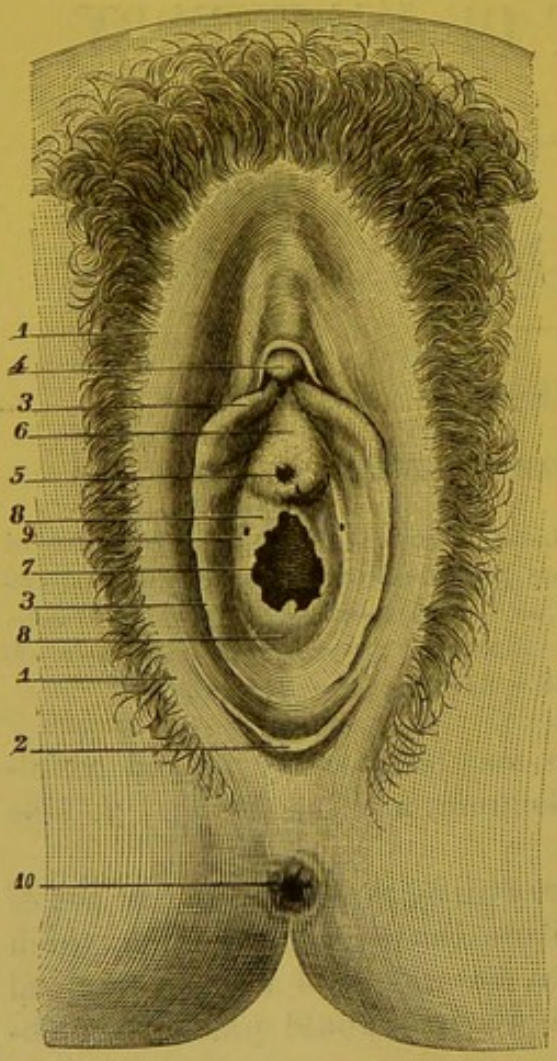


FIG. 1.—The external parts of generation (in the virgin). 1, labium majus; 2, fourchette; 3, the nympha; 4, glans clitoridis; 5, meatus urethræ; 6, vestibule; 7, orifice of vagina; 8, hymen; 9, orifice of the glands of Duverney; 10, anal orifice. (Sappey.)

The labia majora act as a sort of valve, which closes the orifice of the vagina, whence the term vulva —i. e., valva, the folding-door of the ancients. When the labia are full and well rounded, they are approximated closely together, and form the *vulva connivens*. With the loss of adipose tissue, a gaping of the flaccid labia ensues, and forms the *vulva hians*.

The labia offer an external and internal surface. The outer surface presents the usual characteristics of tegumentary tissue, and is abundantly supplied with large sebaceous glands. The inner surface is in all respects like a mucous membrane, except that it possesses sebaceous glands in place of mucous follicles. The subcutaneous tissue is composed of connective tissue, rich in elastic elements, and containing fatty lobules continuous with the underlying adipose structure. It furnishes support to an abundant venous plexus, to which the

turgescence of the labia *in pruritu*, and under sexual excitement, is mainly due. The existence of contractile elements has never been demonstrated.

The two extremities of the vulva have been designated, respectively, the *anterior and posterior commissures of the labia;* but these terms, so far as they convey the idea of connecting bands between the labia, are incorrect, for Luschka* has shown that the labia are directly continuous with the mons Veneris in front and the perinæum behind.

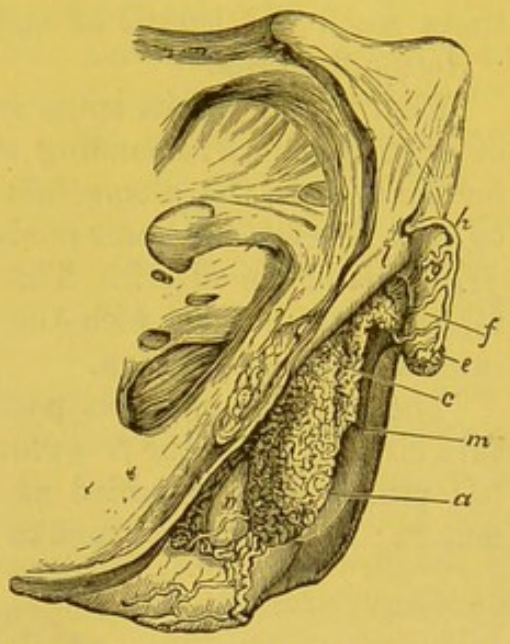


FIG. 2.—Lateral view of the erectile structures of the external organs of the female (from Kobelt), two thirds. The blood-vessels have been injected, and the skin and mucous membrane have been removed. *a*, bulbus vestibuli; *c*, plexus of veins, named the pars intermedia; *e*, glans clitoridis; *f*, corpus clitoridis; *h*, dorsal vein; *l*, right crus clitoridis; *m*, vestibulum; *n*, right gland of Bartholin or Duverney.

The *clitoris* is a small, elongated body, situated beneath the so-called anterior commissure. It resembles the penis in form and structure, but differs in possessing neither corpus spongiosum nor urethra. The clitoris is divided into the crura, the corpus, and the glans. The crura are long, spindle-shaped processes, attached to the borders of the ascending rami of the ischia and the descending rami of the pubis. The *corpus* is formed by the junction of the crura in the median line, just beneath the pubic arch. Even in a state of extreme erection, it does not normally exceed an inch in length. The *glans* is the rounded, imperforate extremity. During erection it attains the dimensions of a small pea. The cuticular covering of the glans is of a pale-red color, and is covered with papillæ, part of which contain vessels, and part, nerve-endings similar to those found in the nipple, and termed by Krause "terminal bulbs" (*End-Kolben*). The nerves of the clitoris are more fully developed than the corresponding nerves in the penis. The clitoris is regarded as the seat of the voluptuous sensations experienced by the female during copulation.

The *labia minora* are two narrow, reddish, moist folds of mucous membrane, situated between the labia majora, with which they are continuous by their outer surface. The inner surface is continuous with the mucous membrane of the vestibulum. They are, sometimes, termed likewise the *nymphæ*. *Nymphæ vocantur vel quod sint castitatis præsides, vel quod sponsum primo intermittant, vel quod aquis*

* LUSCHKA, "Die Anatomie des menschlichen Beckens," p. 407.

prosilientibus præsint (Plazzonus),* or, as Sir Charles Bell words it in his "Anatomy," "The most modest of the uses ascribed to them is that of directing the stream of urine." When the rima pudendi is narrow, as in virgins, the labia minora are concealed and protected by the labia majora. In the vulva hians, the labia minora acquire, from exposure to the atmosphere, a dirty-bluish color, and take on the properties of the cutis. In Hottentot and Bushman women, they sometimes reach the length of eight inches, and constitute the so-called "Hottentot apron."

Each labium minus splits anteriorly into two folds, of which the outer joins the corresponding one of the opposite side to form a cover for the clitoris, the *præputium clitoridis*. The lower folds converge to meet beneath the lower border of the glans clitoridis, and form the *frenulum* of the clitoris. This attachment serves to bring the clitoris forward into contact with the penis, as the labia minora are pressed inward during copulation.

The labia minora meet posteriorly, in most instances, and form a thin circular band, the *frenulum vulvæ* or *fourchette*. The fourchette has usually been regarded as the posterior commissure of the labia majora; but this view Luschka has shown to be incorrect.†

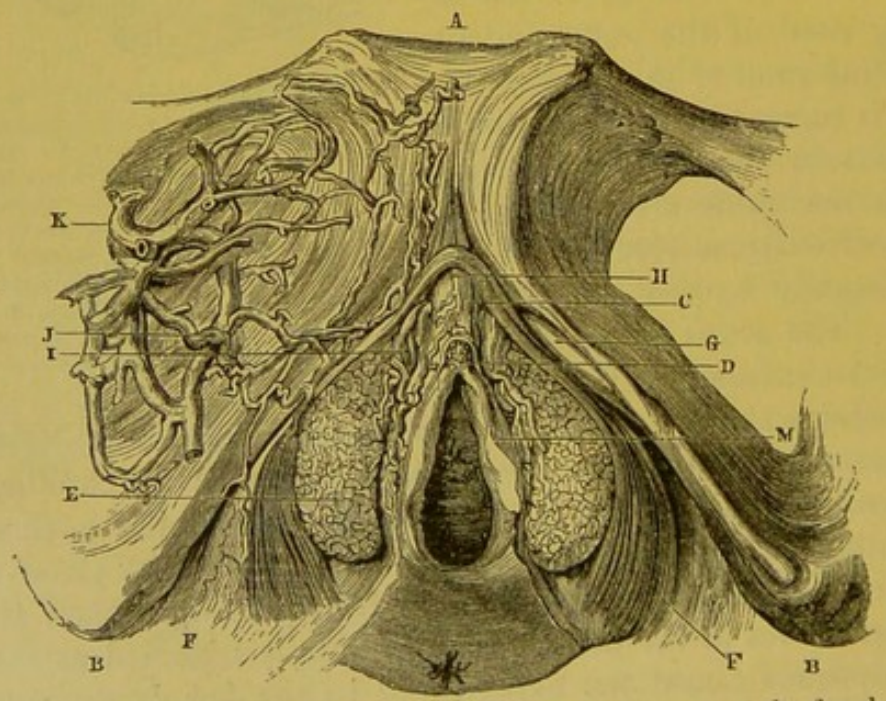


FIG. 3.—Front view of the erectile structures of the external organs of the female (Kobelt). A, pubis; B, B, ischium; C, clitoris; D, gland of the clitoris; E, bulb; F, constrictor muscle of the vulva; G, left pillar of the clitoris; H, dorsal vein of the clitoris; I, intermediary plexus; J, vein of communication with the obturator vein; K, obturator vein; M, labia minora.

The *vestibulum* is the angular space bounded by the labia minora and the vaginal orifice.

* LUSCHKA, "Die Anatomie des menschlichen Beckens," Tübingen, 1864, p. 403.

† *Ibid.*, p. 404.

The *bulbi vestibuli vaginæ*, the bulbs of the vaginal vestibule, are two curved, leech-shaped masses of reticulated veins, situated between the vestibulum and pubic arch of each side. Kobelt has shown that they correspond to the two separated halves of the male bulbus urethræ. They are composed of erectile tissue, and measure, when distended with blood, a little over an inch in length. As the head of the child passes through the vulva during parturition, these bodies are pushed forward to prevent their being compressed between the head and the pubic arch. Still, rupture does sometimes occur, and then the hæmorrhage leads to the formation of thrombus of the labia majora. The upper ends of the vaginal bulbs are rather pointed, and communicate, by means of a small plexus, the *pars intermedia* of Kobelt, with the vessels of the glans clitoridis. Through this connection the blood is pressed, during venereal excitement, by the reflex contractions of the musculus constrictor cunni, from the turgid bulbs into the glans of the clitoris.

The *meatus urethræ* is situated in the median line, at the lower portion of the vestibular space, about three quarters of an inch from the glans of the clitoris. It is surrounded by a ring of muscular fibers, which keep it closed under ordinary circumstances. These fibers cause a puckering of the mucous membrane, which is easily recognized by the experienced finger, and serves as a guide for the introduction of the catheter.

Sebaceous glands are found in great abundance in the tissues of the nymphæ, where they furnish a fatty, yellowish-white material, possessing a peculiar odor. This material, when accumulated beneath the prepuce of the clitoris, constitutes the *smegma præputii*, so common in women who neglect the niceties of the toilet.

The *mucous glands* of the vulva are divided into the glandulæ vestibulares majores and the glandulæ vestibulares minores.

The *glandulæ vestibulares minores* are from five to seven in number, and are irregularly distributed in the neighborhood of the meatus urethræ. They are of the compound racemose variety, of about the size of poppy-seed, and possess short, wide ducts with large orifices. Tyler Smith says that one of these lacunæ may be enlarged sufficiently to admit a small-sized catheter, leading the operator to suppose that he has reached the bladder, while the instrument is really in a *cul-de-sac*.*

Professor Skene,† of Brooklyn, has drawn attention to the existence of two glandular structures, from three eighths to three quarters of an inch in length, situated in the muscular walls of the urethra. The orifices of these glands are found about an eighth of an inch

* W. Tyler Smith, "Manual of Obstetrics," p. 22.

† Skene, "The Anatomy and Physiology of Two Important Glands of the Female Urethra," "American Journal of Obstetrics," April, 1880, p. 265.

above (within) the outer border of the meatus. The correctness of this observation I have had frequent opportunity to verify.

The *glandulæ vestibulares majores* were first discovered in the human subject by Bartholin, and bear sometimes his name and sometimes that of Duverney. They are two in number, of the size of a pea, and of a reddish-yellow color. They are situated behind the posterior extremities of the bulbi vestibuli, which, however, they partially overlap. They are of the compound racemose variety, and their acini open into a duct a little over a half-inch in length, wide at its beginning, but which narrows toward its orifice. The duct takes an oblique course along the inner side of the vaginal bulbs, and terminates in front of the hymen, at the angle which the hymen or its remains (the carunculæ myrtiformes) makes with the walls of the vestibule. The glands of Bartholin secrete a yellowish, adhesive fluid, which is poured out freely during coitus, and preparatory to the passage of the child at the time of labor. This secretion, by rendering the parts moist and slippery, serves to protect the mucous surfaces from mechanical injury. An abundant secretion may likewise be caused by erotic dreams, or, in fact, by any form of sexual excitement. They are more developed in young persons than in those of middle life, and in old age they seem in some cases to disappear altogether.

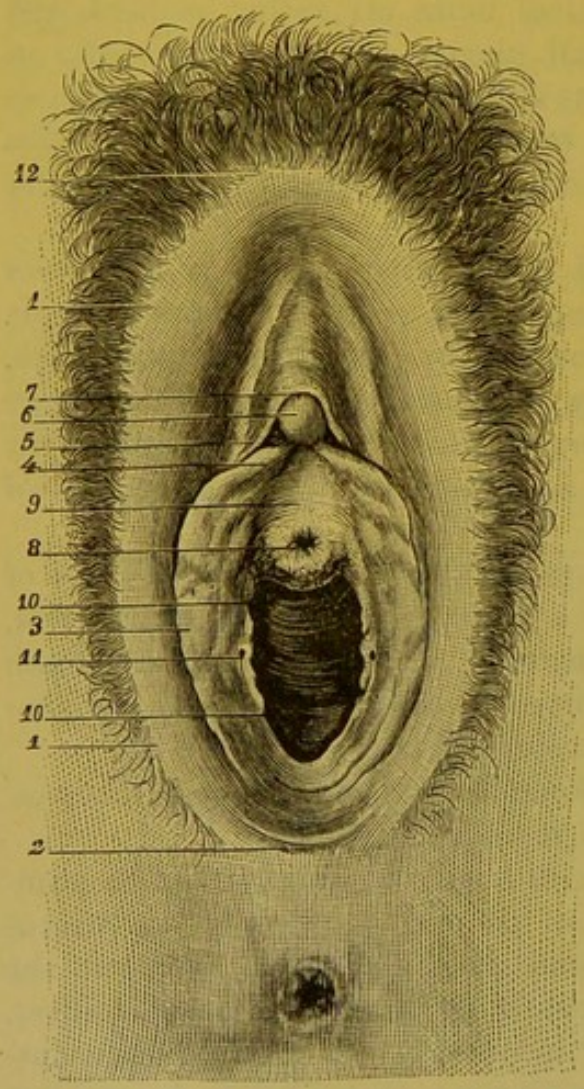


Fig. 4.—Vulva of a woman who has borne children. 1, labium majus; 2, fourchette; 3, labium minus; 4, interior layer passing beneath the clitoris; 5, upper layer forming the prepuce; 6, clitoris; 7, prepuce; 8, meatus urethræ; 9, vestibule; 10, orifice of the vagina, showing lower portion of the vaginal canal; 11, orifice of the gland of Duverney; 12, mons Veneris. (Sappey.)

The *orificium vaginæ* differs greatly, both as to size and appearance, in virgins, in women accustomed to sexual intercourse, and in those who have borne children.

In virgins (*vide* Fig. 1) the anterior extremity of the vagina terminates in a thin membrane, termed the *hymen*, which projects between the labia minora. The mucous membrane of the inner surface of the

hymen is continuous with that of the vagina; the outer surface is covered by an extension of the mucous covering of the vulva. The space between the two mucous surfaces contains blood-vessels and connective tissue derived from the vaginal walls.* The vaginal orifice, which is therefore in virgins identical with that of the hymen, has usually a crescentic shape, with its concave border looking toward the urethral orifice, so that a small opening is left anteriorly for the escape of the menstrual fluid. There are, however, a number of other less common varieties, of which the following are the most important: 1. The hymen annularis, with a small central opening. 2. The hymen cribriformis, with a number of small openings. 3. The hymen imperforatus, which completely occludes the vagina, and occasions retention of the menses. 4. The hymen fimbriatus, from its resemblance to the fringed extremity of a Fallopian tube. This variety possesses medico-legal importance, from the possibility of its being mistaken for a normal ruptured hymen.

The thin tissues which constitute the hymen are usually lacerated by the first complete coitus. Laceration, however, is not, in all cases, the necessary result of sexual intercourse. A young girl, nineteen years of age, at one time under treatment for amenorrhœa in the uterine wards of the Bellevue Hospital, possessed a perfect hymen, the opening of which was of the ordinary size, yet so distensible was its tissue that a medium-sized (one inch) Fergusson speculum was repeatedly introduced, for purposes of exploration, without in the slightest degree affecting its integrity. Hyrtl mentions a specimen of the female genitalia preserved in Meckel's museum, at Halle, where the hymen is perfect, though the woman had given birth to a seven-months child.†

We are indebted to Schroeder for having pointed out that the fleshy eminences, known as the carunculæ myrtiformes, are the result of child-bearing, and not, in the rule at least, of sexual intercourse. Coitus simply causes a solution in the continuity, at one or more points, of the free border of the hymen. The pressure of the child's head, however, during labor causes necrosis and sloughing of the heretofore persistent though lacerated hymen, of which, subsequently, the familiar, isolated elevations of mucous tissue about the vaginal orifice furnish the only visible traces.‡ My own experience is entirely confirmatory upon this point. In the examination of young nulliparous prostitutes, who enter the Bellevue Hospital for uterine disorders, I have always found a torn hymen, but, in no case, carunculæ myrtiformes.

* *Vide* Budin, "Recherches sur l'hymen et l'orifice vaginale," "Publication du progrès médicale," 1879.

† Hyrtl, "Handbuch der topographischen Anatomie," Wien, 5te Auflage, Bd. ii, p. 162.

‡ Schroeder, "Schwangerschaft, Geburt, und Wochenbett," Bonn, 1867, p. 6.

With the destruction of the hymen the *orificium vaginæ* is bounded by the labia minora and the vestibule.

The Vagina.—The vagina is a membranous canal, connecting the uterus with the external parts of generation. It runs in an oblique

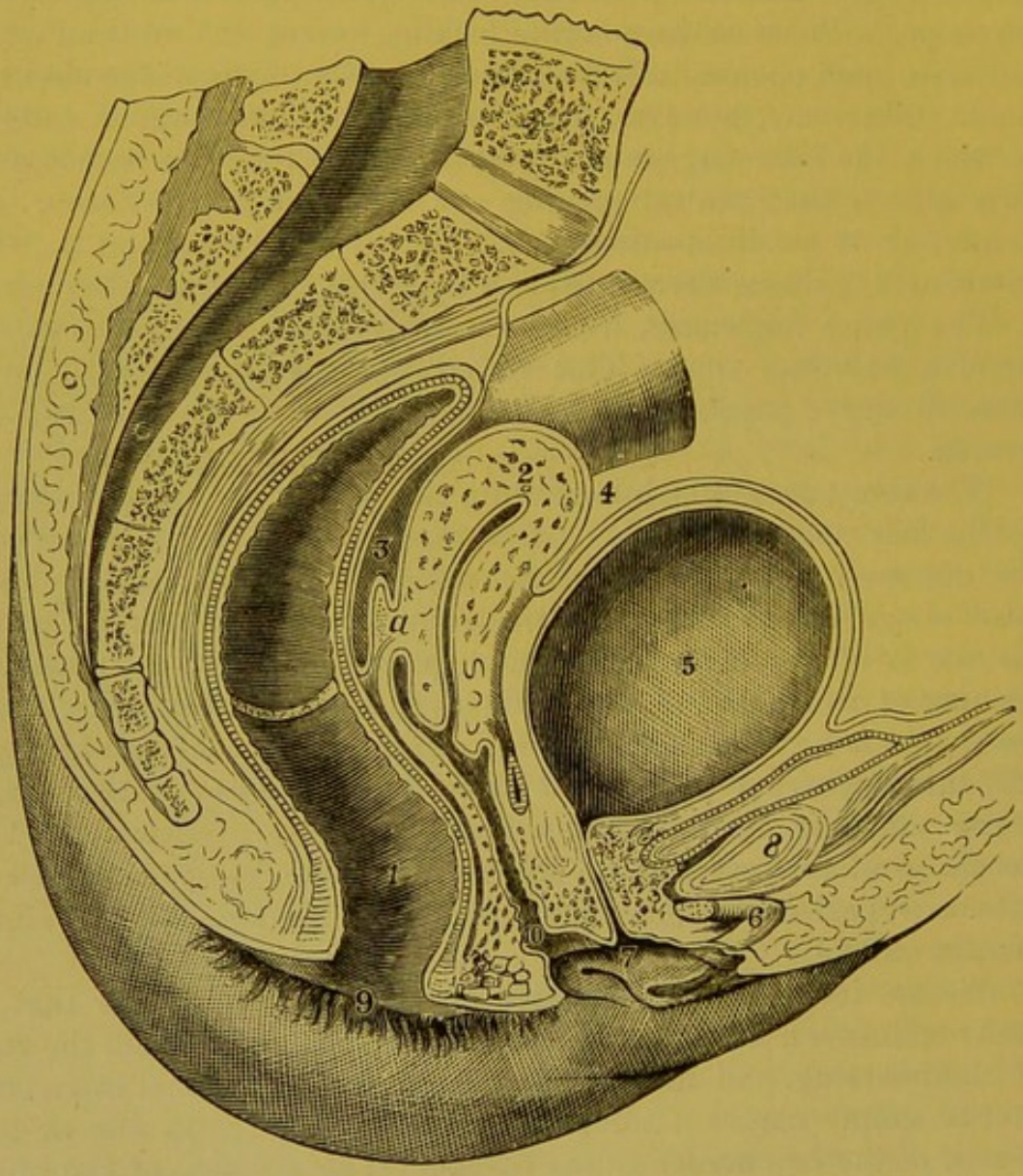


Fig. 5.—Section through the female pelvis.* 1, rectum; 2, uterus; 3, excavatio recto-uterina (cul-de-sac of Douglas); 4, excavatio vesico-uterina; 5, bladder; 6, clitoris; 7, urethra; 8, symphysis; 9, sphincter ani; 10, vagina; 11, connective-tissue layer. (Kohlrausch modified by Spiegelberg.)

direction forward from its attachment at the cervix to its orifice at the vulva. When not artificially dilated, its anterior and posterior walls are in contact with each other. The length of the vagina, owing to its

* In spite of criticisms to which Kohlrausch's drawing has of late been subjected, owing to the dislocation of the vagina and the uterus resulting from the manner of preparation, Kohlrausch having filled the rectum with cotton, and the bladder with alcohol previous to section, I have concluded to retain it in the present edition, because it still furnishes the best profile representation of the relations of the peritonæum, and the situations of the loose connective tissue, both points of especial obstetrical importance.

extraordinary distensibility, is usually greatly over-estimated. Admitting considerable variations, dependent upon weight, position, etc., of the uterus, two and a half inches for the anterior, and a little over three inches for the posterior wall may be accepted as fair average measurements.* The vagina is placed between the rectum and bladder, and is more or less intimately connected with both those organs. In its upper fifth, the vagina is separated from the rectum by the *cul-de-sac* of Douglas. From thence downward, the rectum and vagina form a common partition, the *septum recto-vaginale.* Above the pelvic floor a layer of connective tissue continuous with the pelvic fascia unites the rectum and vagina together. Below the pelvic floor the union of the two organs is immediate. Luschka limits the term "septum recto-vaginale" to this lower half of the common wall.†

The upper half of the anterior vaginal wall is attached to the bladder by means of loose connective tissue, while the lower half is inseparable from the tissues about the urethra. The partition thus formed between the urethra and vagina is termed the *septum urethro-vaginale.*

The *fornix,* as the upper part of the vagina is termed, encircles the vaginal portion of the cervix in such a way as to extend at least twice as high upon its posterior as upon its anterior aspect. The vaginal walls, when not distended artificially, are directly applied to the vaginal portion of the cervix.

The *structure* of the vaginal walls is not identical in all parts of the canal. In the upper portion the internal surface is nearly smooth, and the walls measure from a half a line to a line in thickness. They are composed of a mucous membrane, a muscular coat, and an external connective-tissue sheath, or layer. The latter is highly elastic, and affords support to the vaginal blood-vessels. The muscular fibers, which are of the involuntary variety, run in both a longitudinal and transverse direction, and are so interwoven together that a dissection into distinct strata is impossible.

The connective-tissue and muscular layers gradually increase in thickness as they approach the vaginal orifice. A circular bundle of voluntary fibers, the *sphincter vaginæ* of Luschka, surrounds the lower extremity of the vagina and urethra. The contraction of this sphincter not only acts upon the vaginal orifice, but likewise serves to close the urethra by compressing it against the septum urethro-vaginale.‡

The *vaginal columns* are two thickened ridges, which occur in the median line, upon the anterior and posterior walls, at the lower portion of the vagina. The anterior column is more prominent, in the rule, than the posterior. It is often divided into two portions by a longitudinal furrow. In these thickened ridges the muscular fibers

* Luschka, "Die Anatomie des menschlichen Beckens," Tübingen, 1864, p. 383.

† *Ibid.*, p. 384.

‡ Luschka, "Die Anatomie des menschlichen Beckens," Tübingen, 1864, p. 387.

possess a trabecular arrangement and inclose offshoots from the venous plexus. The columns thus present a cavernous structure. They are not, however, endowed with erectility. When turgid with blood, they serve to close the vagina, but the resistance they offer, like that afforded by a filled sponge, is easily overcome.* The mucous membrane covering the columns is greatly thickened, and abundantly supplied with vessels.

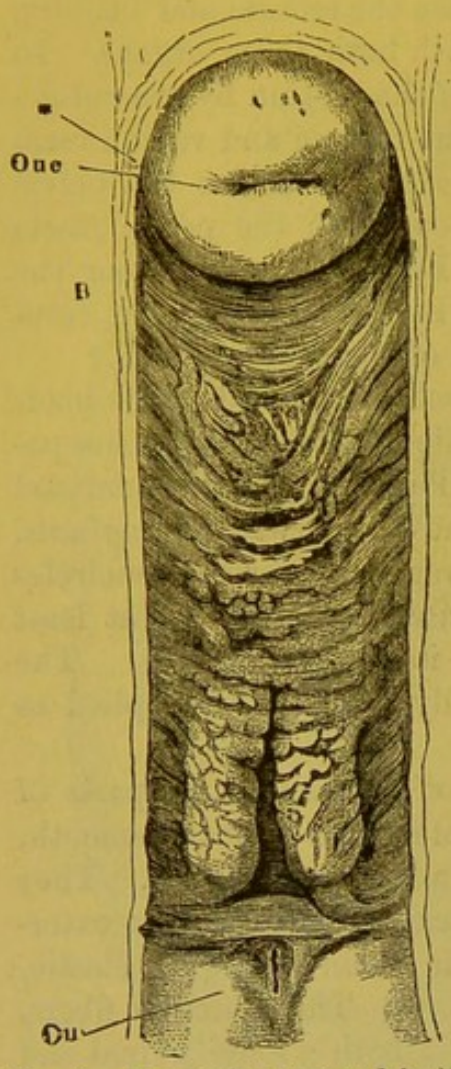


Fig. 6.—The vagina (exposed in its entire length by the removal of the posterior wall). *Ou*, orificium urethræ; *Oue*, orificium uterinum-externum; *B*, section of wall at the fornix vaginæ. (Henle.)

The vagina is likewise furnished with transverse ridges (*cristæ*, not *rugæ*—they are not wrinkles), which are more fully developed upon the anterior than upon the posterior wall. In virgins these ridges possess a nearly cartilaginous consistence. Any relaxing agency, such as chronic catarrh, child-bearing, and the like, serves to efface them, and render the vagina smooth.

The mucous membrane of the vagina is covered with numerous vascular papillæ, which, under certain conditions, especially those pertaining to pregnancy, may reach such a degree of development as to communicate to the finger a distinctly granular sensation.

Though the secreting glands of the vagina† are few in number, it is covered, even in periods of repose, with a thin layer of acid mucus. Under sexual excitement, and during menstruation or pregnancy, the amount of this secretion is largely increased.

The hypogastric, the uterine, the vesical, and the pudendal *arteries* all send branches to the vagina. The pulsations of the uterine artery may sometimes be felt through the upper part of the vaginal walls. During pregnancy these pulsations are always so distinctly marked as to constitute a good inferential sign of that condition.

The *veins* form a close plexus around the vagina. Like all the pelvic veins, they are without valves, and are therefore peculiarly sub-

* Henle, "Handbuch der Eingeweidelehre des Menschen," Braunschweig, 1866, p. 450.

† The occasional presence of glands in the vagina has been demonstrated by Preuschen. *Vide* Virchow's "Archiv," 1877, vol. lxx, p. 111.

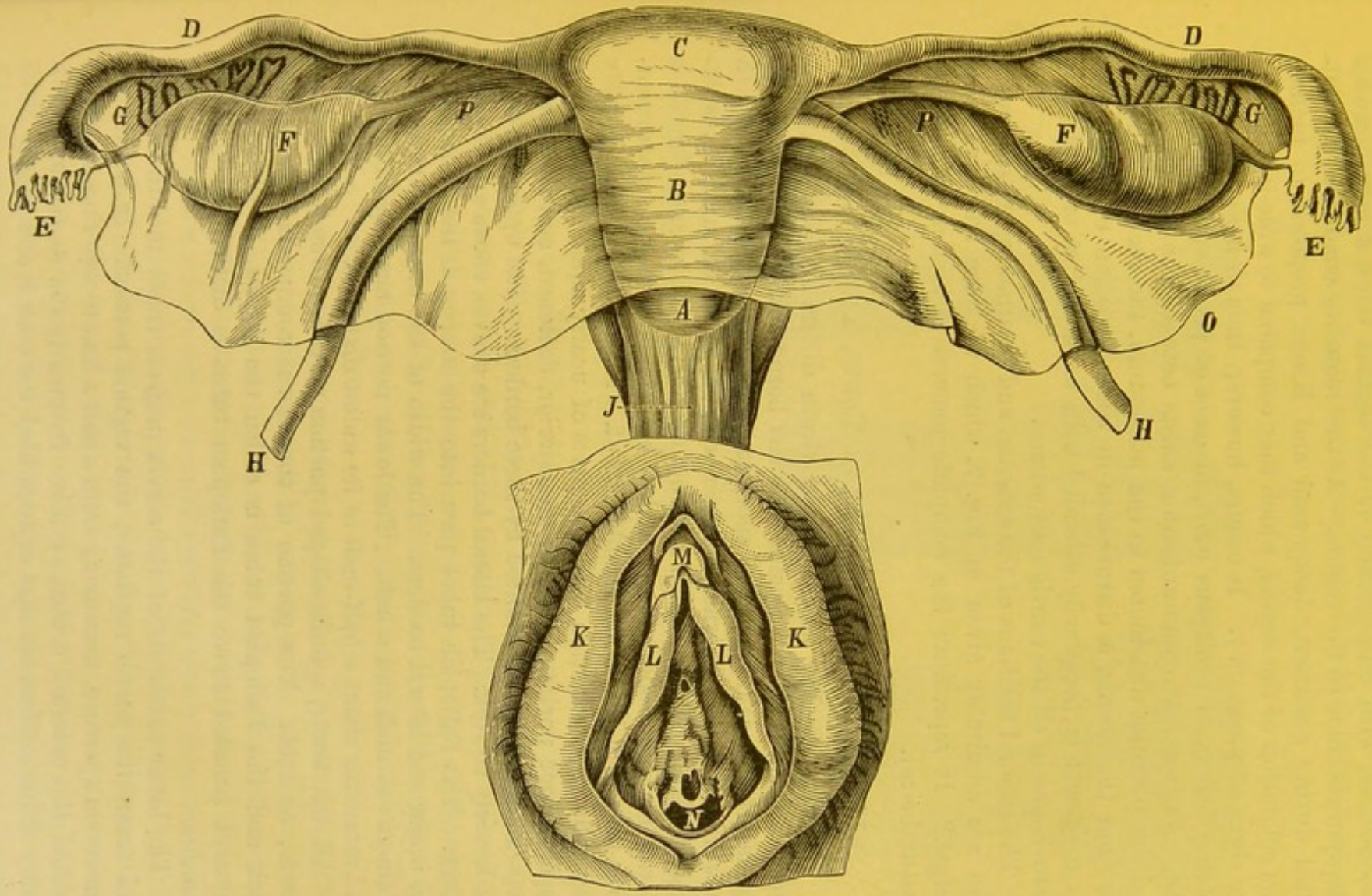


FIG. 7.—*A*, portio vaginalis; *B*, corpus uteri; *C*, fundus; *D*, Fallopian tubes; *E*, fimbriæ; *F*, ovaries; *G*, parovaria; *H*, round ligaments; *I*, vagina; *K*, labia majora; *L*, labia minora; *M*, clitoris; *N*, hymen. (Beigel.)

ject to stasis from anything that interferes with the return circulation. Blood-stasis, with enlargement of the vaginal veins, communicates a deep-purple color to the vagina. As the requisite conditions are fulfilled during gestation, Jacquemin and Kluge proposed to include this coloration of the vagina, which they compared to wine-lees, among the signs of pregnancy. It occurs, however, though perhaps to a less intense degree, in prolapsus uteri, in cases of pelvic tumors, and the like. As free intercommunication exists between the vaginal plexus and the plexuses distributed to the pudendum, the rectum, the bladder, and the uterus, a disturbance in the circulation of any one of these organs is necessarily attended with some degree of circulatory disturbance in all the contiguous organs.

The general relations of the external and internal organs of generation are admirably given in Fig. 7, which we have borrowed from Beigel.* It represents the complete generative system of a virgin (natural size).

II. The Uterus, Fallopian Tubes, and Ovaries.

The Uterus.—The uterus in the virgin differs somewhat in shape and size from that of a woman who has borne children. The following description is intended to apply to the nulliparous uterus only: In outward form the uterus has been compared to an inverted, wide-necked flask. It is flattened antero-posteriorly. Its average length is in the neighborhood of two and a half inches, though its dimensions vary to a very considerable extent. It is divided by a tolerably well-defined constriction into two parts of nearly equal length. The upper, larger portion possesses an anterior, flattened, and a posterior, convex surface. It is limited by three borders. The upper border is moderately convex. The lateral borders are convex above and concave below. The Fallopian tubes pass into the uterus at the junction of the upper and lateral borders. The width of the uterus at this point is about one inch and a half. The lower portion has a spindle shape, and measures about a half-inch in its widest diameter.

All the lower, spindle-shaped portion of the uterus is termed the *cervix*, or neck. The portion of the uterus comprised between the neck and the Fallopian tubes is called the *corpus*, or body. The segment situated above the Fallopian tubes is distinguished as the *fundus*.

The lower extremity of the cervix projects freely into the vagina, and forms the *portio vaginalis*, the vaginal portion. It possesses a transverse aperture, measuring from a half a line to two lines in width, termed the external orifice, or more frequently the *os tincæ*, from a fancy of the anatomists that it resembled the mouth of a tench. The

* Beigel, "Die Krankheiten des weiblichen Geschlechtes," Erlangen, 1874, Bd. i, p. 23, Fig. 2.

os tincæ is bounded by two thick lips, of which the anterior is absolutely longer than the posterior. As, however, the distance from the external orifice to the vaginal insertion is about half as great anteriorly

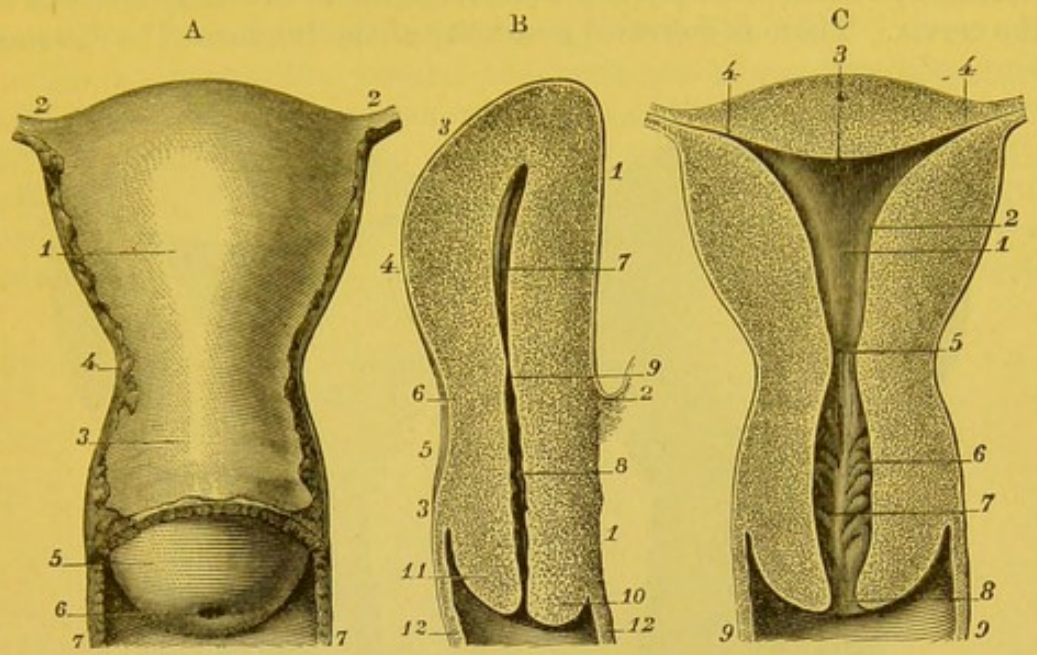


Fig. 8.—Virgin uterus. A, anterior view; B, median section; C, lateral section (Sappey). A, 1, body; 2, 2, angles; 3, cervix; 4, site of the os internum; 5, vaginal portion of the cervix; 6, external os; 7, 7, vagina. B, 1, 1, profile of the anterior surface; 2, vesico-uterine cul-de-sac; 3, 3, profile of the posterior surface: 4, body; 5, neck; 6, isthmus, 7, cavity of the body; 8, cavity of the cervix; 9, os internum; 10, anterior lip of the os externum; 11, posterior lip; 12, 12, vagina. C, 1, cavity of the body; 2, lateral wall; 3, superior wall; 4, 4, cornua; 5, os internum; 6, cavity of the cervix; 7, arbor vitæ of the cervix; 8, os externum; 9, 9, vagina.

as posteriorly, a sensation is communicated to the finger, when an examination is made *per vaginam*, as though the anterior lip were really the shorter of the two. This absolute superior length of the anterior lip, combined with the natural oblique direction of the uterus, causes the external orifice to look nearly directly backward, a fact which is readily recognized when the organs are examined *in situ* by means of a Sims's speculum.

Upon lateral section, the uterus is found to be provided with a cavity, in which the upper portion or cavity of the body is to be distinguished from the lower portion or canal of the cervix. The *cavity of the body* presents a triangular shape with convex borders. The two upper angles communicate by a small opening, hardly large enough to admit a fine bristle, with the canal of the Fallopian tubes. At the lower angle is situated the *os internum*, a circular orifice, large enough to admit a uterine sound, which forms the internal anatomical limit between the body and the cervix. The *canal of the cervix* has a fusiform shape, and is included between the internal and external orifices already described. Its inner surface is characterized by two longitudinal ridges, occupying the anterior and posterior walls, from which

branching processes extend obliquely upward, giving rise to an appearance which justifies the title—*arbor vitæ uterina.*

In women who have borne children, the uterus measures three inches in length, of which nearly two inches belong to the body and one to the cervix. There is increased convexity of the fundus. The distance

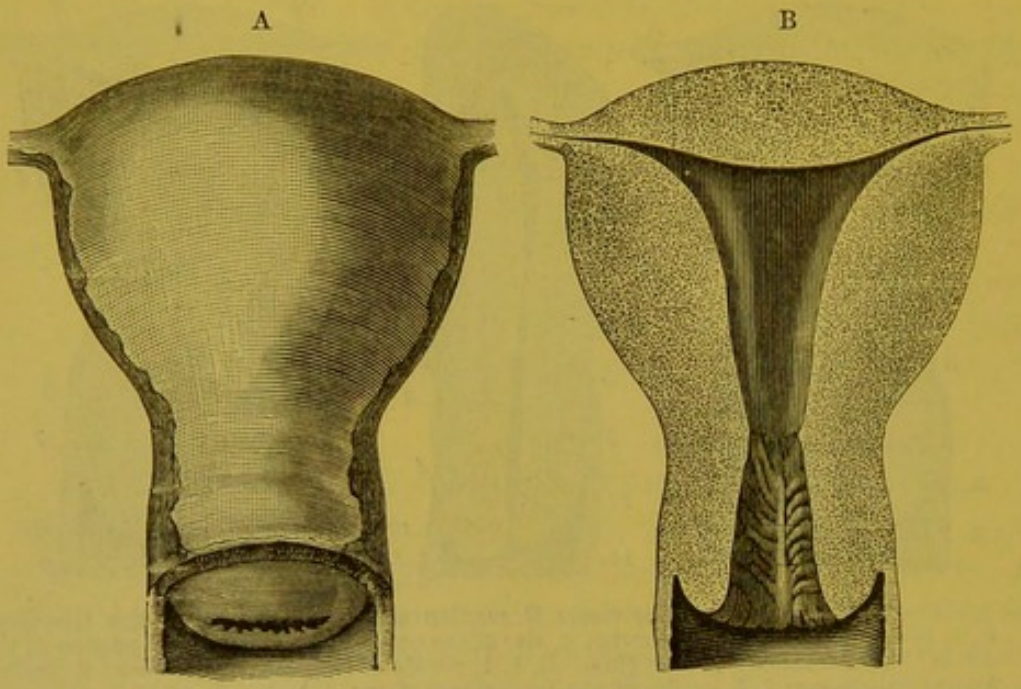


Fig. 9.—A, multiparous uterus, anterior surface; B, uterine cavity. (Sappey.)

between the insertions of the Fallopian tubes measures over two inches. The width of the cervix, at its junction with the body, measures one inch. The uterus thus assumes a pyriform shape. The cavity of the uterus loses its triangular character, and assumes a more ovoid appearance. The external orifice no longer forms a smooth transverse depression, but its edges, lacerated by childbirth, communicate the impression of a rounded, puckered surface.

When a profile section is made through a perfectly healthy unimpregnated uterus, its walls are found in actual contact. A cavity does not, therefore, naturally exist.

The uterus is so situated in the pelvic cavity as to possess a large degree of mobility. Its lower extremity projects, as we have seen, into the vagina. The supra-vaginal portion of the cervix is attached anteriorly to the walls of the bladder. That portion of the uterus which extends freely into the pelvic cavity is covered by a reflection of the peritonæum, precisely as though the uterus had been pushed from below upward into the peritoneal sac. Thus the peritonæum covers the uterus anteriorly and posteriorly. Its two surfaces meet at the lateral borders of the uterus, and thence spread outward to the ilia of the respective sides. These peritoneal folds divide the pelvic cavity into two nearly equal halves, and are termed the *ligamenta lata*, or broad ligaments.

Two peritoneal folds, containing a few contractile fibers derived from the muscular tissue of the uterus, pass forward from the uterus to the bladder—the *plicæ vesico-uterinæ*. These folds form the sides to a space, limited anteriorly and posteriorly by the bladder and uterus, termed the *excavatio vesico-uterina*. (*Vide* 4, Fig. 5.)

Upon the posterior surface, the peritonæum descends down not only over the entire supra-vaginal portion of the uterus, but over that portion of the vagina which covers the posterior lip of the intra-vaginal portion. Thence it curves upward, and becomes continuous with the peritoneal investment of the rectum. Thus a deep *cul-de-sac* is formed between the uterus and the rectum, known as the *excavatio*

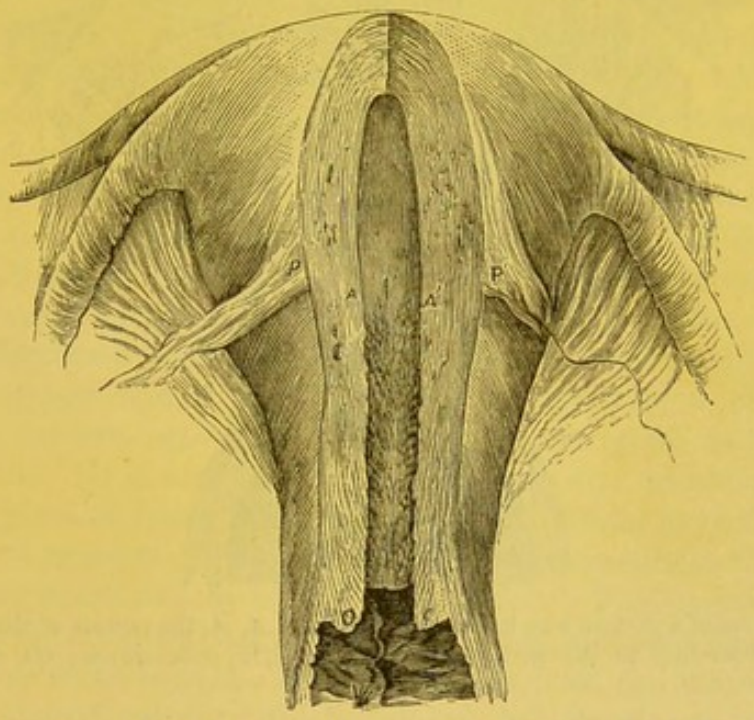


Fig. 10.—Virgin uterus opened posteriorly, showing at *A*, *A*, the os internum; at *O e*, os externum; *P*, peritoneal folds. (Bandl.)

recto-uterina, or *cul-de-sac of Douglas*. Two lateral folds of peritonæum likewise pass from the uterus to the rectum, which form sides to this space, the *plicæ recto-uterinæ*. These folds inclose in their free borders contractile muscular fibers, derived from the uterus and vagina. The plicæ recto-uterinæ pass backward, near the rectum, to the neighborhood of the second sacral vertebra. As the muscular fibers they contain were believed by Luschka to fulfill the function of maintaining the uterus in a state of normal anteversion, he proposed that they should be termed the *retractores uteri*. In Figs. 10 and 11, copied from Bandl, it will be noted that in the virgin uterus the upper borders of the peritoneal folds which bound laterally the *cul-de-sac* of Douglas leave the uterus at a point corresponding very nearly to the site of the os internum; whereas, in the uterus of women who

have borne children, the os internum is situated at a considerable distance below the folds, a difference which Bandl believes to be due to an expansion of the upper portion of the cervical canal by the growth of the ovum during pregnancy, the expanded portion thereafter forming permanently an addition to the uterine cavity.

The peritonæum covering the uterus is an exceedingly delicate membrane. In front it is so adherent to the subjacent tissues that it

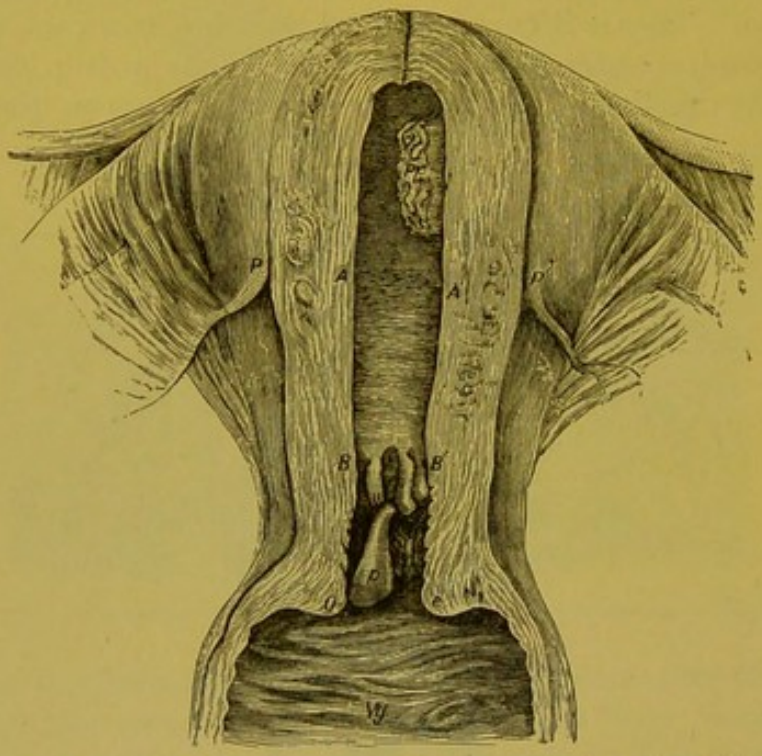


Fig. 11.—Uterus of a woman who has borne children. *A*, *A*, the portion of the uterine cavity corresponding to the peritoneal folds, *P*; *B*, B', os internum; *Oe*, os externum. (Bandl.)

can not be removed by dissection without tearing. Behind, on the contrary, it is connected with the uterus by a loose areolar tissue, and can be easily stripped up by the finger. On this account inflammatory processes are attended with more pain when situated anteriorly than posteriorly.

Though it may be proper to speak, in a general way, of the uterus as occupying a position coincident with the axis of the superior pelvic strait, it must be borne in mind that, in reality, its position is largely influenced by the neighboring organs. Thus, a full bladder pushes the fundus backward. A full rectum shoves the cervix forward. When bladder and rectum are both evacuated, the resiliency of the muscular fibers in the recto-uterine folds produces a limited amount of anteversion. Marked degrees of anteversion or anteflexion following the evacuation of the bladder are abnormal, and are due either to fixation of the cervix resulting from inflammatory changes in the

parametrium, to increased size of the uterus, or to the loss of the muscular *tonus*.

The uterus is composed of muscular fibers of the unstriped variety, arranged in bundles and united together by delicate processes of connective tissue. The arrangement of these muscular fibers has been chiefly studied in advanced pregnancy, when three separate layers may be readily distinguished :

1. The *superficial layer*, which covers the anterior and posterior surfaces of the uterus like a hood, while the sides are left free. It possesses a membranous thinness, and is intimately adherent to the peritonæum. It furnishes longitudinal fibers to the external muscular layer of the Fallopian tubes. From the posterior surface its fibers converge to form the *ligamentum ovarii*, a broad band, measuring about an inch in length and a fifth of an inch in width, which passes from the upper lateral portion of the uterus, between the layers of the broad ligament, to the ovary. From the anterior surface a similar bundle of a round form, the *ligamentum teres*, passes through the inguinal canal to the symphysis pubis, where its fibers terminate in the connective tissue of the mons Veneris. The ligamentum teres is four to five inches in length, and, in the unimpregnated uterus, when the fundus is depressed below the pelvic brim, runs in a curved direction, upward, outward, and forward, to gain the internal inguinal ring.

2. The *median layer*, which constitutes the great bulk of the uterine walls. It is composed of longitudinal and transverse fibers, which, in place of being arranged in distinct strata, as is the rule in other hollow muscles, form an intricate interlacement, in the meshes of which are contained the vessels of the organ. The longitudinal are in part derived from the lower transverse fibers, and pass downward to become continuous with the longitudinal fibers of the vagina, and in part are longitudinal from the beginning, but are closely interwoven with the transverse fibers. As they descend to the cervix, they gradually diminish in bulk, and terminate by fine processes in the connective tissue directly underlying the mucous membrane of the vaginal portion.

3. The *inner layer*, composed of circular fibers, continuous with the circular fibers of the Fallopian tubes above and those of the vagina below. This, like the external layer, is extremely insignificant in size. It represents the vestiges of the early development of the uterus from the filaments of Müller. A special re-enforcement of the muscular fibers around the internal orifice of the cervix, constituting the so-called "sphincter," is admitted by most anatomists.

Upon the outer surface of the cervix, just at the point of the vaginal attachment, there is a well-developed layer of transverse muscular fibers. Circular vessels, imbedded in a loose-meshed connective tissue containing wide lymphatic spaces, surround the cervix at the same

point. Thus a ridge is formed, which is greatly augmented in size during pregnancy. (*Vide a*, Fig. 5.)

In the cervix, the connective tissue exists in the form of well-differentiated fibers of the ordinary variety. In the body of the uterus, a similar loose-meshed, wavy connective tissue is found in the external layer, where it sends processes between the muscular bundles, and surrounds the vessels. In the median layer, rings of connective tissue accompany the vessels, while fibers of the finest description penetrate between the muscular bundles. Fine fibers, of a like character, but more abundant, are found in the inner muscular stratum, whence they pass directly into the connective tissue of the mucous membrane.

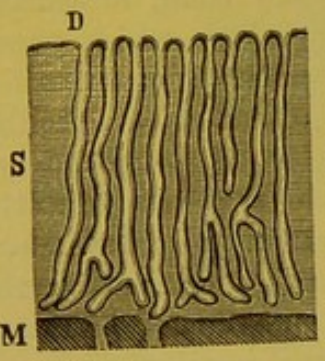


Fig. 12. — Section through the mucous membrane of a normal virgin uterus, magnified about forty diameters (Kundrat and Engelmann). *S*, mucous membrane; *D*, glands; *M*, muscular tissue belonging to the internal layer.

The mucous membrane of the uterus is divided into that lining the body and that which lines the cervical portion, between which characteristic differences of structure exist.

The mucous membrane of the body is smooth and soft. At the fundus and upon the sides it measures about $\frac{1}{25}$ of an inch in thickness, but is thinner in the vicinity of the tubes and the cervical portion. It is covered, under normal conditions, with a thin layer of transparent alkaline mucus. When examined with a magnifying-glass its surface presents a perforated appearance, due to the openings of the *uterine glands*. These glands are of the tubular variety, have a sinuous course, and are oftentimes divided below into two or three separate blind extremities. They extend, in the rule, through the entire thickness of the mucous membrane, and, in rare instances, penetrate into the muscular tissue of the uterus. They possess a delicate basement membrane, composed of spindle-shaped cells, which dovetail into one another like the endothelium of the capillaries and lymphatics.* They are lined by cylindrical cells which are said to possess ciliæ. The mucous membrane of the body of the uterus possesses an epithelium of the ciliated variety, which produces a current in the direction of the Fallopian tubes.†

A very irregular capillary net-work, with delicate walls, extends between the glands, and passes near the free surface into venous radicles, which furnish during menstruation the source of venous hæmorrhage.

* Leopold, "Die Lymphgefässe des normalen nicht schwangeren Uterus," "Arch. f. Gynack.," Bd. vi, 1873, Heft 1, p. 33.

† V. Stricker, "Die Lehre der Geweben," Leipsic, 1871, art. "Uterus," von Dr. R. Chrobak, pp. 1173 *et seq.*

The intermediate space is filled up by a connective-tissue meshwork, composed of fine processes and spindle-shaped cells, whose nuclei impart to hardened specimens a granular appearance. Leopold* claims for this meshwork the significance of lymph-sinuses. The close attachment of the mucous membrane to the muscular tissue is explained by the direct continuity of the connective tissues of the two structures.

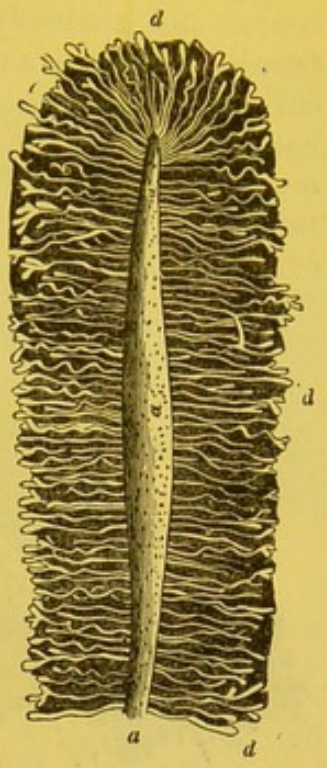


Fig. 13. — Section through uterus showing cavity, *a*, and glandular structures, *d*. (Weber.)

The mucous membrane of the cervix is of a yellowish-red color, of a firm consistence, and possesses the penniform ridges already described. It is therefore readily distinguished, both by the eye and the touch, from the red, smooth, velvety structure of the mucous membrane lining the body. At the time of puberty, it possesses a ciliated, cylindrical epithelium, which extends down to within from two to three lines of the os externum.† Simple gland-tubes, and glands with multiple *culs-de-sac*, are found upon the crests and sides of the ridges and upon those portions of the cervical canal in which ridges do not exist. These glands are, genetically considered, simple inversions of the mucous membrane, and are lined by ciliated epithelium. When the neck of one of these glands becomes obstructed, the secretion accumulates, and forms the straw-colored vesicles which have been termed the ovula of Naboth. Papillary structures, of clavate shape, are very numerous in the lower half or third of the canal. According to Lott,‡ a section through one of these papillæ is not to be distinguished from a section through one of the smaller folds of the arbor vitæ uterina. The cervical mucous membrane affords thus an extensive secretory surface, furnishing an alkaline mucus, which possesses important physiological functions in connection with conception, pregnancy, and labor.

The Fallopian Tubes.—The Fallopian tubes, as the history of their developments goes to demonstrate, are, strictly speaking, integral portions of the uterus. A glance at Fig. 15 will serve to make apparent the continuity between the tissues of the uterus and those of the Fallopian tubes. It will be noticed, too, that the canal of the latter communicates directly with the uterine cavity. The Fallopian tubes

* *Op. cit.*, p. 47.

† Lott, "Zur Anatomie und Physiologie der Cervix Uteri," Erlangen, 1872, p. 17.

‡ Lott, *l. c.*, p. 20.

measure from three to four inches in length. They are included between the folds of the broad ligament at its upper border. As they pass outward from the uterus they follow a somewhat sinuous course, and gradually increase in width and thickness. The free extremity possesses an opening communicating with the abdominal cavity, the *ostium abdominale*, which is large enough to admit a small goose-quill (2″), whereas the uterine opening does not exceed $\frac{1}{25}$ of an inch in diameter. Henle designated the inner, narrower half, which runs a comparatively straight course, the *isthmus*, and the outer, sinous, dilated portion the *ampulla* of the tube. A number of ragged,

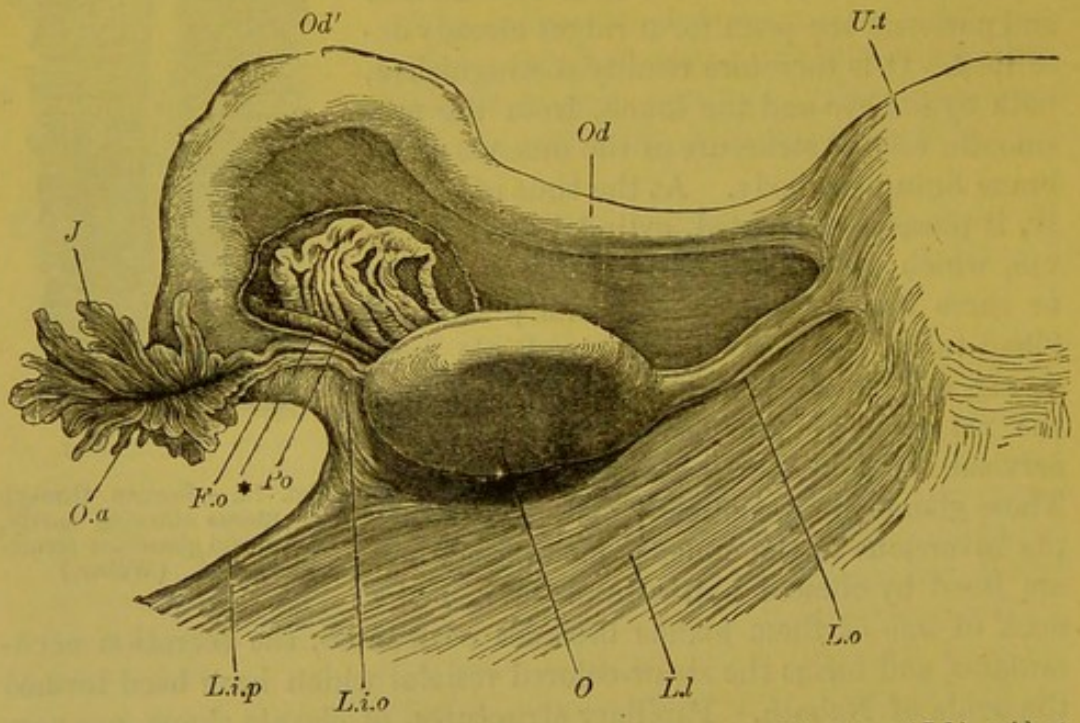


Fig. 14.—Posterior lateral view of the uterus (*U.t.*), with portion of lig. latum (*L.l.*), oviduct, and ovary. *Od*, isthmus; *Od'*, ampulla; *J*, infundibulum; *O.a.*, ostium abdominale; *F.o.*, fimbria ovarica; *O*, ovarium; *L.o.*, lig. ovarii; *L.i.o.*, lig. infundibulo-ovaricum; *L.i.p.*, lig. infundibulo-pelvicum; *Po*, parovarium. (Henle.)

fringe-like processes surround the ostium abdominale, whence the name *fimbriated extremity of the tube*. These fringes received likewise from the mediæval anatomists the name *morsus diaboli* from a supposed resemblance to the root of the scabiosa succissa, the peculiar appearance of which was ascribed by the superstitious to a bite the devil gave it in a fit of anger at its beneficent action in the maladies that affect the human race.* One of the fimbriæ (*F. o.*) is rather longer than the rest, and is attached to the outer angle of the ovary.

The *muscular walls* of the tubes are composed of unstriped fibers, similar to those described as existing in the uterus. They are arranged in two layers: one, longitudinal, continuous with the external layer of the uterus; and the other, circular, continuous with the circular fibers

* Hyrtl, "Topographische Anatomie," Wien, 1865, Bd. xi, p. 210.

of the inner uterine layer. Galvanization of the tubes causes contractions of a vermicular character.

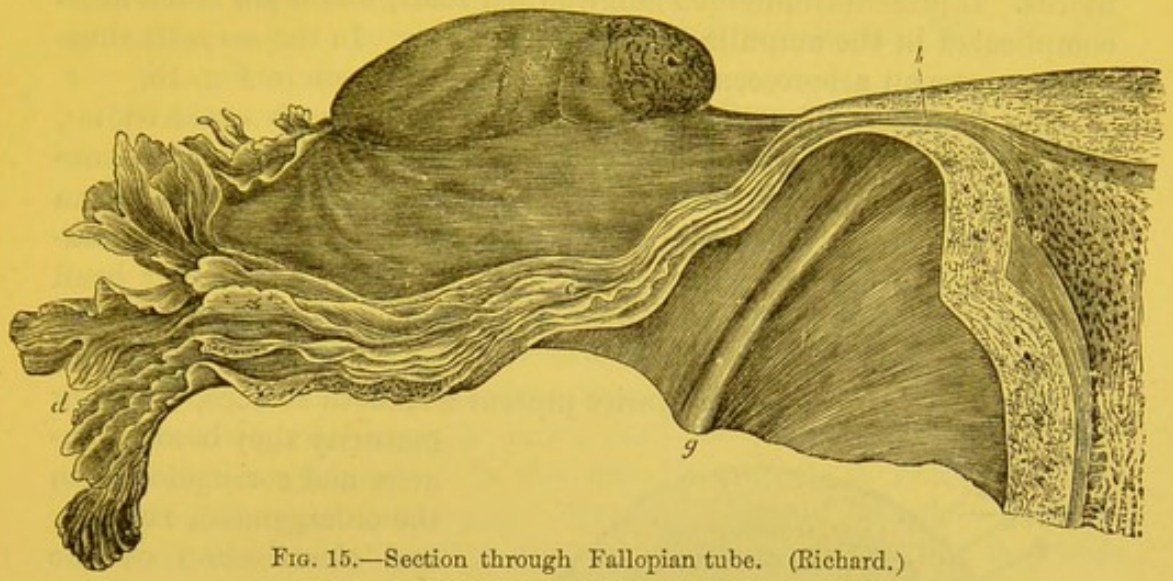


Fig. 15.—Section through Fallopian tube. (Richard.)

Between the muscular walls and the peritoneal covering there is a connective-tissue layer, which gives support to a rich plexus of blood-vessels.

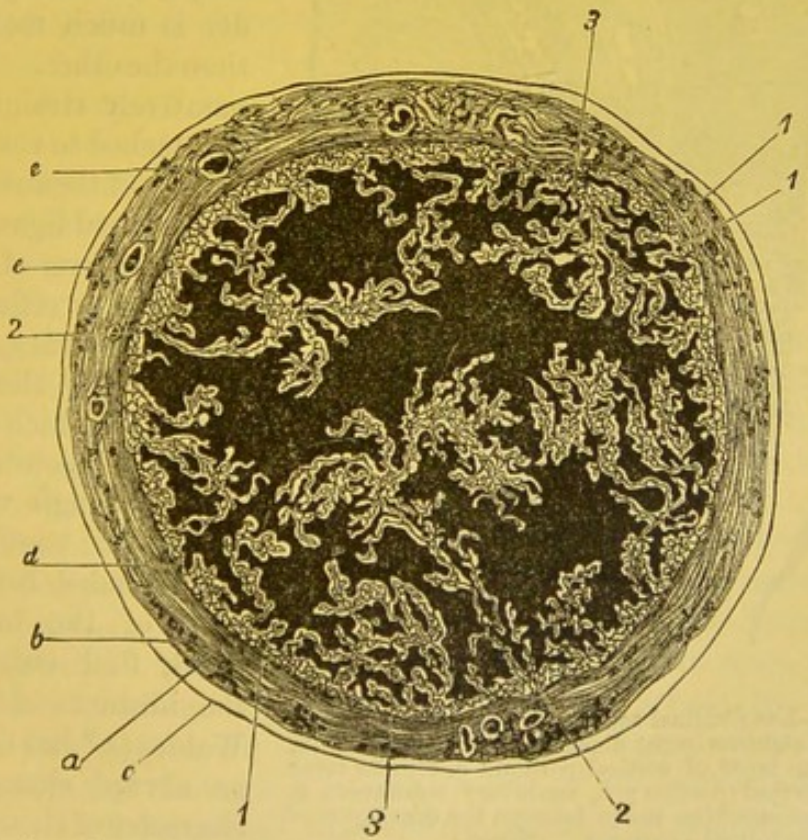


Fig. 16.—Section through ampulla (thirty diameters). *a*, submucous tissue; *b*, muscular layer; *c*, serous coating; *d*, mucous membrane; *e*, *e*, vessels; 1, 1, little folds, resembling villosities when seen in profile; 2, 2, longitudinal folds of larger size, with numerous accessory folds; 3, 3, little folds, united together so as to form a sort of canalicular net-work. (Luschka.)

The *mucous membrane* of the tubes is extremely vascular, and has a ciliated epithelium, which produces a current in the direction of the uterus. It presents numerous longitudinal folds, which are much more complicated in the ampulla than in the isthmus. In the ampulla these folds possess an arborescent character, as may be seen in Fig. 16.

The Ovaries.—The ovaries are two flattened, nearly ovoid bodies, situated between the layers of the broad ligament. They measure from one to one and a half inch in length, from three fourths of an inch to an inch in breadth, and from a third to a half inch in thickness. Each ovary is connected with the uterus by a muscular band about an inch in length and a fifth of an inch in width, termed the *ligamentum ovarii*.

Previous to puberty the ovaries present a smooth surface, but after maturity they become uneven and corrugated from the enlargement, rupture, and cicatrization of the Graafian follicles.

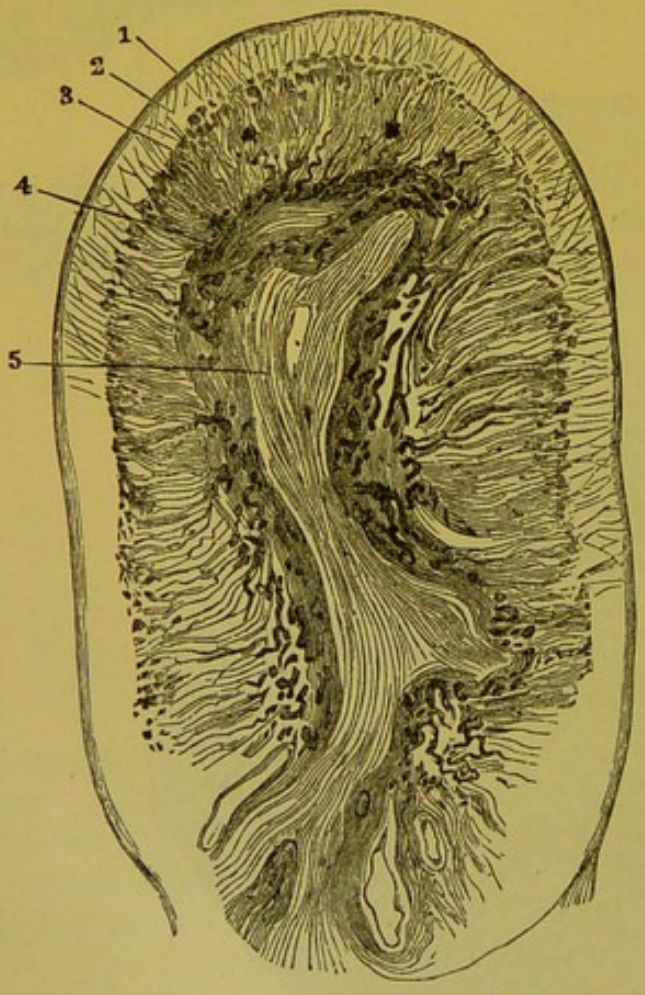


Fig. 17.—Longitudinal section of ovary from a person aged eighteen (eight diameters). 1, albuginea; 2, fibrous layer of cortical portion; 3, cellular layer of cortical portion; 4, medullary substance; 5, loose connective tissue between the firm layers of the medullary substance. (Henle.)

Although the ovaries are said to be of ovoid shape, in reality one border is much more convex than the other. The comparatively straight border is attached to the posterior surface of the anterior layer of the broad ligament. The posterior layer of the broad ligament is reflected over the entire ovary, with the exception of the attached border, at which point the hilum, or opening, is situated, through which the spermatic vessels, which are included between the folds of the broad ligament, find entrance into the substance of the organ. Waldeyer * has shown that an abrupt change in the character of the epithelium

* Waldeyer, "Eierstock und Nebeneierstock," Stricker's "Handbuch der Lehre der Geweben," p. 545. And for modification of Waldeyer's earlier views, *vide* "Archiblast and Parablast," Bonn, 1883, p. 68.

from the pavement to the cylindrical variety takes place where the peritonæum reaches the hilum of the ovary. At this point, too, the connective tissue of the serous membrane ceases to form an independent layer, easily separable from the underlying tissues, but becomes lost in the stroma of the ovary.

When the broad ligaments are removed from the body, and held as nearly as possible in the natural position, the convex border of the ovary looks downward. If the broad and ovarian ligaments are, however, put upon the stretch, the convex border rises and looks directly backward.

The ovary is found, upon section, to contain a fibrous stroma, the arrangement of which can be best understood by reference to the accompanying excellent illustration from Henle.

Externally, the ovary is surrounded by a fibrous coating, the so-called *tunica albuginea.* In the first three years of existence, however, the albuginea is wanting. Even in a state of complete development, it can never be stripped off as a separate layer, but is always intimately adherent to the subjacent tissues.

Beneath the albuginea the parenchyma of the gland is further divided into an outer cortical and an inner medullary substance.

The *medullary substance* has a spongy texture, and is of a reddish color. It contains an abundance of blood-vessels, the branches of which pursue a spiral course. The *cortical substance* is of a grayish color. In it a multitude of small follicles, of the utmost functional importance, lie imbedded. The precise description of these follicles will be given in connection with the subject of ovulation. The stroma of the cortical substance is nowhere sharply distinguished from that of the medullary portion. The fibers of the stroma, for the most part, radiate from the center toward the circumference. Just underneath the albuginea, however, the connective tissue of the cortical substance presents a felted arrangement. This portion is termed in the illustration (Fig. 17) the fibrous layer, in contradistinction to the more central portion, which is largely composed, in the neighborhood of the vessels and the follicles, of round and spindle-shaped cells.

The Vessels of the Uterus and its Appendages.—The uterus receives its arterial supplies from the following sources : 1. The *arteria uterina hypogastrica.* This artery, as its name implies, is derived from the hypogastric. It first pursues a downward course to reach the vaginal fornix, where its pulsations may be felt during pregnancy. Thence it curves upward between the folds of the broad ligament, and follows a tortuous course along the lateral borders of the cervix and corpus uteri. It distributes small branches to the fornix vaginæ, and large ones to the uterus. The uterine branches are, in part, distributed to the surface of the uterus, and, in part, penetrate the muscular tissue, to form a thick capillary net-work immediately under the uterine mu-

cous membrane. Of surgical interest is a circumflex branch, which unites the arteries of each side with one another. The situation of this branch is just at the junction of the cervix and body. During pregnancy other anastomotic branches are developed.* As the pregnant uterus is situated directly under the abdominal walls, the arterial murmurs are at certain points distinctly appreciable, and furnish the auscultatory sign of pregnancy improperly termed the "placental bruit." 2. The *arteria uterina aortica*, or internal spermatic artery. The origin of this artery is situated about two and a half inches above the bifurcation of the aorta. It pursues a serpentine course, and, in places, makes spiral turns, which are specially marked during pregnancy. It descends obliquely downward under the peritonæum to the cavity of the pelvis, and then ascends between the folds of the broad ligaments to reach, by its branches, the ovary, the Fallopian tube, and, by its main trunk, the side of the uterus, where it forms a direct communication with the art. uterina hypogastrica.

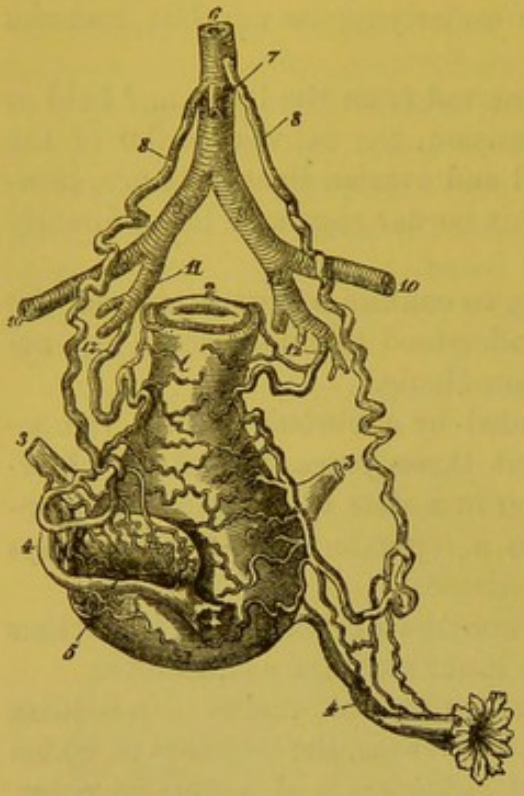


FIG. 18.—Arterial vessels in a uterus ten days after delivery; the uterus is turned forward, so as to present the posterior aspect. 1, fundus uteri; 2, vaginal portion; 3, 3, lig. teres; 4, 4, Fallopian tubes; 5, right ovary; 6, abdominal aorta; 7, art. mesenterica inf.; 8, 8, art. uterina aortica (spermatic arteries); 9, 9, art. iliaca communis; 10, art. iliaca ext.; 11, art. hypogastrica; 12, art. uterina hypogastrica. (Luschka.)

This communication between the aortic and hypogastric uterine arteries serves to maintain a continuous blood-current during gestation. The situation of the uterine artery within the pelvic cavity, and its exposure to pressure, would render it, were it the sole source of blood-supply, an extremely unsafe dependence. It is well to note here, that when pressure is made upon the aorta, after childbirth, with a view to checking *post-partum* hæmorrhage, the manipulation fails to affect in any way the blood-stream which pours into the uterus from the aortic uterine branches.

The beautiful injections of Rouget † have demonstrated a peculiar

* HYRTL disputes the formation of anastomoses during pregnancy, and states that in the pregnant as well as in the non-pregnant uterus none but capillary communication exists between the arteries. "Topographische Anatomie," Wien, 1865, Bd. ii, p. 194.

† ROUGET, "Recherches sur les Organes Érectiles de la Femme," "Jour. de la Physiol.," 1858, t. i, pp. 320 *et seq.*

disposition of the aortic uterine branches, as they penetrate the body of the uterus. Instead of dividing, as they branch, dichotomously, they break up, on reaching the vicinity of the Fallopian tubes, into from twelve to eighteen arterial tufts, of which each branch is twisted in spiral form. These tufts of vessels are so aggregated together as frequently to cover the angles of the uterus.

The *veins* of the *uterus* form a net-work, which traverses the uterine tissues in all directions. As their walls are intimately adherent to the muscular tissues of the uterus, they remain patulous upon section, and, when enlarged by pregnancy, are termed "sinuses." Rouget likewise describes twisted, tangled venous ducts, which often form spirals like those described in the arteries. The same authority claims that the ultimate divisions of the arteries communicate with the venous sinuses by very fine vessels, measuring from $\frac{1}{250}$th to $\frac{1}{75}$th of an inch, instead of by capillary net-works.

The return-currents of the uterus empty into two venous plexuses:

1. The *plexus uterinus.* This plexus receives its blood from the uterus alone. It extends between the folds of the broad ligament, and empties into the hypogastric vein.

2. The *plexus pampiniformis.* The plexus pampiniformis derives its blood from the uterus, the Fallopian tubes, and ovaries. Its vessels combine to form a single trunk, the vena spermatica interna, which follows the course of the artery of the same name, and empties, on the left side, into the vena renalis, on the right into the vena cava.

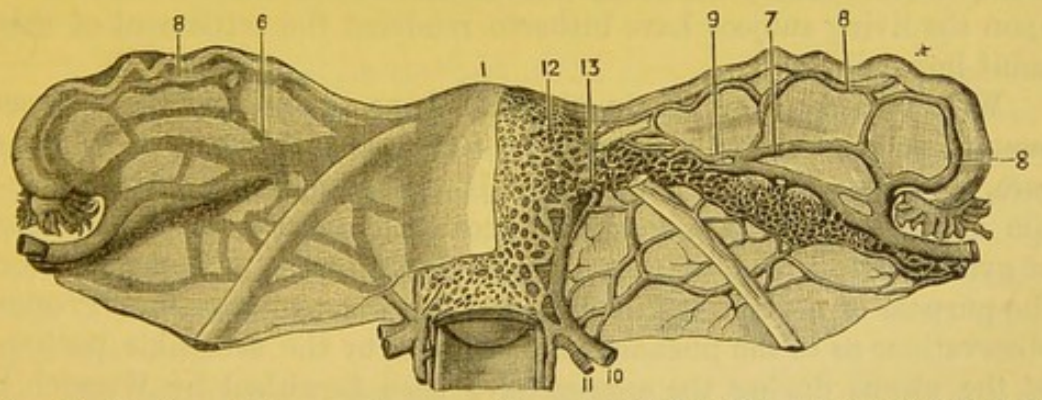


FIG. 19.—Uterine and utero-ovarian veins (plexus pampiniformis). 1, uterus seen from the front; its right half is covered by the peritonæum; upon the left half may be seen the plexus of utero-ovarian veins (internal spermatic); 6, utero-ovarian vessels covered by peritonæum; 7, the same vessels exposed; 8, 8, 8, veins from the Fallopian tube; 9, venous plexus of the hilum ovarii; 10, uterine vein; 11, uterine artery; 12, venous plexus, covering the borders of the uterus; 13, anastomoses of the uterine with the utero-ovarian vein (int. spermatic). (Sappey.)

The *arteries* of the *ovary* are derived, as we have had occasion to notice, from the internal spermatic, penetrate the medullary substance, at the hilum ovarii, and describe a spiral course. The arterial branches anastomose within the ovary, and form an interlacement, including spaces, which become smaller and smaller as the surface of the gland

is approached. The veins start as radicles from the capillaries, then rapidly enlarge, and present a varicose appearance. By their anastomoses they form a plexus, which includes spaces of very irregular size. The blood is then taken up by venous trunks, which run parallel to the arterial branches, and terminate finally in the internal spermatic vein (termed by Sappey, Fig. 19, the utero-ovarian vein).

Upon the basis of the foregoing description * Rouget draws a parallel between the structures of the penis and those of the corpus uteri, and claims identity between the two organs. One feature, however, of the erectile tissue, as generally understood, is wanting in the uterus, viz., a dense, fibrous sheath, a tunica albuginea, inclosing the erectile organ, limiting the degree of its distention and enhancing its turgidity.

As experimental proof that the uterus possesses erectile properties, Rouget has shown that, when an injection is forced by the spermatic artery, in the dead subject, so as completely to distend the vessels of the body of the uterus, the latter becomes elevated in the pelvis, and makes a movement similar to that performed by the penis during venereal excitement.

It is, however, obvious that the forcible distention of the vessels of a flaccid uterus, in which the muscular walls are deprived of their normal *tonus* by death, does not necessarily represent the phenomena produced during life by the turgescence resulting from either ovulation or the sexual orgasm. Unfortunately, so far as the body of the uterus is concerned, the difficulties in the way of direct observation upon the living subject have hitherto rendered the settlement of this point impossible.

With regard to the cervix uteri, we have physiological as well as anatomical reasons for admitting a certain kind of erectility. To be sure, a tunica albuginea is wanting. It is, therefore, not an ideal erectile organ. But it is among the occasional unpleasant experiences of gynæcological practice that a simple digital examination, made for the purpose of a diagnosis, may evoke the venereal orgasm. Precise observations as to the phenomena presented by the accessible portion of the uterus during the orgasm have been furnished by Wernich,† Litzmann,‡ and in one remarkable case by Beck,# which leave very little doubt that strong erotic excitement is attended by a rigidity of the cervix, which produces an impression upon the fingers similar to that imparted by the glans of the male organ during erection.

* Rouget, "Recherches sur les Organes Érectiles de la Femme," "Jour. de la Physiol.," t. i, pp. 338 *et seq.*

† Wernich, "Die Erectionsfähigkeit des unteren Uterus-Abschnittes," "Beitr. zur Geburtsh. und Gynaek.," Bd. i, p. 296.

‡ Wagner's "Handwörterbuch der Physiologie," Bd. iii, p. 53.

Beck, "How do the Spermatozoa enter the Uterus?" "Am. Jour. Obst.," Nov., 1874.

The following anatomical peculiarities of the cervix uteri are furnished by Henle: The walls of the vessels (arteries, capillary branches, and veins) are characterized by an extraordinary development of the circular layer of muscular fibers. For instance, in vessels measuring from $\frac{1}{2500}$ to $\frac{1}{600}$ of an inch, the diameter of the bore is scarcely one third the diameter of the entire vessel. The arrangement of the vessels is likewise peculiar. In the labia uterina, especially within the muscular tissues, small branches pass directly down to the mucous surface. These branches pursue an undulatory course, are parallel, and run at nearly equal distances from one another. Just beneath the mucous surface in like manner the veins arise and make their way upward parallel to the arteries, and with the same orderly arrangement. The capillary connections between these veins and arteries are situated just beneath the epithelium, where they form looped projections into the papillæ. In the plicæ palmatæ the general direction of the vessels is likewise perpendicular to the surface. In commenting upon these facts, Henle remarks that there is nothing in the situation of the arterial walls that would call for their special development, as they are not particularly exposed to external pressure. "Where, however," he says, "extraordinary means are employed in maintaining contraction, extraordinary relaxation and dilatation are possible." He therefore premises, as at least probable, "that the changing degrees of contractility in the finer vessels may serve to impart a sort of capacity for erection, or, at least, turgescence, to the cervical and vaginal portion" —an anatomical deduction sustained, as we have seen, by physiological observation.

A similar attempt on the part of M. Rouget to constitute an erectile organ out of the ovary is disposed of by Sappey as follows: "Erectile tissue is formed by large, short, anastomosing capillaries, supporting muscular trabeculæ, and into which open the ultimate divisions of the arteries; but in the bulb (the vascular portion of the ovary) there are neither dilated capillaries, nor areolæ, nor trabeculæ. The analogy signalized by M. Rouget is therefore much more apparent than real." *

The Nerves.—The nerves of the uterus are derived from the gangliated cords of the sympathetic system, through which important connections are formed with all the abdominal viscera. Just at the bifurcation of the aorta there is a broad band of nerve tissue termed the *plexus uterinus magnus*, formed by the coalescence of filaments from the spermatic ganglia (two pairs of ganglia, situated upon each side of the inferior mesenteric artery) and filaments derived from that portion of the aortic plexus which is distributed mainly to the superior mesenteric artery (plexus mesentericus superior, Frankenhaeuser). †

* "Traité d'Anatomie," Paris, 1874, vol. iv, p. 691.

† FRANKENHAEUSER, "Die Nerven der Gebärmutter," Jena, 1867.

About an inch and a half below the bifurcation of the aorta it divides into two strands, the *plexus hypogastrici*, which pass right and left

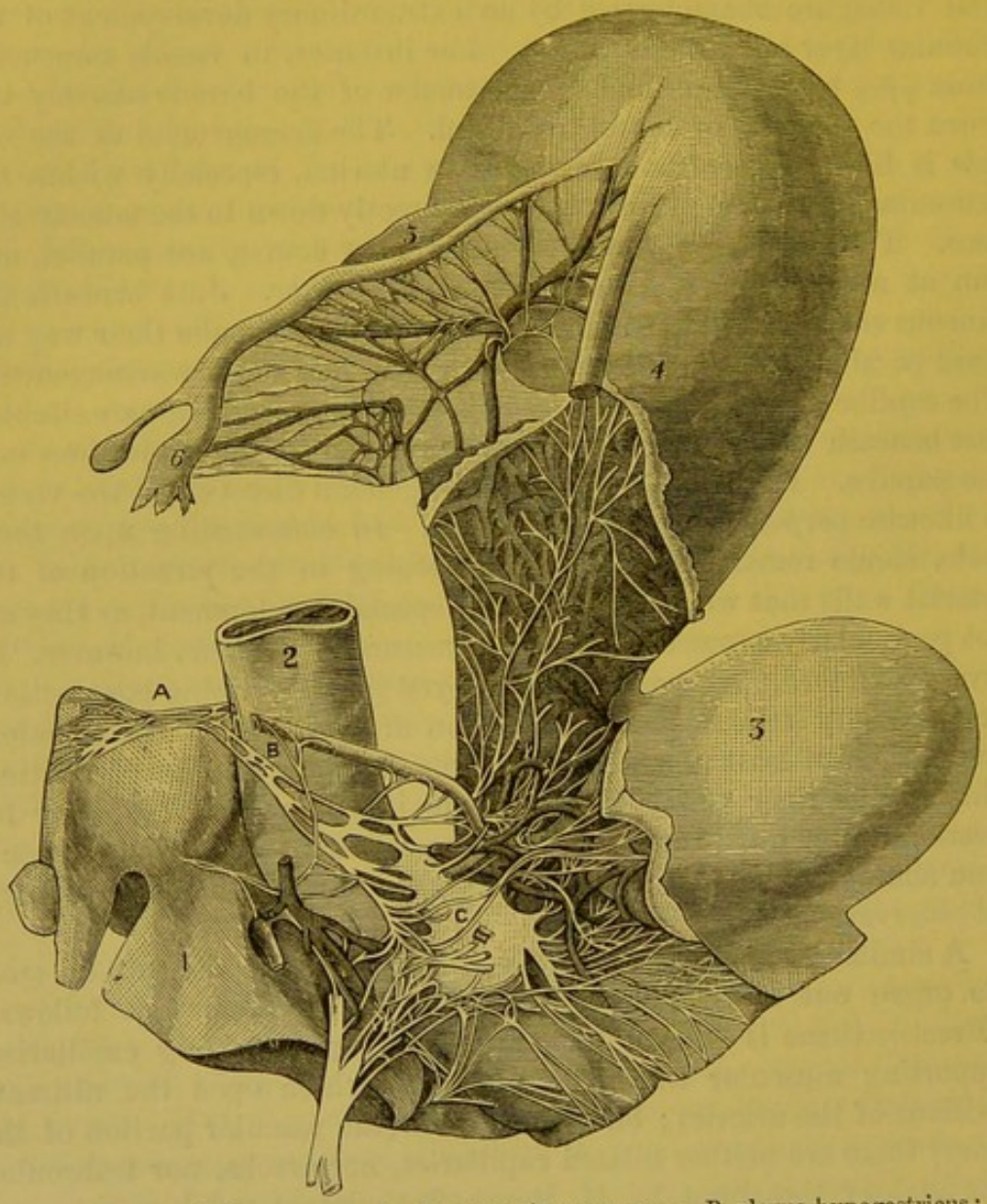


FIG. 20.—Nerves of the uterus. *A*, plexus uterinus magnus; *B*, plexus hypogastricus; *C*, cervical ganglion. 1, sacrum; 2, rectum; 3, bladder; 4, uterus; 5, ovary; 6, extremity of Fallopian tube. (Frankenhaeuser.)

around the rectum to the uterus and upper portion of the vagina. The hypogastric plexuses receive nerve branches from the lower lumbar and three upper sacral ganglia. Upon the sides of the rectum they divide each into two portions, of which the smaller passes directly to the posterior and lateral walls of the uterus, while the larger contributes to the formation of the cervical ganglion.

The cervical ganglion (Frankenhaeuser) is not, according to Jastreboff,* a separate organ, but a large plexus composed of many ganglia,

* JASTREBOFF, "Anatomy of the Ganglion Cervicale Uteri," "London Obst. Trans.," vol. xxiii, p. 266.

which measures during pregnancy two inches in length by one and a half inch in breadth. It is formed by the concurrence of filaments from the hypogastric plexus, the three upper sacral ganglia, and the first, second, and third sacral nerves. The cervical ganglion supplies the entire uterus, and especially the cervical portion, with nerves. Examined with the naked eye, these nerves are soon lost sight of as they penetrate the walls of the uterus, but their ultimate filaments have been traced by Frankenhaeuser, in microscopic preparations, to the muscular element, where they apparently terminate in the nucleus of the fiber-cell.

The Lymphatics.—We have already had occasion to notice the probable existence of lymph-spaces in the uterine mucous membrane. In the muscular tissue of the uterus, lymph-spaces are found in the delicate connective tissue which unites the muscular bundles together. Regular lymphatic vessels are found in the connective tissue which accompanies the arterial trunks into the uterine parenchyma. A network of lymphatic vessels, with dilated and constricted portions, and provided with valves, exists beneath the serous coat. The lymph-spaces of the uterine mucous membrane communicate, by funnel-shaped depressions, with the lymph-spaces and lymphatics of the muscular strata. Just beneath the external muscular layer, upon the lateral borders of the uterus, are large receiving vessels, into which empty the lymphatics from both the subserous and uterine vessels. The lymphatics of the cervix pass to the glands of the pelvic cavity, while those of the border and fundus follow the course of the plexus pampiniformis to form connections with the lymphatics of the lumbar region.*

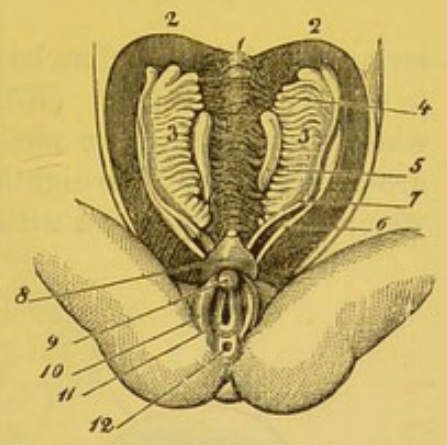


FIG. 21.—Rudimentary sexual organs. The internal organs represented at the seventh week of fetal life; the external organs belong to a later period. 1, spinal column; 3, 3, Wolffian bodies; 5, glands destined to become the ovaries in the female, the testicles in the male; 6, Wolffian duct; 7, filaments of Müller; 8, bladder; 9, tubercle, forming the rudiment of either the clitoris or penis; 10, folds destined to form the labia majora (in the male the scrotum); 11, sinus uro-genitalis; 12, anus. (Luschka.)

DEVELOPMENT OF THE FEMALE GENERATIVE ORGANS. — Three connected structures make their appearance on either side of the spinal column, at an early period of fetal existence, which need to be understood by those who would gain a clear idea of the developed organs of generation in the female. These structures are the Wolffian bodies, the ducts of

* LEOPOLD, "Die Lymphgefässe der normalen nicht schwangeren Uterus," "Arch. f. Gynaek.," Bd. vi, Heft I, pp. 1 *et seq.*; LUSCHKA, "Die Anatomie des menschlichen Beckens," Tübingen, 1865, p. 378.

Müller, and the rudimentary organs which are destined at a more advanced period to become the ovaries.

The **Wolffian bodies** are oblong glandular structures, temporary in character, which are thought to perform, in the embryo, the excretory function of the kidney. They possess ducts, situated at the sides, which converge together below the Wolffian bodies to empty into the sinus uro-genitalis.

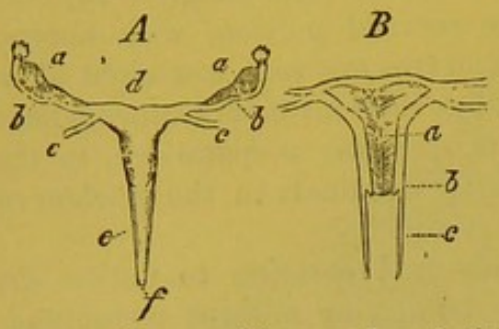


Fig. 22.—Uterus and its appendages in the fœtus at the end of the fourth month (natural size). *A*, external view; *a*, *a*, ovaries, relatively large, nearly as long as the oviducts; *b*, *b*, the Fallopian tubes (oviducts); *c*, *c*, round ligaments; *d*, uterus; *e*, vagina; *f*, vaginal orifice. *B*, interior view; *a*, rami of the arbor vitæ, extending to the fundus of the uterus; *b*, vaginal portion of uterus; *c*, vagina. (Courty.)

Two organs, destined to become the *ovaries*, make their appearance upon the inner side of the Wolffian bodies. They possess at first an elongated, but subsequently assume a more oval appearance.

The **ducts of Müller** are secondary formations, and are produced by an inversion of the peritoneal epithelium, beginning near the anterior end of the Wolffian body and thence extending downward parallel to the Wolffian ducts. (Kölliker.) Below they pass spirally forward, where they meet in the median line, to descend together to the sinus uro-genitalis. By the eighth week the lower portions of the filaments, which are in apposition with one another, fuse together, and furnish

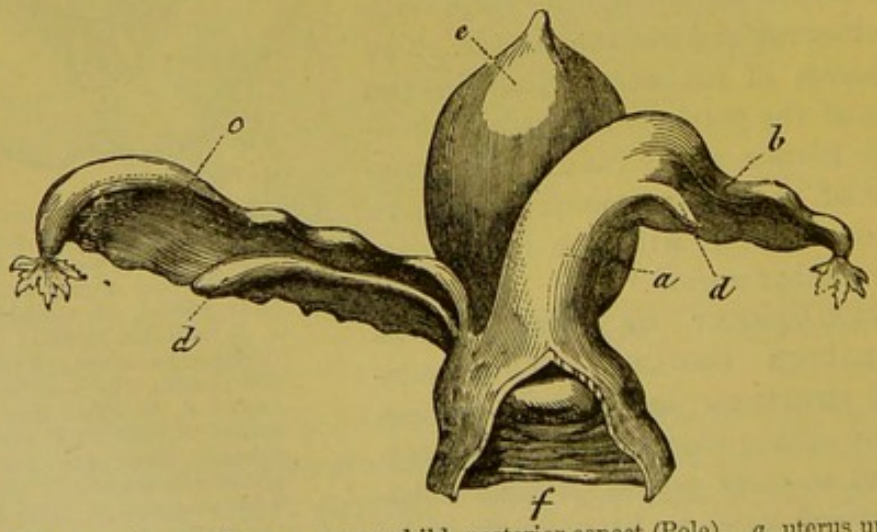


Fig. 23.—Uterus unicornis from a young child, posterior aspect (Pole). *a*, uterus unicornis, left half of uterus undeveloped; *b*, right Fallopian tube; *c*, left Fallopian tube, exceptionally present; *d*, *d*, ovaries; *e*, bladder. (Courty.)

the first rudiments of the uterus and vagina. The free portions of the filaments become the Fallopian tubes. Both uterus and vagina are at first divided into two parts by a common partition-wall, which disappears subsequently from below upward.

The uterus, at the fourth month of fetal life, presents distinct traces of the early origin from the ducts of Müller. The fundus is undeveloped. The ridges of the arbor vitæ uterina, which are confined at a later period to the cervix, extend the entire length of the uterus.

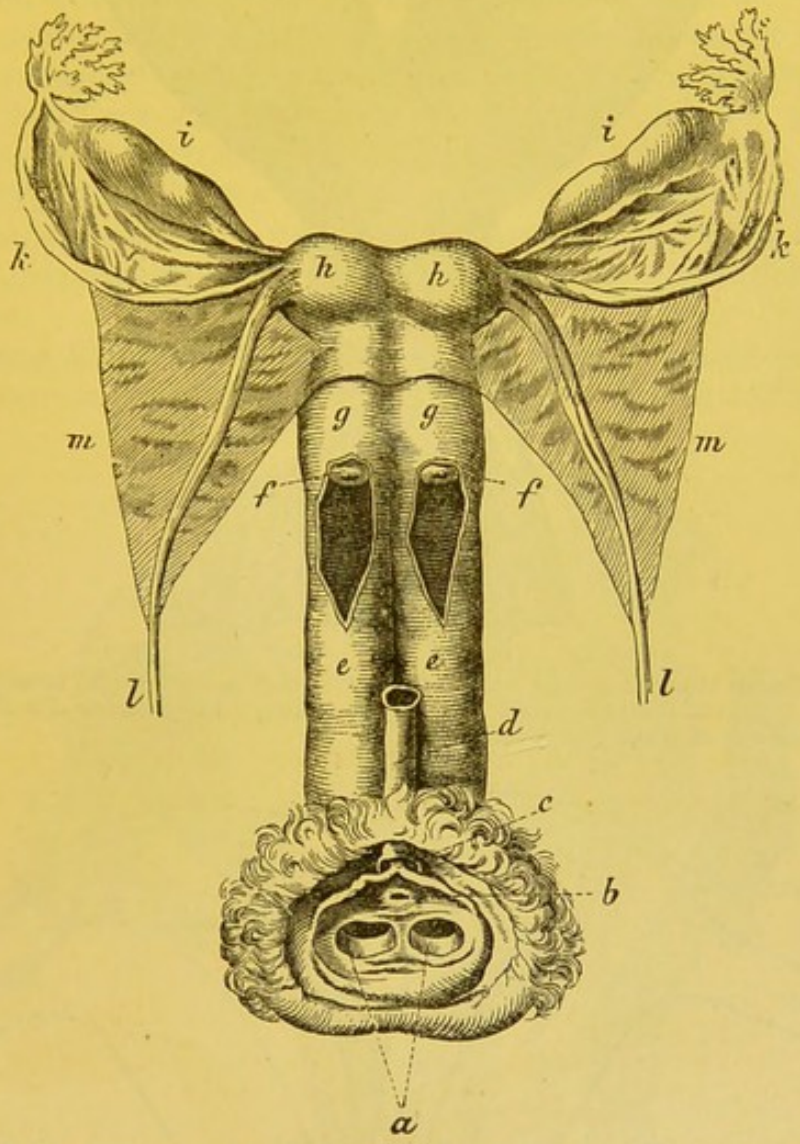


Fig. 24.—Double uterus and vagina from a girl aged nineteen (Eisenmann). *a*, double vaginal orifice with double hymen; *b*, meatus urethræ; *c*, clitoris; *d*, urethra; *e*, *e*, the double vagina; *f*, *f*, uterine orifices; *g*, *g*, cervical portions; *h*, *h*, bodies and cornua; *i*, *i*, ovaries; *k*, *k*, Fallopian tubes; *l*, *l*, round ligaments; *m*, *m*, broad ligaments. (Courty.)

A depression at the fundus marks the point of union between the ducts of Müller. Two cornua, or horns, are thus distinguishable upon the external surface of the uterus. About the eighth or ninth month the convex fundus is developed, and the cornua disappear externally, though all through life they are traceable upon the inner surface in lateral sections of the uterus (*vide* Fig. 15, p. 21).

Before the differentiation of sex has taken place, the external organs of generation present the following appearances: Two ridges,

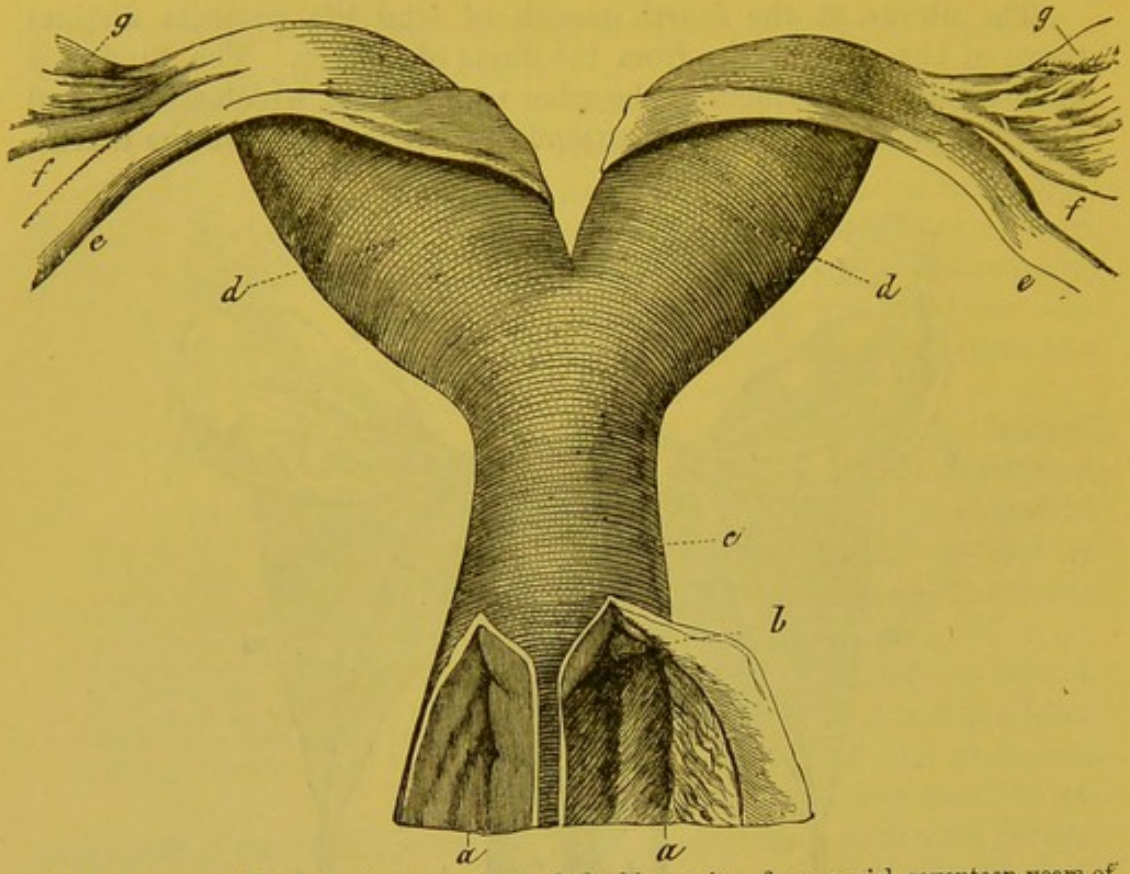


Fig. 25.—Uterus bicornis, double cavity and double vagina, from a girl seventeen years of age. *c*, cervical portions united together, presenting the appearance of a single cervix; *d*, *d*, the two cornua. (Schroeder.)

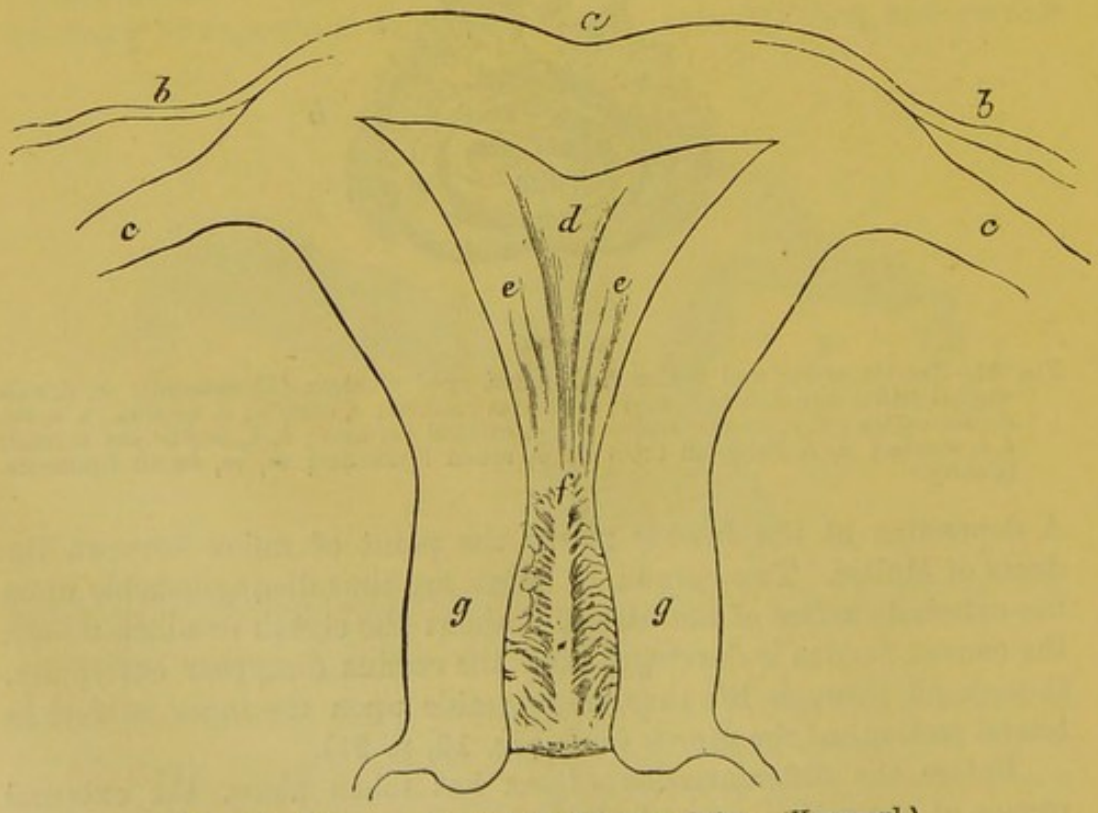


Fig. 26.—Uterus cordiformis, double natural size. (Kussmaul.)

or folds, surround a central opening (sinus uro-genitalis), which either unite to form the scrotum of the male, or develop into the labia majora in the female. Where these folds join together above, there is a small projecting body, or tubercle, destined to become the penis or the clitoris. In either case the lower surface of the tubercle is furnished with a groove. The margins of the groove extend along the sides of the sinus uro-genitalis, and, in the development of the female type, become the labia minora. The sinus uro-genitalis affords a common aperture for the bladder and internal organs of generation.

Abnormalities of the Uterus.—An arrest of fetal development gives rise to a number of deviations from the ordinary uterine type, of which we borrow from Courty the following as of direct obstetrical importance.

1. **Uterus Unicornis.** — The one-horned uterus results from the atrophy or incomplete development of one of the filaments of Müller,

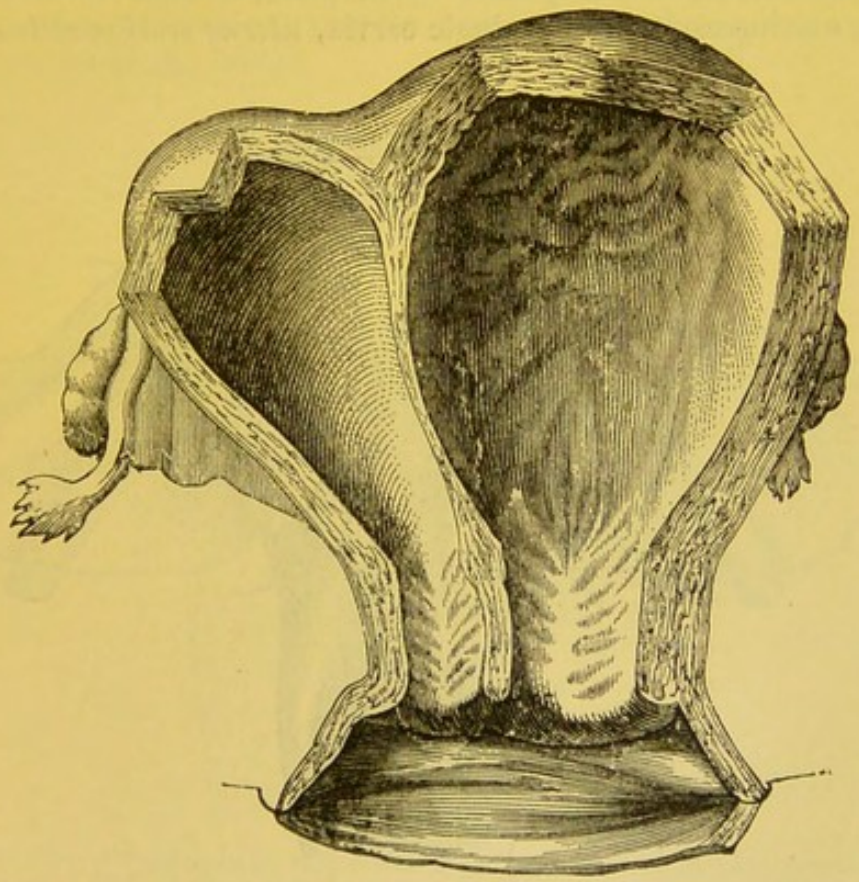


Fig. 27.—Uterus septus bilocularis. Double uterus, with simple vagina, seen from the front. Left walls more developed in consequence of pregnancy. (Cruveilhier.)

while the other continues its evolution. We then have a uterus which is composed of a single lateral half, possessing generally but one Fallopian tube.

2. **Uterus Duplex, or Didelphys.**—Both filaments of Müller are developed, but do not become united together. Thus two distinct uteri

are produced, of which each represents in reality the half of a normal uterus.

3. **Uterus Bicornis.**—Partial union of the filaments of Müller takes place, but without reaching the ordinary level indicated by the insertions of the round ligaments. The upper portion of the uterus is thus divided into two horns, separated by a furrow from one another.

4. **Uterus Cordiformis.**—The uterus remains of the fetal type indicated in Fig. 26. Instead of a complete development of the fundus, the latter remains depressed, and presents an appearance remotely resembling the heart of a playing-card.

5. **Uterus Septus Bilocularis.**—Complete union of the two filaments of Müller has taken place, but the common wall, formed by their coalescence, persists. We have thus two distinct uterine cavities. The septum may extend the whole length of the vagina, and give rise to a double vagina; or absorption of the vaginal septum and a portion of the uterine septum may have taken place, so that we may have a double uterine cavity with a single cervix, *uterus semi-partitus*.

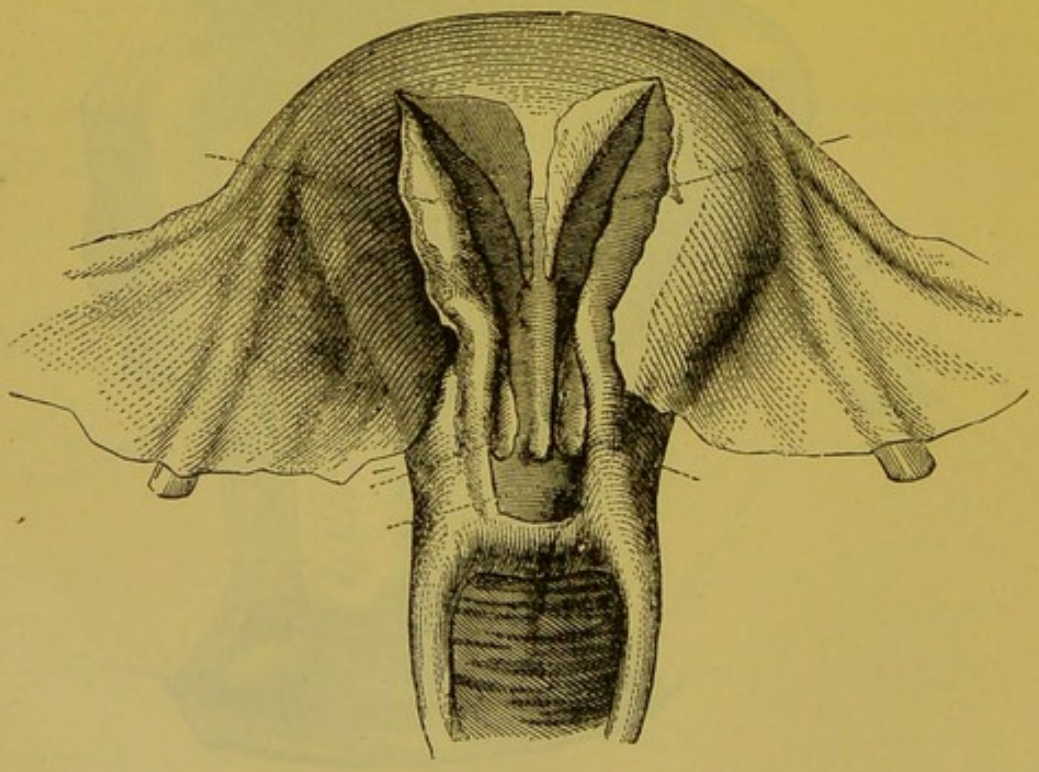


Fig. 28.—Uterus semi-partitus. (Gravel.)

PHYSIOLOGY OF THE OVUM.

CHAPTER II.

DEVELOPMENT OF THE OVUM.

The Graafian follicles and the ovum.—Discharge of the ova from the ovary, and the formation of the corpus luteum.—The migration of the ovum.—Fecundation.—Changes taking place in the ovum subsequent to fecundation.—Nourishment of the embryo.—The allantois and chorion.—The deciduæ.—The placenta; its development and structure.—Formation of the umbilical cord.—The amniotic fluid.

THE physiology of the ovum comprises its genesis, development, and discharge from the ovary, its fecundation, and the entire series of subsequent changes by which the simple structure of the germ becomes converted into a complex organism presenting the specific characteristics of the parent.

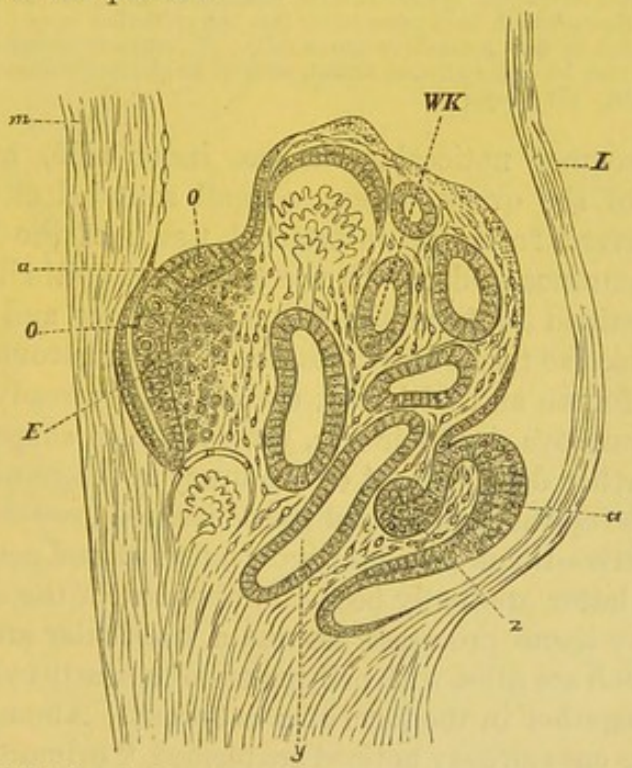


FIG. 29.—Section of Wolffian body, with rudimentary ovary (embryo of chick, fourth day of incubation). *WK*, Wolffian body; *y*, section of Wolffian duct; *a*, *a*, thickened epithelium; *z*, duct of Müller; *E*, early stage in development of ovary; *O*, *O*, primordial ova; *m*, mesentery; *L*, lateral wall of abdomen. (Waldeyer.)

The following account of the history of the ovum is derived from Waldeyer's now tolerably familiar work.*

THE GRAAFIAN FOLLICLES AND THE OVUM.—In the embryo

* "Eierstock und Nebeneierstock," STRICKER'S "Handbuch der Lehre von den Geweben," Leipsic, 1871; "Eierstock und Ei," Leipsic, 1870.

of the chick, by the fourth day of incubation, the Wolffian body is covered by cylindrical epithelium, contrasting sharply with the flattened cells of the peritonæum. Soon after, a thickening of the

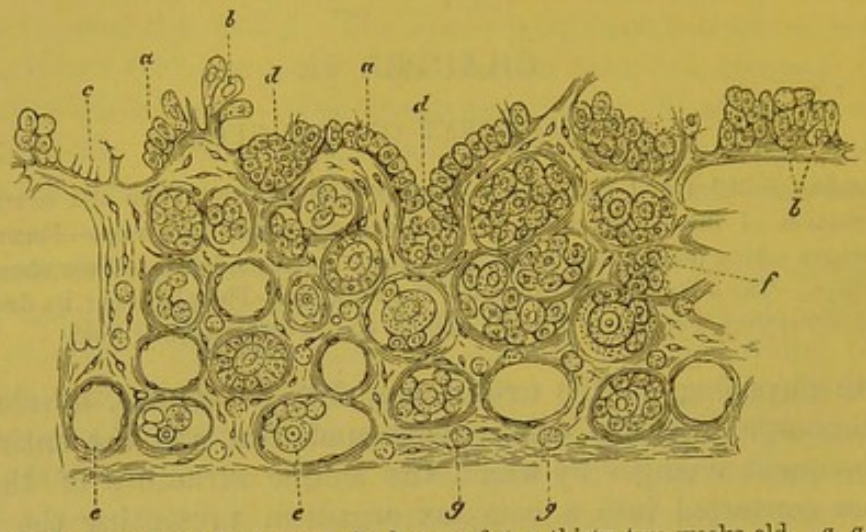


FIG. 30.—Vertical section of an ovary of a human fœtus thirty-two weeks old. *a*, *a*, epithelium; *b*, *b*, latest developed epithelial cells, situated in the epithelial layer; *c*, trabeculæ of connective tissue which have penetrated into the epithelial layer; *e*, *e*, primordial follicles surrounded by fine connective-tissue cells; *f*, groups of imbedded epithelial cells, among which may be distinguished certain ones of large size (primordial ova); *g*, granular cells of His. (Waldeyer.)

epithelium becomes noticeable on the inner side, and forms the earliest trace of the ovary. Next, a small rounded elevation, rich in cells, and derived from the interstitial tissue of the Wolffian body, makes its appearance underneath the thickened epithelium. The epithelium is destined to form the Graafian follicles and ova; the proliferated connective tissue furnishes the vascular stroma of the ovary. Between the fourth and fifth day, certain cells already indicate their destiny as future ova, by their size, their rounded shape, and large nuclei. The further development of the ovary is the result of the multiplication of the epithelial cells and the continued growth of the stroma. As the connective-tissue processes grow outward and penetrate between the cells, the latter gradually become imbedded in the stroma. Thus, the connective-tissue processes assume a trabecular arrangement, the meshes of which are filled with cell-masses of a nearly cylindrical shape, which hang together in the form of a net-work. Among the imbedded cells, the large ones already noticed are termed "primordial ova." The smaller cells remain small, and arrange themselves like epithelium around the larger ones. In the course of development, the interpenetration of the connective tissue continues, until each primordial ovum is contained in its own separate partition. These partitions, with the included cells, are rudimentary Graafian follicles. Two distinct ova, within the same Graafian follicle, are of rare occurrence. As the ova enlarge, and the epithelial cells multiply, an irritative action is set up in the surrounding stroma. An increase in vascularity results, and

young connective tissue is developed about each epithelial collection. As the follicle grows, the outer layer becomes fibrillated. Thus around each Graafian follicle a distinct envelope is formed, termed by Baër the *theca folliculi*, consisting of an internal vascular coat, the *tunica propria*, and an external fibrillated coat, the *tunica fibrosa*.

Each primordial ovum is at first encircled by a single layer of cylindrical cells. Gradually new layers form, in which the ovum lies imbedded. Afterward, at a point remote from the ovum, a crescent-shaped opening makes its appearance, which becomes filled with a clear fluid derived from transuded serum, and possibly in part from

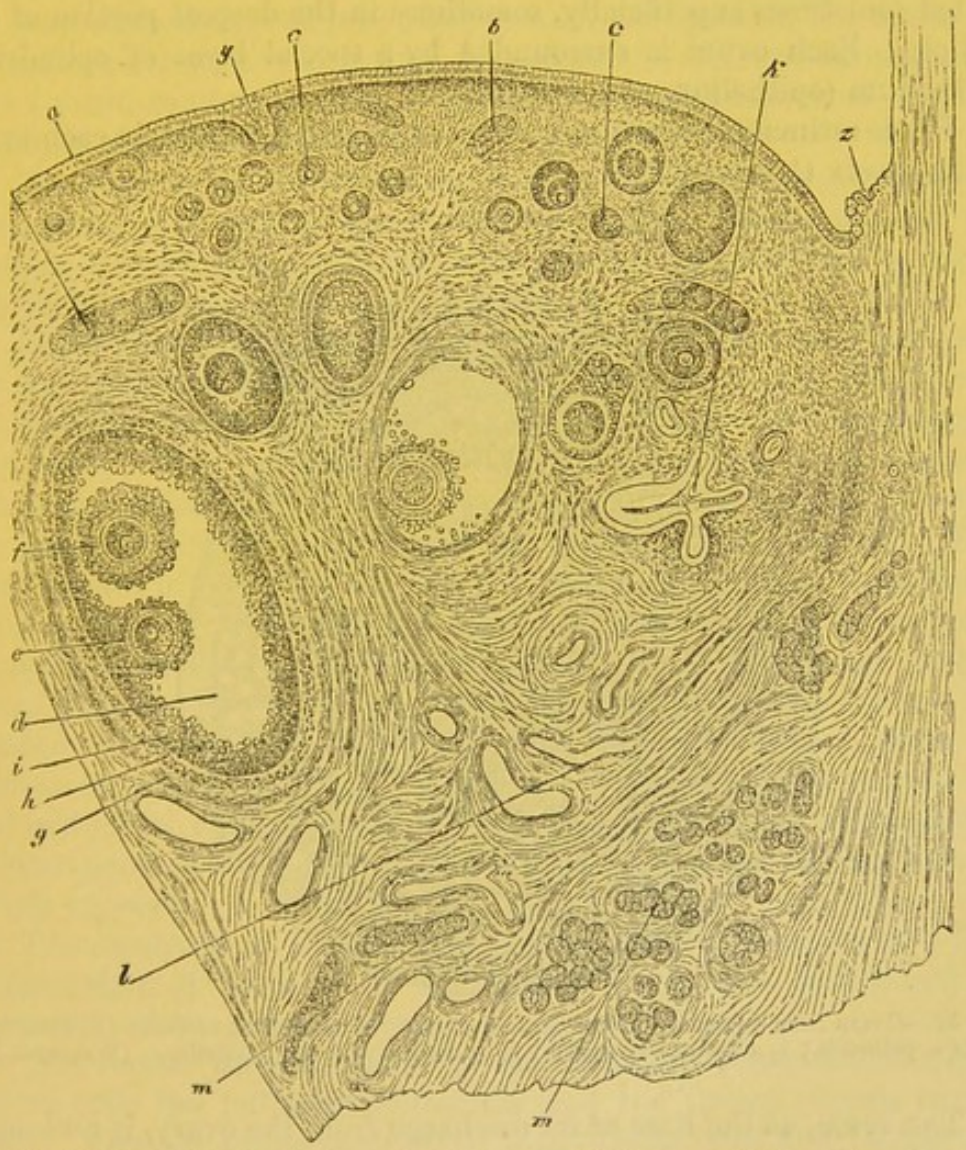


FIG. 31.—Portion of vertical section through ovary of bitch. *a*, epithelium of ovary; *b*, *b*, tubules of ovary; *c*, young follicles; *d*, mature follicles; *e*, discus proligerus, with ovum; epithelium of second ovum in same follicle; *g*, tunica fibrosa folliculi; *h*, tunica propria folliculi; *i*, membrana granulosa. (Waldeyer.)

disintegrated epithelium. A heap of cells remains about the ovum, and forms the *discus proligerus*. With the increase of the follicular

fluid, the cylindrical cells are pressed against the membrana propria, and form a third coating, or layer, termed the *membrana granulosa.*

A glance at a transverse section through the ovary of a mature mammal exhibits follicles of different ages. To recapitulate :

The *young follicles* are composed of primordial ova, surrounded by epithelium, and imbedded in the ovarian stroma.

The *fully developed follicles* possess a vesicular character. They are surrounded by a connective-tissue wall (theca folliculi), which is composed of two layers (tunica propria and tunica fibrosa). The tunica propria is lined by cells (membrana granulosa) which are gathered in heaps (discus proligerus) around the ova. The discus proligerus is seated sometimes superficially, sometimes in the deepest portion of the follicle. Each ovum is surrounded by a special layer of cylindrical epithelium (epithelium of the ovum).

Henle estimates the entire number of Graafian follicles in each ovary at thirty-six thousand.*

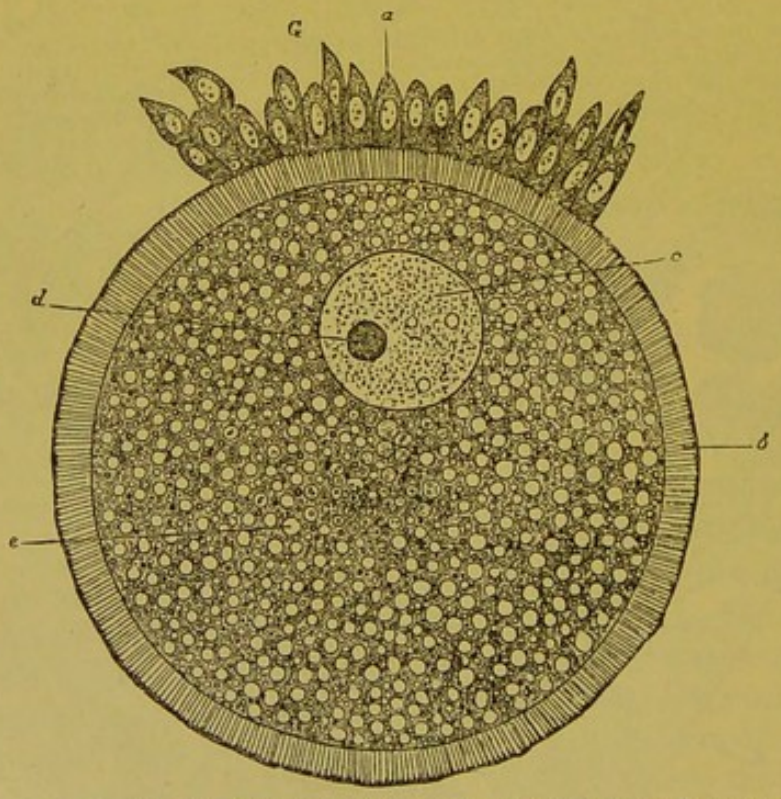


Fig. 32.—Ovum from a Graafian follicle in the rabbit. *a*, epithelium of ovum; *b*, zona radiata s. pellucida; *c*, germinative vesicle; *d*, germinative spot; *e*, vitellus. (Waldeyer.)

The *ovum,* at the time of its discharge from the ovary, is no longer a simple cell, composed of ordinary protoplasm, but presents the following characteristic peculiarities : It is of large size. In the human female the ovum measures about $\frac{1}{120}$ of an inch. It possesses a thick, transparent envelope, termed the *vitelline membrane,* or, from the man-

* Henle, "Handbuch der Eingeweidelehre," Braunschweig, 1866, p. 483.

ner in which it transmits light, the *zona pellucida*. The zona pellucida was formerly thought to be due to a thickening of the cell-membrane. It is now more commonly regarded as something superadded to the primordial ovum. Probably the attached portions of the radiate cells which surround the ovum in the discus proligerus contribute to its formation. The appearances in Fig. 29 represent, according to Waldeyer, these cells undergoing a cuticular transformation. The fine lines which may be seen, when high magnifying powers are used, are, he believes, unchanged filaments of the original protoplasm.* The thickness of the zona pellucida is from $\frac{1}{20}$ to $\frac{1}{10}$ the diameter of the ovum.

The body of the cell becomes the *vitellus* or *yolk* of the ovum. It possesses contractility and other properties of ordinary protoplasm. It has a viscid consistence, and is opaque from the presence of very fine granules and globular vesicles.

The nucleus of the cell becomes converted into a large, clear, colorless vesicle, known as the *germinative vesicle*. The nucleolus persists as a dark, probably solid, body within the germinative vesicle, where it is known as the *germinative spot*.

Discharge of the Ova from the Ovary, and the Formation of the Corpus Luteum.—We have already seen that the number of Graafian follicles within a single ovary is estimated at thirty-six thousand. The formation of these follicles is, in great degree at least, completed during the antenatal period of existence. Previous to puberty, however, they remain in a quiescent condition. With the advent of puberty the ovaries assume functional importance. The surface of the ovary, if examined at this time, is no longer smooth, but studded with small vesicles. These vesicles are nothing more than the enlarged Graafian follicles, which, as they become distended by their fluid contents, approach the periphery, thin the tunica albuginea, and form rounded, translucent prominences. By the additional disappearance of the blood-vessels and the lymphatics, a weak point in the wall of the follicle, the *macula* or *stigma folliculi*, is left exposed.

The discharge of the ovum is due to the conjoint action of a fatty degeneration of the cells in the walls of the mature follicle and the formation of the corpus luteum.

The *corpus luteum* begins by an abundant cell-proliferation, in which both the follicular epithelium and the tunica propria participate. Vascular arches push forth into the cavity of the follicle, and still further encroach upon the already crowded space. Finally, a point is reached at which the follicle ruptures, and its contents, including the ovum, are discharged. When the Graafian follicle has

* Waldeyer, "Eierstock und Nebeneierstock," Stricker's "Handbuch der Lehre von den Geweben," Leipsic, 1871, p. 554.

reached maturity, the congestion, occurring at the time of the menses, operates unquestionably in a most effective manner to the accomplishment of this result.

Immediately following the rupture of the Graafian follicle, blood is effused into its cavity. The active proliferation of the cells of the membrana granulosa continues.* At the same time a process of disintegration ensues. But, in place of a degenerative product, the disintegration furnishes a granular, vitellus-like substance of a yellow color. Examined by the microscope, in addition to the granular mass, globules may be recognized, which are not precisely fat, but correspond to the globules contained in the vitellus of the ovum.

While the above-mentioned process is going on, an abundant transmigration of white corpuscles from the vascular network surrounding the follicle takes place, which lift up the granulosa cells, with the pseudo-yolk substance, and press them toward the center of the follicle. Along with the young wandering cells (white corpuscles), vascular offshoots, like small papillæ, push out from every side into the epithelial and vitellus-like masses. As the larger vessels form more marked projections, they give to the corpus luteum a folded appearance.

In a state of complete development the corpus luteum consists of —1. The pseudo-yolk substance, mingled with effused blood. 2. The thickened layer of the granulosa cells, mingled with yolk-substance. It is this layer which, to a great extent, forms the folded, yellow portion of the corpus luteum. 3. The vessels which, with the wandering cells, push from all directions into the epithelial masses. As these vessels reach the center of the follicle, a complete interpenetration of the connective tissue and epithelial elements of the corpus luteum results, and the foldings become indistinct.

Finally, absorption of the vitellus-like substance occurs; the last vestiges of the effused blood are converted into blood-crystals; the arterial vessels degenerate; the epithelial masses and the connective-tissue mesh-works disappear gradually, until at the last only a white, stellate cicatrix remains.

If the ovum is discharged without impregnation taking place, the corpus luteum reaches its maximum size at the end of three weeks, and then begins to decline, until, at the end of two months, it is reduced to an insignificant cicatrix. But, when conception occurs, the changes in the corpus luteum take place more slowly. The corpus luteum reaches a higher state of development. Its increase in size continues for two months. It then remains stationary up to the end of the sixth month. During the last three months of pregnancy it gradually loses its bright-yellow color, grows smaller, but still measures one half of an inch in diameter at the end of the period of gestation.†

* Benckhiser. According to the recent researches of Benckhiser, the cells of the membrana granulosa disappear after rupture of the follicle. "Arch. f. Gynaek.," vol. xxiii, p. 350, Berlin, 1884.

† Dalton's "Treatise on Human Physiology," Philadelphia, 1861, pp. 564 *et seq.*

The corpus luteum of pregnancy is often termed the *true* corpus luteum, to distinguish it from the more trivial variety which is produced by the rupture of a Graafian follicle at a menstrual period, or between two menstrual epochs. The latter has been termed the *false* corpus luteum, because it is found in virgins, and does not constitute a sign of preëxistent pregnancy.

The Migration of the Ovum.—The number of ova in each ovary has been estimated by Henle at thirty-six thousand. Only a small proportion of them, however, meet with the conditions requisite for fruition. It is probable that many ova perish while still surrounded by the stroma of the ovary. The history of extra-uterine pregnancies teaches us that, in some instances at least, the ovum, after its discharge from the Graafian follicle, escapes into the abdominal cavity. It, therefore, becomes an interesting subject of inquiry as to the conditions which ordinarily determine the passage of the ovum from the ovary into the Fallopian tube of the corresponding side. It will not do to assume, as is usual, a peculiar erectility of the Fallopian tube, which enables it to apply its funnel-shaped extremity to the ovary, just at the moment of the rupture of the Graafian follicle. Setting aside the inherent improbability of the existence of such a degree of intelligence in the fimbriæ as would lead to the exact adaptation of the tube to the precise point at which the ovum is to be discharged, it has been proved that the Fallopian tube possesses none of the characteristics of erectile tissue. Injections of its vessels after death do not communicate to it the slightest change of form or place.*

Muscular action has also been often invoked to explain the assumed manner in which the fimbriæ seize the ovary, but galvanization of the tubes, practiced upon criminals recently executed, produces only vermicular contractions, which do not affect the position of the fimbriæ.† Indeed, when we remember the position of the Fallopian tubes in the pelvis, and bear in mind that they are at all times necessarily subjected to the pressure of the intestines, it becomes difficult to understand how they can execute any very extended movements.‡

In the absence of direct experimental proof, the suggestion of

* Rouget, "Les Organes Érectiles de la Femme," "Jour. de la Physiol.," t. i, 1858, p. 337.

† Hyrtl, "Handbuch der topographischen Anatomie," Wien, 1865, Bd. ii, p. 210.

‡ Henle, "Handbuch der Eingeweidelehre," Braunschweig, 1866, p. 470. Rouget (*vide* "Organes Érectiles," "Jour. de la Physiol.," 1858) has studied with great care the arrangement of the muscular fibers situated between the peritoneal layers of the broad ligament. These fibers are directly continuous with the delicate external muscular layer of the uterus. Certain of them are so distributed, according to Rouget, as to produce by their contraction a direct approximation of the fimbriæ to the ovary. Henle remarks, by way of criticism, that more stress might be laid upon these fibers were they distributed to the Fallopian tubes alone. As, however, they spread likewise over the ovary, their probable action would consist in drawing both ovary and tube toward the median line.

Henle that the passage of the ovum into the Fallopian tube is due to the currents produced in the serum by the ciliated epithelium, which covers both the external and internal surfaces of the fimbriæ, is, on the score of probability, entitled to the most consideration. One of the fimbriæ (fimbria ovarica, Fig. 14, p. 20) is, as we have already seen, permanently attached to the lower angle of the ovary. It is likely that the ovum, discharged from a Graafian follicle, is floated down by the peritoneal serum toward the lower and outer border of the ovary, where a sufficient current is present to insure its being caught up and conveyed into the infundibulum tubæ. Failures on the part of the ovum to reach its destination are, in all probability, not uncommon. Support is given to the theory of the importance of the ciliæ in influencing the migration of the ovum by the observation of Thiry,* that in batrachians, which have the oviducts fixed to the abdominal walls, and situated at a distance from the ovary, during the rutting period little pathways of ciliated epithelium form in the peritonæum, which collectively converge toward the openings of the tubes.†

While the ovum remains in the ampulla, or dilated portion of the tube, its further progress is at first dependent upon the movements of the ciliæ; but, after the isthmus is reached, an additional propelling force is furnished by the circular muscular fibres, which possess a peristaltic action.

Fecundation.—The precise point at which fecundation takes place has been variously ascribed by authors to the tubes, the uterus, and the ovary. The occurrence of fecundation within the uterus may be rejected, as it has been sufficiently demonstrated that the passage of the ovum to the uterus requires a period exceeding ten days in the human female—a period far exceeding the extra-ovarian life of the ovum, when not vivified by the contact of the male element of generation. Abdominal pregnancies prove certainly the possibility of the ovary becoming the seat of fecundation, but their extreme rarity would lead us to infer that, so far as the human female is concerned, in whom it is fair to believe the ovum not uncommonly fails to enter the tube, the phenomenon is unusual. *A priori* reasoning leads us, however, to regard with Henle the ampulla, with its arborescent folds, as specially designed for a receptacle of the seminal fluid. The congestive condition of the mucous membrane, its canalicular structure, and

* Göttinger "Nachrichten," 1862, p. 171.

† Cases of the complete migration of the ovum from the ovary of one side to the Fallopian tube of the opposite side are not readily explained by any hypothesis. Yet the occurrence of such cases is undoubted. Pregnancy, for instance, may exist where there is complete absence or closure of the Fallopian tube upon the same side with the corpus luteum. Leopold tied the right Fallopian tube in rabbits in two places, and exsected a portion of the tube between the ligatures; the left ovary was carefully removed and the abdominal wound was closed. After recovery, the rabbit was put to the male. In two such cases pregnancy followed. "Arch. f. Gynaek.," vol. xvi, p. 24.

the contractions of the muscular fibres, all seem intended to further the intimate contact of the spermatozoa with the ovum after it has reached this situation.*

The *semen*, contact with which is essential to the fecundation of the ovum, is a thick, viscid, albuminous fluid, of a whitish color, and a peculiar odor, which has been compared to that of the raspings of bone. When examined by the microscope, it is found to contain numerous minute anatomical elements, termed *spermatozoa*. Each spermatozoön consists of an oval head and a long filiform extremity or tail. The head is flattened, and measures about $\frac{1}{6000}$ of an inch in width. When seen in profile, it presents a pyriform appearance. The entire spermatozoön measures from $\frac{1}{600}$ to $\frac{1}{400}$ of an inch in length.

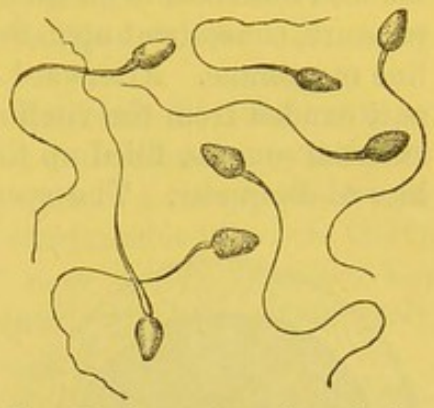


Fig. 33.—Spermatozoa from the human subject (magnified eight hundred diameters). (Luschka.)

The spermatozoa do not simply float in the seminal fluid, but possess the capacity of moving from place to place, as though endowed with volition. Indeed, as the observer sees them advance, now singly, and now in shoals, now diving down, and then rising again to the surface, now avoiding some obstacle, or skillfully picking their way between masses of epithelium, it is difficult to resist the conviction that they are really, what they were long supposed to be, distinct organisms capable of a certain degree of voluntary action. But there is little doubt, at the present day, that the undulatory movements of the tail, which furnish the propelling force, are due to purely molecular tissue-changes, similar to those which give rise to the amœboid movements of protoplasm or the oscillations of the hair-like processes of ciliated epithelium.

Henle estimates that the spermatozoa travel at the rate of an inch in seven and a half minutes. It is to these bodies that the semen owes its fecundating power, but only so long as they retain the faculty of motion—a faculty which has been found to exist in full force, within the female genital organs, eight to ten days after ejaculation.†

Our knowledge of the process of fecundation is limited to the fact that the spermatozoa penetrate through the vitelline membrane, and then dissolve in the vitellus.

In 1840 Martin Barry described a point in the zona pellucida (vitelline membrane) of the rabbit, which appeared to him to be an opening designed for the passage of spermatozoa. At first embryologists pronounced Barry's descriptions to be based upon an illusion, but since

* Henle, "Handbuch der Eingeweidelehre," 1866, p. 476.

† Luschka, "Die Anatomie des menschlichen Beckens," Tübingen, 1864, p. 273.

then the existence of such an opening, termed later by Keber the *micropyle*, has been abundantly demonstrated, at least in the ova of fishes, mollusks, insects, etc.*

A very interesting series of observations, connected with this subject, have been made by M. Robin upon the ova of the *nephelis vulgaris*, or common leech. The earliest token of the maturity of the ovum consisted in the disappearance of the germinative vesicle. At the same time a retraction took place in the viteilus, which became thereby reduced one sixth to one fourth in size. At first the removal of internal pressure, consequent upon this retraction, led to a wrinkling of the vitelline membrane. Afterward, however, a clear, limpid fluid, probably in part exuded from the vitellus and in part derived by endosmosis from external sources, filled up the intervening space, and caused the wrinkles to disappear. The spermatozoa, in their movements around the ovum, assumed a perpendicular or oblique direction to the vitelline membrane. At one point in the membrane the penetration of these bodies could be distinctly observed. At the end of an hour the penetration had ceased, and then a little bundle of spermatozoa could be seen arrested, partly within and partly without the ovum. In the clear, limpid space surrounding the vitellus, the spermatozoa continued to move about actively for a time, but in fifteen to twenty minutes their movements began to grow slow, and in a couple of hours had ended altogether. A comparison, by actual count, of the spermatozoa now remaining, showed that a certain number of those which had found entrance into the limpid space had disappeared. They had been absorbed directly into the vitellus, to serve for its fecundation.†

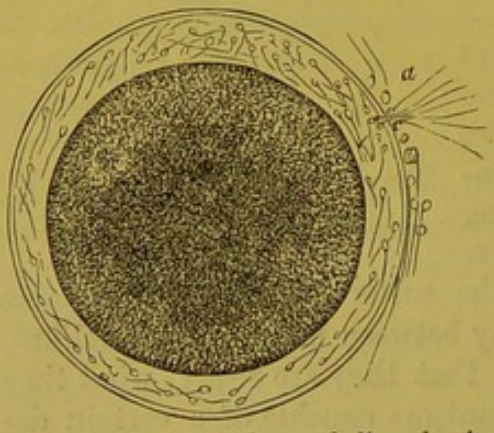


FIG. 34.—Ovum of the nephelis vulgaris, showing retraction of vitellus and the penetration of the spermatozoa through the vitelline membrane (magnified three hundred diameters). (Robin.)

CHANGES TAKING PLACE IN THE OVUM SUBSEQUENT TO FECUNDATION.

In describing its anatomy, we have noted that the ovum was originally a simple cell, possessing contractility and other properties of living matter. The ova of certain of the sponges, which do not possess a zona pellucida, move about under the field of the microscope by

* *Vide* MILNE-EDWARDS, "Leçons de la Physiologie," t. viii, Paris, 1873, pp. 361 *et seq.*; WALDEYER, "Eierstock und Nebeneierstock," STRICKER'S "Handbuch," p. 354.

† "Mémoire sur les Phénomènes qui se passent dans l'Ovule avant la Segmentation du Vitellus," ROBIN, "Jour. de la Physiol.," t. v, pp. 67 *et seq.*

pushing out finger-like processes, precisely like the ordinary amœba.* Contractile movements of the vitellus within the zona pellucida have been described by Robin in the ova of the leech and other low orders of animal life.†

Before the ovum leaves the Graafian vesicle, or soon after its discharge from the ovary, the germinative vesicle disappears. As this disappearance has been observed mostly in the impregnated ovum, the phenomenon has been generally attributed to the penetration of the spermatozoa, but Robin regards it as simply a sign that the ovum has reached maturity, and has become apt for fecundation. It occurs equally within the unfecundated ovum.‡

The first decided indication of the changes effected in the ovum by contact with the male element of generation, and a sign, too, conclusive of fecundation, is the spontaneous appearance of a round nucleus in the center of the vitellus. This nucleus is recognizable fifteen to thirty hours after fecundation. In appearance it so closely resembles the original germinative vesicle that, for a long time, it was erroneously regarded as such.

Almost immediately after its production, the vitelline nucleus subdivides into two nuclei. By a similar process of cleavage, the vitellus likewise separates into two halves. The nuclei act as central points

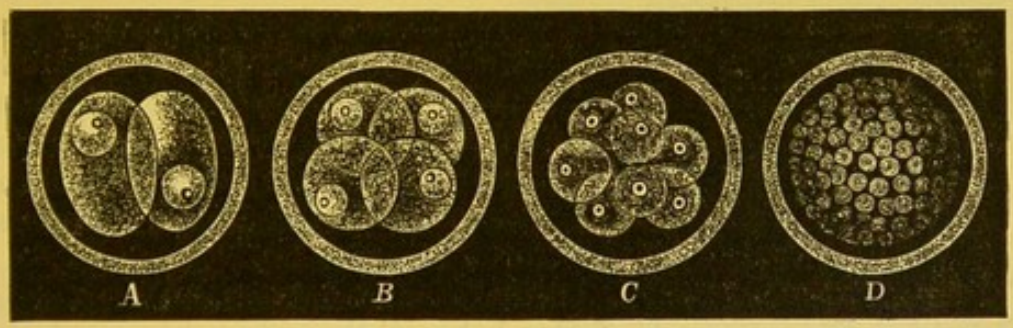


FIG. 35.—Segmentation of the ovum. *A*, the ovum divided into two cells; *B*, the two cells divided into four; *C*, the four cells divided into eight; *D*, by repeated segmentation the ovum has become a round, mulberry-shaped mass—the *morula*. (Haeckel.)

of attraction, around which collect the molecular and viscid portions of the protoplasm. In this manner the original cell is converted into two new cells, exactly resembling one another, and both lying near together within the vitelline membrane. To this cleavage of cells the term *segmentation* has been applied. By a continuation of the process, the two new cells are converted into four, the four into eight, and so on in succession until, finally, a great multitude are generated, all closely crowded together, and giving to the ovum a mulberry appearance,

* HAECKEL, "Anthropogenie," Leipsic, 1874, p. 112.

† *Loc. cit.*, pp. 100 *et seq.*

‡ ROBIN, "Sur la Production du Noyau Vitellin," "Jour. de la Physiol.," t. v, p. 315.

whence the term *morula* has been applied to the ovum at this stage of its development.

A clear fluid next accumulates in the center of the morula, at first small in amount, but gradually increasing in quantity until finally the cells are pressed to the surface. Thus the morula is converted into a globular vesicle, termed the *blastodermic vesicle* (Fig. 33). The walls of the latter are composed of a single layer of cells, which form a continuous membrane, termed the *blastodermic membrane*. By the absorption of fluid in its transit through the Fallopian tube, the ovum is increased, upon the completion of the blastodermic membrane, from $\frac{1}{120}$ of an inch to from $\frac{1}{60}$ to $\frac{1}{25}$ of an inch in diameter.

All the cells resulting from the segmentation of the original vitellus do not, however, take part in the formation of the blastodermic membrane. If we carefully examine the blastodermic vesicle, just after its development, we find, at one point upon its surface, a dark, round spot, which is caused by an accumulation of a portion of the cleavage cells upon the inner surface of the membrane. In profile this spot presents a semicircular projection within the vesicle.* By peripheral extension, its cells gradually spread over and line the inner surface of the blastodermic membrane. Thus the ovum becomes encompassed by two cell-membranes, termed respectively the outer and the inner layer of the blastodermic membrane. The outer layer of the blastodermic membrane is likewise termed the *ectoderm*, in distinction from the inner layer, or *entoderm*.

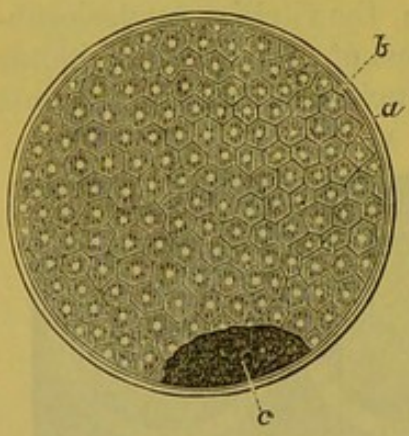


Fig. 36.—Blastodermic vesicle from the uterus of the rabbit. *a*, chorion; *b*, cells, resulting from segmentation, forming a single layer lining the chorion—these cells have become hexagonal from reciprocal pressure; *c*, heap of cells remaining within the blastodermic vesicle after the formation of the blastodermic membrane. (Bischoff.)

At the same time a stratum of fluid forms between the external layer of the blastodermic membrane and the *chorion*, as the zona pellucida is now called. Before the completion of the entoderm, a bright, round spot makes its appearance upon the surface of the blastodermic vesicle. This spot marks the point at which all the more important processes connected with the development of the embryo take place, and is termed the *area germinativa*. At the outset, it differs from other portions of the blastodermic vesicle solely in the increased thickness of the cells composing the ectoderm. Those of the entoderm remain unchanged.

* The theory of Bischoff and others, that the *area germinativa* is developed at this point, is not supported by the recent investigations of Kölliker. — Albert Kölliker, "Entwickelungs-Geschichte," erste Hälfte, p. 227, Leipsic, 1876.

The area germinativa has later an oval shape, with a bright center and a dark border. The clear center is termed the *area pellucida*, and the dark, thickened border the *area opaca* (Fig. 38).

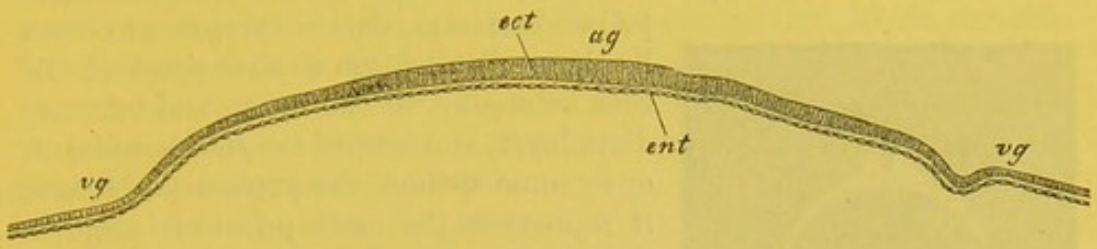


Fig. 37.—Section through area germinativa in the egg of a rabbit, showing the thickening of the ectoderm (*ect.*) at that point, as contrasted with the ectoderm of the blastodermic vesicle beyond the area germinativa (*vg.*). (Kölliker.)

Subsequently a third, intermediate, cell-layer, termed the *mesoderm*, is developed between the ectoderm and the entoderm.* In the mesoderm are developed the primitive blood-vessels, with the growth of which the area opaca becomes known as the *area vasculosa*.

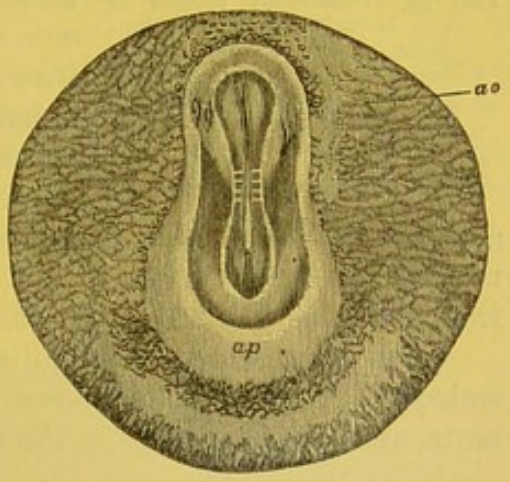


Fig. 38.—*a o*, area opaca; *a p*, area pellucida; with beginning formation of embryo from the embryonic spot. From the ovum of a rabbit on the ninth day. Owing to the advanced stage of development, the area pellucida has lost its primitive shape, and presents the appearance of a constricted ovoid. (Kölliker.)

Finally, the mesoderm separates into two distinct strata, so that the embryo, at one stage, is composed of four distinct layers.

Without entering minutely into the subject, it may be well to state that, according to common acceptance, these layers are assumed to have the following relations to the ulterior development of the body:

The outer layer, or ectoderm, is concerned in the formation of the epidermis, hair, nails, the glandular structures of the skin, the brain, the spinal cord, the organs of special sense, and perhaps in that of the genito-urinary system.

The second, or outer, stratum of the mesoderm gives rise to the corium, the muscles of the trunk (those concerned in the movement of the body), and the bony framework.

The third, or inner, stratum of the mesoderm supplies the muscular and fibrous tissues of the digestive tract, the blood, the blood-vessels, and the blood-glands.

* According to Kölliker, the cells of the mesoderm are derived solely from the proliferation of those of the ectoderm: "Entwickelungs-Geschichte," 2te Auflage, p. 268.

The inner layer, or entoderm, furnishes the epithelium lining the walls and glands of the intestines.*

About the time the area germinativa loses its circular form, and becomes of an oval shape, there appears in the middle of the area pellucida a large, dark, oval spot, produced by the multiplication at that point of the cells belonging to the outer and intermediate layer, and termed the *embryonic spot*, or by some authors the *protosoma*, because it represents the most primitive stage in the development of the embryo. The oval shape of the embryonic spot is suggestive of the future distinction between the head and the posterior extremity, the larger end corresponding to the former, and the smaller to the latter. Then, of a sudden, there appears in the middle of the embryonic spot a delicate line termed the *primitive trace*, which divides it into two lateral halves. The primitive trace consists of a groove or furrow, bordered by two ridges, termed the *dorsal plates*, and formed by a thickening of the external layer. The dorsal plates may be readily understood by reference to the transverse section (Fig. 39), taken from Professor Dalton's "Treatise on Human Physiology."

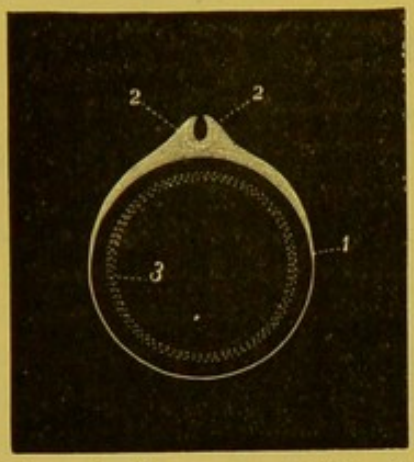


Fig. 39.—Transverse section of egg in early stage of development. 1, external and median layers of blastodermic membrane; 2, 2, dorsal plates; 3, internal layer of blastodermic membrane. (Dalton.)

Upon microscopic examination of such a transverse section, the embryo is found to be composed of three layers, which, in the vertebrata, are united together in the median line. The intermediate layer

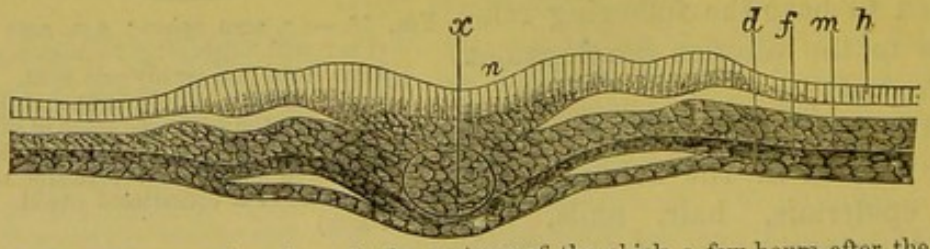


Fig. 40.—Transverse section through the embryo of the chick a few hours after the commencement of incubation. *h*, external layer of the blastodermic membrane; *m*, external stratum of intermediate layer; *f*, internal stratum of intermediate layer; *d*, internal layer of the blastodermic membrane; *n*, primitive trace or furrow; *x*, chorda dorsalis.

* Haeckel, "Anthropogenie," p. 218. According to His, the three primitive layers are concerned in the formation of the epithelial, the muscular, and the nerve-tissues only, whereas the blood and connective tissues, comprising the leucocytes, the red-blood corpuscles, the blood-glands, the endothelia, and all the connective tissue forms, including cartilage, bone, and teeth, are derived from cell elements outside the area germinative into which they subsequently migrate and especially invade the median layer. The three primary layers His terms the Archiblast, and the invading cells the Parablast. The median layer is, to a great extent, a secondary formation. For an excellent discussion as to the origin of the Parablast, the curious reader is referred to "Archiblast and Parablast," Waldeyer, Bonn, 1883.

(mesoderm), which possesses the greatest thickness, already presents the appearance of two closely connected strata. The primitive trace may be recognized in the middle of the upper surface, and the dorsal plates are seen rising up as low ridges. At the same time, just beneath the furrow, a cylindrical organ, known as the *chorda dorsalis*, becomes separated from the cell-mass. The chorda dorsalis owes its importance to the fact that it is around this cylindrical body that the vertebræ subsequently form. The vertebræ themselves are derived from two longitudinal chords, separated by a cleavage from the portions of the intermediate layer next to either side of the chorda dorsalis. The peripheral portions of the intermediate layer are now termed the *lateral* or *abdominal plates*. Meantime the dorsal plates continue to grow, and, by curving toward one another, finally meet in the median line, so as to form a closed tube, the *tubus medullaris*, in which is developed the central nervous system. Thus it will be noticed that the organ through the agency of which the individual is brought into contact with the external world is primitively derived from the external blastodermic layer (ectoderm).

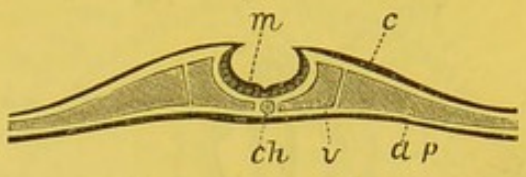


FIG. 41. — Diagram representing transverse section through the embryo of a chick at the end of the first day of incubation. *m*, dorsal plates; *ch*, chorda dorsalis; *v*, vertebral chords; *a p*, abdominal plates.

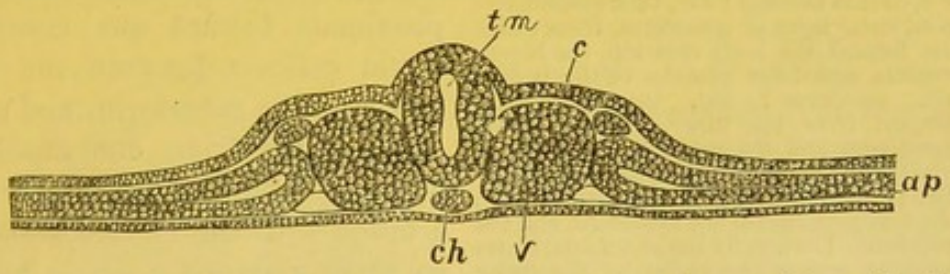


FIG. 42.—Transverse section through the embryo of a chick on the second day of incubation (magnified one hundred diameters). *t m*, the dorsal plates have closed to form *tubus medullaris;* the connection with the outer or cutaneous layer (*c*) is broken off; *ch*, chorda; *v*, vertebral chords; *a p*, the abdominal plates, have separated into an external and internal stratum, united at *m* to form the mesenteric folds.

The intermediate layer (mesoderm) now separates into an internal and external stratum, the existence of which, it has been noted, was indicated at an earlier stage. These two strata remain united by their inner borders, and form later at the point of union the mesenteric folds. The outer extremities of the inner of these strata now curve inward, and finally unite together to form the intestine. They inclose at the same time the internal layer of the blastodermic membrane (entoderm). The closure, unlike that of the dorsal plates, takes place from front to rear, as well as from the two sides. The intestinal tube is thus formed from the inner stratum of the mesoderm,

which furnishes the fibro-muscular tissues, and from the internal blastodermic layer (entoderm), from which the glandular structures are derived. A portion of the blastodermic vesicle is, however, not included in the intestinal tube, but hangs, during the early months of gestation, from the body of the embryo, and is termed the *umbilical vesicle* (*u v*). Finally the outer or cutaneous layer of the blastodermic membrane (ectoderm) and the outer stratum of the mesoderm (the fibro-muscular layer of the trunk) curve forward and inward so as to inclose a long cavity, the *cœlum*, which surrounds the intestine. This cavity in mammals subsequently becomes divided by the diaphragm into thorax and abdomen.

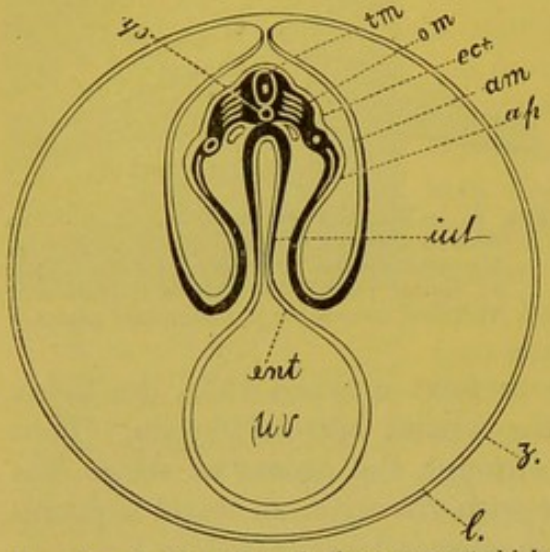


Fig. 43.—Section through the ovum of chick after development of umbilical vesicle. *c h*, chorda dorsalis; *t m*, tuba medullaris; *o m*, outer layer of mesoderm, from which are formed the bony skeleton, the blood-vessels, and large muscles of the trunk; *ect*, ectoderm; *int*, intestinal tube, formed from the inner stratum of the mesoderm and the entoderm (*ent*); *u v*, umbilical vesicle, continuous with intestine; *a p*, abdominal plates, formed from the outer stratum of the mesoderm and the ectoderm. Eventually the abdominal plates meet to inclose the cavity of the trunk (thorax and abdomen); *a m*, amnion, formed from ectoderm and outer stratum of the mesoderm; *z*, zona pellucida; *l*, outer lamina of the amniotic folds, derived from the ectoderm.

The body of the embryo, seen in profile, at the time these changes are going on, possesses a thickened anterior, or cephalic portion, and a tapering posterior extremity. It manifests at an early period a tendency to elevate itself above the level of the area germinativa. The back becomes arched, and the extremities approximate toward one another. Fluid collects between the two strata of the mesoderm, and separates them from one another. Of these the outer stratum forms a union with the cutaneous layer so as to produce a single membrane, folds of which rise at the same time from the extremities and sides of the embryo, and encompass it with an outer wall or parapet. In the process of growth these folds approach one another over the *dorsum* of the embryo, and finally unite together. Thus a sac, including the embryo, is formed, termed the *amnion*, the cavity of which subsequently fills with fluid.

Nourishment of the Embryo.

It now becomes a matter of importance for us to consider the sources from which the embryo receives the nutritive materials requisite for its further growth and development.

We have seen already that the ovum, in its passage through the

Fallopian tube, is increased in size by absorption of nutritive materials from $\frac{1}{120}$ of an inch to from $\frac{1}{60}$ to $\frac{1}{25}$ of an inch.

In describing the formation of the intestinal tube, it was noted that a portion only of the blastodermic vesicle was included by the curving inward of the inner stratum of the mesoderm, while a portion, known as the umbilical vesicle, hung from the abdomen. The umbilical vesicle is lined, like the intestinal tube, by the inner layer of the blastodermic membrane (entoderm), and is covered by an extension of the inner stratum of the mesoderm. At first the cavity of the vesicle communicates with the intestine, and contributes by its contents to the nourishment of the embryo. This arrangement, however, is only temporary. The passage very soon becomes obliterated, and the remains of the umbilical vesicle hang downward, attached by an impervious pedicle to the intestine.

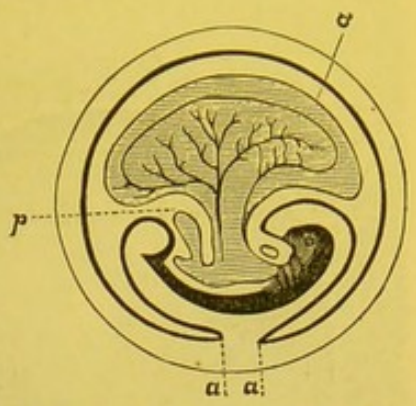


Fig. 44.—Diagram showing early stage in development of amnion. *a*, *a*, external layer of blastodermic membrane, rising up over the dorsum of embryo to form the amniotic folds; *p*, allantois; *u*, umbilical vesicle.

From the time the ovum has passed into the uterus, however, it derives its main nutritive supply from the mucous membrane of that organ, at first by simple absorption, and afterward by the formation of the placenta, an organ through which the blood of the fœtus circulates, separated from that of the mother by the thinnest of partitions. Through the party-wall there pass to the fœtus all the materials necessary for existence and growth, and from the fœtus the excrementitious principles representing the waste which is incident to vital action.

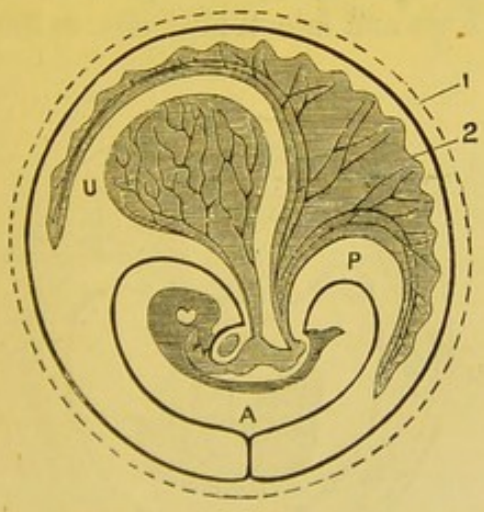


Fig. 45.—Diagram showing completion of the amnion and formation of the chorion. *a*, amnion; 2, outer lamina of the ectoderm after closure of amniotic folds; *p*, allantois; *u*, umbilical vesicle.

There is nothing in physiology more interesting than the process by which the circulation of the fœtus is brought into close relation with that of the mother. It includes the consideration of the *allantois*, the *chorion*, the *decidua*, and finally the joint product of them all, viz., the *placenta*.

The Allantois and Chorion.—The *chorion* is the external membrane that invests the ovum. Before the formation of the amnion it con-

sists simply of the zona pellucida or vitelline membrane. As the ovum is received into the uterus, the vitelline membrane becomes covered with amorphous villi, which help to fix the ovum in the uterine cavity.

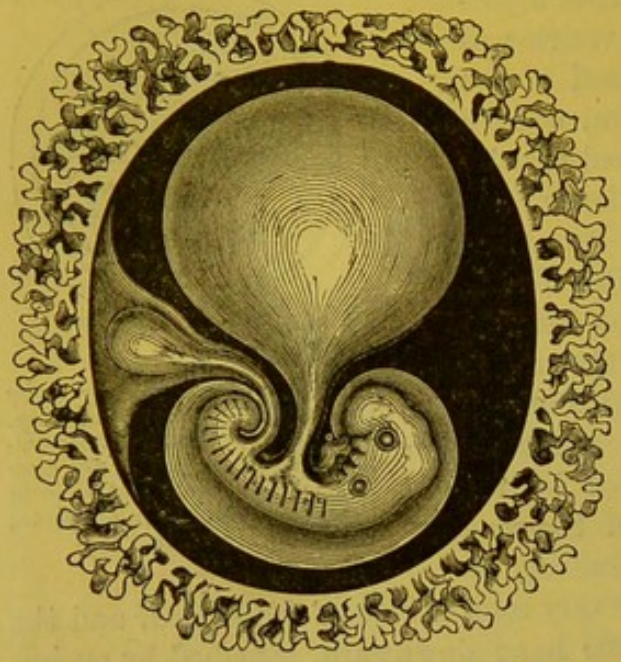


Fig. 46.—Human embryo, at the third week, showing villi covering the entire chorion. (Haeckel.)

After the completion of the amnion by the closure of the amniotic folds, it remains for a time attached to the outer lamina of the ectoderm, at the point where the folds meet over the back of the embryo. The outer lamina meantime expands until it comes in contact with the vitelline membrane, which then disappears. Thus the outer lamina becomes in turn the external covering or chorion. The new chorion, like the one it superseded, is speedily covered by a growth of non-vascular villosities. These villosities are not solid, but hollow, like the finger of a glove. They soon reach an extraordinary development. New villi sprout upward from the chorion, the older ones push out buds and lateral offshoots, so that already in the third week the entire surface of the ovum is covered with a dense forest of villi, presenting the most delicate and graceful characters.

We have just noted that the umbilical vesicle was a temporary structure, and only for a brief period of physiological importance. Meantime a new organ is developed, by means of which a vascular connection is established between the embryo and the villi of the chorion. This organ is termed the *allantois*. The allantois begins as a sac-like projection from the posterior extremity of the intestine, at the time when the amniotic folds rise up around the embryo (*vide* Fig. 44).

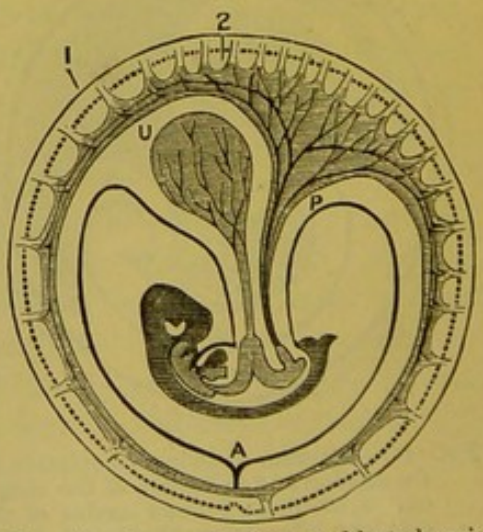
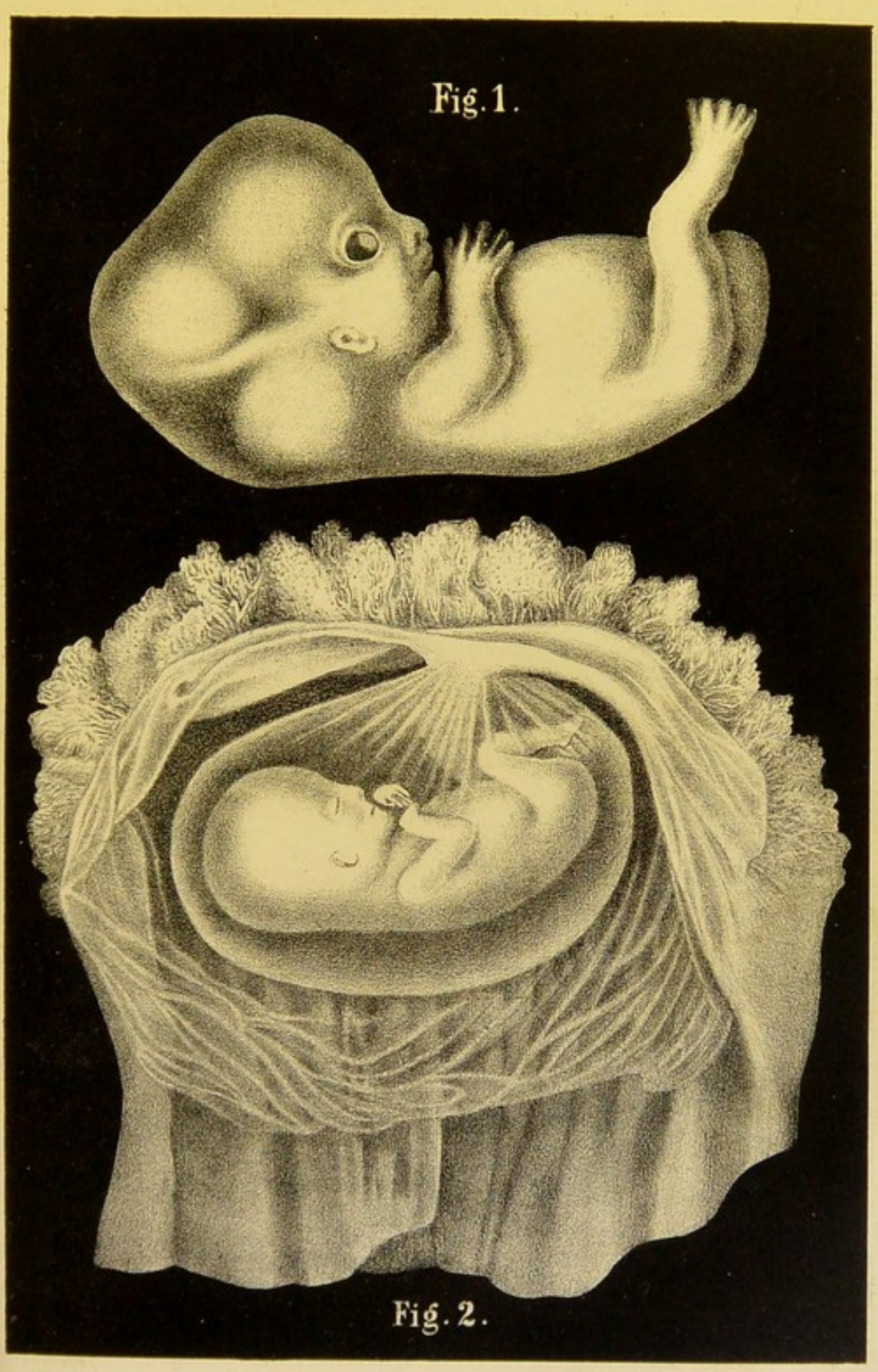


Fig. 47.—1, exochorion; 2, blastodermic chorion; *u*, umbilical vesicle; *a*, amnion; *p*, pedicle of allantois.

in the form of an embankment At this time the umbilical vesicle

Fig. 48.



1. Human embryo, at the ninth week, removed from the membranes; three times the natural size. (Erdl.)
2. Human embryo, at the twelfth week, inclosed in the amnion; natural size. (Erdl.)

is still very large. The allantois, like the umbilical vesicle and the intestine, is composed of two layers derived respectively from the internal layer of the blastodermic membrane (entoderm), and the inner stratum of the mesoderm. It speedily becomes vascular, and increases rapidly in size. The inner surfaces of the sac soon adhere together, so as to form a single membrane. In the course of the third week the allantois reaches the chorion, over which it spreads and forms a complete vascular lining. According to the usual acceptation, the vessels of the allantois everywhere penetrate into the villi of the chorion. Then the chorion and allantois fuse together and form by their consolidation a compound membrane termed *the permanent chorion.** At first the embryo is connected with the vascular chorion by two arteries and two veins. The two arteries persist as the arteries of the umbilical cord. One of the two veins disappears, while the other becomes enlarged in proportion, and forms the umbilical vein.

With the growth of the ovum its surface diminishes in vascularity, except in the neighborhood of the attachment of the allantoic vessels, at which point the villi increase in size and profusion. Over the rest of the ovum the villi atrophy and disappear. Thus the greater portion of the chorion becomes smooth, while about one third of its surface is covered with a thickened, shaggy portion, destined to contribute to the formation of the placenta.

The Deciduæ.—When the ovum passes from the Fallopian tubes into the uterus, it finds the mucous membrane prepared, by certain changes, for its reception. These changes, as shown in a specimen examined by Dr. Engelmann,† in the first month consisted of a ten-fold increase in thickness (two fifths of an inch). The tissues were intensely vascular, and the entire mucous membrane was thrown into convolutions. The thickening was mainly due to an increase in the elements composing the inter-glandular connective tissue. This was more especially the case in the upper layers, where the cells were like those of young connective tissue. A soft, pulpy state of the mucous membrane was occasioned by an augmented production of the amorphous intercellular substance which characterizes connective tissue in the embryonic state.

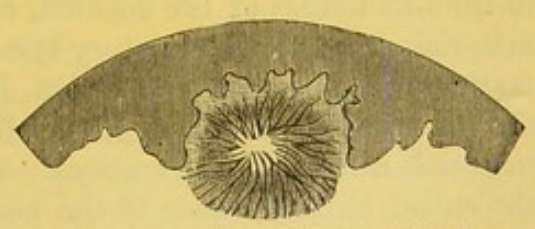


Fig. 49.—Formation of decidua, first stage.

* The outer portion, derived from the ectoderm, furnishes the epithelium, and is called the *exochorion*, while the inner vascular surface furnished by the allantois is entitled the *endochorion*.

† Engelmann, "Mucous Membrane of the Uterus," "Amer. Jour. of Obstet.," May, 1875.

It is this thickened, vascular, softened mucous membrane which furnishes the *decidua vera*.

The ovum, soon after its entry into the uterus, finds a lodgment in one of the folds of the decidua vera. This takes place usually in the upper portion of the uterine cavity, upon the posterior wall, near one of the tubal orifices.

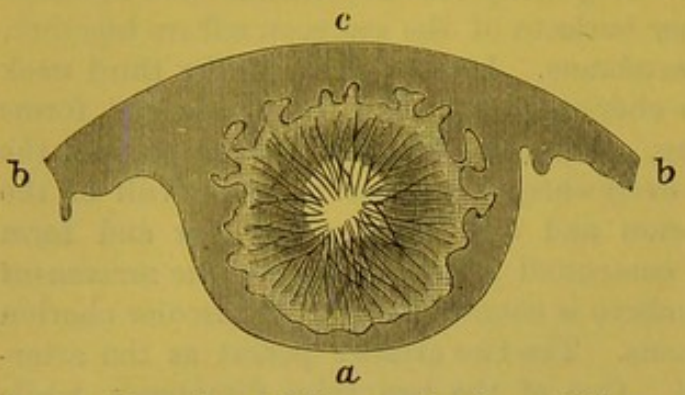


Fig. 50.—Formation of decidua completed. *a*, decidua reflexa; *b*, decidua vera; *c*, decidua serotina.

The point of attachment between the ovum and the decidua is distinguished as the *decidua serotina*. It is physiologically important as the site of the placenta.

The ovum is not simply adherent. It lies, as it were, imbedded in the tumefied membrane, folds of which grow up around it, and finally meet so as to inclose it in a cavity of its own, shut off from the general cavity of the uterus.*

The folds of mucous membrane which inclose the ovum are termed the *decidua reflexa*.

The space between the decidua vera and reflexa is filled by opaque, viscid mucus.

The Placenta.—The villi which cover the chorion become imbedded in the soft tissues of the decidua, and derive, by absorption, nutritive materials from the circulatory system of the mother. After the formation of the permanent chorion, by the extension of the allantois to the inner surface of the egg, the allantoic vessels convey the absorbed materials directly to the embryo. At first, absorption takes place from the entire circumference of the chorion, but with the enlargement of the ovum there ensues a thinning of the reflexa, with obliteration of its vessels. At the same time the villi cease to grow over that portion of the chorion in contact with the reflexa, and the whole process of exchange between fœtus and mother becomes concentrated at the decidua serotina. At this point the chorion, in place of becoming bare,

* Leopold, in his account of the uterine mucous membrane, adopts Reichert's view of the formation of the reflexa, viz., that, owing to the less rapid increase in the growth of the serotina, the ovum becomes buried in the thickening of the vera.—(*Vide* "Studien über die Uterusschleimhaut," etc., "Arch. f. Gynaek.," Bd. xi, p. 455.) In opposition to the accepted view that the decidua is the tumefied mucous membrane, Ercolani ("On the Utricular Glands of the Uterus," translated by Marcy) insists that both the vera and reflexa are organs of new formation, the products of exudations, the neo-formative process consisting in the production of new vessels with single endothelial walls, from the surface of which the decidual cells are elaborated.

is covered with an infinite multitude of villi, which enlarge, lengthen, and, by sending out lateral offshoots, assume an arborescent appearance. The villi are arranged in tufts, sixteen to twenty in number, which together form a soft, spongy mass, and constitute the fetal portion of the placenta.

The uterine mucous membrane, in which the villi lie imbedded, contributes likewise its share to the make-up of the completed placenta. The structure of this so-called maternal portion of the organ has been the subject of much difference of opinion. Indeed, an intelligible idea of its anatomy can hardly be conveyed without a preliminary consideration of certain points connected with its development.

Thus, the villi are often erroneously described as penetrating directly into the glandular structures of the adjacent uterine mucous membrane. Professor Turner has, however, conclusively shown that, in all the less complicated placental forms throughout the animal kingdom, the depressions or crypts into which the villi dip occupy the soft, pulpy, interglandular tissues. Engelmann further draws attention to the large size of the terminal sprouts of the villi in the human placenta, which would render their entrance into the glandular tubules, unless by a mere exceptional chance, a mechanical impossibility. Moreover, Friedländer* has demonstrated, as will be again noted hereafter, the persistence of the enlarged flattened glands in the serotina even after the separation of the placenta at childbirth. It may be deemed, therefore, as fairly settled that the maternal portion of the placenta is derived from the tissues occupying the spaces between the glands, and not from the glands themselves.

In the *mare*, the relations of the villi to the uterine mucosa are of the simplest character. With a little force it is possible to draw the villi from the crypts, which, on vertical section, are seen to be cup-like depressions between the glands. The crypts are surrounded by a dense capillary plexus, and are lined by epithelial cells. The epithelial cells are partly columnar, like those covering the mucous membrane of the uterus in the unimpregnated state, while others are so swollen out that their length but little exceeds their breadth, while others are of irregular shape. Transitional forms prove the derivation of the irregularly shaped cells from ordinary columnar epithelium.†

In the arrangement just described, it will be seen that the villi, containing the vessels communicating with the fœtus, dip into crypts

* Friedländer, "Untersuchungen über den Uterus," 1870—Ueber die Innenfläche des Uterus post partum, "Arch. f. Gynack.," Bd. ix, p. 22, 1876. Friedländer's observations have been confirmed by Kundrat and Engelmann, Langhans, and Leopold.

† Professor Turner, "The Structure of the Placenta," "Jour. of Anat. and Physiol.," vol. x, p. 136.

in the uterine mucous membrane. The crypt-walls are highly vascular, and are lined with epithelium. There is, therefore, no direct communication between the fetal and maternal blood-vessels. The crypts, however, elaborate a secretion, termed by Haller uterine milk, which contains fatty, saline, and albuminous matters dissolved in water. The uterine milk is, therefore, well qualified to serve as a nutrient material, and is without doubt absorbed by the villi for the benefit of the fœtus.*

In the *cat*, the villi of the chorion have the form of broad, sinuous leaflets, which, about the completion of one half the period of gestation, are so interlocked with the crypts that the two surfaces can not be disengaged from one another. Vertical sections show that the walls of the crypts closely follow the sinuosities of the villi in such wise as to form an intimate investment for them. Injections of the maternal capillaries show them to be dilated to two or three times the size of the capillaries in the fetal villi.†

In the *human* placenta the relations of the villi to the uterine mucous membrane differ somewhat at different stages of development. Thus, *at first*, the empty cylindrical villi simply sink into the soft, pulpy, interglandular spaces. *Next*, as the villi sprout and become vascular and arborescent, projections, formed from the proliferation of the superficial portion of the serotina, grow around the offshoots and branching processes. At this time we distinguish in the placenta a fetal portion, the *placenta fœtalis*, composed of the villous tufts of the ovum, and a uterine portion, the *placenta uterina*, derived from the tissues of the serotina.

In the third and fourth months the union of the fetal and maternal tissues is very intimate. But, subsequently, the growth of the uterine tissue does not keep pace with that of the villi, so that the mature placenta is almost altogether a fetal organ. A layer of uterine mucosa, not exceeding $\frac{1}{25}$ of an inch in thickness, covers the surface of the placenta after delivery. Between the cotyledons, however, thin

* The uterine milk can not be obtained from the placenta of the mare unmixed with the secretions from the uterine glands. The analyses of Professors Prevost, Schlossberger, and Gamgee were made upon a fluid derived from polycotyledonous placentæ. —(*Vide* "Structure of the Placenta," p. 176.) Hoffmann, "Sicherer Nachweis der Uterinmilch beim Menschen," "Ztschr. f. Geburtsk. und Gynaek.," Bd. viii, p. 258, claims to have demonstrated the presence of uterine milk in the human placenta likewise. This he obtained by the insertion of capillary tubes into the substance of the placenta from its maternal surface. The fluid consisted of serum, of some of the formed elements of the blood, and of a multitude of spherical bodies which he regarded as analogous to milk globules. Werth, however, "Ueber die sogenannte Uterinmilch des Menschen," "Arch. f. Gynaek.," Bd. xxii, p. 233, has shown that this so-called uterine milk is a post-mortem production, not present directly after delivery; that the serous portion is derived from the villi, and the formed elements from the exochorial cells.

† Turner, *op. cit.*, pp. 155, 156.

partitions from the serotina extend downward for a considerable distance, though never, except near the borders, as far as the chorion.

Sections through the hardened placenta show that the main villous trunks divide at a short distance from the chorion. The secondary branches assume a radiate direction, from which proceed tertiary branches, which terminate in club-shaped extremities and bury them-

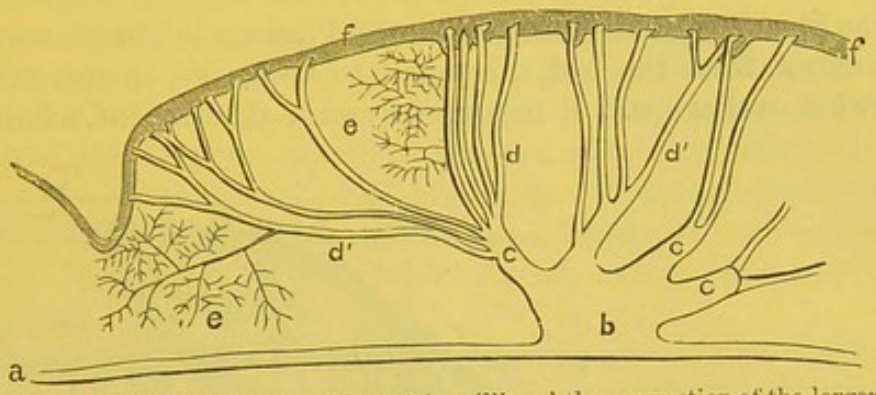


Fig. 51.—Diagram showing the branching of the villi and the connection of the larger trunks with the placenta. *a*, chorion; *b*, primary trunk, with radiate branches (*c*); *d*, the tertiary branches, which either directly, or after previous division (*d'*), penetrate the placenta materna (*f*). The free terminal tufts (*e*) are indicated only at a few points. (Langhans.)

selves in the serotina. From these tertiary branches fine lateral ones, having a dendritic arrangement, are given off, and fill the spaces between the tertiary trunks.

Many of these lateral tufts are attached directly to the serotina, and fill up in part the interval between the larger radiate branches; others, again, float freely in the blood-currents derived from the maternal vessels.*

The precise origin and nature of the vascular spaces between the villi have been a prolific subject of discussion. In the early months, we saw, the serotinal projections extended deep down between the villi, and contained largely dilated capillaries; and yet afterward every trace of these vessels is found to have disappeared throughout the entire placenta, except in the thin layer of the placenta uterina, where the endothelium, or inner lining, may still be detected. The most probable supposition is, that the vessels have become eroded and finally destroyed by the growth of the villi, leaving the blood to flow unimpeded through the intervillous spaces. A delicate layer of epithelium may, indeed, be found upon the villous trunks and tufts; but these, it is sufficiently established, belong to the villi, and are derived from the exochorion.† Whether these cells essen-

* Langhans, "Zur Kenntniss der menschlichen Placenta," "Arch. f. Gynaek.," Bd. i, 1870, p. 317; *vide*, also, Kölliker, "Entwickelungs-Geschichte"; Leopold, "Der Bau der Placenta," "Arch. f. Gynaek.," Bd. xi, 1877, p. 443.

† Kölliker, "Entwickelungs-Geschichte," 2te Auflage, p 333; Leopold, "Der Bau

tially modify the interchange between the fetal and maternal circulations, can only be a matter of conjecture. The fact that certain medicinal substances, such as iodide of potassium and salicylic acid, when administered during the latter days of pregnancy, may be found in the blood and secretions of the fœtus, whereas others, as woorari and perhaps mercury, have not been so found, renders some action on the part of the cells, aside from simple osmosis, at least probable.*

The Structure of the Fully-developed Placenta.—The placenta, after its removal from the body, is found to be a soft, spongy mass, of a somewhat oval shape. It measures upward of seven and a half inches

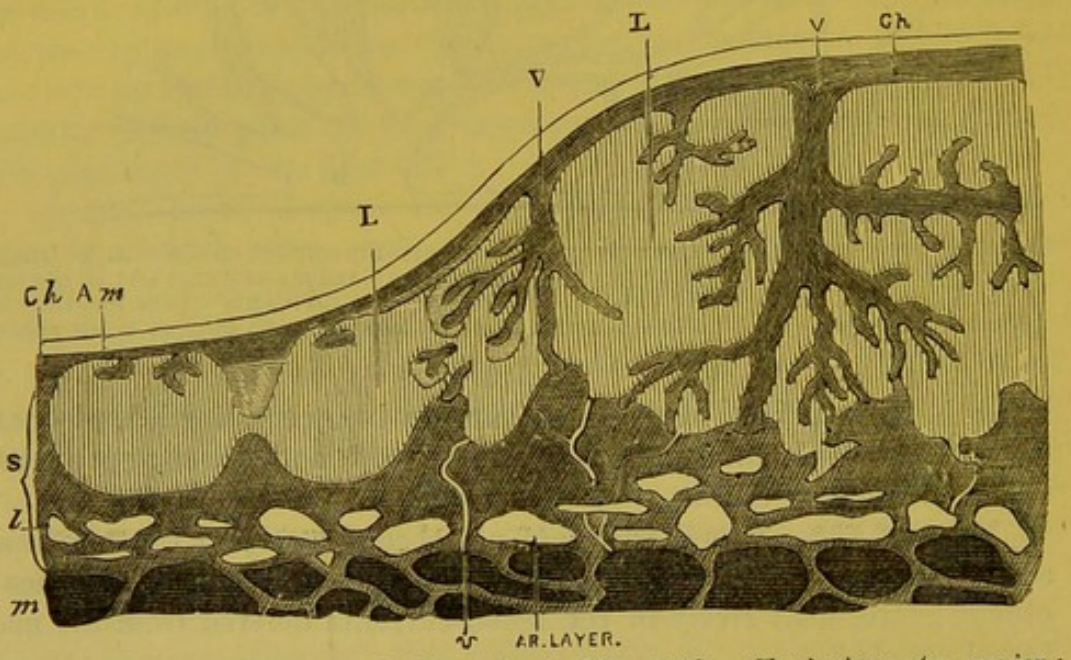


FIG. 52.—Diagram of uterus and placenta in the fifth month. *Ch*, chorion; *Am*, amnion; *V*, villi; *L*, lacunæ; *S*, serotina; *AR*, areolar; *V*, small arteries. (Leopold)

in its longest diameter, is from two thirds to an inch in thickness at the point of insertion of the funis, and weighs about sixteen ounces. Its internal surface is smooth, and is covered by the amnion, through which the vessels, communicating with those of the funis, can be seen in their distribution over the surface of the organ, previous to plunging into the tissues beneath. The uterine surface has a peculiar, granular feel, and is divided into a number of lobes, corresponding to the

der Placenta," "Arch. f. Gynack.," Bd. xi, p. 467. It is, however, proper to state here that Ercolani maintains that the dilated endothelial walls of the maternal vessels are simply bent inward by the proliferating villi, and that the epithelium observed upon the villi are decidual, and are not derived from the exochorion. *Vide* MARCY, "N. Y. Med. Journal," July 28 and Aug. 4, 1883.

* *Vide* FEHLING, "Zur Lehre der Stoffwechsel," "Arch. f. Geburtsk.," Bd. ix, p. 313; BENEKE, "Ztschr. f. Geb. und Frauenkrankheiten," Bd. i, p. 477; GUSSEROW, "Arch. f. Geburtsk.," Bd. iii, p. 241; SCHAUENSTEIN und SPAETH, "Jahrb. der Kinderheilk.," 2ter Jahrg., p. 13.

fetal tufts or cotyledons already described. It is covered with a soft, thin membrane, which sends septa or partitions in between the cotyledons. This membrane is simply the product of the surface layer of the serotina.

Curled arteries from the uterus penetrate the cotyledons, and convey the maternal blood into the spaces or lacunæ between the fetal tufts. Through these spaces the blood flows in a sluggish current, and is conveyed back to the uterus by the coronary vein upon the margin of the placenta, and by means of sinuses situated in the septa between the cotyledons, and continuous with the venous sinuses of the uterine walls.* The fetal tufts which thus bathe in the mother's blood receive, through the umbilical arteries, the blood which comes from the fœtus, darkened with carbonic acid. In the ultimate ramifications of the villi, the arteries communicate by an arch or loop with a corresponding branch of the umbilical vein, which returns to the child red, arterialized blood.†

But the placenta is not simply a respiratory organ. The rapid development of the ovum, from a simple cell of microscopic size to the proportions of the infant at birth, argues as surely that the relations of the blood-currents in the placenta enable the fœtus to derive from the mother all the proximate principles required for the building up of tissue, the differentiation of organs, and the performance of function.

Then, too, the fœtus has been shown to have a temperature of its own, somewhat higher than that of the mother.‡ This production of heat is necessarily attended with destruction of tissue. Of this there is evidence in the presence of urea in the bladder and the amniotic fluid. There can be little question, however, but that the placenta furnishes the chief channel through which the devitalized products are discharged.

The Formation of the Umbilical Cord.

To understand the structure of the cord, it is well to bear in mind the various particulars connected with its development. At the time when the allantois first appears as a sac-like projection from the intestine, the embryo is hardly more than an appendage to the umbilical

* For affirmative evidence of the existence of placental lacunæ, *vide* Professor Turner, "Structure of the Human Placenta," "Jour. of Anat. and Physiol.," vol. vii, p. 120. So, too, Professor Dalton's ingenious inflation of the intervillous spaces with air, "Treatise on Human Physiology," 1867, p. 615. For objections, the elaborate paper of Braxton Hicks, in the London "Obstet. Trans.," vol. xiv, deserves careful perusal.

† *Vide* experiments of Zweifel, "Die Respiration des Fœtus," "Arch. f. Gynaek.," Bd. ix, p. 292. See, also, Bérard, t. iii, p. 422, experiments of Legallois.

‡ Wurster, "Ueber die Eigenwärme der Neugebornen," "Berl. klin. Woch.," Nr. 87, 1869; Alexeef, "Ueber die Temperatur des Kindes im Uterus," "Arch. f. Gynaek," Bd. x, p. 141.

vesicle. The larger size of the latter directs the allantois over the posterior extremity of the fœtus. By its growth and extension, the allantois reaches the chorion, and forms a sort of pedicle, by means of which a vascular communication is established between the embryo and the periphery of the ovum. This pedicle is the first indication of the umbilical cord. Its vessels become reduced to two arteries, the umbilical arteries, and a single vein, the umbilical vein. Meantime, the umbilical vesicle diminishes in size, and finally shrinks to a mere thread. The amnion fills with fluid, exuded probably from the body of the fœtus, and continues to expand, so that often by the end of the second month it comes in contact with the chorion.* In this way, it forms a reflection over the pedicle of the allantois, which it invests like the finger of a glove. Finally, the structure of the cord is completed by the formation of an elastic substance, termed the *gelatine of*

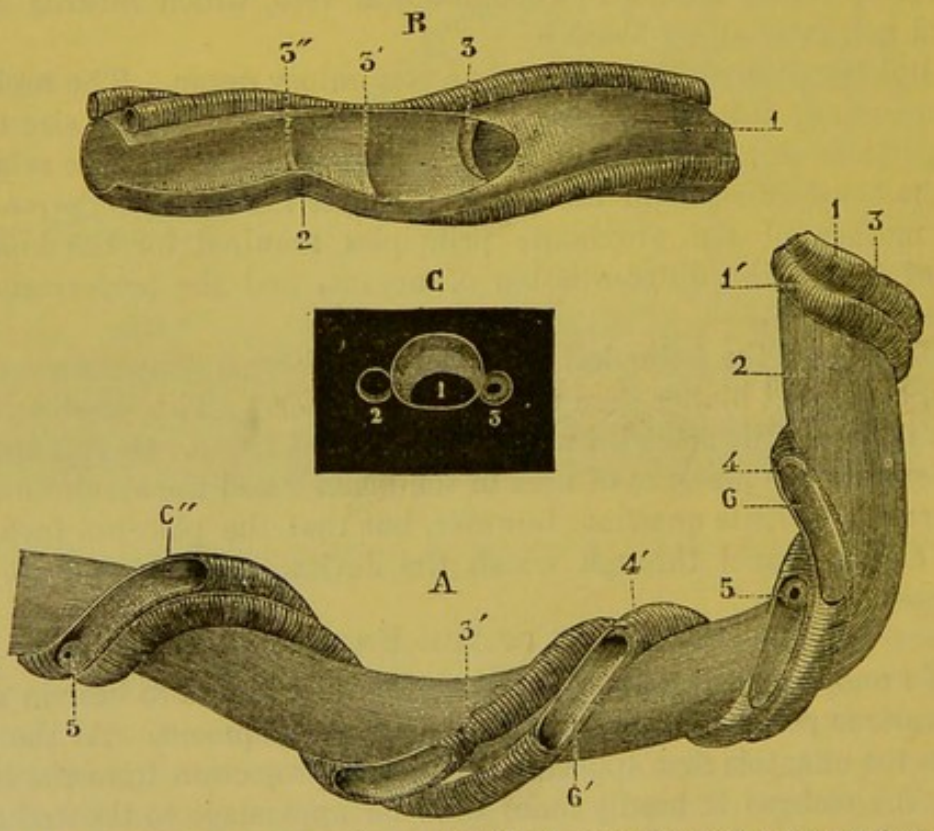


Fig. 53.—A, umbilical arteries forming spirals (1, 1′) around the vein; constrictions indicating the presence of folds (3, 3′); circular folds (5, 5′); lateral openings showing the arterial walls. B, vein opened upon the side, showing a constriction (2) corresponding to an interior valve (3″); semi-lunar valves (3, 3,′ 3″). C, section of vein and arteries showing valve of vein (1), a semi-lunar arterial valve (2), and a circular arterial valve (3). (Tarnier et Chantreuil.)

Wharton, which consists of connective-tissue elements inclosing large spaces containing amorphous matter. The gelatine of Wharton functionally serves to protect the vessels of the cord from compression.

* *Vide* Hunter's "Gravid Uterus," plate xxxiii, Fig. 2; Ecker, "Icon. Physiolog.," plate xxxiii, Fig. 7.

It is formed by hypergenesis from the outer layers of the amnion and the allantois, both of which are derived from the intermediate layer, described in the development of the fœtus (*vide* p. 50). The intermediate layer furnishes, likewise, the connective tissue of the body.

The fully-developed cord consists, therefore, of a sheath from the amnion, the gelatine of Wharton, the umbilical vein and arteries, and traces of the umbilical vesicle,* and the pedicle of the allantois.† It averages twenty inches in length, though it has been observed as long as seventy inches, and as short as two and a half inches.‡ A long cord predisposes to the formation of coils about the neck, body, and limbs of the fœtus. It is usually of about the size of the little finger, but is very variable, its circumference depending chiefly upon the quantity of the gelatine of Wharton. The arteries are so twisted as to form spiral turns around the vein, and, owing to the superior length of the right artery, in most cases in the direction from right to left. As an anatomical peculiarity, may be mentioned the fact that the walls of the arteries are only slightly thicker than those of the vein. The arteries as well as the vein contain semi-lunar valves.

The Amniotic Fluid.—The origin of the amniotic fluid in the earlier months of gestation is not known, the most probable suggestion being that it is simply exuded from the tissues of the fœtus. After the formation of the placenta, a capillary network, connected with the vessels of the umbilical cord, is developed just beneath the amnion in that portion of the chorion which covers the placenta. From these vessels a transudation of serum takes place into the cavity of the amnion.# After the first half of pregnancy has been reached, the capillary network disappears. The continued increase of fluid in the amnion in the later months of gestation is, probably, for the most part, due to the accumulation of urine, which the fœtus passes intermittently during intra-uterine existence.‖ The composition of the amniotic fluid corresponds to its double origin. In addition to water it contains albumen, urea, and the saline substances which are found in serum and urine. Its quantity varies usually between one and two pints, of which nearly one half is contributed during the last three lunar months.△

* Schultze, "Das Nabelbläschen, ein constantes Gebilde," etc., Leipsic, 1861.

† Ahlfeld, "Die Allantois des Menschen," "Arch. f. Gynaek.," vol. x, p. 81.

‡ Chantreuil, "Des Dispositiens du Corden," Paris, 1875.

Jungbluth, "Beitrag zur Lehre vom Fruchtwasser," Inaug. Dissert., Bonn, 1869.

‖ Gusserow, "Zur Lehre vom Stoffwechsel des Fœtus," "Arch. f. Gynaek.," vol. iii, p. 268, 269. Prochownick, "Beiträge zur Lehre vom Fruchtwasser und seiner Entstehung," "Arch. f. Gynaek.," vol. xi, p. 304. Krukenberg, "Kritische und experimentelle Untersuchungen ueber die Herkunft des Fruchtwassers," "Arch. f. Gynaek.," vol. xxii, p. 1.

△ Gusserow, *l. c.*, p. 269.

CHAPTER III.

DEVELOPMENT OF THE FŒTUS.

Area germinativa.—Primitive trace.—Dorsal plates.—Tuba medullaris.—Cerebral vesicles.—Chorda dorsalis.—Vertebral plates.—Abdominal plates.—Central plates.—Development of the bony skeleton.—Development of the intestine, face, lungs, liver, pancreas, bladder, heart.—Development of fœtus in successive months of pregnancy.—Fœtus at term.—Fetal cranium.—The attitude, position, and presentation of the fœtus.

The study of fetal development belongs properly to works on physiology, and to them the reader is referred for completeness of detail. The following enumeration of the principal facts in embryology has, however, been introduced by the writer, in the belief that it will be useful for reference to both the student and practitioner of obstetrics.

First in order will be remembered the segmentation of the ovum, the formation of the blastodermic membrane, and the development of the area germinativa by the accumulation of cells at a limited point upon the inner surface of the blastodermic membrane. An inner blastodermic layer is formed by the peripheral extension of the cells at the area germinativa. Between the outer and inner layers a third or intermediate layer makes its appearance. This third layer is confined to the area germinativa. Subsequently its peripheral portions further separate into two strata. In vertebrate animals a union of these separate layers exists at the point at which the spinal column is to be developed. At first the area germinativa is a round disk with a clear center, the *area pellucida*, and a dark border, the *area opaca*, but afterward becomes of an oval shape. In the middle of the *area pellucida* a dark oval spot, termed the *embryonic spot*, is formed by the rapid multiplication of cells, and is directly concerned in the formation of the embryo.

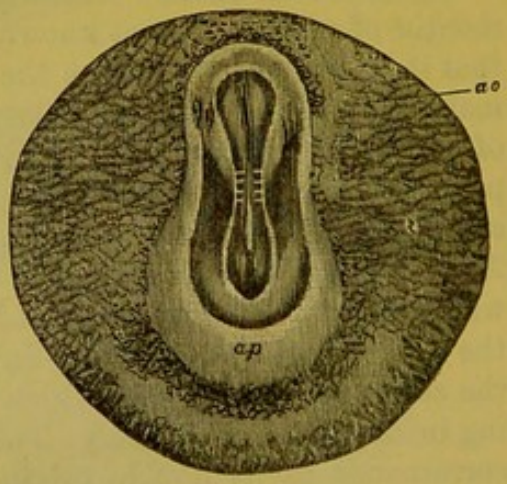


Fig. 54.—*a o*, area opaca; *a p*, area pellucida; with beginning formation of embryo from the embryonic spot. From the ovum of a rabbit on the ninth day. Owing to the advanced stage of development, the area pellucida has lost its primitive shape, and presents the appearance of a constricted ovoid. (Kölliker.)

In the middle of the embryonic spot there suddenly appears the primitive trace, a furrow bordered by two ridges, the dorsal plates,

which finally meet above so as to inclose a cylindrical space, viz., the tubus medullaris. From this closed tube is developed the nervous system, at first in the form of a cord, uniform in size. Soon, however, a dilatation takes place in the anterior extremity, at first single, but afterward by two annular constrictions, divided into three communicating compartments termed the cerebral vesicles. The first of these is

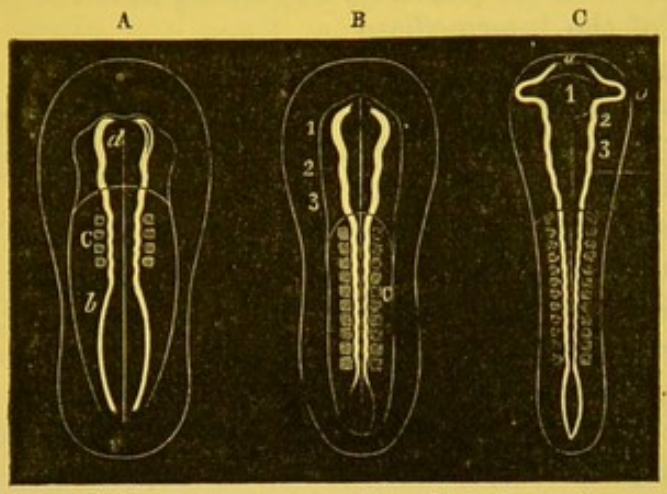


FIG. 55.—Development of the nervous system of the chick (Longet). A, the two primitive halves of the nervous system twenty-four hours after incubation; B, the same thirty-six hours after; C, the same at a more advanced stage. c, the two primitive halves of the vertebræ; *d*, anterior dilatation of the neural canal; *b*, lumbar enlargement; 1, 2, 3, anterior, middle, and inferior cerebral vesicles; *a*, slight flattening of the anterior vesicle; *o*, formation of the ocular vesicles.

further subdivided into two compartments to form respectively the cerebral hemispheres and the optic thalami; the second primitive vesicle is developed into the tubercula quadrigemina, or centers of vision. The third or posterior primitive vesicle is divided into two secondary vesicles, the anterior to form the cerebellum, the posterior to form the medulla oblongata, and the pons Varolii (Flint).

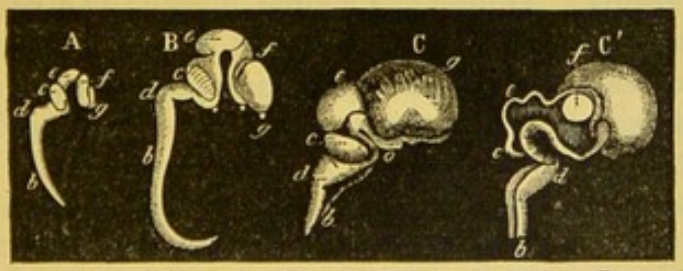


FIG. 56.—Development of spinal cord and brain of human subject (Longet). A, brain and spinal cord at seventh week. B, more advanced stage; *b*, spinal cord; *d*, enlargement of the spinal cord with its anterior curvature; *c*, cerebellum; *e*, tubercula quadrigemina; *f*, optic thalamus; *g*, cerebral hemispheres. C, brain and spinal cord at eleventh week, as in foregoing; *o*, optic nerve of the left side. C', vertical section of the preceding.

Lumbar and brachial enlargements likewise form at the points at which the nerves are given off to the upper and lower extremities.

In the very earliest stages of development, there appears, just beneath the primitive groove, a cylindrical body, tapering at both extrem-

ities, of a cartilage-like consistence, and extending the entire length of the embryo. This organ is termed the chorda dorsalis (*ch.*, Fig. 57). It is a temporary structure, but of great interest from its sustaining an intimate relation in the vertebrate classes to the production of the bony skeleton.

Upon either side of the chorda dorsalis, and running parallel to it, two longitudinal masses (*vide* Fig. 57) are separated off from the central portions of the intermediate layer. They are sometimes termed the primitive vertebral plates, though they are more properly columns. They are concerned in the formation of the vertebræ, the muscles of the back, and the origin of the spinal nerves. The two peripheral portions of the intermediate layer serve to close in the great cavities of the body, and hence are termed the abdominal plates (*a. p.*).

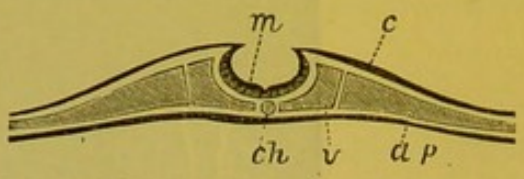


FIG. 57.—Diagram representing transverse section through the embryo of a chick at the end of the first day of incubation. *m*, dorsal plates; *ch*, chorda dorsalis; *v*, vertebral chords; *a p*, abdominal plates.

In its earlier stages the anterior half of the embryo is occupied by the cerebral vesicles. At this portion, the division into vertebral and abdominal plates does not take place. The intermediate layers, here termed the cerebral plates, fold together over the vesicles, and invest them with a simple membranous capsule, from which are derived the bones, the muscles, and the integuments of the head.

In the posterior half of the embryo, the vertebral plates, soon after their formation, separate into a number of cube-shaped segments (C, Fig. 55). These close together above and below around the cord, to form the *primitive vertebræ*. Those portions of the vertebral plates which unite beneath the spinal cord include between their borders the chorda dorsalis. Around the chorda dorsalis as a center is developed the cartilage from which are formed the bodies of the vertebræ. The chorda dorsalis for the most part disappears as the bony framework is developed, so that at birth only a trace of its earlier existence is to be recognized in the intervertebral cartilages.

The spinal column is formed from the inner portion only of the vertebral plates. The outer portions, we have seen, form the dorsal muscles and the roots of the spinal nerves. If the vertebral plates do not close over the dorsal aspect of the fœtus, the bony rings which include the spinal canal remain incomplete. When, as sometimes happens, from arrest of development, this condition exists at birth, a sac-like protrusion of the membranes and cord takes place, constituting the affection known as *spina bifida*.

While these changes are taking place upon the upper aspect of the embryo, a shallow groove appears just beneath, and parallel to, the

chorda dorsalis. At this point the two inner layers—inner blastodermic layer (entoderm) and inner stratum of the intermediate layer (mesoderm)—close laterally, and from front to rear, so as to form a cylindrical tube with blind extremities. This tube, the *tubus intestinalis*, still, however, possesses an open communication with the umbilical vesicle, which at this time is very large. But afterward, as the embryo increases in size, the canal becomes obliterated, and the umbilical vesicle, which has ceased to be of physiological importance, hangs from the embryo by an imperforate cord. From the tubus intestinalis are derived all the viscera of the pleuro-peritoneal cavity, with the exception of those connected with the genito-urinary system.

The openings at the mouth and anus into the intestine are the result of secondary processes. The *oral orifice* begins as a pit-like depression in the membranous envelope covering the head. The depression continuously deepens, until it finally comes in contact with the upper end of the intestine. Then absorption of the intervening tissues takes place. The intestine, lined by the internal blastodermic membrane, unites with the external layer. Even in adult life the sharp distinction between the epithelia of the buccal cavity and the œsophagus points to the difference in origin of their respective mucous membranes. By a similar process the *anus* is produced, and a communication formed with the lower extremity of the intestine. When from arrest of development the anal depression does not occur, or does not reach the intestine, the malformation known as *imperforate anus* is produced.

In the rear of the buccal cavity, and upon each side of the neck, four slit-like openings make their appearance, which possess an interest from the fact that, though temporary in the higher vertebrates, and devoid of physiological importance, they represent permanent structures in fishes, viz., the branchiæ, or organs of respiration. These openings are termed the *visceral clefts*. They include between them four sickle-shaped processes termed the *visceral arches*.

The buccal cavity is at first a large orifice, or cloaca, communicating with the anterior extremity of the intestine. But at a very early period there likewise appear, in the frontal region of the embryo, two funnel-shaped depressions termed the *nasal fossæ*, which constitute the first indications of the olfactory organs. The nasal fossæ are at first widely separated from one another, and do not communicate with the oral cavity. In the closure of the latter to form the mouth, a projection, termed the *frontal* or *intermaxillary process*, is pushed downward from the frontal wall. From the right and left lower borders of the intermaxillary process two secondary minor processes, termed the incisor processes, form, which bound the inner surface of the nasal fossæ. At the same time, two offshoots from the frontal wall

curl around the outer surface of the fossæ. In this way, in the place of the nasal fossæ, two grooved canals are produced, open below, which lead directly into the oral cavity. The growth of the nasal offshoots gives to the intermaxillary process a split or notched appearance.

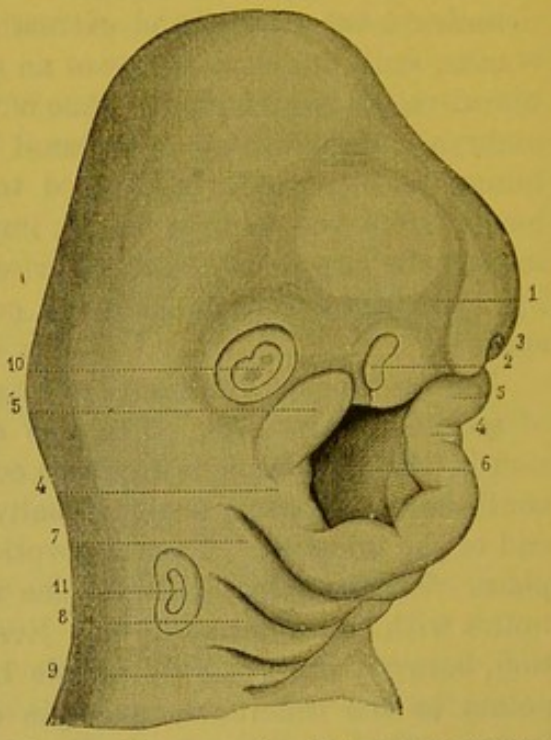


Fig. 58.—Human embryo between the twenty-fifth and twenty-eighth days, showing the visceral arches (7, 8, 9). (Coste.)

The upper jaw is completed by the pushing out from the central ends of the maxillary (upper visceral) arch of two conical growths (5, Fig. 58), which approach one another in the median line. As they do so they include between them the intermaxillary process, and furnish the floors of the olfactory canals. The lateral pressure brings into apposition the divergent halves of the notched surface of the intermaxillary process. The nasal passages, which at first were widely apart, come into close contact. The eyes, too, which were situated at the sides of the head, are moved to the front until their axes look directly forward, and parallel to one another.

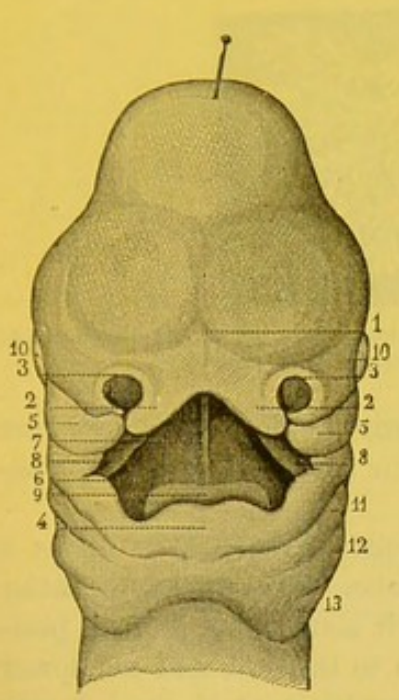
The intermaxillary bone, to which subsequent to dentition the upper central incisor teeth are attached, is derived from the intermaxillary process. The superior maxillary processes not only furnish the two superior maxillæ, but the material from which the sphenoid and palatine bones are derived.

Hare-lip results from an arrest in the development process just described. The lip, like the jaw, is formed by the union of the intermaxillary with the superior maxillary processes. In case of the failure of either superior maxillary process to unite with the intermaxillary process, a fissure is formed to the side of the median line. This is termed *single hare-lip*. An arrest of development upon both sides gives rise to *double hare-lip*. Sometimes the separation is not confined to the lip, but extends to the bony structures of the jaw. The case is then said to be one of *complicated hare-lip*.

The roof of the mouth, or *palatine arch*, which separates the mouth from the nasal passages, is derived from two horizontal plates, springing from the inner surfaces of the superior maxillary processes. These plates approach one another, and finally fuse together in the median line. An arrest of development upon one side gives rise to *cleft palate*.

The vomer, which forms the vertical partition of the nares, is derived from the intermaxillary process.

With the formation of the superior maxillary process, the residue



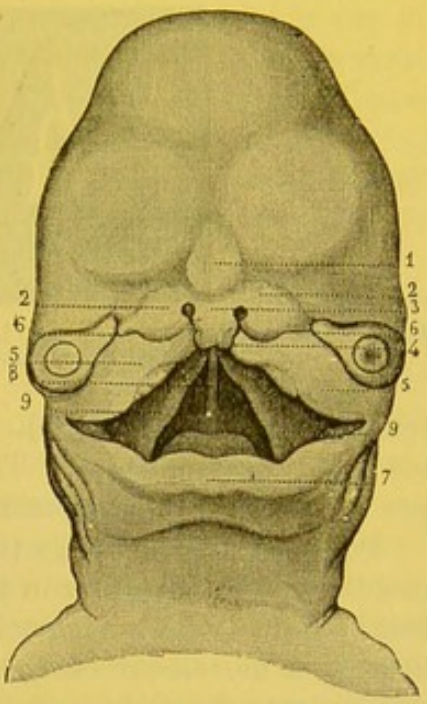


Fig. 59.—Mouth of embryo of thirty-five days (Coste). 1, frontal process widely sloped at its inferior portion; 2, 2, incisor processes produced by this sloping; 3, 3, nostrils; 4, lower lip and maxilla, formed by the union of the inferior maxillary process; 5, 5, superior maxillary processes; 6, mouth; 7, first appearance of closure of nasal fossæ; 8, 8, first appearance of the two halves of the palatine arch; 9, tongue; 10, 10, eyes; 11, 12, 13, visceral arches.

Fig. 60.—Mouth of embryo of forty days (Coste). 1, first appearance of the nose; 2, 2, first appearance of alæ of nose; 3, closure beneath the nose; median portion of upper lip formed by the union of the incisor processes, a little notch in the median line indicating the primitive separation of the two processes; 5, 5, superior maxillary processes; 6, 6, groove for the development of the lachrymal sac and the nasal canal; 7, lower lip; 8, mouth; 9, 9, the two lateral halves of the palatine arch.

of the upper visceral arch (*vide* 4, Fig. 58) becomes known as the inferior maxillary process. From its base are derived two little bones of the ear, viz., the malleus and incus. The outer portion is converted into a cartilaginous band, termed the cartilage of Meckel, which unites with its neighbor of the opposite side. Upon the outer surface of the cartilage of Meckel is formed the permanent structure of the lower jaw.

From the second visceral arch are produced the stapes, the styloid process and ligament, and the lesser cornua of the hyoid bone. The third arch forms the body and greater cornua of the hyoid. The fourth arch in the embryo appears to be a purely rudimentary organ, which does not develop into permanent structures.

The lungs are derived from the anterior portion of the intestinal tube. At first they consist of a single small sac which grows from the tube just posterior to the visceral arches. Afterward the sac be-

comes bifurcated below and forms two lateral halves (A). Each half divides and subdivides after the manner of a racemose gland to form the lung (C and D). The upper portion of the sac elongates and is de-

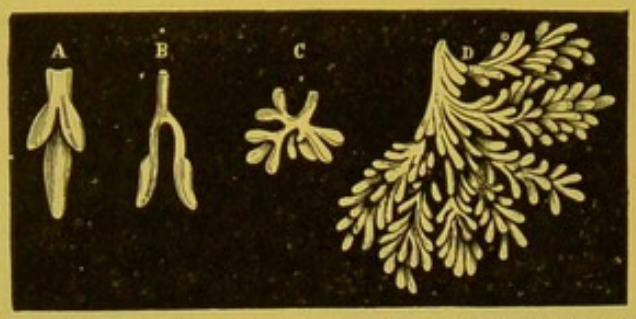


Fig. 61.—Development of the lungs (Longet). A, B, development of the lungs, after Rathke; C, D, histological development of the lungs, after J. Müller.

veloped into the trachea (B). From the anterior portion of the intestine is formed the œsophagus. The opening of the trachea into the œsophagus becomes the rima glottidis.

Posterior to the lungs (passing from front to rear) there forms a spindle-shaped dilatation in the intestinal tube. This dilatation is the first rudiment of the stomach. Afterward it assumes an oblique position by a movement of the upper portion to the left, and the lower extremity to the right. By the unequal development of the left side of the spindle-shaped dilatation the fundus and greater curvature of the stomach are formed.

Below the stomach the intestinal tube increases rapidly in length. At first it forms a loop, attached by the mesentery to the spinal column, and projecting by its convex surface into the umbilical vesicle. Afterward it is thrown by its rapid growth into numerous folds and convolutions. Finally, the distinctions between duodenum, ilium, and jejunum become apparent. Previous to the closure of the abdominal walls a portion of the intestine protrudes at the umbilicus. A persistence of this condition up to the time of birth produces congenital hernia.

The liver begins as two saccular projections from the duodenum. These afterward fuse together to form a single organ. The openings of the sacs into the duodenum constitute the bile-ducts, which are at first double, but subsequently unite to form a single canal. The fibrous coat of the liver and the vessels are derived from the inner layer of the mesoderm. The lobules are produced from branching processes of the internal or glandular layer (entoderm). The growth of the liver is at first rapid. By the third month it fills nearly the entire abdomen. Afterward, by the growth of the stomach and other abdominal viscera, the liver is pushed over to the right side. Although its subsequent growth is less out of proportion to the entire body, it is even at the end of pregnancy relatively much larger than in the adult.

In like manner the pancreas is developed from a blind process springing from the left side of the duodenum. The pancreatic duct is at first single, though afterward it often becomes double.

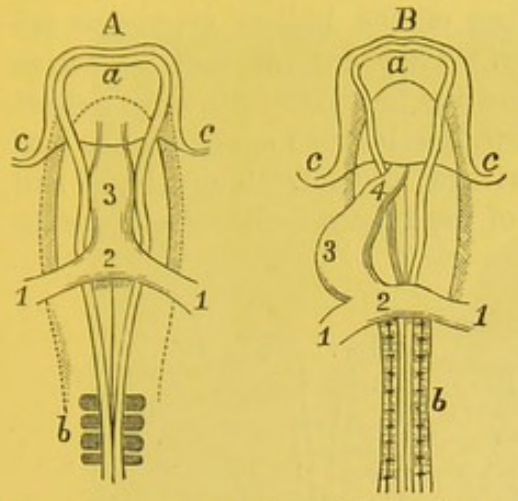


Fig. 62.—Heart of embryo chick in the earliest stages of formation (Remak). *A*, anterior half of embryo after twenty-eight to thirty hours of incubation; *B*, after about thirty-six hours of incubation. 1, 1, veins; 2, auricle; 3, ventricle; 4, aortic bulb.

The terminal portion of the intestine is at the outset straight. With its subsequent growth, however, it is thrown into folds and separates into a longer portion, *the colon;* and a shorter portion, the *rectum.*

The *bladder* is formed from the portion of the allantois which is closed in by the abdominal plates. The allantois, it will be remembered, begins, like the lungs and the liver, as a blind process springing from the intestinal wall, but is situated at the posterior extremity of the tube. At the outset, therefore, both intestine and bladder open into a common cloaca. Afterward, however, a transverse septum forms between the genito-urinary and anal openings.

In the beginning of life the vascular system is extremely simple. The *heart* is at first spindle-shaped, and composed entirely of cells. It then assumes an S-shape, and becomes hollow. Fluid accumulates in the cavity. Single cells detach themselves from the walls and float in the fluid. These are the earliest blood-cells, and contain nuclei. In like manner the vessels are at first solid round cell-cords, which become hollow, fill with fluid, and furnish nucleated cells. It is interesting, physiologically, to note that the heart pulsates long before the muscular fibers appear, and when it is composed entirely of simple cells.*

The anterior extremity of the heart is connected with the arterial system. The posterior or caudal extremity receives the venous blood. The heart soon becomes bent upon itself, and projects forward on the ventral aspect of the embryo, and to the right side. As the bending increases the arterial and venous ends approach one another. Two slight constrictions divide the heart into three compartments, which open into one another. "The first, next to the veins, is termed the *auricular* portion, the middle one is the *ventricular*, and the last, which is the primitive arterial trunk, is named the *bulbus arteriosus*" (Quain). Fig. 63.

The bulbus arteriosus divides into two branches, which convey the

* A. Kölliker, "Entwickelungs-Geschichte," 2te Auflage, p. 159.

blood from the heart upward to the first (upper) visceral arch. At this point, which corresponds to the future base of the brain, they curve backward and then take a downward course in front of the chorda dorsalis. These two branches of the bulbus arteriosus are termed the *superior vertebral arteries.* They are likewise known as the *aortic arches.* Beneath the level of the heart they unite for a short distance to form a common trunk, which in turn again divides into two branches, termed the inferior vertebral arteries. These latter run parallel to one another, on each side of the future vertebral column, to the caudal extremity of the embryo.

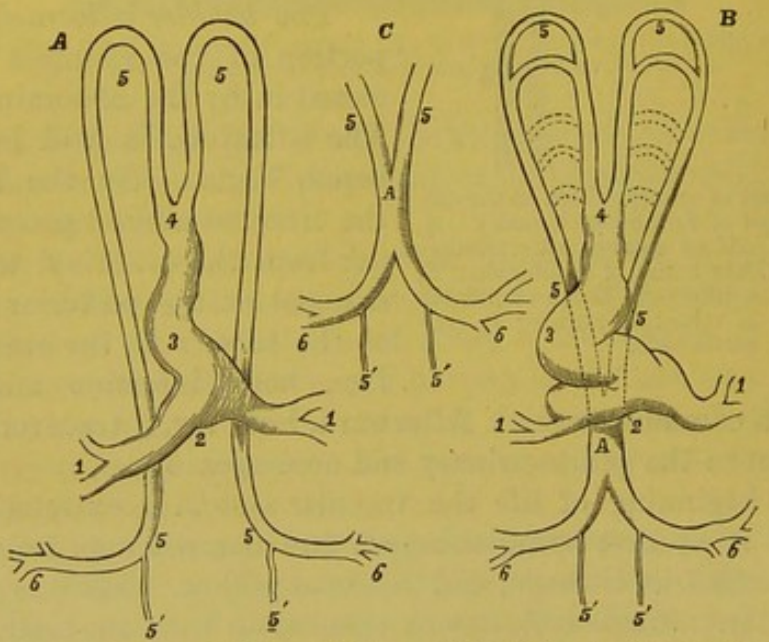


FIG. 63.—Diagram of heart and first arterial vessels (Quain). *A*, at a period corresponding to the thirty-sixth or thirty-eighth hour of incubation; *B* and *C*, at the forty-eighth hour of incubation. 1, 1, primitive veins; 2, auricular part of heart; 3, ventricular part; 4, aortic bulb; 5, 5, aortic arches—in *C*, their coalescence is shown at *a*; in *B*, below the upper 5, the second aortic arch is formed, and farther down the dotted lines indicate the position of the succeeding arches; 5′, 5′, continuation of main vessels (inferior vertebral); 6, 6, omphalo-mesenteric arteries.

In their course the inferior vertebral arteries give off branches which are at first limited to the *area germinativa* by a circular vein, termed the *sinus terminalis.* The veins, which return the blood to the embryo, occupy a lower stratum than the arteries, and empty into two short trunks, communicating with the auricular extremity of the heart. Subsequently the sinus terminalis disappears, and two arteries, distinguished by their superior size, pass beyond the limit of the *area germinativa,* now termed the *area vasculosa,* to extend over the surface of the umbilical vesicle. These vessels are known as the "*omphalo-mesenteric*" or "*vitelline*" arteries. At first four, but afterward two veins, bearing the same name as the corresponding arteries, return the blood to the embryo. Finally, the two omphalo-mesenteric arteries and veins are replaced each by a single trunk, so that the en-

tire vitelline circulation is maintained by a single artery and a single vein.

According to this arrangement, the simple cylindrical heart, during

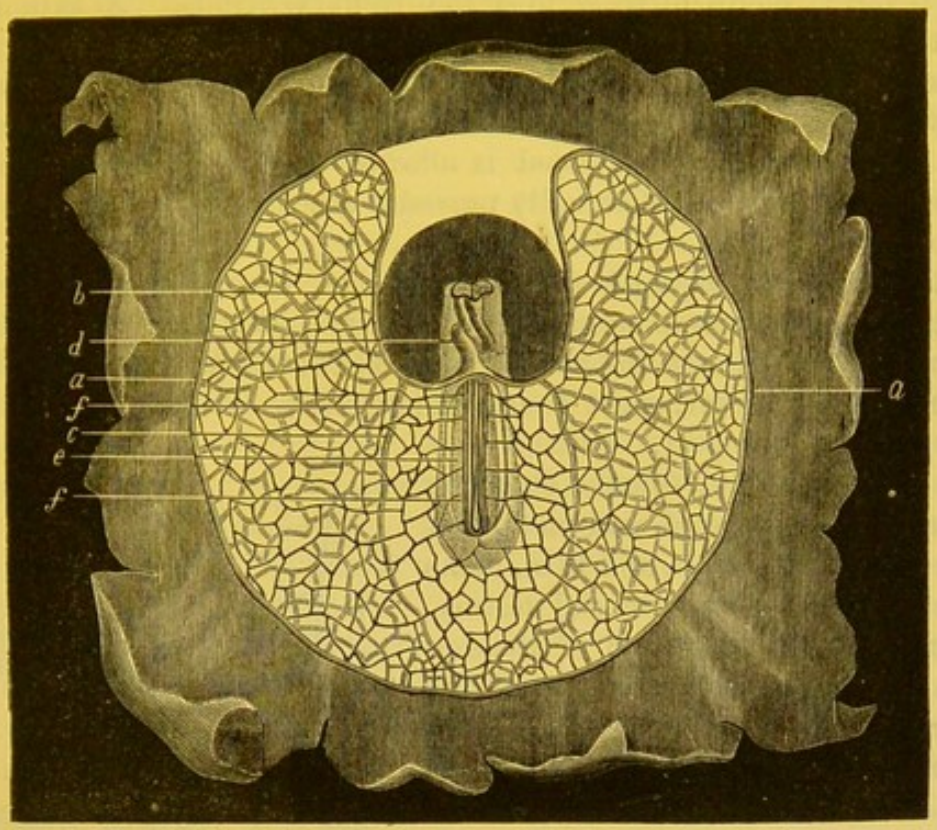


FIG. 64.—Area vasculosa (Bischoff). *a*, *a*, *b*, sinus terminalis; *c*, omphalo-mesenteric vein *d*, heart; *e*, *f*, *f*, posterior vertebral arteries.

its systole, drives the blood into the vertebral arteries, by which it is distributed to the different regions of the embryo, and especially to the walls of the umbilical vesicle. There it becomes charged with nutritive materials, and is conveyed back to the heart during the diastole by the omphalo-mesenteric veins. In the transition from the vitelline to the allantoic or placental circulation, corresponding anatomical changes take place in the entire vascular system. Of these the more noteworthy are as follows: 1. The single ventricle of the heart becomes separated into two compartments by the gradual growth of a partition from the apex to the auricular portion. At the end of the second month the partition is complete, and the heart consists of two ventricles and a single auricle. Next a partition extending from the base toward the ventricles divides the single auricle into a right and left compartment. This partition, unlike the ventricular one, is incomplete posteriorly, leaving an opening, the *foramen ovale*, which persists throughout the entire period of fetal existence. A thin crescentic fold, termed the Eustachian valve, is attached to the anterior border of the orifice of the inferior vena cava. The Eustachian valve divides the right auricle into two unequal portions, and directs the

blood from the inferior cava, which lies behind it, through the foramen ovale into the left auricle. At the same time the blood from the superior cava, passing in front of the foramen ovale and the Eustachian valve, pours directly into the right ventricle. A thin crescentic valvular fold, termed the *valve of the foramen ovale*, grows from the posterior surface of the auricles to the front. It is situated a little to the left of the foramen ovale and projects into the left auricle. By its action the blood is allowed to pass undisturbed from right to left, while it effectually prevents any regurgitation from left to right.

2. Meantime, beneath the aortic arches, there forms a series of vascular loops, corresponding in number and situation to the visceral arches in the sides of the neck of the fœtus (*vide* B, Fig. 63). They do not all, however, exist contemporaneously. A number of them atrophy and disappear. On the right side the third and fourth, counting from above downward, and on the left side the third, fourth, and fifth, alone persist, reserved for a special destiny. Soon after the formation of the septum in the ventricular portion of the heart, the bulbus arteriosus divides into two distinct vessels, of which one (B) communicates with the right, and the other (A) with the left ventricle. The left division (A) communicates with the second of the series of loops (counting from below) formed between the ascending and descending portions of the aortic arches. The loop on the right side (4) becomes the subclavian artery; that on the left enlarges and forms the arch of the aorta. The right division of the bulbus arteriosus (B) opens into the first vascular loop on the left side. This loop gives off branches (*p*) to the lungs and becomes the pulmonary artery. That portion of the loop situated beyond the pulmonary branches continues during fetal life in open communication with the aorta, and is termed the *ductus arteriosus* (*d*). The lower portion of the vertebral artery on the left side becomes the permanent aorta, while that upon the right side atrophies and disappears. The ascending branches of the primitive aortic arches furnish the common and external carotids (*c e*). The in-

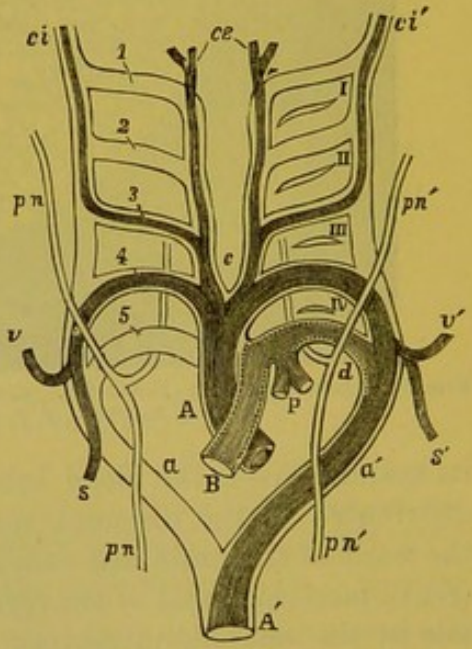


Fig. 65.—Diagram of the vascular arches, with transformations giving rise to the permanent arterial vessels (Rathke). The aortic bulb is divided into *A*, the ascending part of the aortic arch; and *P*, the pulmonary part. The vascular arches are numbered 1, 2, 3, 4, 5, from below upward. *p*, pulmonary branches; *d*, ductus arteriosus; *c e*, external carotids; *c i*, and *c i'*, internal carotids.

ternal carotids (*c i*) are formed from the third vascular loops and a portion of the vertebral arteries.

The umbilical arteries at first take their origin from the inferior vertebral arteries, and afterward from the hypogastric or internal iliac arteries.

The umbilical vein enters the abdomen at the navel, and thence passes to the lower surface of the liver; it gives off a number of branches to the left lobe, the lobus quadratus, and the lobus Spigelii. At the transverse fissure it divides into two branches, the larger of which empties directly into the portal vein, and supplies the right lobe with umbilical blood; the other passes to the inferior vena cava, and is termed the *ductus venosus*. Thus the greater portion of the regenerated blood, brought by the umbilical vein from the placenta, first passes through the liver before entering the general circulation of the fœtus, while the lesser amount empties at once into the inferior vena cava. As, however, with the advance of gestation, the relative disproportion between the hepatic trunks and the ductus venosus is increased, toward the end nearly all the blood from the placenta has to make the circuit of the liver.

Thus the inferior vena cava carries to the right auricle, in part, blood from the lower extremities charged with effete matters, and, in part, placental blood, either received direct from the umbilical vein through the ductus venosus, or after having previously traversed the liver.

In the fœtus the currents of blood through the heart are especially adapted to the unexpanded condition of the pulmonary organs. Previous to the first respiratory act at birth, the lung is small, and, were the entire contents of the right side of the heart, as in the adult, at once discharged into the pulmonary vessels, intense engorgement with rupture of the capillaries would ensue. This danger is, however, averted by the anatomical peculiarities already stated. Thus, in the early months the blood from the inferior cava, in place of emptying from the right auricle into the right ventricle, passes directly across the right auricle, guided by the Eustachian valve, through the foramen ovale to the left auricle, and thence to the left ventricle. As the heart contracts it enters the aorta, and is distributed by the large vessels which spring from the latter to the head and upper extremities. The blood returned from the upper portion of the body by the superior vena cava enters the right auricle, where it passes in front of the Eustachian valve into the right ventricle. A commingling of the currents from the superior and inferior venæ cavæ in the right auricle is almost completely prevented in the earlier months by the Eustachian valve. With the advance of gestation, however, a gradual disappearance of the Eustachian valve takes place, so that a part of the blood from the inferior cava enters with that of the superior cava into the

right ventricle. The contraction of the right ventricle forces the blood into the pulmonary artery, which distributes an insignificant quantity to the lungs, while the main current passes through the ductus arteri-

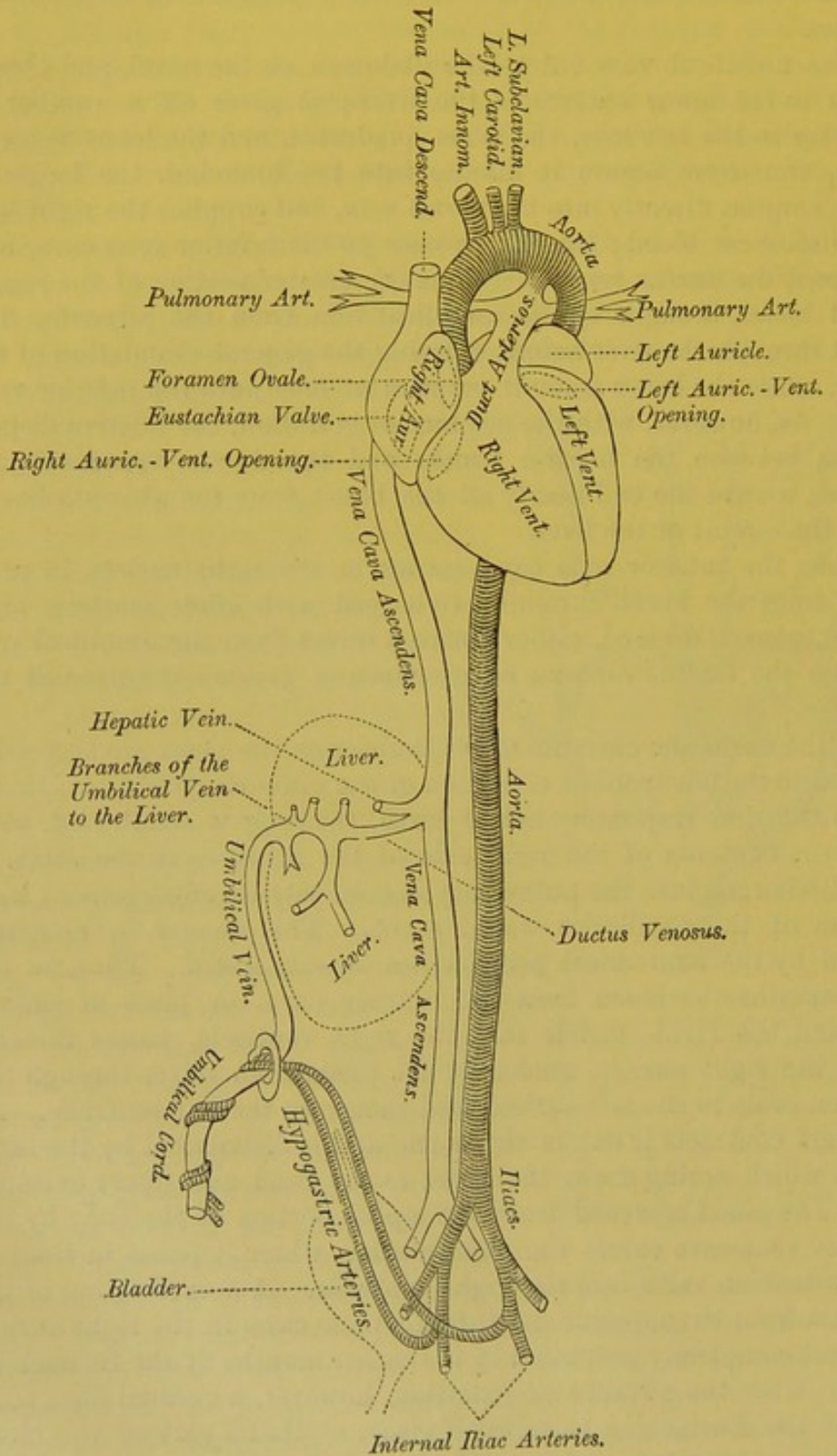


Fig. 66.—Diagram of the fetal circulation. (Flint.)

osus into the aorta, by which it is distributed to the lower portion of the body.

Thus it will be noted that at all times provision is made for supplying the head and upper parts of the body with regenerated placental blood. On the other hand, the lower extremities are for a time almost entirely supplied with blood which has already fed the tissues and received the waste of the upper portion of the body. As pregnancy, however, advances, with the disappearance of the Eustachian valve, a small measure of placental blood is likewise distributed to the lower portion of the body. This is in unison with the well-known fact that the relative development of the lower extremities increases as the end of gestation is approached.

With the cessation of the placental circulation at birth, the umbilical vessels close, with the exception of the umbilical arteries, which remain pervious at their lower portion and constitute the vesical arteries. After the establishment of respiration, the blood from the right side of the heart makes the circuit of the lungs and returns to the left side by the pulmonary veins. The ductus arteriosus then contracts and disappears. As the left auricle fills with blood, the pressure closes the valve of the foramen ovale. Occasionally, however, the foramen ovale remains open after birth, and allows a portion of the venous blood to pass from the right to the left auricle. We have then one form of the condition known as *cyanosis neonatorum*, an affection characterized by intermittent attacks of dyspnœa, blueness of the surface of the body, and depression of the temperature.

Development of the Fœtus in the Successive Months of Pregnancy.

It is customary to reckon the duration of pregnancy at two hundred and eighty days, and to divide that space into ten months of twenty-eight days each. As it is often a matter of importance that an accoucheur should be able to judge the age of a prematurely expelled embryo or fœtus, the following particulars concerning the changes in each month are furnished as a guide to the formation of an opinion. In the writer's experience all rules regarding the age of the ovum possess, however, nothing more than an approximative value, owing to the very great normal variations in the rapidity of development in different individual cases.

First Month.—At the end of the second week, the embryo is represented by the embryonic spot, which has assumed a biscuit-shape. The dorsal plates are developed. The entire ovum measures one fourth of an inch, and the embryo one twelfth of an inch. A week later the embryo has doubled in length, and presents as special features a curving of the back, an enlargement of the cephalic extremity, with rudiments of the three higher organs of special sense, and the appearance

of the visceral arches. The amnion is fully developed. The embryo is nourished by the umbilical vesicle. The allantois carries the vessels from the embryo to the periphery of the ovum, but the vessels do not penetrate the villi. An ovum described by Waldeyer, exactly four weeks old, was of about the size of a pigeon-egg, and three fourths of an inch long by two thirds of an inch broad. It weighed upward of two scruples. The embryo measured nearly one third of an inch in length, or four fifths of an inch in length following the dorsal curvature from the top of the cephalic extremity to the end of the coccyx. The head of the embryo presented the primitive cerebral vesicles. The eyes were in the sides of the head, and the ears posterior to the eyes. Beneath, the visceral arches were well marked. Four bud-like processes indicated the beginnings of the anterior and posterior extremities. The intestine, with anal and oral openings, was formed. The cord was short and thick, with a single vein and two arteries. The amnion was only moderately distended, and space still existed between the amnion and chorion. The umbilical vesicle was tolerably large.

Second Month.—An embryo described by Waldeyer from the sixth to the seventh week measured about one inch in length, following the dorsal curve. Another in the eighth week described by Ecker measured two thirds of an inch in a direct line from the head to the caudal curve.* The ovum itself was of about the size of a hen's-egg. The amnion at the end of the second month is distended with fluid and in contact with the chorion.† The villi become abundant near the implantation of the umbilical cord. The umbilical vesicle is greatly reduced in size, and hangs from the embryo by a slender pedicle. The umbilical cord is increased in length, but its vessels do not yet assume a spiral direction. The umbilical ring is small, though still containing loops of intestine. Ossification begins in the lower jaw and clavicle. The three divisions of the extremities are clearly indicated.

Third Month.—Toward the end of the third month the ovum measures nearly four inches in length. The embryo is between three and three and a half inches long, and weighs about an ounce. The chorion has lost in great measure its villosities. The placenta is formed, though of small size. The cord lengthens, and forms spiral turns. The neck now separates the head from the trunk. The development of the ribs distinguishes the thorax from the abdomen. The mouth is closed by the lips, and the nasal separated from the oral cavity by the palate. Points of ossification appear in most of the bones. Thin, membrane-like nails appear upon the fingers and toes. The scrotum and labia majora begin to form from cutaneous folds. The penis and clitoris do not differ from one another in length.

* Spiegelberg, "Lehrbuch der Geburtshülfe," p. 84.

† *Loc. cit.*, p. 84.

Fourth Month.—Toward the end of the fourth month there is an increase of size and thickness in the placenta. The cord is increased to two or three times the length of the fœtus, and has become thicker from the formation of the gelatine of Wharton. The fœtus measures four to six inches in length. The weight is estimated all the way between two and four ounces. The head of the fœtus is one fourth the length of the entire body. The bones of the skull are partly ossified. The sutures and fontanelles are widely separated. The mouth, eyes, ears, and nose assume their proper shape. The sex is distinguishable, the skin firmer, and hair begins to form upon the scalp. The fœtus makes slight movements with its limbs.

Fifth Month.—The fœtus measures from seven to ten inches in length, and weighs nearly ten ounces. The head is still relatively large. The face, however, is wrinkled, and wears a senile aspect. Fine hair (lanugo) appears over the whole surface of the body. The fetal movements are now distinctly felt by the mother.

Sixth Month.—Near the end of the sixth month the fœtus is eleven to thirteen inches long and weighs about twenty-three ounces. The deposition of fat in the subcutaneous cellular tissue begins. The eyelids separate. A fœtus born at this time breathes feebly, but in the course of a few hours dies.

Seventh Month.—The fœtus measures fourteen to fifteen inches, and weighs in the neighborhood of thirty-nine ounces. The skin is still wrinkled, of a red color, and covered with vernix caseosa. Children born between the twenty-fourth and the twenty-eighth week move their limbs and cry feebly at birth, but in spite of every care they die in the course of a few hours or days.

Note.—Ahlfeld has recently suggested the inquiry as to whether the assumption, that children born before the completion of the twenty-eighth week necessarily perish, is not too arbitrary. Many practitioners have observed instances of the survival of a premature child which, both from the data obtained from the parents and from all the indications presented by the child, they, at the time of birth, had placed within the limit regarded as hopeless. Ahlfeld has culled a number of such cases from the published literature of the subject. Granting the many sources of error which would lead us to accept such cases with caution, it none the less seems incumbent upon us to regard Ahlfeld's advice, and look upon every child which respires at birth as one whose life may possibly be preserved by suitable care. It may be that the skepticism of medical men may be in part the cause of the unfavorable results.*

Eighth Month.—The fœtus measures sixteen to seventeen inches, and weighs upon the average about fifty-two ounces. The papillary membrane disappears; the hair of the head increases in thickness; the lanugo begins to disappear from the face; the nails are harder, but do not yet reach the tips of the fingers. Usually, in boys, a testicle may be felt in the scrotum; the navel is situated nearly in the center

* Ahlfeld, "Ueber unzeitig und sehr frühzeitig geborene Früchte die am Leben blieben," "Arch. f. Gynaek.," Bd. viii, p. 194.

of the child's body. With care, the life of a child born within this period may be preserved.

Ninth Month.—The length is between sixteen and a half and seventeen and a half inches; the weight is about sixty-four ounces; the body becomes rounded and the face more comely, losing its wrinkled, antiquated aspect; the bones of the head bend easily, and the lanugo begins to disappear from the body. Children at this period are less energetic than at full term, sleep a great part of the time, and are prone to die with lack of careful attention.

Tenth Month.—In the first two weeks the fœtus measures eighteen to nineteen inches, and weighs about seventy-seven ounces.*

For convenience of reckoning from memory it is sufficiently accurate to assume the length of the child in the third and fourth month at respectively three and four inches. In the fifth, sixth, seventh, and eighth months close approximations to the average length may be obtained by doubling the number of months. In the ninth and tenth months the length may be placed respectively at seventeen and eighteen inches.

The Fœtus at Term.—In the child at birth the body is well rounded, and the skin has lost its deep-red coloring; the fine down (lanugo) has, for the most part, disappeared; the nails project beyond the finger-tips; in the male the scrotum contains both testicles, and in the female the labia majora are in contact. In the fifth month the surface of the fetal body is covered by the *vernix caseosa*, a whitish substance composed of a commingling of surface epithelium, down, and the products of the sebaceous glands. This coating probably protects the skin during intra-uterine life from the penetration of the amniotic fluid. The amount of this substance upon the body is very variable at birth, when it is chiefly found upon the back and flexor surfaces of the extremities.

Children at term cry lustily soon after birth, move their limbs freely, and nurse when put to the breast. In the first few hours they pass urine and the so-called *meconium*, a mixture of intestinal mucus with epithelium, epidermis cells, lanugo, and bile, which gives to it a black or brownish-green color.†

The average length at birth is from twenty to twenty-one inches. The average weight seems to be, in some degree, dependent upon race

* The weights and measures are taken from Hecker's averages, based on 486 observations. (*Vide* "Monatsschr. f. Geburtsk.," Bd. xxvii, 1866.)

Observations of Fesser showed similar results. ("Lehrbuch der Geburtshülfe," von Otto Spiegelberg, 1877, p. 86.)

Ahlfeld obtained considerably larger averages from 250 observations in which the date of conception could be determined. ("Bestimmungen der Grosse und des Alters der Frucht vor der Geburt," "Arch. f. Gynaek.," ii, 1871, p. 361.)

† Zweifel, "Untersuchungen über das Meconium," "Arch. f. Gynaek," Bd. vii, 1875, p. 474.

peculiarities. Scanzoni* found, in nearly 9,000 births, an average for both sexes of nearly seven pounds. Ingerslev,† in Copenhagen, from statistics based upon 3,450 births, arrived at nearly the same results. Hecker,‡ in Munich, out of something over 1,000 births, obtained six and four-fifths pounds as the average; while Fesser,# in Breslau, found it only six and a half pounds. Bailly‖ likewise reports the average weight as something less than seven pounds. The weights of 200 infants born in the Bellevue Hospital gave to the writer an average of seven and two thirds pounds for the two sexes. The boys averaged seven and nine tenths pounds, and the girls seven and one third pounds. Three fourths of the mothers were of Irish birth, one fifth were born in America, while the remaining fraction was divided between English, Scotch, and Germans. The largest child weighed eleven pounds. Ingerslev's largest child weighed ten and three eighths pounds; Hecker found two weighing between ten and eleven pounds; La Chapelle, out of 7,000 cases, found thirteen infants weighing ten pounds, but none exceeded that limit. Credible histories^ of children weighing from twelve to sixteen pounds are extant; such children have generally been still-born. Waller, however, reports a case of a living infant delivered by him with forceps, which weighed fifteen pounds fifteen ounces.◊ The size of the child is influenced in especial by—1. The sex. Boys average a greater weight than girls. 2. The number of pregnancies. The children of primiparæ average less than those of multiparæ. The increase in weight of children in each successive pregnancy is progressive, though this law is liable to interruption where pregnancies follow one another too rapidly, or in cases in which there is a change of sex. In the latter instance the variation is to the disadvantage of the female born in succession to a male.‡ 3. The age of the mother. Duncan found the greatest weight in children born of mothers between the twenty-fifth and twenty-ninth years;‡ Wernich, between the thirtieth and thirty-fourth years.‡ 4. The constitution and health of the parents. By some, too, the size of the father is supposed to exercise an influence upon that of the child.

The Fetal Cranium.—Except in children of exaggerated size, the

* Scanzoni, "Lehrbuch der Geburtshülfe," p. 96.

† Ingerslev's "On the Weight of New-born Children," "Obstet. Jour.," iii, 1876, p. 705.

‡ "Klinik der Geburtskunde," ii, 1864.

Spiegelberg, "Lehrbüch der Geburtshülfe," p. 86.

‖ Bailly, "Nouveau Dictionnaire," t. xv, art. "Fœtus," p. 5.

^ Nægele's "Lehrbuch der Geburtshülfe," bearbeitet von Grenser, 8te Auflage, p. 624.

◊ Waller, London "Obstet. Trans.," vol. i, p. 309.

‡ Wernich, "Ueber die Zunähme der weiblichen Zeugungsfähigkeit," "Beitr. zur Geburtsh.," Bd. 1, p. 3.

‡ Duncan, "Fecundity, Fertility, and Sterility," p. 53.

‡ *Loc. cit.*, p. 10.

head is the most voluminous and unyielding part which has to traverse the parturient canal.* The diameters of the head and the physical characters of its bones are chiefly of importance in connection with the mechanism of labor. Their consideration may, therefore, be conveniently postponed to the study of that subject. A knowledge, however, of the general structure of the skull is essential to the diagnosis of pregnancy.

The face is very small in proportion to the cranium. The latter consists of the two frontal bones, the two parietal bones, the occipital bone, the temporal bones, and the alæ of the sphenoid bone. At birth these various bones are not, as in the adult, directly articulated together, but are united by means of fibrous bands, termed *sutures*,



Fig. 67.—Fetal head, side-view. (Hodge.)

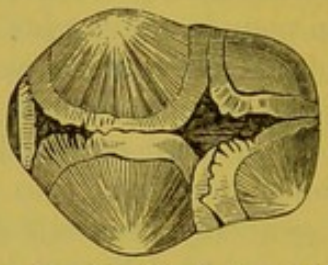


Fig. 68.—Fetal head, viewed from above. (Hodge.)

in which ossification subsequently takes place. It is important to become familiar with the following sutures: 1. *The frontal suture*, between the frontal bones. 2. *The sagittal suture*, between the two parietal bones. 3. *The coronal suture*, between the frontal and parietal bones. 4. *The lambda suture*, between the occipital and two parietal bones.

When three or more bones meet together, the rounded angles of the bones offer at the point of concurrence a deficiency of osseous substance, which is closed by fibrous membrane similar to that which forms the sutures. These membranous interspaces are termed *fontanelles*. Two of these, the large anterior and the small posterior fontanelle, are of immediate obstetrical interest, as they, with the sutures, furnish the guiding points which enable the examining finger to determine, in advanced pregnancy, the position of the child's head.

The *large fontanelle*, or bregmatic space (bregma, the sinciput), occupies the gap between the parietal and frontal bones. It possesses a lozenge-shape. Its anterior angle is continuous with the frontal suture; its posterior angle with the sagittal suture; and its lateral angles with the two halves which compose the coronal suture. Its anterior angle is much longer than the posterior angle.

The *small fontanelle* is situated at the junction of the occipital with the parietal bones. It is of a triangular shape, and, as its name

* In bulky children, the shoulders sometimes offer the greatest difficulties in delivery.

indicates, of small size. As a rule, it no longer exists at birth, owing to the complete ossification of the angles which form it.

The anterior fontanelle may be recognized by the finger, during labor, by its large size, its lozenge shape, and by its four converging sutures which cross one another at right angles. The posterior fontanelle, on the contrary, is small and triangular; the sagittal suture forms, with the lambda suture, an obtuse angle on either side, and terminates at the occipital bone. During the descent of the child's head into the pelvis, the occipital bone is frequently depressed beneath the parietal bones, which thus form a relief, along which the finger readily passes to the site of the small fontanelle, even when the latter no longer exists as an open gap or space.

The Attitude, Presentation, and Position of the Fœtus.

The attitude of the fœtus *in utero* is as follows: The spinal column is bent forward, the chin is inclined toward the chest, the arms are bent at the elbow, and the forearms are crossed upon the breast, the thighs are flexed upon the abdomen, and the feet extended so as to come in contact with the legs, which, like the forearms, are often crossed. By this arrangement the fœtus assumes the smallest bulk, and presents an ovoid form, of which the head furnishes the smaller end.

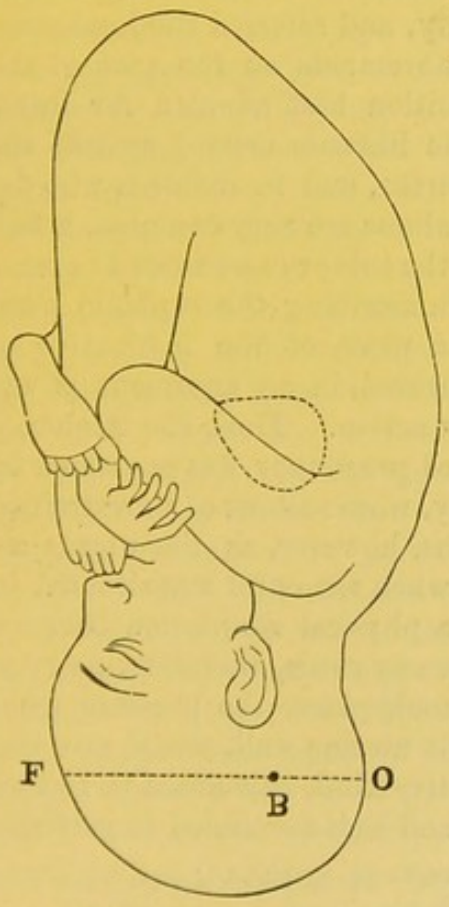


Fig. 69.—Attitude of fœtus *in utero*. (Tarnier et Chantreuil.)

By *presentation* we understand that portion of the fœtus which occupies the lower segment of the uterus. By the determination of the presentation, we are enabled to decide upon the relation of the axis of the child to the long diameter of the uterus. When these two coincide, either of the two extremities of the child, viz., the head or the breech, becomes the presenting part. When the long diameter of the child corresponds to the oblique or transverse diameter of the uterus, the shoulder becomes the presenting part.

Though head-presentations form, during labor, by far the large majority of all cases (ninety-six per cent.), changes of position are very common during pregnancy. The frequency of these changes is in inverse ratio to the advance of preg-

nancy, occurring with diminished frequency in the later months. In multiparæ they take place oftener than in primiparæ. In multiparæ they occur not rarely shortly before birth, while it is exceptional in primiparæ for them to take place in the last three weeks of pregnancy. Great ingenuity has been exercised to account for the preponderating frequency, at the time of labor, of head-presentations. Hippocrates taught that, during the early months of pregnancy, the fœtus occupied a sitting posture, with the head uppermost. In the seventh month, however, it made a complete turn or somersault preparatory to its exit from the womb, an act accomplished by the voluntary efforts of the child. Aristotle referred the head-presentations to the laws of gravity, a theory which has always had many adherents and is still actively defended at the present day.*

Dubois † made a serious breach in this doctrine by showing that if he allowed a dead fœtus, of any period between the fourth and ninth month, to sink in a vessel filled with water, it was not the head, but the back or right shoulder which first reached the bottom. Dubois thereupon denied the influence of gravity, and referred the head-presentations to instinctive or voluntary movements on the part of the fœtus, designed to bring it into a position best adapted for intra-uterine domicile, or for parturition. He likewise argued against the gravitation theory, that in premature births, and in children who die *in utero*, pelvic and transverse presentations are very common, a fact that would be inexplicable were gravity the sole or chief force in operation. Simpson ‡ agreed with Dubois in ascribing the cephalic presentations to fetal movements, but, in place of the instinctive or voluntary movements of Dubois, substituted, in an argument of extraordinary ingenuity, a theory of reflex action. Thus, the frequency of malpositions in the first six months of pregnancy was explained by the spheroidal shape of the uterine cavity, which allows of unrestrained fetal movements. In the latter months, however, as the uterus assumed a more ovoid shape, it was only when the child was situated in the uterus with the head lowest that a physical adaptation between fœtus and uterus existed. In case, from any cause, therefore, a deviation from this, the normal position, took place, the pressure upon the cutaneous surface of the child, by the uterine wall, would give rise to excito-motory movements of an adaptive kind, calculated to restore the disturbed presentation. Duncan # and Veit succeeded in partially

* *Vide* historical part of Cohnstein's paper entitled "Die Aetiologie der normalen Kinderlage," "Monatssch. f. Geburtsk.," Bd. xxxi, p. 142.

† Dubois, "Mémoire sur la cause des présentations de la tête," "Mém. de l'Acad. Roy. de Méd.," tome ii, 1833, p. 265.

‡ Simpson, "Attitude and Positions of the Fœtus in Utero," "Obstetric Works," edited by Priestley and Storer, vol. ii, p. 81.

Duncan, "Researches in Obstetrics," p. 14. Veit, Scanzoni's "Beiträge," Bd. iv, p. 279.

rehabilitating the gravitation theory by showing that, notwithstanding Dubois's experiments, the center of gravity lies much nearer the cephalic than the pelvic extremity of the child. They found that a fresh fœtus immersed in a saline fluid possessing nearly the same specific gravity as the fœtus, in place of sinking upon its back or side to the bottom of the vessel, assumed an oblique direction in the fluid with the right shoulder looking downward.* They, therefore, concluded that the fœtus, lying upon the inclined plane furnished by the uterine walls, would naturally assume a similar position, were no other forces operative to interfere. Finally, we have the opinion of Credé, of Kristeller,† and of Braxton Hicks, ‡ that the contractions of the pregnant uterus adapt the position of the fœtus to the form of the uterus.

Now, each one of these conflicting ideas undoubtedly represents a portion of, but not all, the truth. It is certain that all the influences cited do exist, and it only remains for us clinically to assign to each its relative value. In the early months of pregnancy, the spheroidal shape of the uterine cavity, the small size of the fœtus in comparison with that of the uterus, and the large proportion of amniotic fluid, all allow the fœtus the greatest measure of mobility. At this time the position of the child must be influenced by the active movements, which are felt by the mother subjectively often as early as the fourteenth week. As, usually, during the first half of pregnancy even, the shoulder and head are turned downward, it is fair to ascribe this position to the laws of gravity. The frequency of malpresentations in premature labors is explained in part by the tardy dilatation of the cervix and the mobility of the fœtus, which render easy the displacement of the head from its first position, under the influence of pressure exerted upon the axis of the child's body. Malpresentations are more frequent in the case of a dead fœtus than in the living, but Duncan has shown that in the dead fœtus, owing to *post-mortem* changes, the center of gravity often shifts toward the pelvic extremity. With the advance of pregnancy, as the longitudinal exceeds the lateral growth of the uterus, the child adapts itself to the long axis of the uterus; and the further pregnancy advances the more complete the adaptation becomes. When from any cause or condition the correspondence between the fetal and uterine axis is disturbed, compression of a portion of the cutaneous surface of the fœtus results. Reflex movements, especially in the lower extremities, are excited, which restore the fœtus to that position in which it enjoys the most complete freedom from discomfort. Often, too, the uterine walls resent the pressure of the fœtus, and, by their contractions, serve to maintain the body of the child in the uterine axis.

* On account of the liver upon the right side.

† *Vide* Schroeder's "Handbuch der Geburtshülfe," 4te Auflage, p. 47.

‡ Hicks, "Contractions of Pregnant Uterus," "Obstet. Trans.," p. 224.

In cases of hydramnios the conditions more nearly resemble those which exist in early pregnancy; hence malpresentations occur with greater frequency, favored by the mobility of the fœtus in the surplus-age of amniotic fluid. *Per contra*, when, as is the case toward the end of normal pregnancies, the fœtus nearly fills the intra-uterine space, the movements are very restricted, and displacements rare.

In primiparous women, the pyriform shape of the uterus in the later months is most marked, and as a consequence the head of the child is usually held by the uterine walls in the pelvic cavity. In multiparæ, on the contrary, owing to the relaxation of the uterine parietes, it is usual for the child, in obedience to the laws of gravity, to lie somewhat obliquely in the uterus, with its head resting upon one of the iliac fossæ. As soon as labor begins, however, the uterine contractions carry the head to the axis of the superior strait of the pelvis.

The changes in the fetal presentation are not, however, confined to simple conversions from an oblique to an upright direction, or to shiftings of position in obedience to laws of gravity. But even in advanced pregnancy a breech-presentation may become a head-presentation, and *vice versa*.* P. Müller reported a case in which the fœtus made six such revolutions within five days.† Now, it can not be supposed that the difficulties which the fœtus must encounter from the resistance of the short transverse diameter of the uterus could be overcome by such comparatively feeble forces as gravity, or reflex adaptive movements, or partial uterine contraction. In Müller's case the changes, if the mother's story be correct, must have taken place, not gradually, but suddenly, and by the vigorous movements of the child's limbs. Meeh ‡ calls attention to the fact that the movements of the child are produced chiefly by the extension of the lower extremities, and argues that these movements aid to a greater extent in changing the presentation of the child when the breech occupies the lower segment of the uterus, because of the solid resistance offered by the bony pelvic ring, while in head-presentations the pressure of the extremities against the elastic fundus is in the rule unavailing to effect any considerable changes of position.

By *position* is designated the relation of a determinate point in the body of the fœtus to the uterine walls. In head or breech presentations, the back of the child is most commonly turned to the left, which, hence, is termed the first position. The back turned to the right is known as the second position, and occurs with much less frequency.

In the first position the back is usually directed somewhat anteriorly, while in the second position it is turned rather to the rear.

* Schroeder, "Schwang., Geb. u. Wochenbett," Bonn, 1867, p. 21; Schultze, "Unters. über den Wechsel der Lage," etc., Leipsic, 1868; Fassbender, Berl. "Beiträge zur Geb. und Gynaek.," Bd. i, p. 41.

† Scanzoni's "Handbuch der Geb.," 4te Auflage, p. 123.

‡ Meeh, "Warum kommt das Kind am häufigsten in der Kopfendlage zur Welt?" "Arch. f. Gynaek.," vol. xx, p. 185.

In shoulder-presentations the back is usually directed to the front. Changes of position are frequent in pregnancy, and take place, when other influences do not prevent, in obedience to laws of gravity. When the woman stands erect, the axis of the uterus is continuous with the axis of the superior strait of the pelvis, and forms with the horizon an angle of thirty-five degrees. The uterus does not occupy exactly the median line, but lies more to the right. It is also twisted slightly upon its axis, so that the left lateral portion is directed somewhat to the front. In the upright position, therefore, the anterior wall of the uterus not only forms an inclined plane, but one, too, with a downward drop toward the left side. Now, if these relations be borne in mind, it will be readily seen that the child, resting upon the inclined plane furnished by the anterior wall, with its right shoulder looking downward, must, if left to itself, turn with its back to the left side of the uterus. In the recumbent posture, the axis of the uterus forms with the horizon an angle of thirty degrees, and the downward slope is to the right side. The child, now resting upon the inclined plane furnished by the posterior wall, with its right shoulder looking downward, would naturally turn with its back to the right side of the uterus. These considerations are not purely theoretical, as, when the conditions have been such as to allow the fœtus latitude of movement, the changes indicated in the fetal position followed changes in the attitude of the mother.*

PHYSIOLOGY OF PREGNANCY.

CHAPTER IV.

CHANGES EFFECTED IN THE MATERNAL ORGANISM BY PREGNANCY.

Changes in the sexual apparatus and neighboring organs.—Changes in the uterus.—Explanation of apparent shortening of cervix.—Changes in the vagina, vulva, abdomen, navel, breasts, nipple.—Functional disturbances of bladder.—Constipation.—Œdema.—Changes effected in the entire organism.

Changes occurring in the Sexual Apparatus and Neighboring Organs.

The pregnant state is signalized by the nutritive energy imparted by the fecundated ovum to the generative organs and to the viscera in their vicinity.

The uterus, from the inception of pregnancy, increases in vascularity. Its mucous membrane becomes soft and thickened. The muscular fibers are increased seven to eleven times in length, and three to five times in width. During the first five months new muscular fibers are developed, especially upon the inner layer of the uterus.

* Höning, Scanzoni's "Beiträge," Bd. vii, p. 99.

The delicate connective-tissue processes, between the muscular fibers, become more abundant, and, toward the termination of pregnancy, display distinct fibrillæ. The vessels increase in number, length, and circumference. The arteries, as we have noticed, assume a spiral course, and in places communicate directly with the veins. The veins are dilated, and form, especially in the placental region, wide-meshed net-works. The walls of the veins are intimately united with the muscular walls of the uterus, and form, when divided, open-mouthed canals. The lymphatics, starting from the spongy tissues of the lining mucous membrane, traverse the muscular structures, and are gathered up by abundant plexuses, which are distributed especially over the fundus and sides of the womb. The nerves increase in length and thickness, and grow inward toward the uterine cavity. Upon the inner surface of the uterus ganglia may be observed.* The ganglion cervicale, which measures in the non-pregnant condition three fourths of an inch in length and one half an inch in width, is now an inch and a half in breadth, and possesses a length of two inches.

These textural changes are accompanied by an enormous increase in the volume of the uterus. The weight of the latter in the virgin state is about an ounce, while toward the end of pregnancy it weighs in the neighborhood of two pounds. The increase in the bulk of the uterus is progressive. The following table, by Arthur Farre,† furnishes approximate measurements for the different months of pregnancy:

	Length.	Width.
End of 3d month.	4½–5 inches,	4 inches.
" 4th "	5½–6 "	5 "
" 5th "	6 –7 "	5½ "
" 6th "	8 –9 "	6½ "
" 7th "	10 "	7½ "
" 8th "	11 "	8 "
" 9th "	12 "	9 "

According to Levret, the surface of the virgin uterus measures sixteen square inches, while that of the pregnant uterus at term measures three hundred and thirty-nine square inches.‡ The uterine cavity is stated by Krause to be enlarged five hundred and nineteen times.#

The enlargement of the uterus is not due, in the beginning of pregnancy at least, to the pressure of the expanding ovum, for the same changes occur during the first four months in cases of extra-uterine pregnancy. In the latter months, however, a mechanical

* Spiegelberg, "Handbuch der Geburtshülfe," p. 50.

† "Cyclopædia of Anatomy and Physiology," article "Uterus and its Appendages," p. 645.

‡ *Vide* Scanzoni, "Handbuch der Geburtshülfe," p. 77.

Vide Spiegelberg, "Handbuch der Geburtshülfe," p. 51.

stretching is probable, as the walls become thinned and conform to the size of the ovum. At term, the walls are not of uniform thickness, but vary between one sixth and one fourth of an inch.

In advanced pregnancy three muscular layers are distinctly marked. They consist of—1. The external layer, which covers the uterus like a delicate veil, and which is intimately adherent to the peritonæum ; 2. The middle layer, which makes up the bulk of the uterine walls—it consists of circular fibers surrounding the vessels, and circular and longitudinal fibers, which interlace with one another ; 3. The inner layer, composed mainly of circular muscular fibers, which form concentric rings about the orifices of the tubes and os internum.* The third, like the first layer, is feebly developed. The existence of a distinct sphincter muscle at the os internum is admitted by many anatomists, and questioned by others. The clinical evidence in its favor is strong. According to Kreitzer's investigations, the muscular fibers around the os internum in all the layers have a more or less transverse direction.†

With the growth of the gravid uterus, the peritoneal coat is put upon the stretch, and, in places, a thickening of the serous membrane takes place by the formation of new tissue-elements. At the same time, the folds of the broad ligaments gradually separate, so that toward the end of pregnancy the ovaries and Fallopian tubes are in close contact with the uterus.

The growth of the uterus is confined chiefly to the body, the cervix participating only to a slight extent. In the early months, the increase is rather in the antero-posterior and lateral diameters than in the longitudinal diameter. As a consequence, in the rule, it is not until the fourth month that the fundus can be felt through the abdominal walls above the symphysis pubis. In these earlier months the normal anteflexion of the uterus is increased by the weight of the corpus uteri. In the fifth month the uterus fills the hypogastrium, and in the ninth month reaches the epigastrium. During the last two weeks, however, the uterus sinks somewhat into the pelvic cavity. At the same time the fundus of the uterus sinks downward and forward, so as to stand about three inches beneath the lower extremity of the sternum.

In the upright posture the uterus, in advanced pregnancy, rests upon the anterior abdominal walls. As, in the intervals of contraction, the uterus is a mere sac with fluid contents, it becomes flattened from front to rear, and the width increases at the expense of the dis-

* For a minute description of the intricate arrangement of the muscular fibers in the different layers of the uterus, *vide* Hélié, "Recherches sur les dispositions des fibres musculeuses de l'utérus dévellopées par la grossesse," Paris, 1864.

† Kreitzer, "Anat. Unters., über die Musculatur der nicht schwangern Gebärmutter," "St. Petersb. med. Ztschr," 1871, Heft ii, p. 113.

tance from the fundus to the symphysis pubis. In the horizontal position, in which the uterus rests upon the vertebral column, its length is, on the contrary, increased and its width diminished. In the upright position, the intestines occupy the space posterior to the uterus. In the dorsal position, the intestines lie chiefly upon the sides, but partly too in front of the uterus.

During the first three months of pregnancy, the pyriform shape of the uterus is preserved. During the succeeding three months, owing to the relative increase in the lateral and antero-posterior diameters, the body gradually assumes the appearance of a flattened spheroid. After the sixth month the longitudinal diameter again preponderates.

As the dilatation of the uterus takes place more rapidly in its upper than in its lower segment, the cavity of the organ assumes, under normal conditions, an oval shape, with the narrow end pointing downward, corresponding to the ovoid shape of the fœtus in head-presentations. It was long taught and believed that this change of shape, occurring in the latter months of pregnancy, was due to the gradual unfolding of the cervix uteri from above downward, which thus contributed to the enlargement of the uterine cavity. It is, however, probable that, with rare exceptions, the cervix uteri maintains its complete integrity up to the commencement of labor. The enlargement of the uterus, necessitated by the development of the fœtus, results chiefly from the growth and distention of the fundus and posterior uterine wall.*

The cervix uteri participates in the hypertrophy of the entire uterus. Its development, however, is completed by the fourth month, and is the result not so much of increased growth or new formation of tissue-elements as of the loosening of its structure and swelling from serous infiltration. This latter is the consequence of a hyperæmia of the cervix, which results from the passive relaxation and dilatation of the cervical vessels. It occasions a physiological softening of the tissues, which first manifests itself in those portions of the cervix where the least resistance is encountered, viz., beneath the mucous membrane beginning at the os externum, extending outward through the muscular structures of the vaginal portion, and afterward upward toward the os internum.† The follicles of the cervical mucous membrane furnish a thickened secretion, which fills the cervical canal, and forms what is known as the "mucous plug." Frequently the orifices of the follicles become occluded. The follicular sacs then fill with their own secretion, and project from the mucous surface as the ovules of Naboth. Erosions about the os externum are rarely absent in advanced pregnancy.

* For the contrary view, maintained by Bandl, *vide* note, p. 28, article "Labor."

† Lott, "Zur Anatomie und Physiologie des Cervix Uteri," Erlangen, 1872, pp 35, 36.

With the advance of pregnancy an apparent shortening of the cervix takes place, at first confined to the vaginal portion, but afterward involving the entire organ. The earlier explanation of this phenomenon, and one which still meets with very general acceptance, assumes that, after the sixth month, a gradual unfolding of the cervix from above downward takes place, which contributes to the enlargement of the uterine cavity. In this manner space is provided in correspondence with the rapidly increasing growth of the fœtus. The strength of this doctrine lay, in a great measure, in the seemingly confirmatory evidence afforded by digital explorations.

In opposition to the current opinion, Stoltz, in his inaugural thesis, published in 1826,* maintained that the internal os remained closed up to the last two weeks preceding delivery, when, indeed, under the influence of painless contractions, the effacement of the cervix, described by earlier writers, did in fact, at least in primiparæ, take place. Stoltz explained the apparent shortening of the cervix as the result of a spindle-shaped dilatation of the cervical canal, causing an approximation of the external and internal orifices. In 1859 Duncan† furnished corroborative evidence of the general correctness of Stoltz's view, by means of two dissections of uteri derived from women who died respectively in the seventh and eighth months of pregnancy. In these cases the length of the cervix uteri had undergone little or no change consequent upon pregnancy. Duncan, however, in common with Stoltz, admitted that, during the latter days of gestation, incipient uterine contractions of a painless nature may lead to the opening of the internal os. In 1863 he showed that Stoltz's discovery had been anticipated by Weitbrecht in 1750.‡ In 1862 Professor I. E. Taylor,# of New York, stated, what is without doubt true in the majority of cases, that the cervix remained closed, and retained its entire length up to the very beginning of active labor. In evidence he offered the results of four *post-mortem* examinations made upon women dying from accidental causes during the first stage of labor. ‖ In 1873 I found in the dissecting-room a woman, seven months pregnant, who had died in the first stage of labor, but after dilatation of the cervix had well advanced. The bag of waters, in the form of a cylindrical sac two inches in diameter, protruded into the vagina. Both the cervical orifices were distinctly defined; the cervix was equally expanded throughout its entire extent; and the head rested above the os internum. The cervix clearly formed no part of the uterine cavity, but

* "Sur les différents états du col de l'utérus, mais principalement sur les changements que la gestation et l'accouchement lui font éprouver," Strasbourg, 1826.

† "On the Cervix Uteri in Pregnancy," "Edinburgh Med. Jour.," vol. iv, 1859, p. 774.

‡ *Vide* "Edinburgh Med. Jour.," September, 1863.

Taylor, "On the Cervix Uteri," "Am. Med. Times," June 21, 1862.

‖ *Vide* likewise case of Angus McDonald, in "Edinburgh Med. Jour.," April, 1877.

served merely as a communicating passage between the uterus and vagina. Dr. Taylor has made some very interesting observations upon the action of the cervix during labor, using for the purpose a large

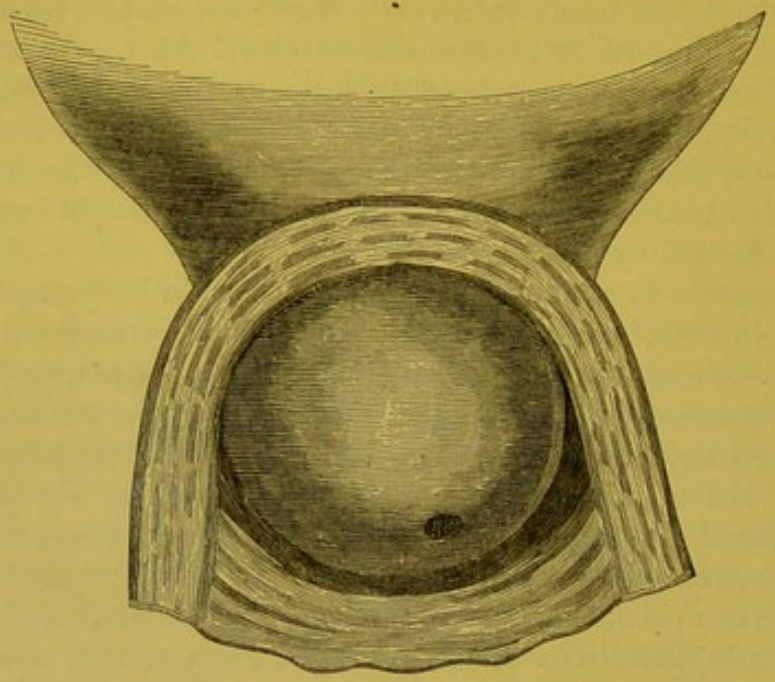


Fig. 70.—Appearance of vaginal portion in primipara; end of ninth month. (Taylor.)

(three to three and a half inch) cylindrical speculum, by means of which the entire process can be freely witnessed. In multiparous women he has seen the head descend during a pain so as to produce complete obliteration of the cervix, and then recede, leaving the latter with the same appearances as existed previous to labor.*

While the non-shortening of the cervix has been fairly demonstrated, it is not so clear that the os internum remains closed in all cases up to the beginning of labor. Certainly there are rare exceptions to the rule. Litzmann† reported a case in which the membranes were found, at the time of labor, attached to the cervical wall around the periphery of the os externum. In a few instances I have had an opportunity, during the last period of pregnancy, to determine by touch the dilatation of the os internum. The cervix, however, did not expand in such a way as to become continuous with the uterine cavity, but remained distinct and apart, preserving its independent existence. How far such a dilatation is due to painless labor it is impossible to say. Müller‡ regards it rather as the result of the

* "Med. Record," October 13, 1877.

† "Das Verhalten des Cervix Uteri in der Schwangerschaft," "Arch. f. Gynaek.," Bd. x, p. 130.

‡ "Untersuchungen über die Verkürzung der Vaginalportion in den letzten Monaten der Gravidität": Scanzoni's "Beiträge," Bd. v, H. 2, 1869, pp. 306 *et seq.* Müller does not, however, exclude the possible action of uterine contractions.

pressure of the head upon the softened cervix. I had once occasion to examine a multipara toward the end of gestation, to determine the question as to the safety of her making a railroad journey to a neighboring city. I found the head low, the cervix soft, and the os internum clearly dilated to the size of a dollar. Two weeks later I was called to see her in the early stage of labor, and found, under the influence of the uterine contractions, the canal of the cervix had again closed.

The apparent shortening of the cervix is unquestionably due in part to the swelling, incident to pregnancy, of the vaginal mucous membrane, and of the vascular, loose-meshed tissues surrounding the cervix at the vaginal junction. But, in addition, a noticeable difference may be observed between cases in which the head occupies the pelvis and those in which it rests upon an iliac fossa. In the latter the cervix is found, both by the speculum and by the touch, to have pre-

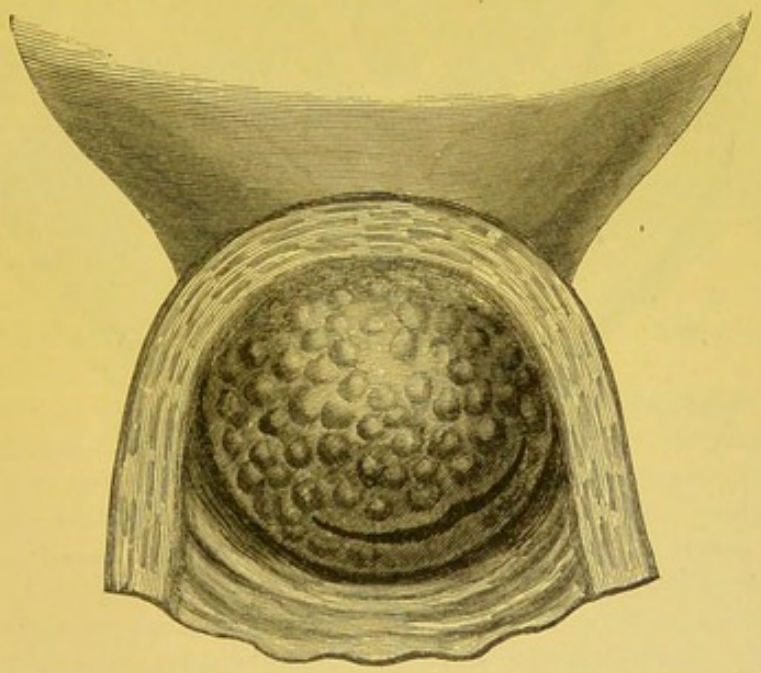


Fig. 71.—Appearance of vaginal portion in multipara; ninth month. (Taylor.)

served its entire length. In the former, on the contrary, the anterior lip is often obliterated, while the length of the canal and the posterior cervical wall remain unchanged.

In explanation of this phenomenon, it is to be borne in mind that in the upright position the uterus forms with the horizon an angle of thirty-five degrees. The weight of the ovum, resting upon the inclined plane of the uterus, increases the convexity of the anterior wall, and the head of the fœtus, when it enters the pelvic cavity, does not fall directly upon the os internum, but somewhat in front, producing, in accordance with the laws of gravity, a bulging of the anterior lower segment. Upon vaginal examination the head is felt, therefore, low

down, and covered by the uterine walls, while the cervix is directed backward, not always in the median line, and is often reached with difficulty, because the finger, in passing to it, has first to make the circuit of the child's head. The bulging, produced by the latter, effaces the angle between the anterior lip and the vaginal wall, while

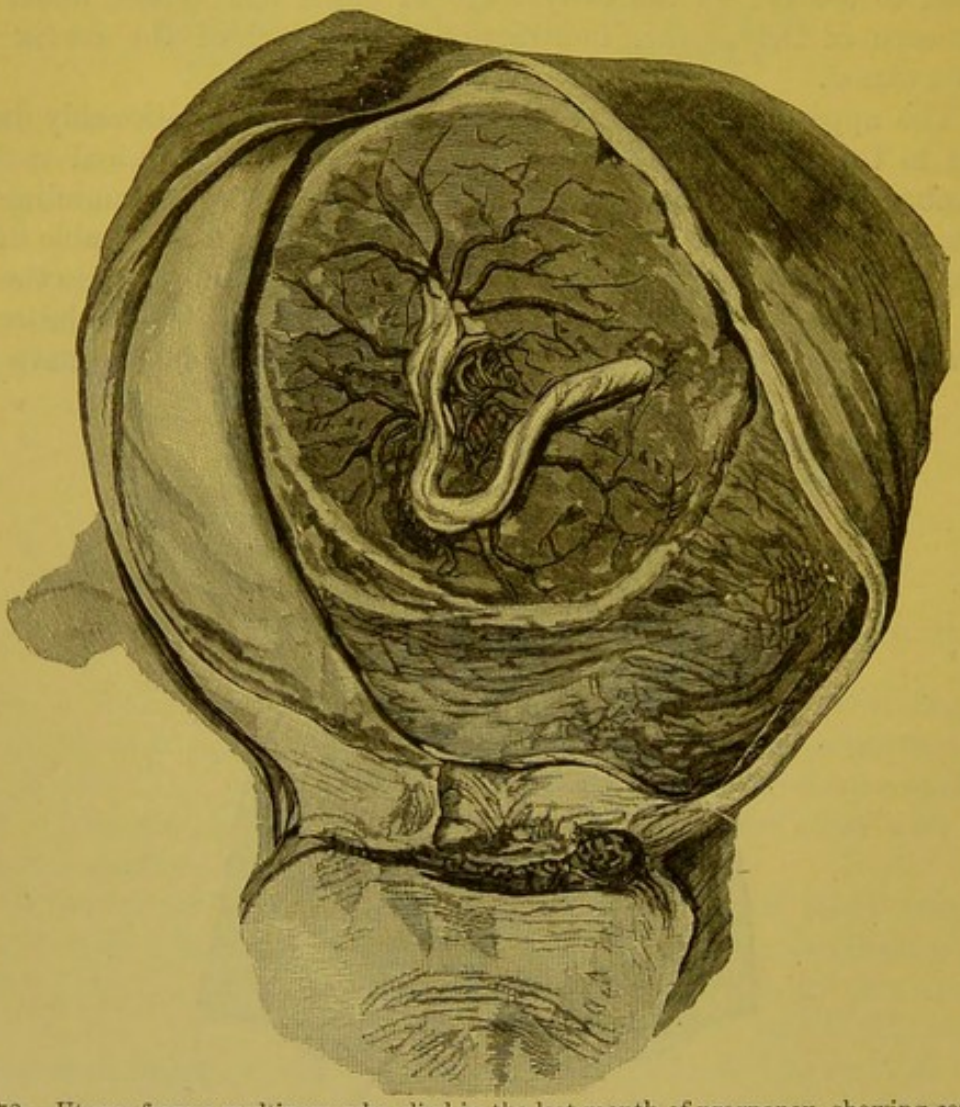


FIG. 72.—Uterus from a multipara who died in the last month of pregnancy, showing cervix of normal length with membranes adherent to the os internum.

the posterior lip remains unchanged. The canal of the cervix assumes a nearly vertical direction, and when examined with care, with due regard to the physiological softening of its tissues, is found to have preserved its normal length. By pushing the head away from the cervix, or by placing the patient in the knee-elbow position, so as to allow the head to recede, the anterior lip resumes its normal dimensions.*

* P. MÜLLER, *op. cit.*, p. 342.

LOTT, "Verhalten des Cervix Uteri während der Schwangerschaft," p. 71.

I. E. TAYLOR, "Non-shortening of the Cervix during Gestation," "Med. Record," October 13, 1877, p. 646, with verbal statement of the author concerning the results of his examinations of pregnant women in the genu-pectoral position.

Bandl ("Ueber das Verhalten des Uterus und Cervix in der Schwangerschaft und während der Geburt," 1876) has sought to prove that, whereas, in point of fact a portion of the cervix remains closed to the end of pregnancy, a portion of the same does, as Roederer taught, contribute to the formation of the uterine cavity.

In presenting his views to the Naturforscher-Versammlung, at Hamburg, in 1876, Bandl stated that, upon examination of the familiar Braune section, made upon the cadaver of a parturient woman, he was struck with the impossibility that the cervix therein depicted, measuring eleven centimetres in front and ten centimetres posteriorly, could be the short narrow canal, from two to four centimetres long, observed by Müller toward the end of gestation. As a rule, however, in case of the deep position of the ovum, or fœtal head, above the constriction designated by Müller as the os internum, may be felt a second and much larger ring, which his subsequent investigations showed was the os internum proper. The lower constriction he termed, therefore, the spurious os internum, or the ring of Müller. Owing to the fact that the walls of the canal between the upper and lower rings are much thinner than those of the uterine body, a well-defined ridge is felt, which has since been termed the ring of Bandl.

At first Bandl supposed that the new cervico-uterine canal was covered by decidua, the mucous membrane proper having been crowded downward by the pressure of the ovum. In this way, by the formation of overlapping folds, the ring of Müller is approximated to the os externum, and the apparent shortening of the cervix is accomplished. At the same time, by the continued growth, and, by what he termed the vital action of the parts, a "new cervix" was formed above the remains of the old canal, derived chiefly by a sort of migratory movement from the muscular structure of the original cervix. The decidua, meantime, unable to follow the expansion of the outer layers, was torn in many places, forming scattered islets, between which the chorion came into immediate contact with the muscular walls.

In September, 1877, at a meeting of the German gynæcologists at Munich, Bandl abandoned his theory of a new cervix formed by a movement upward of muscular fibers and the crowding down of the cervical mucous membrane, and taught in its place that, in primiparæ, a portion of the cervix really expands to contribute to the uterine cavity. In the earlier months, he stated, the mucous membrane of this portion retains its cervical characteristics, but in the latter part of gestation it is converted into a kind of decidua. The flattened, expanded portion in multiparæ, he acknowledged, was often extremely small. This, at first, he attributed to morbid conditions, such as slight inflammations, or defective involution, which interfered with the rolling out of the upper portion of the canal. In 1879, before the Natur.-Versammlung at Baden-Baden, he explains finally that, in first labors, the mucous membrane of the dilated portion of the cervix becomes torn and stripped off. Subsequently a new membrane is formed upon the denuded surface which is not distinguishable from that of the uterine body, and upon which, in future pregnancies, the decidual formation may be traced to the persistent portion of the canal. The os internum, according to this view, is not marked by the cervical mucous membrane, but is situated in the muscular walls, and usually corresponds to the point at which the peritonæum leaves the uterus.

Küstner ("Beiträg. zur Anatomie der Cervix Uteri," "Arch. f. Gynaek.," vol. xii, p. 383) and Marchand ("Noch Einmal das Verhalten der Cervix Uteri in der

Schwangerschaft," "Arch. f. Gynaek.," vol. xv, p. 169) claimed in certain cases to have found the plicæ palmatæ and cylindrical epithelial cells at the distance of from two to two and a half centimetres from the internal os, showing that a funnel-shaped expansion of the upper portion of the cervix does take place during pregnancy.

Results directly opposed to the foregoing were, however, obtained by Leopold, McDonald, Müller, Sänger, and myself. In three autopsies made upon women who had died in the last month of pregnancy—one primipara and two multiparæ—the same conditions prevailed in all, viz.: the cervix exceeded four centimetres in length and was increased in thickness, the mucous plug terminated at the upper orifice, the membranes adhered closely to the lower segment and to the borders of the internal orifice, and the most careful examination failed to reveal the slightest trace of a second ring. That the cervix maintains its independence to the beginning of labor is, therefore, true in many instances. That there are no exceptions it would be hazardous to maintain, in the face of the positive testimony of both Bandl and Marchand. Meantime, it seems desirable to abandon the terms "ring of Müller" and "ring of Bandl," and to employ once more the term os internum for the upper limit of the cervical canal. Clearly demonstrated instances of the partial funnel-shaped expansion of the cervix occurring independently of muscular contractions, if, in future, they can be shown to be other than rare phenomena, it will be best to indicate by specific mention of the fact.

In the vagina changes take place corresponding to those in the uterus, though, of course, less in degree. The smooth muscular fibers hypertrophy; the vessels of the venous plexus increase in size and impart a blue color to the vaginal walls; the mucous membrane becomes thickened, and furnishes a more abundant secretion. The mucous membrane likewise increases in length, so that, in spite of the fact that it is lifted upward by the elevation of the uterus, the anterior vaginal wall not unfrequently protrudes from the vulva. The papillæ swell and impart a granular feel to the finger.

The vulva becomes turgescent, the labia gape apart, to the mucous surface the enlargement of the veins and venous plexuses gives a dusky hue, and the follicles secrete abundantly.

The connective tissue between the layers of the broad ligaments and around the uterus becomes succulent from serous infiltration. The lymphatics, which convey away the waste engendered by the rapid tissue-changes in the pelvic organs, enlarge in conformity with the increased labor thrown upon them. The hips broaden from the deposit of fat in the subcutaneous tissue of the entire pelvic region.

With the growth of the uterus the abdominal walls are put upon the stretch, and, in well-nourished individuals, are increased in thickness, by the more abundant formation of adipose tissue. By the fifth month the navel begins to diminish in depth, and about the seventh month becomes level with the skin. During the last two months the navel often is everted by the pressure of the uterine tumor, and forms a rounded elevation. Another consequence of the stretching of the

abdominal walls is the formation of reddish, bluish, and at times of white glistening streaks (striæ), which do not disappear after delivery, though they lose their coloring. They rarely fail in the last third of pregnancy. They are found most abundant upon the lower half of

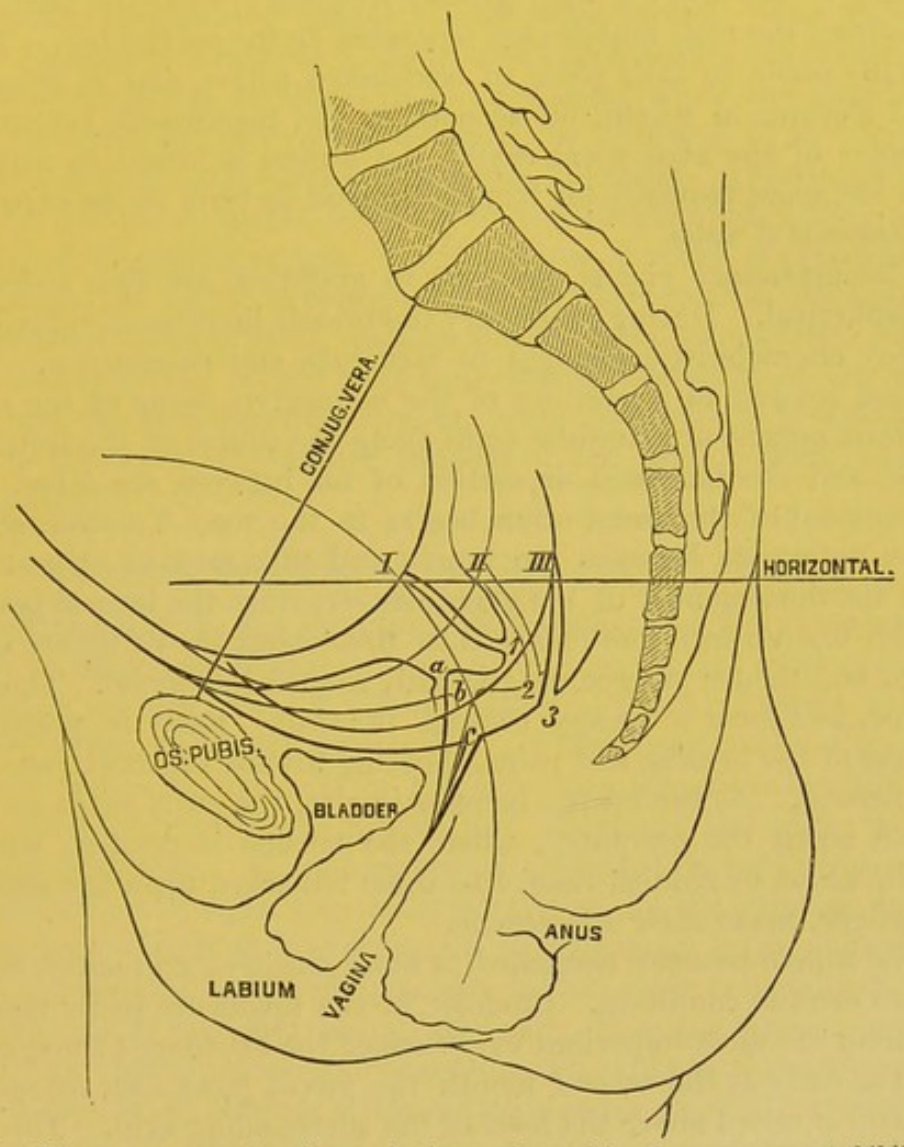


FIG. 73.—Diagram representing changes in the cervix resulting from pressure of child's head on anterior wall. (Lott.)

the abdomen, especially upon the sides, where they form curved, sinuous lines. They are due to an atrophic condition of all the skin-layers, to partial obliteration of the lymph-spaces, and to a condensation of the connective-tissue elements, which, in place of forming rhomboid meshes, run parallel to one another.* Striæ are produced likewise in pathological distentions of the abdomen, and are not peculiar to pregnancy. Similar streaks form upon the nates and upon the anterior and posterior surfaces of the thighs. They may occur, too, independ-

* BUSEY, "The Cicatrices of Pregnancy," "Trans. of the Am. Gynæc. Soc.," vol. iv, p 141.

ent of pregnancy, as in the rapid development of the hips at puberty. Painful sensations at the costal insertions of the abdominal muscles are often experienced during pregnancy. They occur more commonly in multiparæ, and, owing to the preponderance of the right lateral position of the uterus, with greater frequency upon the right side. Sometimes the recti muscles are separated from one another. This is specially liable to take place in contracted pelves, and in women of small stature, in whom, on account of the insufficient longitudinal diameter of the abdominal cavity, the uterus is forced to make for itself the space requisite for its development to term at the expense of the abdominal walls.

The mammary glands, previous to gestation, are firm and nearly hemispherical. During pregnancy the breasts increase in volume, and present characteristic changes in structure and consistence. These changes are due to a swelling of the connective tissue of the organ, the development of glandular acini along the course of the lactiferous ducts, and the increased deposition of fat between the lobes. The enlargement of the breast often begins in the second month, and becomes noticeable between the fourth and fifth months of gestation. With the development of the glandular structure the breasts possess a knotty, uneven feel, more marked at first about the periphery of the organ, and thence proceeding gradually toward the nipple. The veins enlarge, and form a tracery beneath the skin. Early in pregnancy, fullness of the breasts, and pains, shooting toward the axilla, are often experienced. As the breasts increase in size, the cutis yields in many women about the periphery, where the tension is greatest, whereby bluish, white, or reddish lines, like those remarked upon the abdomen and thighs, make their appearance.

The nipple becomes elongated, is more sensitive, and enters readily into an erectile condition. Changes in the areola are justly regarded as among the most important evidences of the existence of pregnancy. Often as early as the second month the areola has a soft, œdematous feel, and is raised above the level of the surrounding skin. The sebaceous follicles, ten to twenty in number, enlarge, and bedew the surface with moisture. By the middle of pregnancy a circle, due to pigmentary deposit, is formed around the nipple, the coloration of which depends in part, though not altogether, upon the complexion of the individual, being usually more intense in brunettes than in women with fair hair and delicate skins. In the negress the areola is jet-black, while in the albino it is of a delicate rose-color (Montgomery). The diameter of the pigmented circle averages from an inch to an inch and a half, though it sometimes greatly exceeds the figures mentioned. In the latter part of pregnancy there often forms around the outer part of the areola a so-called secondary areola, consisting of scattered round spots, presenting the appearance as though, to use the language of

Montgomery, the color had been discharged by a shower of drops. This peculiarity is due, for the most part, to the presence of enlarged, non-pigmented sebaceous follicles.

The pressure of the gravid uterus gives rise to functional disturbances in the neighboring organs of the pelvic cavity. The capacity of the bladder is diminished, and, as a consequence, increased frequency of urination results. In some women, when the bladder is moderately full, the mere act of coughing or sneezing, or the upright posture, produces involuntary discharges of water. Constipation is common, due not so much, however, to mechanical obstruction as to diminished intestinal action. In the latter months of pregnancy, pressure on the sacral nerves gives rise at times to numbness of the extremities, neuralgic pains, cramps, and hindered locomotion. Œdema of the lower half of the body and varicose dilatation of the veins of the legs, the rectum, and vulva, are referable partly to pressure and partly to the increased vascular fullness of the pelvic vessels induced by pregnancy.

Changes effected in the Entire Organism.

Corresponding to the enormous development of the vascular apparatus in the gravid uterus, there is an increase in the total quantity of blood in the circulation.* Thus a sort of plethora is formed, which, however, is serous in character. The red blood corpuscles, the albumen, the iron, and the salts of the blood are diminished, while the white blood corpuscles, the fibrine, and, above all, the water of the blood, are increased. These changes are explained, in part at least, by the demands made upon the maternal system by the growing fœtus. With increased waste in the organism, as evidenced by an augmentation in the carbonic acid and urea eliminated, there is usually diminished capacity to take and assimilate food. How far these causes are operative in producing the above-mentioned conditions is shown by the slight degree of hydræmia, or the entire absence of blood impoverishment, in women who possess during pregnancy good appetites and excellent digestions, and who, at the same time, are able to procure an abundance of nutritious food.†

As a necessary corollary to the increase of the total blood-supply in pregnant women, the maintenance of the circulation would require either greater frequency in the contractions of the heart, or that the

* This assertion, which is simply the formal statement of a physiological necessity, has been experimentally proved to be correct in bitches by Spiegelberg and Gscheidlin. *Vide* "Untersuchungen über die Blutmenge trächtiger Hünde," "Arch. f. Gynack.," Bd. iv, p. 112.

† Nasse, "Das Blut der Schwangeren," "Arch. f. Gynack.," Bd. x, p. 351. *Vide ibid.*, for new experiments relative to the diminution in the salts and iron (hæmatin) of the blood, and for facts relative to increased destructive assimilation.

entire quantity of blood entering the ventricles during the diastole should be increased. Now, it is known that the frequency of the pulsations of the heart remains unchanged. For the alternate contingency, however, the dilatation of the cavities becomes a necessity. For the same reason the arterial tension is increased, imparting a fullness to the pulse, which was formerly regarded as an indication for venesection. The interposition of the enlarged and multiplied vascular channels in the pelvic organs increases the labor thrown upon the heart, in response to which an eccentric hypertrophy of the left ventricle takes place.*

Pregnancy increases the size of the thyroid gland. In districts where goître is endemic, and in women in whom a predisposition already exists, pregnancy may produce a temporary form of the disease, or furnish the starting-point of the permanent affection. †

In rather more than half the cases of pregnancy, thin bone-like lamellæ, consisting chiefly of phosphate and carbonate of lime, measuring from one sixth to one half a line in thickness, are found deposited upon the inner surface of the skull. These plates have been termed osteophytes by Rokitansky. They occur after the third month, and are found chiefly upon the frontal and parietal bones, especially along the course of the sulcus falciformis and the *arteria meningea media.* ‡

We have already noticed the increase in the carbonic acid discharged by the lungs during pregnancy. Andral and Gavarret found the mean consumption of carbon hourly in pregnant women equaled 8 grammes instead of 6·4 grammes, as in menstruating women. The thorax is increased in breadth and diminished in depth, a condition which becomes reversed after delivery. There is usually, toward the end at least, a diminution in the vital capacity of the lungs.# Subjectively, there is often experienced, especially in primiparæ, a sense of oppressed respiration during the latter months of pregnancy. This feeling is relieved, however, to a considerable extent, when the uterus, in the last two to three weeks of pregnancy, sinks downward and forward.

* For the results of Larcher and other French investigators upon this point, *vide* Joulin, "Traité complet d'accouchement," p. 383.

† L. Tait, "Enlargement of the Thyroid Body," "Obstet. Jour. of Gr. Brit. and Ire.," June, 1875.

‡ Förster, "Handbuch der patholog. Anat.," Bd. ii, p. 945. These osteophytes are not peculiar to pregnancy; they likewise occur commonly in consumptives. "Nouveau Dict. de Chir. et de Méd.," t. xvii, Art. "Grossesse."

Dohrn found that in sixty per cent there was a marked diminution in the vital capacity of the lungs of women in the latter part of pregnancy, as compared with that of the same women tested twelve to fourteen days after delivery. "Zur Kenntniss des Einflusses von Schwangerschaft und Wochenbett auf die vitale Capacität der Lungen," "Monatsschr. f. Geburtsk.," Bd. xxviii, 1866, p. 457. Earlier observations, not entirely in accord with those of Dohrn, were made by Fabius and Wintrich. *Vide* Spiegelberg, "Lehrbuch der Geburtshülfe," 1877, p. 63.

Very few pregnant women escape altogether troubles of digestion; of these the most common are nausea and vomiting, due to spasmodic contractions of the stomach and diaphragm. The nausea and vomiting usually occur on waking in the morning, i. e., with an empty stomach, more rarely after meals. In a few cases, these gastric disturbances take place only three or four times in the beginning of pregnancy, upon the first suppression of the menses. Usually, however, they recur daily during the first three months, and then gradually disappear. In the early period of pregnancy, the appetite is, as a rule, capricious, like that of chlorotic women. Some are said to crave unusual and even disgusting articles of food (longings). An increased secretion of the salivary glands is often a noticeable symptom. The bowels are more commonly constipated. In a few, however, diarrhœa takes place, often about the time of the month when the woman would, if not pregnant, have her menstrual flow.

It is not surprising that in the first three months of pregnancy many women lose their flesh and color, have dark circles about their eyes, and wear a drawn, haggard look; but after the third month, or later, after fetal movements have been felt, the appetite returns, the digestion becomes more active, the nutrition is improved, and an increase of weight in normal cases takes place, which can not be accounted for simply by the growth of the ovum. According to Gassner's estimates, the average gain in the eight months amounts to five and a half pounds, in the ninth month to three and a half pounds, and in the tenth month to about three and a quarter pounds. The total increase he found not far from one thirteenth of the entire weight of the body.*

We have already noticed the pigmentation of the areola in speaking of the changes produced in the breasts of pregnancy. The forehead likewise at times becomes covered with dirty-looking brownish patches, which may extend over the entire face, especially over the eyelids, the root of the nose, and the upper lip. These spots, with the disfigurement they occasion, rarely remain permanent, but, as a rule, disappear shortly after confinement. Similar discolorations are often observed about the external organs of generation, upon the abdomen, and, with considerable constancy, along the linea alba and around the umbilicus.

Owing to the increased arterial tension, the urine is more abundant and watery. Albumen in the urine is not an infrequent occurrence, due, probably, in the milder cases, to transitory catarrhal affections of the bladder.†

The nervous system becomes more impressionable. The whole

* "Monatsschr. f. Geburtsk.," Bd. xix, p. 1.

† KALTENBACH, "Ueber Albuminurie und Erkrankungen der Harnorgane in der Fortpflanzungsperiode," "Arch. f. Gynack.," Bd. iii, p. 1.

character frequently undergoes a change. The most amiable of women are liable to become fretful, peevish, and unreasonable. The spirits are often depressed, especially in the earlier months, when the general nutrition is most impaired. The melancholia in women already predisposed to insanity may terminate in mania. The memory is generally weakened, especially in women who have borne a number of children in rapid succession. On the other hand, nervous women sometimes lose their nervousness, and, exceptionally, there are individuals who experience during pregnancy a peculiar sense of well-being. Neuralgic affections are common (face-ache, toothache, etc.); local anæsthesia and paresis occur at times; the senses are often disordered (nyctalopia, amaurosis, amblyopia, deafness, perversions of taste and smell); pruritus is sometimes troublesome; and, finally, pregnant women are subject to attacks of dizziness and syncope.

CHAPTER V.

THE DIAGNOSIS OF PREGNANCY.

Signs of pregnancy.—Suppression of menses.—Nausea.—Salivation.—Breasts.—Increase of abdomen.—Changes of the os and cervix.—Quickening.—Ballottement.—Fetal heart-beat.—Uterine bruit.—Funic souffle.—Interrogation of the patient.—Methods of physical examination.—Inspection of abdomen.—Palpation.—Auscultation.—The vaginal touch.—Distinction between first and subsequent pregnancies.—Diagnosis of death of fœtus.—Duration of pregnancy.—Prediction of day of confinement from date of last menstruation.—Date of quickening.—Size of uterus.

A THOROUGH familiarity with all the signs which lead us to the recognition of pregnancy is an essential part of the outfit of every practicing physician. The reasons for this are obvious. Mistakes as to the diagnosis of the pregnant state can never be covered up. They therefore inevitably subject the author of them to criticism and ridicule. But, apart from personal considerations, it is to be remembered that, in the practice of both medicine and surgery, the coexistence of pregnancy not infrequently modifies materially the prognosis and treatment. Moreover, it is one of the most grateful functions the physician is called upon to perform to be able to dissipate unjust suspicions of pregnancy, which sometimes cloud the reputations of perfectly pure women. On the other hand, the writer has known many cases of grievous wrong and injustice done to the innocent by a careless, hasty, and incorrect decision on the part of the medical examiner. The so-called "signs of pregnancy" are based upon the physiological changes which take place in the ovum, and the changes wrought by the growth of the ovum upon the maternal organism. Many of the

signs, therefore, possess little weight, and serve only to draw attention to the possible existence of pregnancy. A number of the signs taken together furnish cumulative evidence of the probability of pregnancy. There are, however, single signs, which, taken individually, make pregnancy probable; only a few possess a positive significance. Hence the rule that the physician keep ever in mind possible sources of error, and, in cases of doubt, that he maintain a prudent reserve in the expression of his opinion.

The diagnosis of pregnancy depends upon an acquired facility in the mental grouping of symptoms in the order of their respective weight, and upon a familiarity with all the methods by which objective symptoms can be determined.

We have, therefore, to consider:

1. The signs of pregnancy, with their limitations and possible sources of error.
2. Methods of physical exploration.
3. The differential diagnosis of pregnancy.

The Signs of Pregnancy.

The *suppression of the menses* is, to most women who have been exposed to impregnation, the first warning of the occurrence of conception. Certainly, where they have been previously habitually regular, this sign rarely leads them into error. Still, it is by no means reliable. To estimate it at its true value, it is necessary to bear in mind the numerous aberrations to which the menstrual function is subject. In married women a retardation of the menses for a few days, or even two or three weeks, is not an uncommon occurrence. These retardations are not unusual in newly-married women, in whom the disturbance appears to follow the novelty of the matrimonial relation. Again, they may be the result of colds, fatigue, and mental emotions. In the unmarried, who, by reason of imprudent conduct, have had occasion to fear pregnancy, a retardation sometimes occurs as the result of pure apprehension.

The causes of amenorrhœa do not need to be specified here. They are operative in the married as well as in the unmarried. The family physician, however, cognizant of the peculiarities and temperaments of his patients, will easily recognize such conditions, and separate them from the cessation of the menses induced by pregnancy. Should any doubt exist, of course it would be proper to suspend judgment, and await the advent of other symptoms before expressing an opinion.

Pregnancy, while it suspends ovulation, the usual concomitant of menstruation, is not incompatible with a periodic flow, which may obscure the diagnosis. When conception occurs immediately prior to a menstrual period, it frequently does not arrest the discharge, though it usually diminishes the amount. A few women have periodic dis-

charges during the first two or three months of pregnancy, and, in very rare cases, throughout its entire duration. Authors have likewise recorded instances of women whose habit it was to menstruate (?) only during pregnancy (Montgomery). In all such cases it is probable that the hæmorrhage is of cervical origin, and is a pathological phenomenon. In one instance my friend Dr. L. M Yale, of this city, verified the presence in the cervical canal of a small mucous polypus, with the removal of which the trouble disappeared. In mentioning these deviations from the standard, it is necessary to invite the student to view them in proper perspective. They are of extremely rare occurrence, and the physician will not often fall into error who maintains a skeptical attitude toward cases of supposed pregnancy in which apparently normal menstruation is reported to continue.

In women who are habitually irregular, or in whom the menstrual periods are absent altogether, the question of the existence of pregnancy is often in the early months a very puzzling one. There are now and then patients who menstruate only at long intervals. If they once suspect pregnancy, they are apt to simulate other corroborative signs ; or, on the other hand, they may proceed far in gestation without the slightest misgivings of their true condition. In such instances the physician, unless he bases his opinion on purely objective symptoms, is at times drawn into error, which places both himself and his patient in a ludicrous position.

In the same category are to be placed cases of pregnancy occurring in nursing women before the return of the menses, in young girls before the appearance of menstruation, and in women who have apparently passed the climacteric.

Among the *sympathetic* disturbances, those of the stomach possess the greatest diagnostic importance. *Nausea* and *vomiting*, occurring especially in the morning, and following suppression of the menses, are signs to which the women themselves, and the laity in general, attach great value. They are, however, sometimes absent in pregnancy, while they are present in a variety of other conditions. They are notable features of chlorosis, where they are likewise often associated with suspension of menstruation. However, after eliminating other morbid causes, they are always suspicious symptoms in women who, in their sexual relations, have exposed themselves to conception, and who never experienced similar sensations in the unimpregnated state. Abundant *salivation* possesses a similar significance.*

Tingling sensations and swelling of the *breasts*, turgescence and

* A pellicle, formed upon the surface of the urine, twenty-four to forty-eight hours after emission, was once regarded as of great diagnostic value. It received the name of kiesteine, and has been found to consist of a proteine substance, triple phosphates, fungi, and infusoria. It is not invariably present in the urine of pregnant women. It may occur at other times, and has even been found in the urine of the male.

pigmentation of the areola, the development of the glandular follicles around the nipple, enlargement of the superficial veins, and the secretion of milk, are valuable though not infallible signs of pregnancy. Thus, painful sensations and sympathetic swelling of the breasts may depend upon pathological conditions of the sexual organs. To be of importance, they should be persistent and progressive. The coloration may be the relic of a previous pregnancy. The other changes in the areola rarely lead us into error when they are present, but I have often noted their entire absence. I have likewise noted cases where there was entire absence of milk in the breasts until after confinement. Numerous and very curious instances of milk in the breasts of the non-pregnant have been recorded. The importance of these exceptions is greatly lessened by the fact that milk rarely appears in pregnancy before the development of other signs which enable us to make the diagnosis certain.

Increase in the size of the abdomen during the child-bearing period always suggests the existence of pregnancy. But it is to be remembered that it is not invariably of uterine origin. Thus, it may result from ascites, from an excessive deposit of adipose tissue in the abdominal walls, from tympanitic distention, and from various abdominal tumors having no connection with the uterus. If the enlargement proves to be due to a uterine tumor, we have then to exclude fibroids in the earlier months, subinvolution, and the increase of size often associated with peri-uterine inflammations. The absence of uterine enlargement, in women supposed to be several months pregnant, possesses, of course, absolute value in the way of purely negative testimony.

The changes in the *os* and *cervix uteri* are of great value in deciding the question of pregnancy. They consist of softening and œdematous swelling of the cervix, velvety character of the mucous membrane, associated with increased cervical secretion. In primiparæ the external orifice, instead of offering the sensation of a transverse slit, feels circular. In multiparæ the tip of the finger penetrates to a greater depth than in its former state. During the first two months the changes are rarely sufficiently marked to distinguish them from conditions that obtain at or near the menstrual period.

Quickening is the term used to designate the earliest movements of the fœtus perceived by the mother. They are at first slight, and have been compared "to the tremulous motion of a little bird, held in the hand" (Montgomery). Modern investigations place the time at which the fœtus first begins to employ its muscles at about the tenth week. It is, however, somewhat rare for these movements to excite the attention of the mother before the sixteenth to the eighteenth week, though experienced matrons may recognize them at an earlier period. Hyperæsthetic women do so, I should say, as a rule. The clear

statements of intelligent women leave me no reason to doubt that they may feel life as early as the twelfth week. At first the sensation is that of a flutter or tap, but the intensity of the movements is increased as pregnancy advances. They are rendered more active by a long fast, and by certain positions in bed. For considerable periods during the day they disappear altogether. Occasionally they may be suspended for days or weeks at a time, without the life of the child having become necessarily compromised. Cases have been cited in which women have never recognized the feeling of quickening throughout the entire period of pregnancy. Dropsy of the amnion and ascites are said to obscure the sensation of the fetal movements.

The subjective impressions of women as to quickening require, however, to be received with reserve. Instances are not infrequent where sterile women, misled by their eager longings for maternity, have not only deceived themselves, but have succeeded in betraying their medical advisers into error by their confident assurances of having distinctly felt the movements of the child in the womb.

Fetal movements, on the other hand, when recognized by the medical expert, furnish conclusive evidence of pregnancy. These movements may be *active* or *passive*. *Active movements* may be detected by the eye, or by immediate contact. They seldom assume much distinctness before the sixth month, though this is not invariably the rule. (Thus, a patient of mine, the mother of six children, aborted at the fourth month. The ovum was expelled on the 27th of March. She gave birth on the 25th of December following, i. e., just nine months later, to a full-term child. In the latter part of July the movements were clearly appreciable to both the sight and touch.) At first the sensation is that of a simple pat or throb, but in the sixth and seventh month the limbs may be felt to escape from under the hand with a rolling or gliding movement. In the last two months, in women with lax abdominal parietes, it is sometimes possible to seize with the fingers a limb of the fœtus, especially when it chances to form a projection recognizable through the intermediate coverings. The fetal movements have been closely simulated by the irregular and spasmodic action of certain of the abdominal muscles. In the celebrated case of Joanna Southcote, who at the age of sixty-four claimed to be with child by the Holy Ghost, Dr. Reece says, "I felt something move under my hand, possessing a kind of undulatory motion, and appearing and disappearing in the same manner as a fœtus." *

Ballottement is the term applied to the *passive movements* communicated to the fœtus by the physician. It may be performed either by

* Montgomery, "Signs of Pregnancy," second edition, p. 144.

impressing the uterine contents with the two hands, laid upon the abdominal wall, so as to cause the intervening body to float between them ; or by introducing two fingers into the vagina and pushing them suddenly against the lower segment of the uterus just anterior to the cervix. When this is done, the head, if the presenting part, is made to bound away from the fingers, to drop down again in a few moments upon them with a gentle tap. Vaginal ballottement can sometimes be practiced successfully as early as the latter part of the fourth month. Ballottement is to be regarded as positive proof of pregnancy, as there is no other condition in which a solid body is found floating in the uterine cavity.

The *auscultatory* signs consist of the *uterine bruit* and the sounds of the *fetal heart.* The discovery of the latter was made by M. Mayor, a surgeon of Geneva, as appears by the following note contributed by the editor of the "Bibliothèque Universelle," in speaking of the *compte rendu*, made by Percy, June 29, 1818, to the Academy of Sciences, upon the memoir of Laënnec relative to auscultation : "This observation reminds us of one made by M. Mayor, which has appeared very interesting to us in its connection with the art of midwifery and legal medicine. He has discovered that it is possible to recognize with certainty whether a child is living or no, by applying the ear to the abdomen of the mother of the child ; if the child is living, one can hear very well the beatings of its heart, and distinguish them from those of the maternal pulse." * Time has served only to confirm in the most complete manner the accuracy of this statement. The heart-sounds of the fœtus, when once clearly heard, are now regarded as the most valuable of the signs of pregnancy, and conclusive evidence that the child is alive. They are, like those of the mother, distinctly double, and have been aptly compared by Kergaradec to the tic-tac of a watch. They are much more rapid than the corresponding sounds in the heart of the mother, oscillating between 120 and 160 per minute. They may be temporarily increased in frequency by movements of the mother, and by both the active and passive movements of the child. At the beginning of a pain, especially after rupture of the membrane, the heart-sounds often become more frequent ; on the other hand, they become slowed during the height of the contraction, and may even for the moment cease altogether, either in consequence of the compression of the child's body, or as the result of the disturbance produced in the placental circulation. In the interval between the pains, the average frequency is usually restored. If at any time the frequency of the heart-beat permanently either rises above or falls below the normal average, the child's life is to be regarded as endangered. As the fetal circulation is entirely independent of that of the mother, there is no direct relation between the rapidity of the pulsations of the fetal and

* Joulin, "Traité complet d'accouchement," 1867, p. 410.

maternal hearts. However, in the febrile affections of the mother, the health of the child may become coincidently deranged, with resulting increase in the frequency of its heart's sounds. In general, the heart beats more frequently in girls than in boys, a circumstance probably owing to the average smaller size of the female at birth. In fifty observations, Frankenhaeuser* found the average in the boys was 124, while that of the girls was 144. He believed, therefore, that it would prove possible to predict the sex of the child *in utero* three months previous to confinement. Subsequent experience has demonstrated, however, that prophecies based upon the frequency of the heart-beats are at best of only approximative value, and that it is the part of wisdom to reserve a prognosis which may be falsified by time.

The fetal heart may generally be made out by the eighteenth to the twentieth week. Under favorable circumstances it has been detected as early as the fifteenth to the sixteenth week. It is usually heard over the dorsum of the fœtus; in face-presentations, on the contrary, it is heard most distinctly over the anterior surface of the thorax. The sound is often obscured by the thickness of the abdominal walls in fat women, and by an excessive amount of amniotic fluid. When the dorsum of the fœtus is turned posteriorly, it may be absent altogether. It is customary, therefore, to make frequent examinations at intervals before deciding, in consequence of its failure, upon the death of the child.

The *uterine bruit* is a blowing sound synchronous with the maternal pulse. It resembles strongly the souffle heard in aneurismal tumors, and varies greatly in quality and intensity. It is apt to be louder in markedly anæmic women. During uterine contractions it possesses more of a musical character; at the height of a pain it may disappear for the moment altogether. It may be modified by the pressure of the stethoscope or arrested altogether. When first discovered by Kergaradec (1822), it was attributed to the utero-placental circulation, and was therefore termed the placental bruit. As, however, it was found to persist two or three days after delivery, it became evident that the sound must be of uterine origin. It is now the generally accepted belief that the sound is produced in the ascending branches of the arteria uterina. Rotter† and Rapin have shown that, in pressure along the course of the artery, both when made through the abdominal walls and through the vagina, a vibratory thrill may be experienced by the touch, which corresponds to the sounds heard in auscultation.

It is seldom heard before the fourth month. Spiegelberg‡ states

* "Monatsschr. f. Geburtsk.," Bd. xiv, p. 161.

† Rotter, "Ueber fühlbares Uteringeräusch," "Arch. f. Gynaek.," p. 539.

‡ "Lehrbuch der Geb.," p. 104.

that, in women with lax abdominal parietes, he has succeeded, by pressing the stethoscope, placed above the symphysis pubis, deep downward so as to reach the sides of the lower portion of the uterus, in detecting the murmur as early as the eighth to the ninth week. As a sound similar to the uterine bruit may sometimes be detected in uterine fibroids, its value as a distinctive sign of pregnancy is thereby greatly impaired.

A hissing sound synchronous with those of the fetal heart is sometimes heard in auscultating the abdomen. This sound is referable to the umbilical cord, and is termed the *funic souffle*. Its etiology is a matter of conjecture. As it is only found in fourteen to fifteen per cent of cases examined, it possesses moderate value as a sign of pregnancy.

Interrogation of the Patient.—In all cases of presumed pregnancy it is customary to commence an investigation by preliminary inquiries as to the existence of the more important subjective symptoms. As such are to be regarded the suppression of the menses, the so-called "morning-sickness," salivation, pricking sensations and lancinating pains in the breasts, enlargement of the abdomen, and quickening. As we have already seen, however, none of these symptoms are really decisive. Patients, by their statements, may in perfect good faith lead the physician into error; or, where they have an interest in practicing deception, may deny the existence of incriminating symptoms altogether. It is, therefore, often necessary to supplement the testimony of patients by the evidences to be obtained by a clinical examination. Ordinarily the vaginal touch suffices. In a few cases of doubt it may be necessary to possess one's self of all the objective signs before arriving at a conclusion.

Methods of Physical Exploration.

The patient may be examined in the upright or recumbent position. In the upright position, the physician may first examine the breasts, with reference to the existence of the changes characteristic of pregnancy. With the eye he takes note of the œdema and discoloration of the areola, the development of the follicles, the secondary areola, and the increased size of the organ. To distinguish from the enlargement of the breast due to adipose tissue, he looks for the presence of developed veins upon its surface, and with the touch recognizes the knotty, uneven feel produced by the development of the glandular tissue. By pressing the breast near the nipple between the thumb and index-finger the presence of milk may be determined.

An examination *per vaginam* is sometimes made in the upright position, in cases where the physician desires simply to rapidly acquaint himself with the condition of the generative passages and the

lower portion of the uterus. The patient either stands with the feet apart, or with one foot raised upon a stool, while the physician, kneeling before her, encircles her hips with the left arm, and with the right hand, passed beneath the clothing, makes the requisite exploration. This method furnishes incomplete results, and is apt to offend sensitive patients. It possesses no advantages over that in the recumbent position, and is rarely resorted to except in the hurry of office practice.

Although for certain purposes it may prove advantageous to choose the lateral or knee-chest position, in all ordinary cases it is advisable to examine the patient upon her back, as being most convenient for both external, internal, and conjoined exploration.

In the dorsal position the body should be as nearly horizontal as possible, with the head and shoulders resting upon a pillow, and the thighs flexed at right angles to the body, and separated from one another. In this way the greatest possible relaxation of the abdominal walls and of the perinæum is attained. Corsets, or other articles of apparel interfering with freedom of investigation, should be removed. The woman should be covered with a sheet, and the clothes reflected upward so as to expose the abdomen. Where actual inspection is not necessary, it is well to draw the chemise smoothly over the abdominal walls to avoid offending the modesty of the patient. When it is of importance to survey the external surface, care should be taken to so arrange the sheet as to cover the pubic region.

Inspection of the abdomen enables us to recognize its form and shape, the coloration of its surface, the striæ due to distention, and the condition of the navel. A flattening of the abdomen at the umbilical region, with bulging at the sides, would lead to the suspicion of ascites. A depression of the navel is incompatible with advanced pregnancy. Fetal movements are sometimes visible through the abdominal parietes.

Palpation of the abdomen enables us—1. To recognize the size, shape, and consistency of the uterine tumor, and to distinguish it from other intra-abdominal growths; 2. To ascertain, in advanced pregnancy, the presence of the fœtus. In a very large number of cases palpation alone serves to establish the existence of pregnancy. It is, however, only after the third month of pregnancy, when the fundus uteri can be felt above the symphysis pubis, that this method of exploration becomes available.

In its performance the physician stands by the side of the patient, and with the tips of his fingers rapidly traverses the abdomen from the pubes upward. In this way he takes note of the thickness of the abdominal walls and of the general position of the uterus. The latter may then be outlined by pressing the abdominal walls inward to the

sides of the uterus, with the ulnar borders of the two hands. The uterus is then steadied with one hand, while, with the other, intermittent pressure is made to determine the consistence of the tumor. In pregnancy, after the second month, the uterus becomes soft and elastic, a condition that increases with the growth of the ovum, so that, toward the end, palpation often furnishes an obscure sense of fluctuation. The physician should next turn his face toward the feet of his patient, and make deep pressure above the symphysis pubis to the lower borders of the uterus. He should here seek to discover the vibratory thrill, which may sometimes be detected along the course of the uterine arteries. At the same time, in head-presentations (after the sixth month), a hard, round body can generally be felt, and made to float to and fro between the examining fingers of the two hands. In thin persons, with relaxed abdominal and uterine parietes, it is possible, in the later months, to trace upward the back, the breech, and the extremities of the fœtus. During the progress of the examination in advanced pregnancy, the movements of the child are usually excited, and are readily appreciated.

The Differential Diagnosis of Pregnancy.

The differential diagnosis between pregnancy and other sources of abdominal enlargement is, in most cases, not difficult. In subperitoneal myomata of the uterus, the unevenness of the surface and the hardness of the tissues are distinctive. But it must be remembered that myomata, though they commonly cause sterility, do not actually exclude pregnancy. In the rare cases in which myomata and pregnancy coexist, the diagnosis for a time may be doubtful.*

It is, therefore, important, where any uncertainty exists, to abstain from the use of sounds and to await the result of a future examination. In a few weeks' time the rapid growth of the pregnant uterus, quickening, ballottement, and the fetal heart will furnish the necessary data for establishing the distinction.

Ovarian cysts, in the early stages of their growth, occupy a position to the side of the pelvis, and are hardly likely to be confounded with the pregnant uterus. When, however, by their increase in size, they fill the abdomen, the history of ovariotomy shows that, without

* Braxton Hicks lays great stress on the fact that, from the third month to the completion of labor, spontaneous contractions of the uterus take place, lasting generally from one to two minutes, and occurring at intervals of from five to twenty minutes. This enables us to determine the fact of pregnancy, and that the pregnancy is intra-uterine. It occurs, likewise, in degenerations of the ovum, and in cases of a dead fœtus. He found, too, that where pregnancy coexisted with myomata the exact relations of the uterus were readily made out by the alteration which occurred at short intervals in the density of the uterus. "Trans. Internat. Med. Congress," 1881–'84.

a full and complete examination, such a mistake is possible. Where ovarian cysts are complicated by pregnancy, the latter has been at times overlooked, simply because it was not so much as suspected. Thus, a young servant-girl was sent to me some years ago to consult me relative to the nature of an abdominal tumor. The diagnosis of ovarian cyst was readily established. A year later she sought the advice of a surgeon, formerly of this city, who counseled its removal. Having obtained her consent, he made the usual incision in the median line, and exposed, to his horror, the pregnant uterus. He afterward learned that the girl, having been assured that conception was impossible on account of the ovarian disease, had yielded to the solicitations of her lover. Finding herself pregnant, she purposely concealed her condition, and had sought the operation when seven months advanced, in the hope that a fatal issue would cover her shame. The ovarian tumor was left untouched, and the wound was quickly closed. The girl died, however, a few days afterward. In this case, the undoubted presence of an ovarian cyst and the reputable character of the girl combined to disarm suspicion.

In ovarian cysts there is, on palpation, ordinarily greater distinctness of fluctuation than in the gravid uterus. The diagnosis is, however, mainly based upon the presence or absence of the usual signs of pregnancy.

Thick layers of fat in the abdominal walls and ascites could hardly be mistaken for pregnancy, though they may serve to obscure palpation.

Tympanitic distention is recognized, in part, by the character of the percussion-note, and, in part, by demonstrating the absence of the uterine tumor. The latter is accomplished by directing the patient to make alternate deep inspirations and prolonged expirations. The physician then places the left hand upon the abdomen. During the long inspiration he remains passive; with the expiration, he presses with the fingers of the right hand, placed obliquely against those of the left, in the direction of the spinal column. With the recurrence of inspiration, he holds steadily the ground previously gained. During the following expiration further progress is made, and thus by successive advances, in case no intervening body prevents, the hand is made to sink inward until the vertebræ are felt.* In cases of undue sensitiveness of the abdominal walls, chloroform may be administered to complete anæsthesia. Some patients, by means of contractions of the abdominal muscles, succeed in producing the semblance of a tumor, which may even be mapped out with the hands applied to the abdomen. These so-called "phantom tumors" occur most commonly in hysterical women who are earnestly desirous of becoming mothers.

* This valuable method is borrowed from Professor SPIEGELBERG's "Diagnose der Eierstocktumoren," Volkmann's "Samml. klin. Vortr.," No. 55.

They are eminently calculated to entrap the unwary, if the examination be confined to the abdomen, or to listening to the patient's subjective symptoms. They flatten down and disappear under chloroform, or when the attention is distracted during the course of an investigation.

Auscultation furnishes the most certain evidences of the existence of pregnancy. The stethoscope may be employed, or the ear may be applied directly to the abdomen. To hear the fetal heart requires a certain amount of practice, but the art can be readily acquired. As the sounds are, at best, of feeble intensity, the utmost stillness in the neighborhood of the patient is necessary for this appreciation. They are always heard with great difficulty before the end of the sixth month. There is no special point at which they can be invariably distinguished. In head or breech presentations, with the back of the fœtus curved and in contact with the uterine wall, the sounds are most clearly to be made out over its dorsal aspect. In face-presentations, on the contrary, the anterior surface of the child is pressed against the uterine walls, and the sounds are heard with the greatest distinctness over the chest. As in the last three months of pregnancy the cephalic presentations, with the back to the left, preponderate, the heart-sounds are oftenest heard in a line extending from the anterior superior spinous process to the umbilicus. When the back of the child is turned to the right, they are likewise directed somewhat posteriorly. The heart-sounds are then less accessible, and therefore appear feebler. Care must be taken not to confound with the fetal heart the conducted heart-sounds of the mother, or the aortic pulse. Thick abdominal walls, or abundant amniotic fluid, may interfere with the recognition of the heart-sounds. When the back of the child is turned to the rear, or during a uterine contraction, they may disappear altogether. If the child be living, however, repeated examinations will not fail to detect them. The uterine souffle is heard with maximum intensity to the sides of the uterus. In the early months it is to be sought for near the median line, just over the symphysis pubis.

The vaginal touch enables one to effect an examination of the genital canal and that portion of the uterus which is contained within the pelvic cavity. The accoucheur should accustom himself to use either hand with equal ease, and to conduct an examination upon whichever side of the bed his patient chances to be lying. The index-finger should be anointed with cold cream, lard, butter, vaseline, oil, or simple soap-and-water, to make its introduction into the vagina less painful. As the hand is passed under the clothes, it is a good plan to cover the index with the thumb and remaining fingers, to prevent its soiling the patient's wearing-apparel. The patient should now be told to separate her knees widely, while the index-finger glides forward over the perinæum to the introitus vaginæ. Note should be

taken here of the size and direction of the orifice, and the degree of resistance afforded by the external parts. Where there is much hair about the pubes, the introduction of the index-finger into the vagina is greatly favored by separating the labia with the fingers of the other hand. As the finger enters the vagina, it is well to notice the urethra, the condition of the rectum (whether filled with fæces), the length and width of the vagina, and the amount of lubricating secretion furnished by the vaginal walls. To explore the anterior half of the pelvis, close the unemployed fingers upon the palm of the hand, direct the palmar surface of the index-finger to the front, and press upward to the presenting part. In the early months, place the unemployed hand upon the abdomen above the symphysis pubis, and, by conjoined manipulation, make out the size, shape, and consistence of the uterus. If pregnancy is sufficiently advanced, ballottement may be produced. To reach the cervix, the finger should be next turned to the rear. Many practitioners now prefer to extend the previously closed fingers, and press them opened against the perinæum. Should the cervix not be readily reached, the examination should be made with both the index and middle fingers. If the middle finger is introduced slowly and with care, it gives no additional pain, and increases the reach by nearly an inch. The actual distance to the cervix may be diminished by placing the closed hand under the extremity of the sacrum, so as to diminish the degree of pelvic inclination. It is often necessary to resort to this measure when, toward the end of pregnancy, the cervix is situated unusually high up and is directed well to the rear. With the touch, we recognize the size and thickness of the cervix, the length of both the anterior and posterior walls, the shape of the os, and, if open, the character of the cervical canal.

The rectal touch is only necessary where there is obliteration of the vagina, a condition which does not exclude pregnancy, but it is sometimes usefully resorted to in other cases to complete information obtained by vaginal exploration.

The speculum, though it furnishes us with a view of the coloration of the vagina, a most valuable sign, is rarely employed as a means of diagnosis.

Distinction between First and Subsequent Pregnancies.

In women who have once completed the full term of utero-gestation, the imprints left by the pregnant state are indelible, and easy to recognize. As it is sometimes a matter of forensic importance for a physician to be able to distinguish between first and subsequent pregnancies, it is desirable for every practitioner to make himself familiar with the characteristic differences between the two conditions.

In primiparæ the abdominal integuments are firm and tense, so

that it is difficult to map out through them the underlying uterus, or to feel the head, the breech, or the limbs of the child. The striæ found upon the abdomen, the nates, and the thighs, appear late in pregnancy, and have a reddish-brown or slaty color. The breasts are full, firm, and sensitive to pressure. The labia are in apposition, and the frænulum is intact. The hymen is torn, but each fragment remains attached in its entirety to the introitus vaginæ. The urethra is hypertrophied, and appears as a cylindrical body, of a reddish-blue color, in the vaginal orifice. The vagina itself is narrow, with distinct transverse ridges, and oftentimes possesses a granular feel, from the enlargement of the papillæ. The vaginal portion of the cervix is soft. When the head enters the pelvis, toward the end of pregnancy, shortening of the anterior lip takes place. The os externum is closed, or, not infrequently toward the close of gestation, admits the passage of the extremity of the examining finger. It then feels like a round opening, with smooth borders, and a sharp inner edge at the point where it joins the cervical mucous membrane. The cervical canal has a spindle shape. The head, in the latter months, as a rule, sinks into the pelvis, and bulges the vagina.

In *women who have already borne children*, the skin of the abdomen is loose, wrinkled, and can be gathered into folds by the hands. The uterus is likewise relaxed, and through its walls can be felt, in many cases, the projecting parts of the fœtus. The uterus is easily defined. In addition to the striæ upon the abdomen, noted in primiparæ, many of older date, possessing a shining white or silvery appearance, can be made out. The breasts are flabby, pendulous, and marked with silvery lines. The vulva gapes open, and wears a bluish aspect from the development of the superficial veins. The frænulum is usually found to have been lacerated. The carunculæ myrtiformes alone remain as vestiges of the hymen.* The vagina is smooth, from the obliteration of the transverse ridges. Swelling of the vaginal papillæ is exceptional. The cervix is swollen, and has a cylindrical rather than a conical shape. At times it is like a cone, with the base downward. The os is open, and admits the extremity of the finger. This patulous condition is due to lacerations of the cervix, which are the inseparable concomitants of child-bearing. The lacerations differ greatly in degree, but are rarely difficult of recognition. As they are situated usually on the sides of the cervix, they convert the os into a wide, transverse slit, bounded by a well-defined anterior and posterior lip. The cervical canal has a funnel-shape, narrowing above. In the ninth month (in some cases earlier) the finger passes readily through the os internum to the child's head. The latter rarely descends into the pelvis before the advent of labor, but either is situated at the brim, or rests upon one of the iliac fossæ.

* *Vide* p. 7.

It should be added, finally, by way of caution, that while the presence of the foregoing signs speaks plainly in favor of the existence of a previous pregnancy, their absence is not absolutely incompatible with the occurrence of a premature labor, or even, in rare cases, with the delivery of a small fœtus at full term.

The Diagnosis of the Death of the Fœtus.

The presence of a dead child *in utero* may be inferred where active movements are not elicited by palpation, or where the heart-sounds, after repeated trials, can not be made out. As we have seen, a number of conditions sometimes combine to temporarily render it impossible, even when the child is living, to obtain positive results by auscultation. A decision should not, therefore, be based upon the results of an isolated examination.

In the earlier months, previous to the period when the fetal heart can be heard, the death of the fœtus is rendered probable by flabbiness and diminution in size of the uterus, by a flaccid condition of the breasts, and certain subjective sensations experienced by the mother, such as languor, chilliness, bad taste in the mouth, and the feeling of a weight like a foreign body in the hypogastrium. Certainty is obtained when, through the open cervix, the cranial bones can be made out, and are found loose and movable within the integuments.

The Duration of Pregnancy.

There is no question, in obstetrics, upon the solution of which so much ingenuity has been expended as the determining of the normal duration of pregnancy. Inasmuch as it has proved impossible to ascertain the precise moment in which conception (i. e., the fertilizing of the ovum by the spermatozoa) takes place, it has been customary to assume as the starting-point for the reckoning of gestation either the date of the last menstruation, or that of a single fruitful coitus. It would seem at first as though the latter would lead us to more nearly accurate results. But, aside from the fact that the distance of time between insemination and conception is avowedly variable,* it is only in rare cases that the particular coitus which has resulted in pregnancy can be definitely ascertained. Duncan collected 46 cases in which connection took place during a single day only, and found the average time to the date of parturition was 275 days. Ahlfeld, from an analysis of 425 cases, obtained an average of 271 days.† In 108

* Duncan, "Fecundity, Fertility, and Sterility," second edition, pp. 433, 435.

† "Beobachtungen über die Dauer der Schwangerschaft," "Monatsschr. f. Geburtsk.," Bd. xxxiv, p. 208. Ahlfeld's actual reckoning gave an average of 269·91 days, but this was afterward corrected by Löwenhardt, who found Ahlfeld's tables really furnished an average of 270·94. *Vide* Löwenhardt, "Die Berechnung und Dauer der Schwangerschaft," "Arch. f. Gynaek.," Bd. iii, p. 458.

cases furnished by Hecker the average was 273·52 days.* Veit published 43 cases, with an average of 276·42 days.† In 63 cases of Faye's the average was 270·66.‡ Undoubtedly many of the cases included in these tables are of questionable reliability; two of them, indeed, in which confinement is reported to have followed coitus, respectively in 329 and 330 days, evidently belong to the realm of fable. Assuming, however, that the size of the tables serves to nearly neutralize specific inaccuracies, the small value of the averages obtained, as a means of predicting the date of confinement, is shown by the wide differences between the terms of gestation in the individual cases of which the tables are composed. Thus, in Ahlfeld's table there existed, between the longest and shortest gestation, a difference of 99 days; in Hecker's, a difference of 63 days; and in Veit's, a difference of 36 days. In the breeding of domestic animals, in which conception, as a rule, follows a single act of sexual congress, similar variations are common. In the now familiar observations of Tessier, Krahmer, and Spencer, the average duration of gestation in rabbits is 31 days, the variation 8 days; in sheep, pregnancy averages 151 days, and the variation amounts to 26 days; in cows, the average time of gestation is 283 days, but calving may occur between the 183d and the 356th day; in mares, the average time is 347 days, but foaling may occur between the 287th and the 419th day.#

However, Ahlfeld's tables show that the bulk of confinements vary within narrow limits. Of 653 women, in 15·93 per cent. delivery occurred in the thirty-eighth week; in 27·56 per cent., in the thirty-ninth week; in 26·19 per cent., in the fortieth week; and in 10·01 per cent., in the forty-first week. In other words, more than half the cases occurred in the thirty-ninth and fortieth weeks, and 80 per cent. between the thirty-eighth and forty-first week inclusive. Of the remainder, 14 per cent. took place prior to the thirty-eighth week, and were probably influenced by the many operative accidental causes which favor prematurity. Of the 6 per cent. reported as occurring later than the forty-first week, a considerable number are of questionable authenticity. Gestation protracted beyond the two hundred and eighty-fifth day is certainly of very rare occurrence.‖

* Ahlfeld, *op. cit.*, p. 208.

† *Ibid.*, p. 210.

‡ Other tables may be found in Montgomery, "Signs of Pregnancy," second edition, pp. 493 *et seq.*

Vide Ahlfeld, *op. cit*, p. 216; St. Cyr, "Traité d'obstétrique vétérinaire," pp. 107 *et seq.*

‖ Many cases of apparent protracted gestation find their explanation in the fact that conception may occur just prior to the menstruation period succeeding to that from which the count is made. In one instance, in which a lady was confined three hundred and six days after the last menstrual period, the statement was volunteered that for twenty days following menstruation "precautions" against pregnancy had been resorted to.

Prediction of the Day of Confinement.

In all schemes for predicting the date of confinement, it is customary to throw out, as defying calculation, the exceptional cases, which fall much below or greatly exceed the usual average. No scheme is ever likely to be devised which will insure accuracy with regard to the day upon which labor will occur. In every scheme it has been assumed that errors of from four to five days are inevitable. Moral emotions, fatigue, attacks of indigestion, mechanical causes, and the like, are recognized as liable, toward the end of gestation, to precipitate labor at any time. But a vast deal of ingenuity has been expended in the endeavor to reduce ordinary errors within the narrowest limits.

The Last Menstruation.—Now, it has already been remarked that it is only in rare cases that the day of conception (i. e., insemination) can be utilized. In all calculations of the duration of pregnancy, it has been customary, therefore, to select the menstrual period as the starting-point. As the days immediately following menstruation are those in which conception usually occurs, the end of menstruation has been adopted by some as the most suitable point of departure. Ahlfeld estimated that 35·55 per cent. of married women conceived on the last day of menstruation, and that 88·44 per cent. conceived within twelve days, counting from the first of menstruation.* Experience has shown, however, that there is no single day in the intermenstrual period in which conception may not occur. Jewish women, indeed, who are forbidden sexual intercourse by the Mosaic law during menstruation and the seven days following, are proverbially fruitful. Löwenhardt has shown that, though in two women conception follow in each a single act of coitus, occurring the same number of days after menstruation, there is no necessary correspondence of the date of confinement in the two.†

As, therefore, there is little to be gained by estimating the day of confinement from the probable day of conception, it has become the usual rule to reckon from the first rather than from the last day of menstruation, especially as most women exercise more care in preserving the record of the former date.

From the days of Hippocrates, it has been customary to regard pregnancy as extending over ten lunar months, or ten menstrual periods of twenty-eight days each. In accordance with this idea, Naegele‡ proposed a ready method of computing two hundred and eighty days from any given date, which has since his time been generally adopted. This consisted in counting forward nine months, or, what amounted to the same thing, counting backward three months, and then adding seven days (in leap-years, after February, six) to the date

* Ahlfeld, *op. cit.*, p. 191. † *Op. cit.*, pp. 461 *et seq.*

‡ Naegele, "Lehrbuch der Geb.," achter Auflage, p. 122.

chosen as the starting-point of the calculation. Naegele selected the first day of the last menstruation. His method is, of course, equally applicable, when the day of cessation is preferred as the point of departure. For seven months in the year Naegele's method is absolutely correct. In February, however, four days, in December and January, five days, and in April and September, six days only are required to complete two hundred and eighty days. Tables may be found in most physicians' visiting lists, by means of which the two hundred and eighty days may be determined at a glance. The following circle of

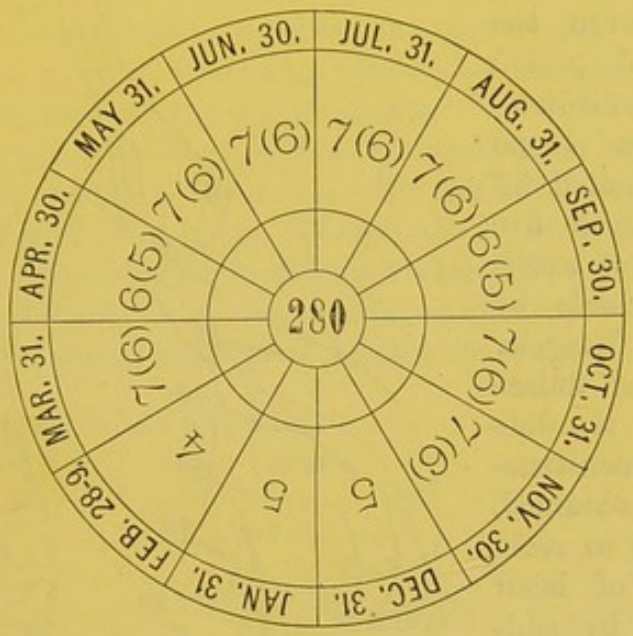


Fig. 74.—Diagram for computing pregnancy. (Schultze.)

Schultze is based upon Naegele's method. The figures between the radii show the exact number of days to be added for each of the months severally. The figures in parentheses are to be employed in leap-year.

Unfortunately, the supposition that labor comes on after the expiration of ten menstrual periods of twenty-eight days each is correct for only a small number of cases, so that it has been found necessary to shift the ground somewhat to the position that the normal duration of pregnancy covers ten menstrual periods. The instability of the reckoning would then find its explanation in the common experience that ten consecutive periods of exactly twenty-eight days each are rare even in the most regular of women. Although ovulation is suspended during pregnancy, at the return of the menstrual epochs the existence of an ovarian influence upon the generative organs may be clearly traced in many individuals. At such times a sensation of fullness is often experienced in the pelvic organs, associated in some women with an awakening of the sexual appetite. At such times, too, there has

been observed a tendency to miscarry, so that it becomes incumbent upon sensitive, impressionable females, predisposed to abort, to especially avoid either reflex or mechanical sources of disturbance during the continuance of the state under notice. When the ovum reaches maturity, the recurrence of the tenth menstrual epoch furnishes local conditions in a peculiar degree favoring the production of labor. Löwenhardt * found it was possible to calculate the duration of pregnancy in twenty-two individuals with tolerable accuracy, by assuming that ten menstrual periods represent not two hundred and eighty days, but ten times the length of time between the last menstrual period and the one immediately preceding it. In no case thus calculated did the error exceed five days, a degree of exactitude unattainable by the method of Naegele.

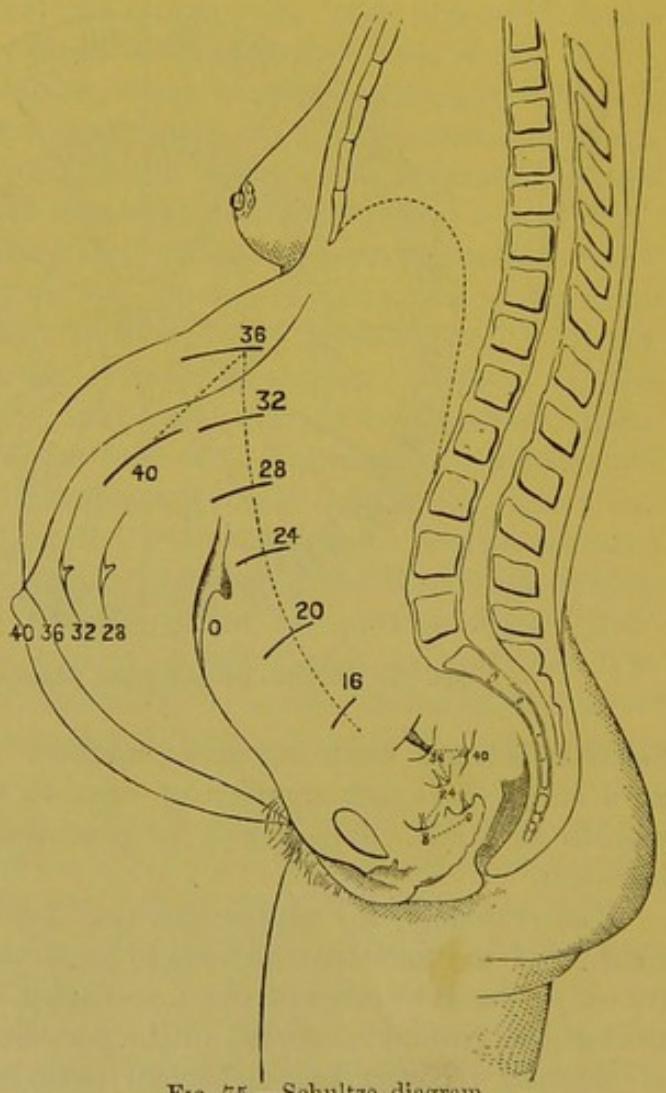


Fig. 75.—Schultze diagram.

The Date of Quickening.—When the date of the last menstruation can not be obtained, it is customary to reckon the time of labor approximately by adding twenty-two weeks to the date of quickening, which is assumed to occur in the eighteenth week of pregnancy. The extreme variation, however, in the time at which quickening occurs in different individuals renders this method of calculation a very uncertain one.

The Size of the Uterus.—As the increase of the uterus is progressive, its size is sometimes used in determining approximatively the

* "Die Berechnung und die Dauer der Schwangerschaft," "Arch. f. Gynaek.," Bd. iii, p. 476. In quite a number of instances I have had curious confirmation of Löwenhardt's theory. Thus I can recall two cases where the menses recurred once in twenty-six days, and the apparent length of gestation was two hundred and sixty days. But the rule has many exceptions.

period to which gestation has advanced. According to a rude formula, commonly employed at the bedside, the uterus is, in the second month, of the size of an orange; in the third month, of the size of a child's head; in the fourth month, it can be felt above the symphysis pubis. In the fifth month, the fundus of the uterus rises to a point midway between the symphysis and the navel. By the sixth month, it reaches the level of the navel. In the seventh month, it should be the breadth of two to three fingers above the navel. In the eighth month, it rises half-way between the navel and the epigastrium. In the ninth month, it reaches the epigastrium. In the tenth month, two to three weeks before confinement, the uterus sinks downward and somewhat forward, so that its upper level corresponds very nearly to that of the uterus in the eighth month.

In the foregoing calculation most of the data are obtained from the relation of the fundus to the navel. But the navel is not a fixed point. Spiegelberg found the distance between the upper border of the symphysis and the navel varied in different women as much as six inches.* The average distance from the symphysis pubis to the fundus of the uterus in the different months of pregnancy he found was—

From the 22d	to the	26th week..	.....	8½	inches.†
"	"	"	28th week.....	10½	"
"	"	"	30th week	11	"
"	"	"	32d and 33d week.....	11½	"
"	"	"	34th week.....	12	"
"	"	"	35th and 36th week.....	12½	"
"	"	"	37th and 38th week.....	13	"
"	"	"	39th and 40th week.....	13¼	"

But the size of the uterus is subject to considerable variations, due to the size of the child and the amount of the amniotic fluid.

* "Lehrbuch der Geb.," Bd. ii, p. 115.

† These measurements exceed considerably those furnished by Farre, p. 83. The discrepancies are due in part to the extent of individual variation, and in part to the fact that they were made with a tape-measure. Thus, Ahlfeld, employing the cyrtomètre of Baudelocque, found the distance from the symphysis pubis to the fundus only ten and a half inches in the fortieth week. Ahlfeld found the length of the child to be nearly double the distance between the head and breech when the child assumed the attitude usual in the uterus. To determine the date of pregnancy, he proposed to measure the axis of the fœtus *in utero*, by means of a cyrtomètre, one extremity of which, passed into the vagina, rested upon the child's head, while the other was extended to a mark upon the abdominal wall corresponding to the breech. He then sought to establish the length of a child at each week of pregnancy. His tables show, however, such variations in the size of children born in the same week as to impair the practical value of the method. *Vide* AHLFELD, "Bestimmung der Grösse und des Alters der Frucht vor der Geburt," "Arch. f. Gynaek.," Bd. ii, p. 353.

PREGNANCY.

CHAPTER VI.

THE MANAGEMENT OF PREGNANCY.

Hygiene of pregnancy.—The disorders of pregnancy.—The blood-changes of pregnancy.—Pernicious anæmia.—Hydræmic œdema.—Varicose veins.—Nausea and vomiting.—Heart-burn.—Insalivation.—Pruritus.—Face-ache.—Cephalalgia.—Insomnia.

In studying the effects of pregnancy we saw that, besides the local changes in the sexual apparatus and the disturbances produced by pressure, the organism had to adapt itself to a variety of new conditions, of which the most conspicuous were alterations in the quality of the blood and increase of its quantity, with additional work thrown upon the lungs and kidneys, and reflex derangements of the nervous and digestive systems. The physiological condition of the pregnant woman approximates so closely to what would be regarded as pathological at other times that the necessity arises for the patient to carefully observe hygienic rules, while the physician often finds himself called upon to exercise his art in restraining distressing symptoms within limits consistent with the healthy progress of gestation.

The Hygiene of Pregnancy.—During the pregnant state, the increased elimination of carbonic acid by the lungs is necessarily associated with increased consumption of oxygen. This respiratory activity makes an abundance of fresh, pure air a matter of prime importance. As a rule, therefore, a rural neighborhood is more conducive to normal pregnancy than large cities. To be avoided are small, close, heated rooms, confinement in-doors, and crowded assemblages.

The dietary should embrace all nutritious, easily-digested articles of food. The natural tendency to acidity, heart-burn, flatulence, and colic is apt to be increased by indulgence in the products of the frying-pan and the dainties of the pastry-cook and confectioner. The consuming desire for unwonted articles of food, which is customarily termed "longings," I have never yet witnessed, and am tempted to regard as in a great measure mythical. A good appetite is the best safeguard against most of the discomforts of pregnancy. Owing, however, to the activity of the assimilative processes, a very moderate appetite is not incompatible with a considerable gain in weight. A very large appetite is not normal during pregnancy, and requires to be restrained.

The dress should be loose and easy. Garters and tight corsets should be discarded. When the projection of the abdomen removes

the folds of the dress from the lower limbs, flannel drawers reaching to the waist should be worn as a protection.

Gentle exercise, not pushed to the verge of fatigue, should be encouraged. Walks and drives in the fresh air are the best means of fostering sleep and maintaining the appetite and general assimilative processes. Violent exercise, on the other hand, is liable to produce miscarriage. It is stated that the predisposition to miscarriage is greatest at the third and seventh month. Throughout pregnancy special care should be observed at the recurrence of the menstrual epochs. Long railway journeys at such times are a frequent cause of trouble. Marital relations, though not absolutely to be prohibited, should be of infrequent occurrence. Excesses in the newly married are a common source of abortion.

The skin should be kept in good condition by frequent bathing, as by its eliminative action it is capable of relieving the kidneys of a portion of the work thrown upon them. The increased vaginal secretion renders it important for the woman to frequently wash the external genitals. The vaginal douche is a source of comfort to many women, but the quantity injected should not exceed a pint of water, and should be introduced slowly, with every precaution in the way of allowing an immediate reflux to take place.

The increased irritability often observable in pregnant women calls for the greatest forbearance and gentleness on the part of those who are brought into close contact with them. Their unreasonableness is not to be cured by either impatience or stern treatment. It is the product of nervous derangement, and is to be regarded as due rather to physical than to moral fault.

The Disorders of Pregnancy.—Among women reared amid the refinements of civilization the entire period of pregnancy is very frequently attended with a great deal of discomfort. The attempt to relieve the disorders of pregnancy *seriatim*, it should be stated in a general way, is a vain undertaking, and is a good method to beget hysteria by fixing the female's attention upon minor ailments. The best medicines, in a large proportion of cases, are amusements and occupations calculated to produce a forgetfulness of self. When, however, the disorders of pregnancy advance beyond the stage of discomfort to that of actual suffering or danger, every effort should be put forth for their relief or mitigation.

The Blood-Changes of Pregnancy.—The most important changes consist in the loss of red corpuscles and albumen. The former, as the oxygen-carriers to the tissues, are illy spared from the economy. When they have undergone destruction to any material extent, the cell-elements, whose vitality is intimately associated with the power to take oxygen from the blood, suffer from inanition, and the starved cells waste or fill with fatty molecules. These changes are of neces-

sity followed by loss of weight, muscular prostration, impaired functional activity of the secretory organs, and increased nerve irritability. As a consequence, the appetite fails, the digestion is weakened, neuralgic pains develop, and even moderate muscular exertion is attended with effort and followed by a sense of fatigue; vertigo, loss of memory, and, in severe cases, chorea, hysteria, and insanity, may result from the deranged condition of the nerve-centers; attacks of syncope, palpitations, and præcordial oppression point to feeble heart-action; the arterial tension is lowered and venous hyperæmia results; and, finally, the stagnant blood, deprived of its albumen, in place of inviting endosmotic currents, transudes through the walls of the vessels, giving rise to œdema and dropsical effusions. Gusserow* (1871) called attention to the fact that the anæmia of pregnancy might progress to such an extreme as to produce a fatal termination.

The treatment of anæmia is largely prophylactic. Light, air, moderate exercise, good food, regulation of the bowels, cheerful society, and an occasional respite from household and family cares, will always be the main checks to its extreme development. Iron, though of little avail in repairing losses which have already taken place, is of the utmost value in limiting the progress of the malady. Iron reduced by hydrogen, in three-grain doses, either alone or combined with a fiftieth of a grain of arsenic, has rendered me most service in this affection. It should, however, be continued without intermission for weeks at a time in order to obtain the full advantage of its beneficent action. The liquid forms of iron, so useful at other times, I have rarely found tolerated for a lengthened period in the pregnant state. In weakened states of the stomach, when the latter revolts at beefsteak and mutton, easily assimilated albuminoid articles, such as milk, soft-boiled eggs, and scraped raw or underdone meat, should be administered in small but frequently repeated portions. Where the marasmus is extreme, and the rectum tolerant, the stomach may be relieved of a part of its duty by the use of nutritive enemata prepared in accordance with the now familiar prescription of Leube. In the pernicious form of anæmia, Gusserow tried transfusion, but without success. He recommended, therefore, the resort to premature labor. In a case which occurred to me in hospital practice, before my attention was drawn to Gusserow's essay, I employed the latter method after consultation with my colleagues. The patient made a slow but apparently sure progress toward recovery, until, at the end of a month, she managed, in the temporary absence of the ward nurse, to get out of bed and make a hearty meal of corned-beef and cabbage. Vomiting set in, followed by collapse, which proved fatal in a few hours. This pernicious form of anæmia, though not confined to multiparæ, develops most

* Gusserow, "Ueber hochgradigste Anaemie Schwangerer," "Arch. f. Gynaek.," Bd. ii, p. 218.

frequently in women who have borne many children in rapid succession.

A not unusual result of hydræmia consists in a swelling of the lower extremities, beginning at the ankles, and thence extending upward and invading often the labia, the vagina, and the lower segment of the uterus. When not associated with kidney complications, this œdema is rarely dangerous, though often the source of extreme discomfort. In some cases of œdema of the vulva, the labia may attain to the size of a man's head, and become nearly diaphanous from the serous infiltration. When the distention is extreme, gangrene may threaten and make it necessary to resort to puncture. In lying-in hospitals this should be done with every antiseptic precaution. With free drainage established, the swelling rapidly subsides. In a half-dozen cases which I have thus far treated in this manner, premature labor has followed in the course of two or three days, a coincidence of such frequent occurrence as to make it necessary to employ puncture with circumspection.

Œdema of the lower extremities seldom disappears entirely before confinement, though relief is sometimes experienced in the last month, when the fundus of the uterus falls forward. Slight degrees, such as swelling limited to the feet, making it necessary for the woman to go around in old shoes or her husband's slippers, do not require treatment. Where, however, the skin of the limbs becomes tense and painful, warm cloths should be applied, diaphoresis if possible should be induced, tonics should be administered, and the patient be kept in a recumbent position, or with the extremities raised *à l'Américaine*. Hydragogue cathartics, by still further impoverishing the blood, tend to aggravate the difficulty.

Varicose Veins.—Varicose veins occur with greater frequency in multiparæ than in primiparæ. So long as the large veins are not involved, they possess slight significance. The saphena is always first affected, then the lateral branches upon the inner surface of the leg and thigh, especially just above the knee,* and less commonly the veins of the vulva. Dilatation of the hæmorrhoidal veins is a very frequent occurrence.

The treatment of varicose veins is limited to the adoption of measures to prevent their increase, and to provide against the dangers of rupture. The first indication is best fulfilled by regulation of the bowels and the wearing of elastic stockings. The subcutaneous injection of one to two grains of ergotine in solution has been recommended, and is reported not to awaken uterine contractions. As the danger of rupture is not speculative (Spiegelberg † reports two cases of fatal hæmorrhage

* Spiegelberg, *loc. cit.*, p. 250.

† *Ibid.*, p. 250. For a complete discussion of the subject, *vide* "Des varices chez la femme enceinte," "Thèse d'Agrégation," par le Dr. P. Budin.

from this cause), the patient should always be provided with a compress and bandage, which she should be taught to apply herself in case of a sudden emergency before professional aid can be obtained.

Nausea and Vomiting.—There are few known therapeutical agents which have not at one time or another been essayed as remedies for the nausea and vomiting of pregnancy. Some of them have even enjoyed for a time high repute as specifics, but the sobering effect of experience has invariably served to dispel illusive hopes, the most successful of them proving uncertain, and of benefit to only a limited class of patients. It is usually, therefore, the part of prudence to do nothing for the minor degrees of the affection, such as the ordinary morning-sickness, or even for continuous nausea, so long as the ingestion of food and the general nutrition of the patient are undisturbed. For these cases Seyfert's advice to let the wife go home on a visit to her mother, implying the value of changed surroundings, furnishes a serviceable hint in the way of practice. When, however, the distressing symptoms continue after the first three months, and perceptibly tend to exhaust the vital powers, every resource should be tried in turn, in the hope that some one of the many in repute may prove of service as a means of warding off impending disaster.

At the outset of any systematic plan of treatment for pregnancy-vomiting, it is essential that the physician should inspire his patient with confidence in his ultimate success. Care should be taken to regulate the bowels, as constipation invariably aggravates existing gastric disturbance. Coitus often increases the sickness. If, in the early months, the uterus is found retroverted or retroflexed, it should be replaced in the knee-chest position, and the recurrence of the displacement should be prevented by a suitable pessary. A speculum examination should be made of the cervix, and, should it be found eroded, the raw surface should be brushed at intervals of from two to three days with a ten-per-cent solution of nitrate of silver. In quite a number of cases a mitigation of the distress is obtained by applying the faradaic current to the pit of the stomach ; in others, the ice-bag applied to the cervical vertebræ affords a considerable measure of relief ; and again in still others the sickness is helped by spraying the pit of the stomach with ether. The inhalation of oxygen has likewise been tried by Pinard with success. To many, ice-cold effervescent drinks are grateful. Dr. Fordyce Barker recommends carbonic-acid water containing a drachm of bromide of potassium to the siphon. Dry champagne is of assistance to a comparatively small class, but more often I have found it revolting to a squeamish stomach. Of medicinal agents, subnitrate of bismuth and the oxalate of cerium possess the widest application. Usually I order ten grains of the former, combined with five to ten grains of the latter, to be taken ten minutes before eating. In cases of gastric catarrh, my favorite is the tincture of nux vomica given in

ten-drop doses before meals. Drop-doses of Fowler's solution at meal-time are said to exert considerable influence in allaying stomach irritability. A twelfth of a grain of morphia given hypodermically or by the mouth will frequently aid the retention of food by the stomach, but may lead to the formation of the opium-habit. Simmons, of Yokohama, recommends the injection of thirty grains of chloral per rectum morning and evening, a practice of which Richardson advises further trial.* After eating, digestion may be promoted by ten grains of pepsin, given alone or with either the dilute muriatic acid or Horsford's acid phosphate.

If the foregoing measures prove of no avail, the patient should be made to take small quantities of easily digested food, such as milk and lime-water, koumyss, Valentine's beef-juice, or the pulp scraped from raw or underdone beef, at hourly intervals, while rest in bed is maintained for the purpose of avoiding the slightest unnecessary waste of tissue.

In very rare instances the vomiting becomes incessant, and resists every remedy. If death from starvation threatens, it may become necessary, as an ultimate resource, to terminate pregnancy by artificial means. The severest cases rarely are such at the beginning. Usually, at the outset, there is a period of nausea, followed by occasional attacks of easy, painless vomiting. But in time everything taken into the stomach is rejected. The patient experiences a disgust for all food, or, rarely, a craving for indigestible articles of diet. With this condition is often associated pains in the stomach and profuse salivation; constipation is common; diarrhœa is the exception. According to Horwitz, patients sometimes complain of unpleasant odors (hyperosmia). With the constant vomiting, they become wasted, pale, and apathetic. As exhaustion becomes marked, the pulse grows weak and rapid; the respirations are more frequent; the skin of the body becomes dry and hard; the extremities are cold and blue, and at times are covered with sweat. Now and then a slight elevation of temperature is observable. The vomited matter consists of mucus mingled with bile, and is sometimes tinged with blood. Toward the end constant thirst is felt, the mouth and throat are dry, the buccal mucous membrane is reddened, the tongue is red at the tip and brown at the root, sordes cover the gums and the teeth, and the breath has a most disgusting odor. The quantity of the urine sinks to a few ounces daily, is concentrated, and contains both albumen and casts, the latter ordinarily epithelial, but sometimes fibrinous. Toward the close of life extreme emaciation and weakness ensue, the face is pinched, the eyes are dull and sunken, fainting attacks are frequent, the sensorium is sometimes unobscured, but often there are hallucinations and delirium. Before life closes the vomiting ceases.

* Richardson, "Hydrate of Chloral in Obstetric Practice," "Trans. of the Am. Gynæc. Soc.," vol. i, p. 247.

Remissions in the course of the disease are not uncommon. Sometimes the strength holds out to the end of pregnancy. The fœtus in these cases suffers but little from the exhaustion of the mother. In general, however, the prognosis is bad. Joulin has reported one hundred and twenty-one cases, with forty-nine deaths. Without treatment, of fifty-seven cases, twenty-eight were fatal; with treatment (abortion induced), of thirty-six patients, nine only died.

The treatment consists first in the careful removal of all complicating conditions. In the early stages it may be sufficient to resort to the measures already recommended. If the vomiting is literally uncontrollable, the patient should be placed at rest in bed. Every unnecessary movement should be avoided. Horwitz recommends that the room be darkened, and in advanced cases that warmth be applied to the body. Rectal alimentation is often capable of rendering excellent service.* Peptonized milk, defibrinated blood,† and the beef and pancreas solution of Leube,‡ may be used for this purpose. The quantity should not exceed four to six ounces, and should not be repeated more frequently than three to four times in twenty-four hours. Sometimes it is necessary that the stomach-rest should be absolute. It is, however, permissible for the patient to ease her thirst with bits of ice or small quantities of sparkling drinks when they are not immediately ejected. If the latter is the case, I administer eight ounces of water, with the addition of two whites of eggs, *per rectum* three times daily, in addition to the regular enemas. Usually it will be necessary to quiet the nervous system by some anodyne agent. Dr. Busey recommends the rectal administration of bromide of potassium. Horwitz and Sutugin press the claims of chloral. Codeia by the mouth, and morphia hypodermically, are of undoubted service in many cases. But the choice will have to be determined by the idiosyncrasy of the patient.

After the regular continuance for a few days of the rectal alimentation, attempts should be made to test the capacity of the stomach to retain solid food. Sutugin got good results from little balls of meat

* Dr. Busey, in an article published in the "Am. Jour. of the Med. Sci." (1879, pp. 112–117), advises stomach-rest, nutritive enemata, and the rectal administration of bromide of potassium. Later experiences have fully confirmed the value of his recommendations.

† We owe this excellent suggestion to Dr. A. H. Smith. The defibrinated blood should be administered warmed, three to four ounces at a time, once in eight hours. To prevent decomposition, Dr. Smith advises the addition of a grain and a half of chloral to each fluidounce of the blood.

‡ Leube's formula consists of five to ten ounces of finely chopped beef, to which should be added one third its weight of finely minced pancreas (pig or ox). The mixture should be treated in a mortar with five ounces of lukewarm water, and reduced to a thick soup (Foster's "Clinical Medicine," p. 24). Not more than four to six ounces should be given at a time, nor more frequently than once in four hours.

which he had cooked over a spirit-lamp. Small quantities of peptonized milk, or pancreatized solutions of meat, should be tried, though sometimes indigestible articles of food are found to be those which are really best tolerated.

Dr. Henry F. Campbell* relates a case where he nourished a patient fifty-two days by the rectum alone. Such cases are very rare, owing to the fact that in time the rectum becomes intolerant of the presence of injected materials. If, therefore, the rectal method of nutrition fails to relieve the patient, the induction of abortion or premature labor should be resorted to before the stage of extreme inanition is reached. But first in such a case it is well to recall the experience of Dr. Copeman, of Norwich, England. Desirous of exciting abortion (patient at sixth month), he pushed his finger upward through the cervix to the membranes. These he tried to rupture with a sound, but without success. Two hours later he returned to his patient, and found, to his astonishment, the vomiting had ceased. Later he tried the plan of dilating the os externum and cervix with the index-finger for the cure of persistent vomiting, and in four cases he succeeded by this method in removing the distressing symptom. In three subsequent trials he found that it was not necessary to press up to the os internum, but that it sufficed to pass the index-finger to the first joint. Rosenthal has since reported two favorable cases. Dr. W. Gill Wylie† believes that most cases of nausea may be cured by Copeman's method combined with treatment of any discoverable cervical lesion. He has devised a special steel dilator to take the place of the finger. His description of his plan of conduct is as follows:

"The vulva and vagina are carefully washed with a 1-to-3,000 solution of mercuric bichloride. I then dip the blades of my dilator in pure carbolic acid and shake off the free acid and introduce the points into the cervix for about half an inch, and slowly dilate until the blades separate from one third to one half an inch. If there is an eroded or everted diseased tissue present, I touch it lightly with an applicator that has been dipped in pure carbolic acid. I then, with a powder-blower, cover the cervix with a thin layer of iodoform, and place against the cervix a flat pledget of borated absorbent cotton soaked in pure glycerine, which is to be removed in twenty-four hours by means of a short string attached to it. In some cases there is slight pain, but in most cases no pain or real disturbance whatever is produced. As a rule, this will relieve nausea; but after four or five days, if there is still nausea, I repeat the dilatation, and may pass the dilator three fourths of an inch, and in some cases, where the cervix is long, even more. Very rarely will more than two dilatations be needed. In some cases

* H. F. Campbell, "Rectal Alimentation in Pregnancy," "Trans. of the Am. Gyn. Soc.," vol. iii, p. 273.

† Wylie, "Vomiting in Pregnancy," "N. Y. Med. Record," Dec. 6, 1884.

the cervix is so patulous that dilatation may seem to be useless, but well up in the cervix tight bands may be found, and, when stretched, complete relief is effected. Even where the cervix is lacerated and apparently open, bands may be found, and, when stretched, relief is obtained. It is easy in such cases to recognize when the end of the dilator comes against the os internum, for it is firmly closed, and by passing the instrument until the os is felt, and then slightly withdrawing it, dilatation can be done without much risk. In severe cases the cervix may be of a very bluish-black color. The glycerine application causes a free watery discharge, and relieves this congestion. Formerly I used nitrate of silver for granular erosion, but I found that the carbolic acid and glycerine had an equally good effect."

Horwitz was less fortunate; still, the trial of the measure is justifiable, inasmuch as its failure does not aggravate the patient's discomfort, and does not measurably delay the resort to the artificial interruption of pregnancy. By the latter method McClintock reports in thirty-six cases the saving of twenty-seven lives. It is obvious that the results are mainly determined by the condition of the patient at the time the operation is undertaken. In the advanced stages of the disease, after the tongue has become dry and brown, the urine scanty and albuminous, and when the wasting and prostration have reached an extreme degree, it is hardly to be expected that many lives are to be rescued.*

Heart-burn.—Heart-burn becomes distressing in the later months of pregnancy. It can rarely be cured before delivery, but may, in most cases, be palliated by carbonate of magnesia, or half-teaspoonful doses of aromatic spirits of ammonia.

Salivation.—Excessive flow of saliva to the extent of two to three quarts in the course of the day has been observed. For this disorder small doses of atropia, the twelfth of a grain of pilocarpine, and the fluid extract of viburnum prunifolium have been severally recommended.

Pruritus.—Pruritus, without any visible affection of the skin, sometimes occasions in pregnant women an unendurable degree of suffering. When general, temporary relief may be obtained by placing the patient in a prolonged soda-bath, and subsequently rubbing the entire surface with vaseline. Very commonly the itching is confined to the distended abdominal walls. In such cases, cloths wet with camphor-liniments, with the addition of chloroform (lin. saponis comp., ℥ v; chloroformi, ℥ j), or a solution of carbolic acid (℥ j ad Oj) applied to the itching surface will usually allay the irritation for the time. In pruritus of the vulva, in addition to local external ap-

* For recent discussions of this subject, *vide* Horwitz, "Ueber das unstillbare Erbrechen der Schwangeren," "Ztschr. f. Geburtsk. und Gynaek.," vol. ix, p. 110. Sutugin, "Hyperemesis Gravidarum," Berlin, 1883.

plications, great pains should be taken to cleanse the vagina with solutions of borax or carbolic acid. A half-pint slowly injected into the vagina may be employed twice daily, without risk of provoking labor. If the itching results from an acrid discharge proceeding from an ulcerated cervix, the application of nitrate of silver or the introduction at night of a cotton plug soaked in a solution of tannin in glycerine (ac. tannic., ʒ j ; glycerinæ, ℥ j) will usually afford relief.

Face-ache.—Neuralgia of the fifth nerve is a common affection in pregnant women. It can often be quieted by the external application of aconite, chloroform, or camphor liniment. Should these or kindred remedies fail, it is best to resort at once to the hypodermic injection of morphia. The recurrence of pain, as the effects of the morphia pass away, can in most cases be prevented by giving to the patient once in four hours from three- to five-drop doses of the fluid extract of gelsemium, suspending its administration so soon as the slightest indication of ptosis is produced. Croton-chloral, in from two- to five-grain doses hourly, has likewise proved effective. Bartholow advises not to push the remedy beyond fifteen grains. Lindner ("Arch. f. Gynaek.," Bd. xvi, p. 312) recommends ten grains at a dose given at bedtime.

Cephalalgia.—Headache should be treated according to the cause. Constipation should be removed, and iron should be given when the headache is dependent upon anæmia. If of malarial origin, I have never hesitated to give quinine in large doses, and have never yet observed its acting as an oxytocic. When purely of reflex origin, the guarana-powder, the diffusible stimulants, and the entire range of nerve sedatives are indicated. Unfortunately, there are no fixed rules by which, in a given case, the appropriate remedy can be invariably selected.

Insomnia.—Troublesome sleeplessness may toward the end of pregnancy reduce a woman to an unfavorable condition for encountering the perils of childbirth. The main reliance should be placed, where possible, upon moderate exercise, upon bromide of potassium, chloral, camphor and hyoscyamus, and codeine. The ordinary forms of opium should be placed under the ban, on account of the fatal facility with which the opium-habit is acquired. Even in ordering the less objectionable hypnotics, care should be taken against their continued employment. With proper caution, however, their occasional administration for the purpose of breaking a morbid habit is to be commended.

LABOR.

CHAPTER VII.

THE PHYSIOLOGY OF LABOR AND ITS CLINICAL PHENOMENA.

Causes of labor.—Uterine contractions.—Action of labor-pains upon the uterine walls — Contraction of ligaments.—Action of abdominal muscles.—Action of vagina.—The pain of labor.—General influence of labor-pains upon the organism.—Precursory symptoms of labor.—First, second, and third stages of labor.—Duration.—Action of the expellent forces.

Under the term *labor* are comprised all the physiological and mechanical processes by means of which the extrusion of the ovum from the maternal organs of generation is effected. As the term implies exertion, its application is restricted to the parturient efforts of viviparous animals. The duration of pregnancy varies widely in the different classes of the animal kingdom. The occurrence of normal labor is coincident with the maturity of the fœtus. This, in man, is found to correspond very nearly to the interval between ten menstrual periods.

Causes of Labor.

Speculation as to the proximate causes of labor has so far proved profitless. The following particulars comprise the extent of our knowledge of the conditions which prepare the way during pregnancy for the final expulsive efforts :

1. During the first three months the growth of the uterus is more rapid than that of the ovum, which is freely movable within the uterine cavity, except at its placental attachment. In the fourth month the reflexa becomes so far adherent to the chorion that it can only be separated by the exertion of some slight degree of force, and the amnion is in contact with the chorion. After the fourth month the chorion and amnion are agglutinated together, though even at the termination of pregnancy they may with care be separated from one another. After the fifth month the agglutination of the decidua vera and reflexa takes place. In the second half of pregnancy the rapid development of the ovum causes a corresponding expansion of the uterine cavity, the uterine walls becoming thinned, so that by the end of gestation they do not exceed upon the average two to three lines in thickness. The vast extension of the uterine surface is not, however, simply a consequence of over-stretching, a fact shown by the circumstance that the uterus toward the close of gestation is increased from twenty- to thirty-fold in weight, and by the histories of extra-uterine fetations, in which, up to a certain limit, the uterus enlarges progres-

sively, in spite of the non-presence of the ovum. The augmented weight of the uterus is the result of the increase in length and width of the individual muscular fiber-cells, the extreme vascular development, and the abundant formation of connective tissue. Up to the sixth and a half month there has further been observed a genesis of new fiber-cells, especially upon the inner uterine surface. According to Ranvier, the smooth muscular fibers become striated as the end of gestation is reached.*

The precise manner in which the distention of the uterus is accomplished has as yet not been demonstrated. *A priori* only two possibilities are apparently admissible, viz., either the individual structure elements are stretched after the manner of elastic bands, or a rearrangement of the muscular elements takes place in such wise that a certain proportion of the fiber-cells, instead of lying, as in the beginning of pregnancy, parallel to one another, gradually, with the advance of gestation, are displaced, so that the ends only are in juxtaposition. It is probable, though not proved, that toward the close the thinning of the walls is the result of both conditions. Bearing these premises in mind, it becomes a disputed question as to whether one of the causes of labor is not to be found in the reaction of the uterus, as a hollow muscular organ, from the extreme tension to which its fibers are ultimately subjected. Countenance to the affirmative side is afforded by the tendency to premature labor in hydramnion and multiple pregnancies, in which a high degree of tension is reached at a period considerably antedating the complete development of the fœtus.

2. There is a perceptible increase of irritability in the uterus from the very beginning of gestation. Indeed, the occurrence of spontaneous contractions has been put forward by Braxton Hicks as one of the distinguishing signs of pregnancy. This irritability is especially marked at the recurrence of the menstrual epochs ; it is very apparent at the beginning of pregnancy, then diminishes in the middle period, and becomes once more a prominent feature in the latter months, when spontaneous painless contractions are ordinary incidents of the normal condition.

3. The researches of Friedländer, Kundrat, Engelmann, and Leopold have demonstrated that the decidua vera of pregnancy is distinguishable into an outer, dense, membranous stratum, composed of large cells resembling pavement epithelia, probably metamorphosed cylindrical cells, and an — in appearance — underlying mesh-work, formed from the walls of the enlarged decidual glands. It is in this spongy layer that the separation of the decidua takes place, the fundi of the glands persisting, even after the expulsion of the ovum. By many, a fatty degeneration of the cells of the decidua has been

* *Vide* Tarnier et Chantreuil, "Traité de l'art des accouchements," p. 203.

observed toward the end of pregnancy, but Leopold, Dohrn, and Langhans have shown that this is not of constant occurrence.* The trabeculæ which inclose the spaces of the net-work diminish in size

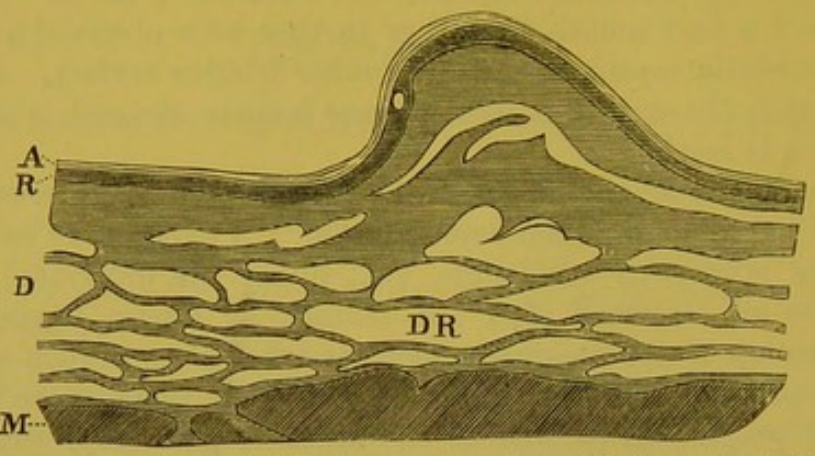


FIG. 76.—The mucous membrane of the uterus. *A*, amnion; *R*, reflexa; *D*, decidua vera; *D*, *R*, glandular spaces of the lower stratum; *M*, muscular structure of uterus. (Engelmann.)

with the advance of pregnancy. Thus, while they measure at the fourth month about $\frac{1}{500}$ of an inch in thickness, they become gradually reduced in the subsequent months to $\frac{1}{2500}$ of an inch, a change which materially facilitates the peeling off of the decidual surface.†

4. From the fifth month onward, large-sized cells make their appearance in the serotina, especially in the neighborhood of thin-walled vessels. The largest of the so-called giant-cells contain sometimes as many as forty nuclei. Though a physiological product, they resemble for the most part the so-called specific cancer-cells of the older writers. They are of special obstetrical interest from the fact observed by Friedländer, and confirmed by Leopold,‡ that they penetrate the uterine sinuses from the eighth month, and lead to coagulation of the blood, and to the formation of young connective tissue, by means of which a portion of the venous sinuses becomes obliterated before labor begins. The subtraction of these vessels from the circulation tends to increase the amount of the venous blood in the intervillous spaces of the placenta.

5. It is proper to recall here the fact that the nerve-filaments of the uterus are derived in principal measure from the sympathetic system. The large cervical ganglion, which in pregnancy measures about two inches in length by one and a half inch in breadth, receives, however, in addition to the sympathetic fibers, filaments from the second, third, and fourth sacral nerves.

Physiology has as yet left unsettled the question as to the main

* LEOPOLD, "Studien über die Schleimhaut," etc., "Arch. f. Gynack.," Bd. xi, p. 49.

† ENGELMANN, "The Mucous Membrane of the Uterus," p. 45.

‡ *Op. cit.*, pp. 492, *et seq.*

channels of the motor impulses which are conveyed to the uterus during labor. One of my hospital patients, with paralysis of the lower extremities, retention of urine, and loss of power over the sphincter-ani muscle, had a perfectly natural though painless labor. The cause of the paralysis was obscure, the patient subsequently making a complete recovery. Jacquemart * reports a similar case, in which the paralysis was due to partial compression of the cord at the level of the first dorsal vertebra. On the other hand, Schlesinger † has shown that the sympathetic is not the only motor nerve, as reflex movements of the uterus follow stimulation of the organ when all the branches of the aortic plexus have been carefully divided.

A motor center for uterine contractions has been proved to exist in the medulla oblongata. This center is excited directly to action by anæmic conditions, and by the presence of carbonic acid in the blood conveyed to it. Vivid mental emotions may either awaken or suspend uterine contractility.

Reflex movements of the uterus may be provoked by stimulating the central end of any of the spinal nerves, a fact which serves to explain the consensus long recognized as existing between the breasts and the organs of generation. When the spinal cord is divided below the medulla oblongata, this phenomenon is no longer observed. Direct stimuli to the uterus, however, determine contractions independently of the medulla oblongata, the spinal cord then acting as a reflex center. The presence of asphyxiated blood in the arterial trunks acts as a physiological stimulus to labor.‡ By the separation of the decidua from its organic connection with the uterus, the ovum acts as a foreign body, and, as is well known, speedily awakens uterine movements. Finally, Kehrer # has shown that, when a cornu is removed from the uterus during labor, rhythmic contractions of the muscular fibers will continue from a half-hour to an hour after separation, provided only the tissues be kept moist and at a suitable temperature. ‖

The following theory of the causes of labor is offered, not because of its completeness, but merely as a means of grouping the foregoing facts together in the order of their relative importance. The advance of pregnancy is associated with increase in the irritability of the uterus,

* Tarnier et Chantreuil, "Traité de l'art des accouchements," p. 229.

† Ober und Schlesinger, Stricker's "Wiener med. Jahrbuch," 1872.

‡ *Vide* Schlesinger, Stricker's "Wiener med. Jahrbuch," 1873.

Kehrer, "Beiträge zur vergleichende und experimentellen Geburtskunde," 2tes Heft, p. 48.

‖ Cohnstein ("Zur Innervation der Gebärmutter," "Arch. f. Gynæk.," vol. xviii. p. 394), from his own experiments and those of others, concludes that the determining cause of the uterine contractions is contained in the intra-muscular ganglionic cells; that the central nerve-organs regulate the uterine activity, and that the sympathetic acts simply as a vaso-motor nerve.

a property most pronounced at the recurrence of the menstrual epochs. By thinning of the partitions between the glandular structures the way is prepared, as the time for labor approaches, for the easy separation of the dense inner stratum of the decidua. The ready response of the uterus to stimuli reflected from the peripheral extremities of the spinal nerves, to direct local irritation, and to the presence of blood surcharged with carbonic acid in the uterine vessels, explains the frequency of painless contractions for days, or even weeks, in some cases, previous to labor. To these means of exciting uterine motility there should be added, in all probability, the reaction of the uterine muscle, from the tension to which it is subjected by the growth of the ovum, and to circulatory disturbances in the cerebral centers sometimes effected by vivid emotions. Frequently repeated uterine contractions, without partial separation of the decidua, are hardly comprehensible after the decidua vera and reflexa are brought into close contact with one another. Such a physiological separation would, of necessity, when of sufficient extent, by converting the ovum into a foreign body, furnish an active cause for the advent of labor, in the same way that labor is prematurely excited by a similar separation when artificially induced. Thus, by the time the development of the fœtus is completed, all things are in train for its expulsion. When other causes do not early operate as determining forces, the increase of uterine irritability at the recurrence of the menstrual epochs probably accounts for the ordinary coincidence of labor with the tenth catamenial date.

Physiological Phenomena of Labor.

The Uterine Contractions.—The uterine contractions are entirely independent of volition. As in other organs composed of smooth muscular fibers, each contraction at the beginning is slow and weak; gradually it reaches the point of greatest intensity; the acme continues for a brief period, and then, finally, is followed by complete relaxation. Each complete excursion is termed a labor-pain. Peristaltic movements have been observed in animals with two-horned uteri. A similar action, proceeding from the fundus to the cervix, has been sometimes assumed for the human subject. The peristaltic wave, however, if, indeed, it exists, extends so rapidly that it is best to consider the uterus as a hollow muscle, which contracts simultaneously in all its parts. As labor advances, an increase in the length and the force of the contractions is developed. The stronger the pains, the shorter is the interval between them. The average normal duration of a labor-pain is about one minute.

The Action of Labor-Pains upon the Uterine Walls.—During the intervals between the pains, it is well known that the uterus possesses an ovoid shape, and is flattened antero-posteriorly by the pressure of the abdominal walls. During the pains, however, the uterus, as it

closes upon the fluid contents of the ovum, assumes a more nearly globular outline. As a consequence, the transverse diameter is diminished, and the antero-posterior increased in corresponding proportion.

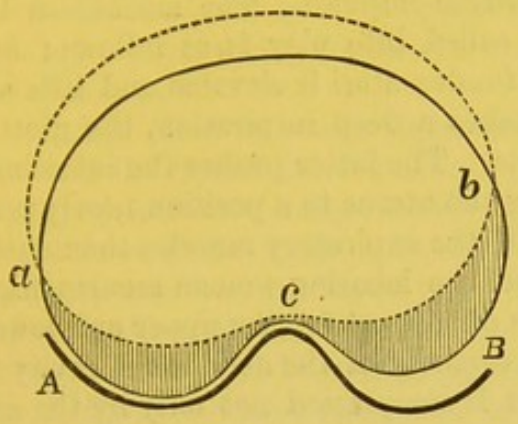


FIG. 77.—Transverse section, dotted line representing shape of uterus during a pain. (Lahs.)

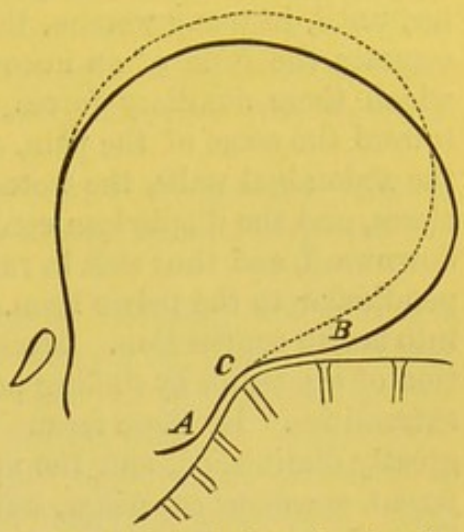


FIG. 78.—Longitudinal section, dotted line representing elevation of fundus during a pain. (Lahs.)

By this change, the uterus, which had previously rested by its posterior surface upon the spinal column, rises upward so that its fundus produces a bulging of the anterior abdominal walls.

Inasmuch as the lower uterine segment diminishes in thickness toward the cervix, its walls offer less resistance to the pressure of the ovum, and thus are stretched downward during each pain. While, in contractions of the uterus, the lower segment is thinned, the diminished bulk of the contracted organ leads to an increase in the thickness of the walls of the body and fundus.*

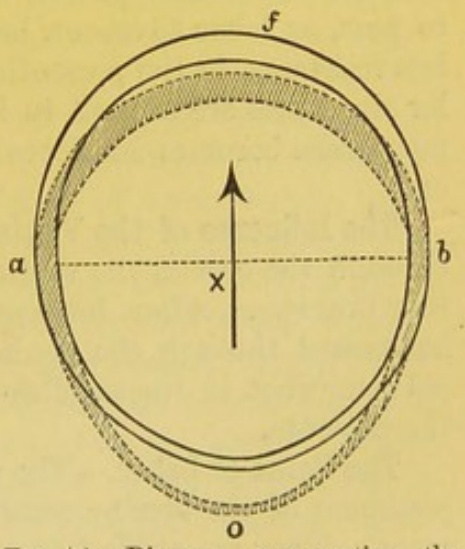


FIG. 79.—Diagram representing the changes in the thickness of the uterine walls during labor. (Lahs.)

The Contractions of the Uterine Ligaments.—Structurally the muscular fibers of the round and broad ligaments are in direct continuity with the external muscular layer of the uterus. As would be anticipated, they contract simultaneously with that organ. In contracting, they fix the uterus at the pelvic brim, while the round ligaments serve additionally to incline the fundus forward.

* For most of the following deductions the writer is indebted to Dr. LAHS's ingenious work, entitled "Die Theorie der Geburt."

The Action of the Abdominal Muscles.—The contraction of the abdominal walls is a powerful auxiliary to the expulsive action of the uterus. At the beginning of labor, the contractions are voluntary, but, as labor advances, they become more and more reflex in character, until, in many women, the disposition to press during each pain assumes the form of an uncontrollable impulse. The mechanisn by which these auxiliary forces are called into play is as follows: As, toward the acme of the pain, the fundus uteri is elevated and lifts up the abdominal walls, the woman takes a deep inspiration, the glottis closes, and the diaphragm contracts. The latter pushes the intestines downward, and thus aids in raising the uterus to a position nearly perpendicular to the pelvic brim. All the expiratory muscles then enter into active contraction. Meantime, the laboring woman secures fixation of the trunk by finding points of support for the upper and lower extremities. By these means the capacity of the abdominal cavity is greatly diminished, and the uterus is compressed not only by the adjacent muscular coverings, but by the entire mass of inclosed viscera. The effect is twofold:

1. There results an augmentation of the intra-uterine pressure.

2. A portion of the contents of the large vessels of the trunk is forced to the extremities. To this cause is attributable the flushed, congested appearance of the face during labor-pains. As the intra-abdominal pressure is not brought to bear upon the organs within the pelvic cavity, hyperæmia of the vagina and the contiguous tissues follows. As a consequence, the channel through which the head has to pass, as labor advances, becomes infiltrated with serum, and offers less resistance to the presenting part. At the same time the glandular structures are excited to increased action, and the lining mucous membrane becomes lubricated by the secretion which is freely poured out.

The Influence of the Vagina in Parturition.—As the head advances through the cervix, the vagina at first opposes an obstacle to its further progress. After. however, the largest circumference of the child has passed through the genital canal, the contractions of the vagina aid somewhat in the expulsion of the after-coming extremities and of the placenta.

The Pains of Labor.—The painful sensations, which are the accompaniment of the uterine contractions, begin in the lower uterine segment. They are at first especially felt over the sacrum, whence they radiate to the rectum and the bladder, across the abdomen, and down the thighs. In the beginning of labor, the sensations are dull, and of a bearing-down character. As labor advances, however, the pains increase in acuteness, and in many persons reach an unendurable degree of severity. They are mainly induced through the compression of the uterine nerves by the contractions of the muscular fibers. The

severity of the pains is consequently proportioned to the resistance to be overcome. At first, as has been stated, confined to the lower segment of the uterus, the pains subsequently invade the body and the fundus. The sufferings of the female increase with the mechanical distention of the cervix, especially with that of the external orifice, and finally reach the point of supreme agony as the head passes through the vagina and vulva, which are abundantly supplied with sensitive spinal nerves.

Though labor is rarely absolutely painless, where the first stage is slow and the resistance of the soft parts slight, the suffering may become comparatively insignificant.

Influence of the Pains upon the Organism.—During each pain the arterial pressure is increased; the frequency of the pulse rises until the acme is reached, when it slowly declines to the normal point; the respirations are slowed during the pains, owing to the contraction of the abdominal walls, but are more rapid in the pauses as a consequence of the general muscular exertion; the temperature rises progressively during labor, but, as a rule, within narrow limits; and the urinary excretion, in consequence of the increased arterial pressure, is augmented.*

The Clinical Course of Labor.

Precursory Symptoms.—About the thirty-ninth week of pregnancy it is usual for the entire uterus to sink somewhat downward into the pelvis, while the fundus falls forward. This change of position is followed by considerable relief to the respiration, and to previously existing gastric disturbances. At the same time there is experienced an increased difficulty in locomotion; the œdema of the lower extremities is aggravated; the intra-pelvic pressure causes a frequent desire to urinate, and predisposes to the development of hæmorrhoids, especially where, as is the rule in primiparæ, the head likewise descends deep into the pelvic cavity. Indeed, in primiparæ the changes of position are more pronounced than in women who have passed through repeated pregnancies. As gestation draws to a close, a copious glairy secretion is poured out from the cervix, the vagina relaxes, the labia majora become swollen, and the vulva gapes open. For a variable period preceding the advent of labor, painless contractions occur at irregular intervals. These so-called *dolores presagientes* are the ordinary prelude to labor in multiparæ, though they are often inappreciable in primiparæ. They very commonly begin in the evening hours and continue till toward the middle of the night. Very often they are associated with a dragging sensation between the sacrum and symphysis, and a feeling of tension in the abdominal region. Sometimes they expand the os internum to a considerable extent, but never in such a

* Naegele, "Lehrbuch der Geb.," p. 163.

way that any portion of the cervical canal contributes to the enlargement of the uterine cavity.

Actual labor has been divided, as a matter of clinical convenience, into three stages, as follows :

First stage, or stage of dilatation of the cervical canal.

Second stage, generally termed the stage of expulsion, comprising the period from the dilatation of the cervix to the expulsion of the child.

Third stage, or stage of the placental delivery.

1. The First Stage—Dilatation of the Cervix.—The advent of true labor is characterized by painful contractions, which render the patient

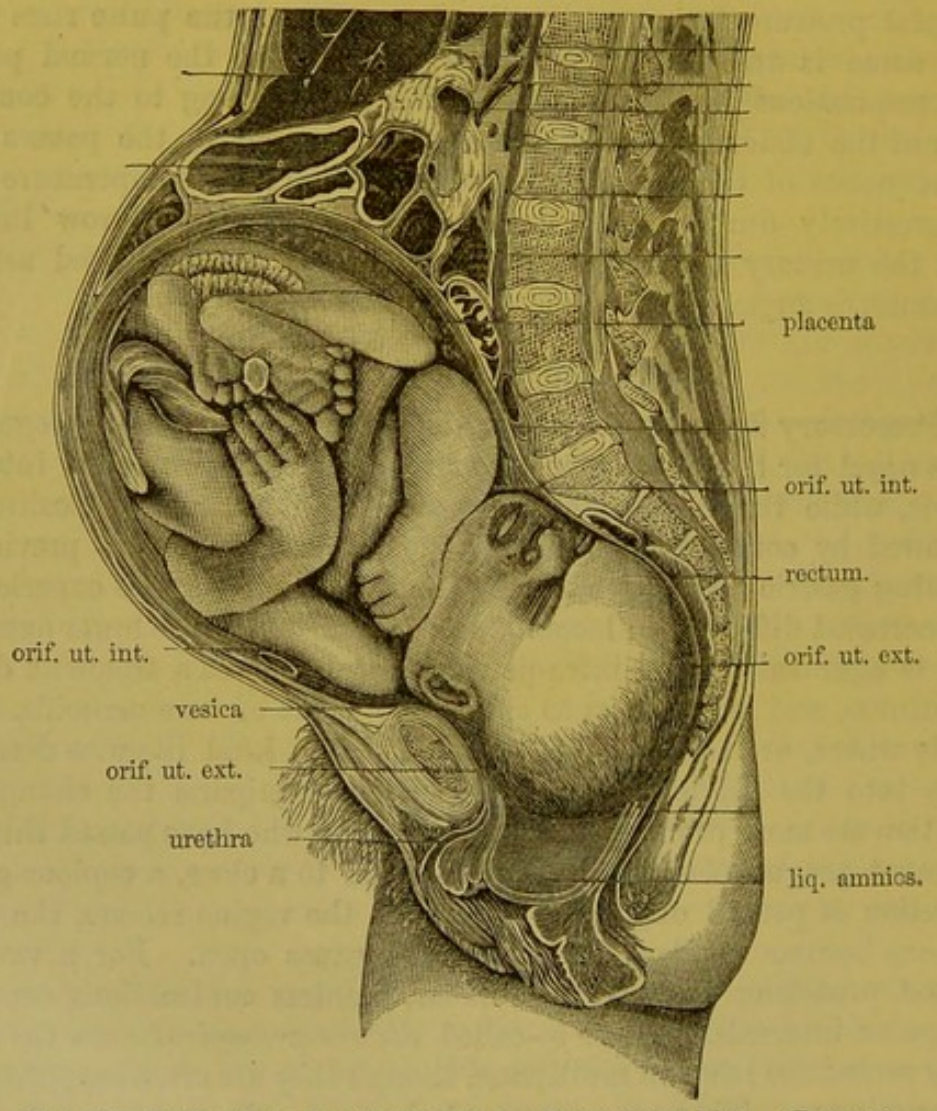


Fig. 80.—Section through a frozen corpse. Stage of expulsion. (Braune.)

restless, and dispose her either to bend forward with clinched hands, or to seek some firm support for the sacrum to ease her sufferings. Usually, in the beginning of labor, women prefer the sitting posture, which enables them to press with the forearm against the sacrum dur-

ing the pains. The pain of labor begins with the dilatation of the internal os. In true labor the dilatation progresses gradually. As the os internum opens, the contractions cause the membranes to descend and press upon the cervical canal. With the advance of labor, the pains increase in intensity and frequency. During their persistence the external os is put upon the stretch, so that the border becomes thin and sharply defined.* As the pain subsides, the os relaxes and the membranes retreat. Each new pain increases the dilatation, and forces the membranes somewhat deeper. The softening, the relaxation, and the hypersection of the soft parts become more and more

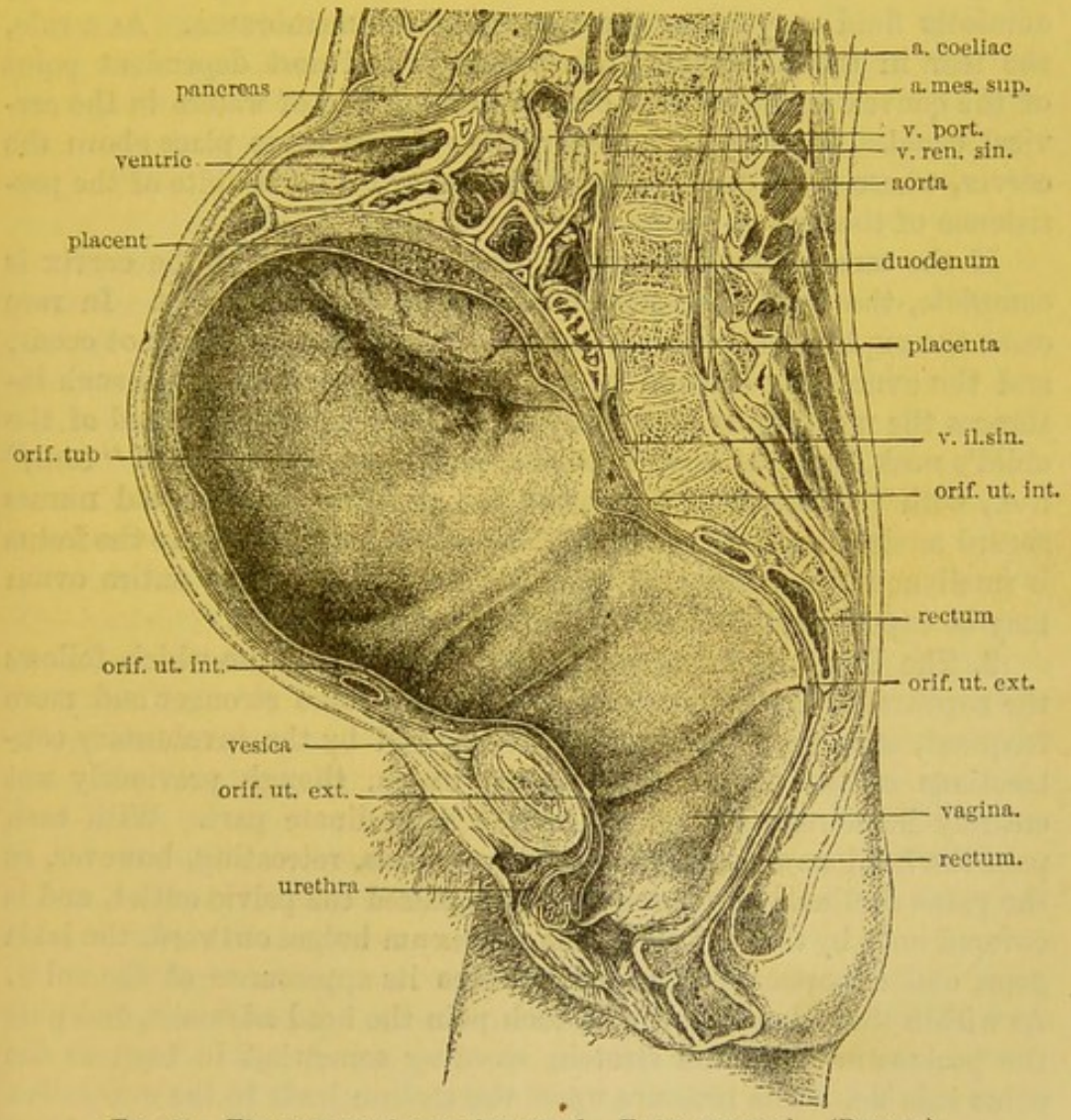


FIG. 81.—The uterus and parturient canal. Fœtus removed. (Braune.)

decided. As the borders of the os yield to pressure, lacerations form, which tinge the mucous discharges with blood. When the dilatation has reached a certain limit (usually by the time the diameter of the

* In multiparæ this resistance of the external os may be entirely lacking.

external os is three to three and a half inches), the protruding membranes remain tense in the intervals between the pains, and are then ready for rupture. After rupture, which usually occurs spontaneously, the water in front of the child's head escapes, though the greater part of the amniotic fluid is retained within the uterus by the valve-like pressure of the presenting part. After a short pause the head descends into the cervix, the walls of which are stretched to the pelvic borders, and finally become so far dilated that cervix and vagina form one continuous canal.

In case the presenting part does not thoroughly tampon the lower segment of the uterus, a more or less complete escape of the entire amniotic fluid may follow the rupture of the membranes. As a rule, the tear in the membranes takes place in the most dependent point of the convex portion which constitutes the bag of waters in the cervical canal. Sometimes, however, the rupture takes place above the cervix, where there can be a gradual escape of fluid in spite of the persistence of the bag of waters.

If the membranes rupture before the dilatation of the cervix is complete, the head descends and acts as a dilating wedge. In rare cases the rupture of the membranes, if left to nature, does not occur, and the ovum may descend in its integrity to the vulva. In such instances the membranes sometimes rupture in the neighborhood of the child's neck, and the head is born covered with the so-called "caul," i. e., with the detached portion of the membranes, which old nurses regard as significant of good luck. In still rarer cases, where the fœtus is small and the amount of amniotic fluid limited, the entire ovum may be expelled without rupture of its coverings.

2. The Stage of Expulsion.—After the short pause which follows the rupture of the membranes, the pains become stronger and more frequent, and are now powerfully reënforced by the involuntary contractions of the abdominal muscles, which, though previously not entirely inactive, have played only a subordinate part. With each pain the head now makes perceptible progress, retreating, however, as the pains decline. After the head has passed the pelvic outlet, and is covered only by the soft parts, the perinæum bulges outward, the labia gape, and a portion of the head makes its appearance at the vulva. As within the pelvic canal, with each pain the head advances, and puts the perinæum upon the stretch, receding somewhat in turn as the pains subside. The pressure upon the rectum leads to the evacuation of fecal contents. Finally, the thinning of the perinæum reaches a point at which the sutures can be readily felt through its structure; the recession of the head ceases; the anus assumes an oval shape; the orifice of the vulva looks forward and upward; the urethra is pushed against the symphysis pubis; while, as the circumference of the head in the neighborhood of the parietal bosses engages in the vulva, the

labia and frænulum form a thin circular band, through which, during a pain or the contraction of the abdominal walls, the head makes its way, usually leaving behind moderate lacerations of the frænulum or anterior portion of the perinæum. The same, or the succeeding pain, leads to the expulsion of the trunk. The birth of the child is followed by the outpouring of the amniotic fluid, which, as a rule, escapes colored with blood from the site of the wholly or partially detached placenta.

3. **The Placental Period.**—The placental period embraces the time from the birth of the child to the delivery of the placenta and membranes.

After the birth of the child, the recession of the blood from the brain, which follows the diminution of the intra-abdominal pressure, often produces a sense of faintness, and sometimes temporary syncope. The rapid evacuation of the uterus is, at times, too, succeeded by a chill, which, however, does not betoken the onset of fever, but is the result of vaso-motor disturbance, and the loss, through the expulsion of the child, of a source of heat-supply. Most women, however, experience a restful feeling of comfort and repose. This sense of quietude lasts anywhere from a few minutes to a quarter of an hour, when the contractions return, which detach the placenta, and force it into the vagina. The separation of the placenta takes place in the meshy, lamellated layer which is formed in the serotina by the thinned, elongated walls of the gland-tubules, the dense cell-layer of the maternal portion remaining adherent to the placenta. As the maternal vessels are necessarily torn across, some hæmorrhage follows the detachment. The hæmorrhage is, however, speedily arrested by the contractions of the uterus, which both compress the vessels and furnish the conditions favorable to the formation of fibrinous clots in their distal extremities. When the mechanism of expulsion is left to nature, the placenta descends by its edge into the vagina, while premature tractions upon the cord cause it to present by its fetal surface at the cervical orifice. When once in the vagina, the expulsion is completed by the action of the abdominal muscles, sustained by the retraction of the muscles which form the floor of the pelvis.

According to Gassner,* after confinement the female experiences, as a consequence of the expulsion of the ovum, of the exhalations from the lungs and skin, from the discharge of excrements, and from hæmorrhage, a loss of weight equivalent to one ninth of that of the entire body.

Duration of Labor.—Spiegelberg found, in 506 labors, the average for primiparæ was 17 hours, for multiparæ 12 hours. In primiparæ past the thirtieth year Hecker found the average 21·1 hours, while

* Gassner, "Ueber d. Veränderungen des Körpergewichtes b. Schwang., Gebär. und Wöchner," "Monatsschr. f. Geburtsk.," xix, p. 18.

Ahlfeld in 82 women over thirty-two years of age obtained an average of 27·6 hours.*

In ordinary normal labor the second stage lasts about two hours in primiparæ, and about half as long in multiparæ, though in the latter the resistance is frequently so slight that a few pains suffice to complete the delivery.

According to Kleinwächter,† the time at which labor-pains begin occurs most frequently between ten and twelve o'clock in the evening. Spiegelberg ‡ states that the maximum frequency of births takes place between twelve and three o'clock in the morning.

The Action of the Expellent Forces.

Having considered separately the action of the uterus, the uterine appendages, and the abdominal muscles during labor, there remains for us to combine these factors together, and to show in what manner they contribute to the end of all parturient effort, viz., the expulsion of the ovum.

In the first place, the contractions of the uterus are intermittent. When they lose their rhythmical quality, and become continuous, they cease to belong to the domain of physiology. It is only during the act of contraction that work is performed. Whenever the alternating relaxation ceases, and the uterus passes into a condition of tonic contraction, no work is accomplished, and the pains are ineffective.

The uterus is a hollow muscle, which, during a pain, closes down upon its contents. If all parts of the uterine walls were of equal thickness, the contractions would be entirely expended upon the periphery of the ovum, and, as the contents of the latter are practically incompressible, the effort would be resultless. If, however, the walls were so constructed that the thickness varied in different regions, the peripheral compression exerted during a pain would be followed by a bulging at the points of least resistance, provided the thinned tissues possessed the property of elasticity. Now, the unequal development of the uterine walls and the elasticity of the uterine tissue-elements are both anatomical facts. Thus, the fundus and the lower uterine segment are materially thinner than the intermediate portion. Indeed, the latter is often two to three times as thick as the lower segment. As a result, therefore, of these conditions, concentric pressure of the fluid contents of the ovum is followed by an increase in the longitudinal diameter of the uterus. While the convexity of the fundus is unquestionably increased during a pain, the effect of the latter is chiefly manifested in the distention of the lower segment. Various causes

* Spiegelberg, "Lehrbuch," pp. 134, 135.

† Kleinwächter, "Die Zeit des Geburtsbeginnes," "Ztschr. f. Geburtsh.," Bd. i, p. 230.

‡ Spiegelberg, "Lehrbuch," etc., p. 135.

combine to produce this result. Near the cervix the tissues are not alone thinner, but the fibers run for the most part in a more nearly longitudinal direction, and therefore offer a weaker resistance than that afforded by the close interlacement of both circular and longitudinal fibers which prevails in the fundal and upper uterine zones. Then, too, as was pointed out by Lahs,* the lower segment sustains, in the ordinary positions assumed by the female, the entire weight of the superimposed ovum with its fluid and solid contents; and, finally, the pressure, transmitted from the abdominal muscles, takes a direction from above downward.

In 1876 Bandl ("Ueber das Verhalten des Uterus und Cervix in der Schwangerschaft und während der Geburt") called attention to the thinned condition of the lower uterine segment, extending from what had been previously regarded as the os internum from four to six inches upward, and terminating abruptly in a muscular ridge upon the inner surface. This ridge he regarded as the upper limit of the cervical canal, which had been opened up by the growth of the ovum. Lahs ("Was heisst Unteres Uterinsegment," "Arch. f. Gynaek.," vol. xxiii, p. 215), however, places this ring at the level of the pelvic brim. Above the pelvic brim, he says, the convexity of the uterus is nearly uniform, while the portion of the uterus below forms, as it were, a segment of a sphere with a short radius attached to the abdominal division. In this way, upon longitudinal section, a projection of the wall toward the uterine cavity is observable at the pelvic brim where the two segments meet. He therefore proposes that the ridge thus produced be called the "pelvic-brim stricture." My own observations, which correspond to those of Schroeder, show that in many instances this ridge is but slightly indicated before the beginning of labor. During and as a consequence of the labor-pains, the ridge becomes well marked, and clearly defines the limits between the thinned, stretched lower portion, and the thickened, retracted upper portion of the uterus. Both from a physiological and a pathological point of view this limiting ring possesses great importance. It is desirable, therefore, that it receive a designation definitive of its character. The term "ring of Bandl," which has received some currency, is objectionable because that term has already become associated with Bandl's views as to the true position of the internal os. The "pelvic-brim stricture" of Lahs has an awkward sound in English, and expresses a theory not yet absolutely established. Ebell proposed the name "mechanical or clinical os," but it requires a complete familiarity with the discussion which the subject has occasioned not to confound the structure with the orifices of the cervical canal. My own choice would be to term it the "retraction ring," as indicative of what I believe to be its origin. As, however, Schroeder has already introduced the

* Lahs, "Die Theorie der Geburt," p. 116.

term "contraction ring," and as that term has become somewhat familiar, I have thought it best to accept that designation in these pages in spite of criticisms which have been made as regards its propriety.

So far, for the sake of simplicity, we have regarded the uterus as a closed sac, possessing walls of unequal thickness. In reality the lower segment terminates in an opening, the canal of the cervix, which, though at the beginning of labor of small size, and offering considerable resistance to the pressure of the ovum, is capable of sufficient distention to permit the exit of the fœtus.

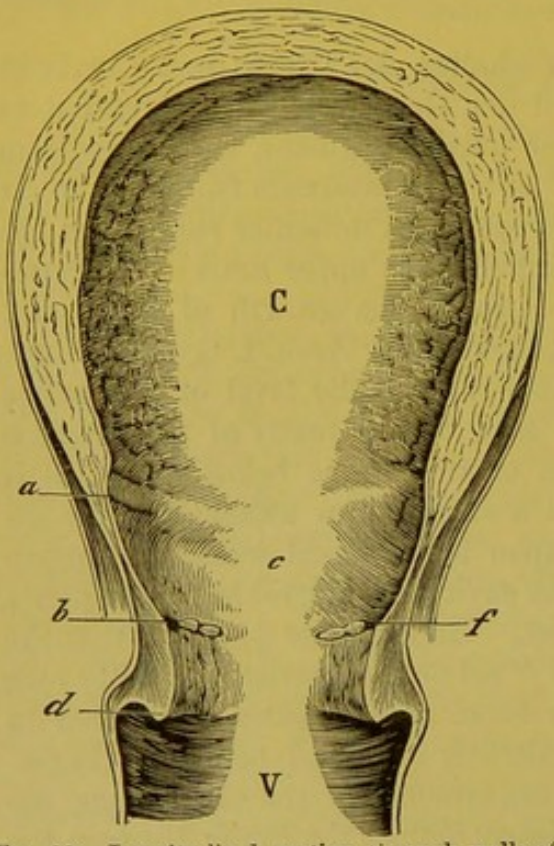


Fig. 82.—Longitudinal section through walls of uterus in eighth month of pregnancy (Bandl). *a*, ring of Bandl; *b*, os internum; *d*, os externum.

The dilatation of the cervix is partly mechanical, and partly the effect of certain organic changes which have already received cursory mention.

The mechanical dilatation is the result of—1. The pressure of the ovum upon the lower uterine segment, which forces open the os internum, and unfolds the cervix from above downward.

2. The retraction of the uterus, an important property, which requires brief description. While each contraction of the uterus is followed by relaxation, and a period of repose, a gradual change is continually going on in the length and arrangement of the muscular fibers. In the thinned lower segment the fibers are stretched, and separated from one another. In the upper portion, on the contrary, they shorten, and change their position in such a way that those which previously had only their extremities in contact assume a more nearly parallel arrangement. The walls, therefore, in the upper zones, thicken and shorten, especially in the longitudinal direction. The limit between the thinned lower segment and the upper thickened zones is marked, as we have seen, by a distinct ridge termed by Schroeder the contraction ring. It is to the changes in the uterus which take place above the contraction ring that the term retraction is applicable. As the retraction is progressive, it leads to a gradual withdrawal upward of the uterine walls, in consequence of which the lower segment is not only put upon the stretch during the pains, but, toward the end of the

period of dilatation, is subjected to a greater or less degree of permanent tension. Then, too, as the contraction ring moves upward, a phenomenon observable where the descent of the head is hindered, the longitudinal fibers of the lower segment, by reason of their insertion in part at least into the vaginal portion, exert a direct influence in dilating the cervical canal.

3. When the abdominal muscles contract, the uterus is pressed downward into the pelvic cavity. The descent is, however, limited by the attachment of the uterine ligaments, and the adjacent organs. But the resistance afforded by the uterine attachments exercises a peripheral traction upon the cervix, and thus tends to draw its walls asunder.

The normal dilatation of the cervix is, however, by no means a matter of pure mechanical distention. If the canal which forms the communication between the vagina and the uterus were simply an elastic tube, it would of necessity retract down upon the neck of the fœtus after the passage of the head, and thus a new distention would be required to permit the passage of the shoulders. Indeed, the conditions of an elastic tube are not unfrequently realized in versions, where an attempt is made to extract the fœtus through an imperfectly dilated os; in which case, after the disengagement of the shoulders, the cervix is apt to close upon the neck, and arrest the delivery of the after-coming head. That this complication does not happen as a rule is due to the fact that in natural labors the mechanical expansion is associated with certain organic changes which render the cervix soft and distensible, and at the same time diminish its retractility. The basis of the organic changes consists in the serous infiltration of the lymphatic interspaces, which separates the tissue-elements, and deprives them of the resistance afforded by the force of cohesion. The main factor in the production of the softening of the cervix is an active hyperæmia, which the cervix shares during pregnancy with all the pelvic organs, and which during labor is greatly enhanced by the diminished pressure to which the parts below the pelvic brim are subjected. We have already noticed how, during the acme of a pain, the contents of the uterine vessels are forced into the vessels of the intra-pelvic viscera.

In normal head presentations the organic changes are in a special degree furthered by the formation of what is known as the bag of waters. As the head descends into the lower uterine segment, the contraction of the muscular fibers around its largest circumference separates a layer of fluid from the contents of the uterine cavity. At first this layer becomes tense only during a pain. With the descent of the head the tension increases, and the "bag of waters" is formed. As the abdominal pressure is not operative below the pelvic line, and as the intra-uterine pressure is arrested in a measure by the child's

head, in that portion of the uterus which lies below the circle of cephalic compression, hyperæmia, serous infiltration, and softening follow as necessary corollaries of the anatomical conditions. The value of the bag of waters in dilating the cervix is due, therefore, not only to the hydrostatic pressure it exerts, but to the manner in which it favors the development of the organic processes described.

Thus far we have considered the expellent forces as acting upon the ovum as a whole. Many authorities accept in addition a direct pressure of the fundus upon the breech of the child, which is transmitted through the spinal column to the cephalic pole. A little reflection, however, will show, as Lahs* has pointed out, that so long as the ovum contains any measurable quantity of fluid, or at least more than enough to fill the fetal interspaces, the immediate contact of the breech with the fundus is hardly possible. To be sure, Ahlfeld† determined, by direct measurements, that there was an actual increase of about one and a half inch in the distance between the two poles of the child in head-presentations during the height of a pain. Schroeder‡ attributes this extension to the lateral compression of the fœtus, which results from the diminution of the transverse diameter of the uterus during contraction ; but it is evident that lateral pressure would equally produce an elevation of the fluid contents of the ovum, and thus, as the fundus assumes a spherical shape, prevent the impingement of the breech. Moreover, it is not easy to see how, so long as the fœtus is surrounded by a fluid medium, any effective propulsive force can be transmitted through a flexible column like the spine. It is certain that, in the intervals of the pains, manual pressure upon the breech through the fundus simply bends the fetal body, and deflects it from the vertical direction. Even if during a pain the lessening of the uterus in the transverse diameter hinders this movement to some extent, the increase antero-posteriorly would still leave ample space for lateral incurvation.

The descent of the ovum is followed necessarily by increased tension of the bag of waters. Under a pressure, estimated by Duncan# as varying, according to the resistance of the membranes, between four‖ and thirty-seven and a half pounds, rupture occurs. The cervix then usually closes, but remains dilatable ; i. e., it yields readily to pressure, and offers no resistance to the advancing head.

The pressure exerted by the united action of the uterine and abdominal walls requisite to accomplish delivery, according to the esti-

* Lahs, "Studien zur Geburtskunde," "Arch. f. Gynaek.," Bd. iii, p. 195.

† Ahlfeld, "Arch. f. Gynaek.," Bd. ii, p. 367.

‡ Schroeder, "Lehrbuch der Geburtshülfe," 6te Aufl., p. 156.

Duncan, "Researches in Obstetrics."

‖ Ribémont, "Recherches expérimentales sur la résistance, etc., des membranes de l'œuf humain," p. 35, places the minimum resistance at fifteen and three fourths pounds.

mates of Schatz,* based upon manometric observations, varies between seventeen and fifty-five pounds.† Although the methods by which both the results of Schatz and Duncan have been obtained possess defects, which the authors themselves make no attempts to conceal, they are quoted as furnishing approximations to the truth.

CHAPTER VIII.

MECHANISM OF LABOR.

Anatomical factors.—Anatomy of pelvis.—Sacrum.—Coccyx.—Ossa innominata.—The ilia.—The pubes.—The ischia.—Articulations of the pelvis.—Sacro-iliac articulations.—Symphysis pubis.—The pelvic ligaments.—Obturator membrane.—Sacro-sciatic ligaments.—Inclination of the pelvis.—The pelvis as a whole.—The pelvic planes.—Plane of the brim.—Plane of the outlet.—Planes of the cavity.—Ischial planes.—Pelvic axis.—Differences between male and female pelvis.—Differences between the infantile and adult pelvis.—The soft parts of the pelvis.—The perineal floor.—The head of the fœtus at term.—Sutures and fontanelles.—The diameters of the fetal head.—The articulation of the head with the spinal column.

THE mechanism of labor comprehends the movements of adjustment, by means of which the fœtus accommodates itself to the dimensions of the bony pelvis and to the variations in the direction of the parturient canal. Its study is, therefore, properly prefaced by the enumeration of a series of anatomical details relating to the pelvic ring and the soft tissues which form the floor of the pelvic basin, and to the structure, the diameters, and the reductibility of the fetal head.

THE ANATOMY OF THE PELVIS.

The following description includes only such points as are of direct obstetrical interest:

The bony pelvis is formed by the union of the sacrum and coccyx and the two ossa innominata.

The Sacrum.—The sacrum is a curved quadrilateral bone, inserted like a wedge between the ossa innominata. Like a wedge, it is broad above and tapers toward its lower extremity. It is composed of a central vertebral portion, and two outer masses termed the alæ or wings. The central portion, as its name implies, is really a continuation of the spinal column. In early childhood it consists of five distinct vertebræ with well-defined joint-surfaces and intermediate cartilaginous disks; but, with the completion of the growth, the whole becomes consolidated into a single piece by the inter-articular deposition of bone.

* *Vide* SCHROEDER, "Lehrbuch," 6te Aufl., p. 158.

† POLAILLON, "Recherches sur la physiologie de l'utérus gravide," p. 38, estimates the minimum pressure at twenty-three pounds.

The bony union is confined chiefly to the outer circumference, and is marked by ridges termed the *lineæ transversæ*. The base of the sacrum articulates with the last lumbar vertebra, with which it forms a projecting angle. It possesses a convex anterior surface, termed the promontory, which juts forward and encroaches upon the pelvic space.

From the sides of the central piece there extend two triangular portions of bone, termed the alæ or wings. Under normal conditions they are symmetrical. They are developed upon each side from three independent nuclei, which make their appearance near the bodies of the three upper vertebræ. They are supposed to have the morphological significance of ribs. In the course of this growth they fuse together, except at the points of junction of the bodies of the vertebræ, where they leave between them open spaces or foramina, for the passage of the spinal nerves.

The sacrum in the female is about four and a half inches wide, and from four to four and a half inches long, when measured from the promontory to the lower extremity. The sacrum possesses two curves :

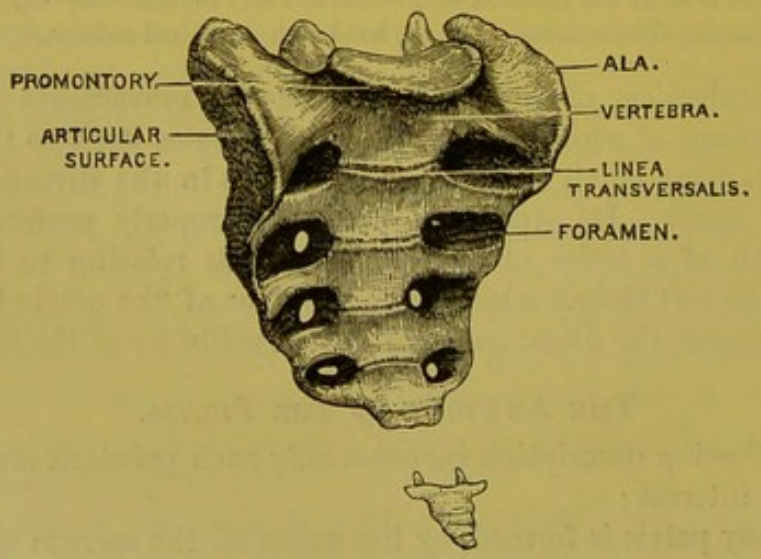


Fig. 83.—Sacrum and coccyx (anterior surface).

one, less marked, from side to side, and the other extending from above downward. The depth of the latter is greatest just below the upper border of the third vertebra, where it measures a little over an inch.

Upon the posterior surface we notice a canal, continuous with the spinal canal, which runs the entire length of the sacrum, but is incompletely closed at the fifth vertebra, giving rise to a slit-like opening, termed the *hiatus sacralis*. In the middle line the spinous processes coalesce into a vertical crest for the attachment of the erector spinæ muscle. The posterior lateral masses are formed by the fusion of the transverse processes, and their consolidation with the anterior structures. Next to the vertebræ, however, spaces are left between the

processes for the passage of the posterior sacral nerves. Opposite the three upper vertebræ, the outer border is known as the tuberosity of the sacrum. It possesses a roughened surface, to which are attached the sacro-iliac ligaments.

The upper portion of the side of the sacrum is furnished with an ear-shaped articulating surface termed the *superficies auricularis*.

The Coccyx.—The coccyx is composed of four rudimentary vertebræ, which progressively diminish in size from above downward. It possesses as a whole, therefore, a triangular shape. It is attached to the extremity of the sacrum by a hinge-joint, and is pushed backward during defecation, and in childbirth as the head passes the pelvic outlet. It is only when anchylosed that the coccyx assumes obstetrical importance.

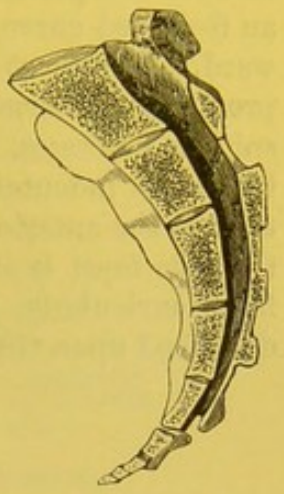


Fig. 84.—Section of sacrum and coccyx.

The Ossa Innominata.—Each os innominatum may be roughly compared to a figure eight, of which the upper and larger portion slants upward, outward, and backward, while the lower smaller division inclines downward and inward. Up to the age of puberty it consists really of three bones, which are connected at the acetabulum by cartilage of a Y-shape. These three bones are termed respectively the ilium, the ischium, and the pubes, names which are subsequently retained for convenience of description, in spite of the fact that in adult life the separate parts become solidly united, by the deposition of bone-tissue, into a single continuous piece.

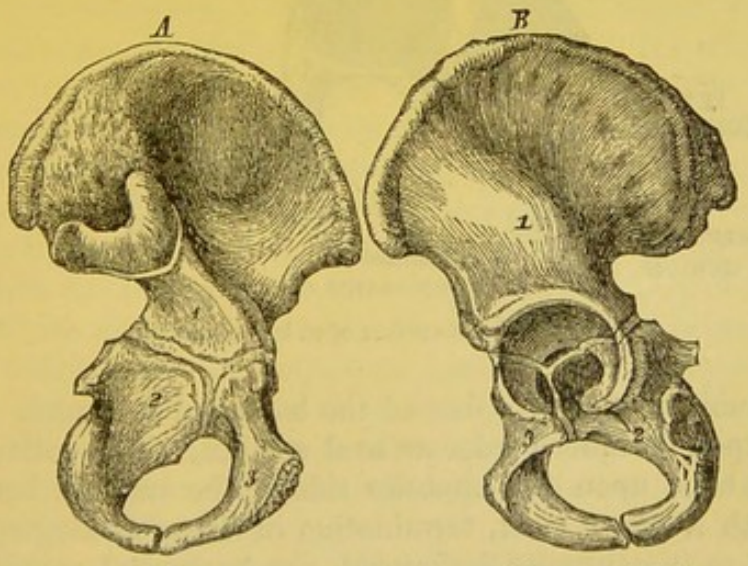


Fig. 85.—Os innominatum, before consolidation. 1, ilium; 2, ischium; 3, pubes.

The iliac portion has an external surface marked by a number of roughened lines, to which are attached the three gluteal muscles. The inner surface is excavated and forms the so-called iliac fossa, which

contains the internal iliac muscle. The fossa is bounded below by the linea arcuata interna, a convex ridge which contributes to form the brim of the pelvis. The upper border or crest of the ilium possesses an S-shaped curve, the anterior extremities of which are directed inward. The crest of the ilium terminates, front and rear, in bony prominences, termed respectively the anterior and posterior superior spinous processes. Beneath the upper spines, and separated from them by curved indentations, are two lower, less sharply defined projections, termed the anterior and posterior inferior spinous processes. Behind the iliac fossa is situated an ear-shaped articular surface, the superficies auricularis, which corresponds to the surface of similar name described upon the sides of the sacrum.

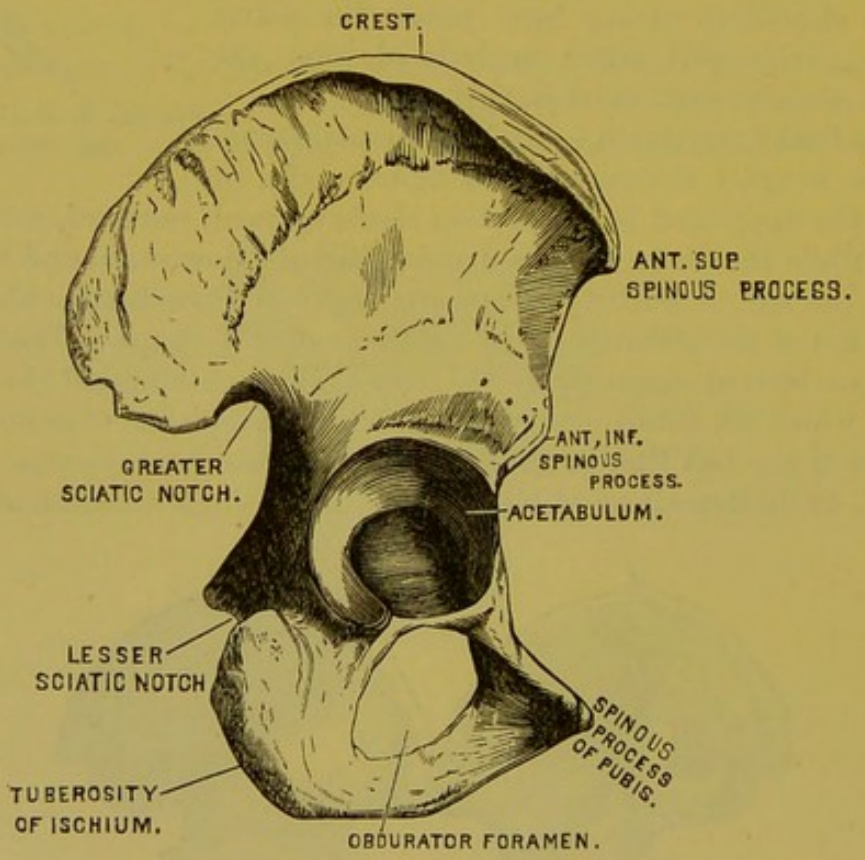


Fig. 86.—Outer surface of os innominatum.

The pubic portion consists of the body and two rami. The body presents upon its inner border an oval surface, which articulates with the pubic bone upon the opposite side. The superior border is furnished with a rough crest, terminating in the projecting spine. The upper, or, as it is usually designated, the horizontal ramus, possesses a ridge, the pecten pubis, extending from the spine and becoming continuous with the linea arcuata of the ilium. The linea terminalis, or boundary-line of the pelvic brim, is generally known as the ilio-pectineal line, from its sources of origin. Near the junction of the ilium

and os pubis is situated a slight elevation, the ilio-pectineal eminence, which, however, according to Luschka,* belongs entirely to the pubic

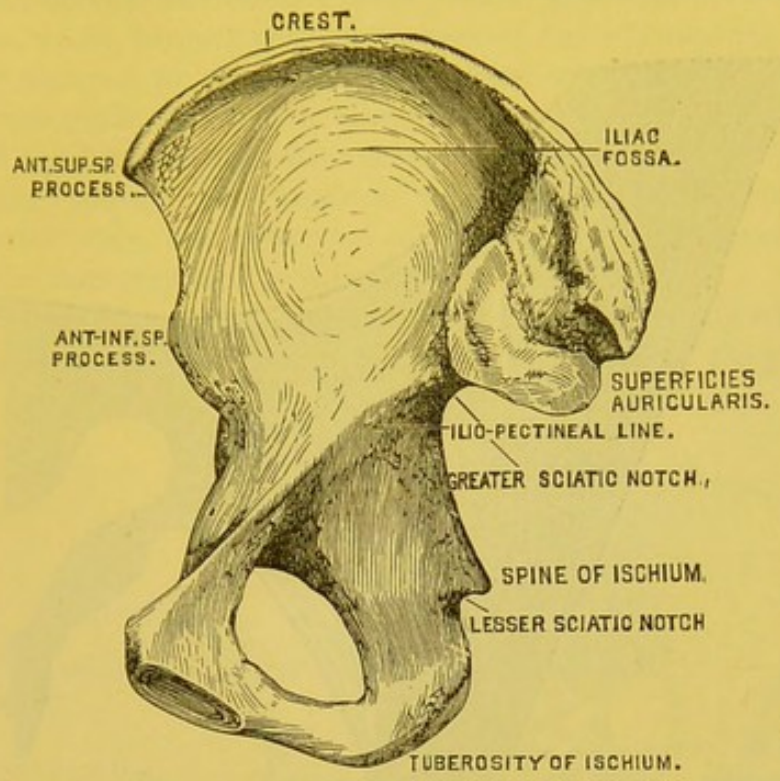


Fig. 87.—Inner surface of os innominatum.

bone. The descending ramus helps to bound the obturator foramen, and to form the pubic arch. The ischium completes the lower portion of the os innominatum. It consists of two rami, which, with the rami of the pubic bones, include the obturator foramen. It contributes about two fifths to the formation of the acetabulum ; from this the descending ramus drops vertically downward, and thence curves forward, and forms the ascending ramus, which unites with the descending ramus of the pubes. At the point where the descending ramus hooks forward there is a thickened projection, termed the tuberosity of the ischium, upon which the body rests in the sitting posture. Upon the posterior border of the descending ramus there is a sharp spine, projecting inward, which plays an important part in the mechanism of labor. Between the posterior inferior spinous process and the spine of the ischium there is a deep incurvation, termed the great sciatic notch ; while a smaller incurvation, between the spine and the tuberosity, is known as the small sciatic notch.

The Pelvic Articulations.—The articulations of the ossa innominata with the sacrum are usually termed the sacro-iliac synchondroses. The anterior articulation of the innominate bones with one another is known as the symphysis pubis.

* Luschka, "Die Anatomie des menschlichen Beckens," p. 86.

The term "synchondrosis," as applied to the sacro-iliac articulation, is really a misnomer. Luschka has shown that, in place of an intervening plate of cartilage, section demonstrates the existence of a true

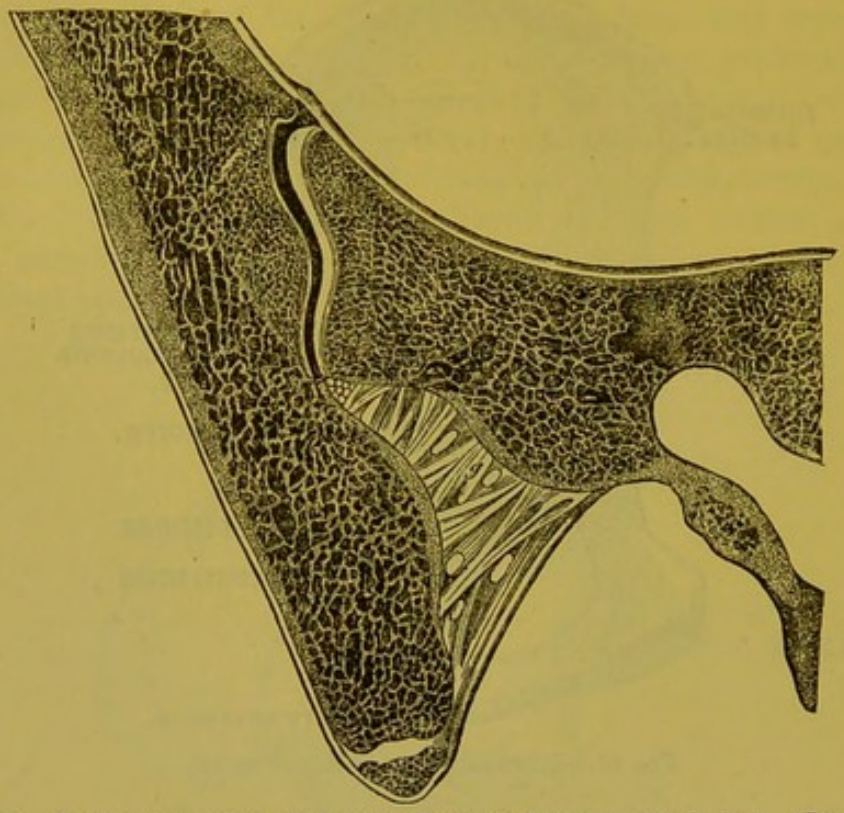


Fig. 88.—Section through the left sacro-iliac articulation (natural size). (Luschka.)

synovial membrane, limiting a narrow but well-defined joint-cavity. The middle third of the iliac surface is convex, and fits into a corresponding concave depression on the sacral end. There is likewise a

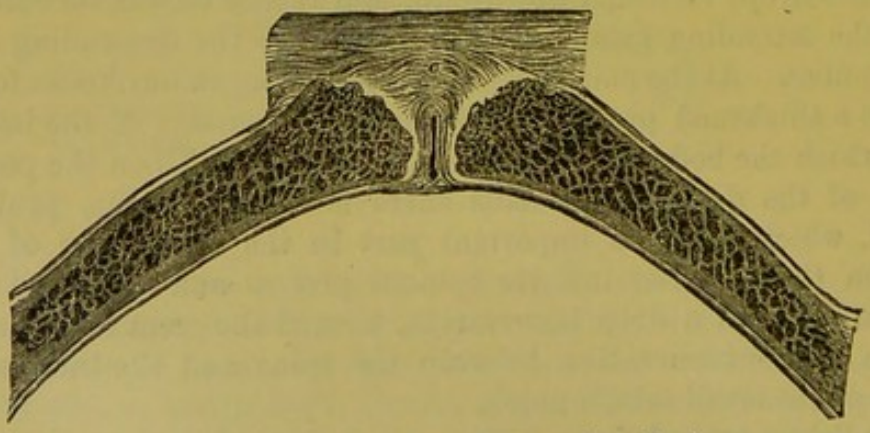


Fig. 89.—Section of symphysis. (Luschka.)

"bite" or ledge in front, formed by the ilium, which aids in preventing the sacrum from slipping forward into the pelvic cavity.

The office of maintaining the sacrum in position devolves chiefly

upon the ligaments distributed front and rear, and particularly upon the very numerous and closely interwoven bundles extending from the tuberosities of the sacrum to the roughened portions, or tuberosities, of the ilia, which project posteriorly beyond the articulation.

The symphysis pubis is likewise supplied with a small cavity, only the posterior portion of which possesses a synovial membrane. The fibro-cartilage between the articulating surfaces of the bones is thicker in front than behind. The anterior ligaments are more developed than the posterior ones, and allow no movements of importance to take place in the non-pregnant condition.

The Pelvic Ligaments.—In addition to the ligaments which have already been noticed as contributing to the solidity of the joints, the

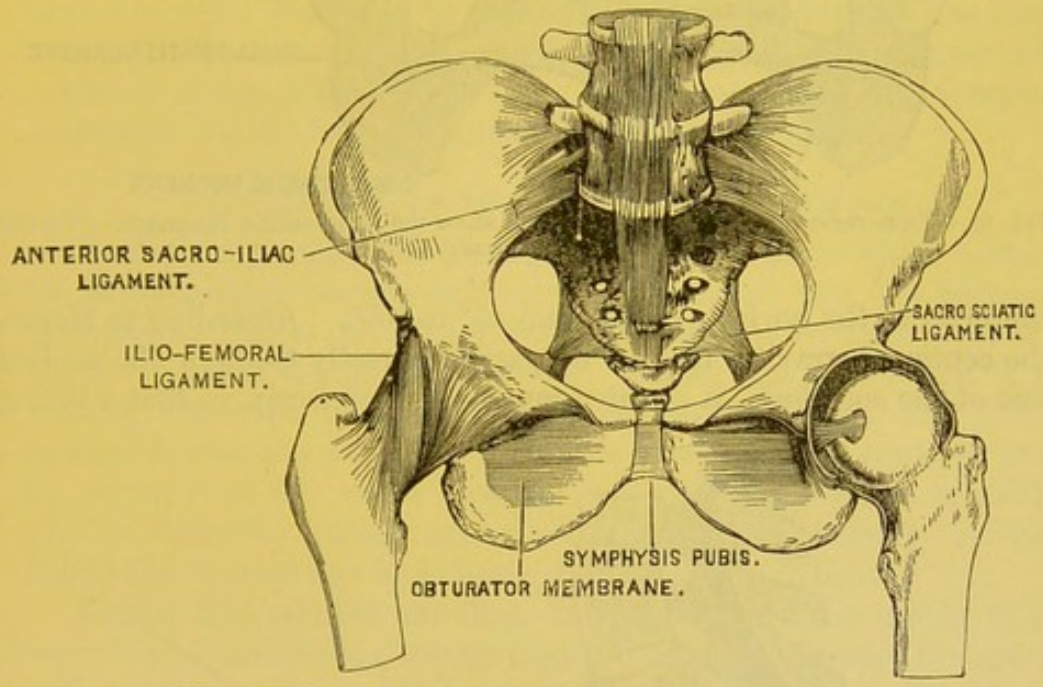


Fig. 90.—Front view of pelvis, with ligaments. (Quain.)

following help to close in the pelvis. Across the obturator foramen is stretched a fibrous septum, complete except where a small opening is left for the passage of the nerve and vessels.

The great sacro-sciatic ligament extends partly from the lower border of the sacro-iliac articulation, and partly from the lower border of the sacrum and coccyx to the tuberosity of the ischium. The small sacro-sciatic ligament lies in front of the preceding, and extends from the side of the sacrum and coccyx to the spinous process of the ischium. These two ligaments close the large and small sacro-sciatic notches, and convert them into two foramina, which bear the same name.

The Inclination of the Pelvis.—The plane of the brim of the pelvis was formerly supposed to run nearly parallel to the horizon, whence

the term "horizontal ramus," applied to the upper branch of the pubes. As a fact, however, in the upright position, the inclination of

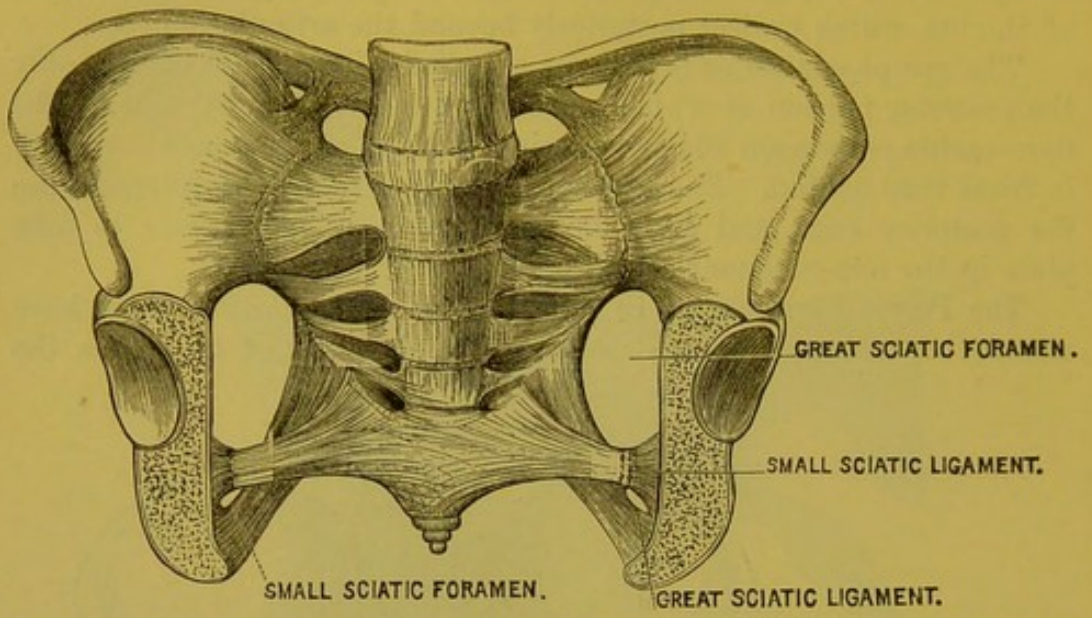


FIG. 91.—Transverse section through pelvis, to show the sacro-sciatic ligaments. (Tarnier et Chantreuil.)

the brim to the horizon varies from 45° to 100°. According to Meyer, the center of gravity, instead of passing directly through the median line of the acetabula, is situated somewhat posteriorly, so that a tilting

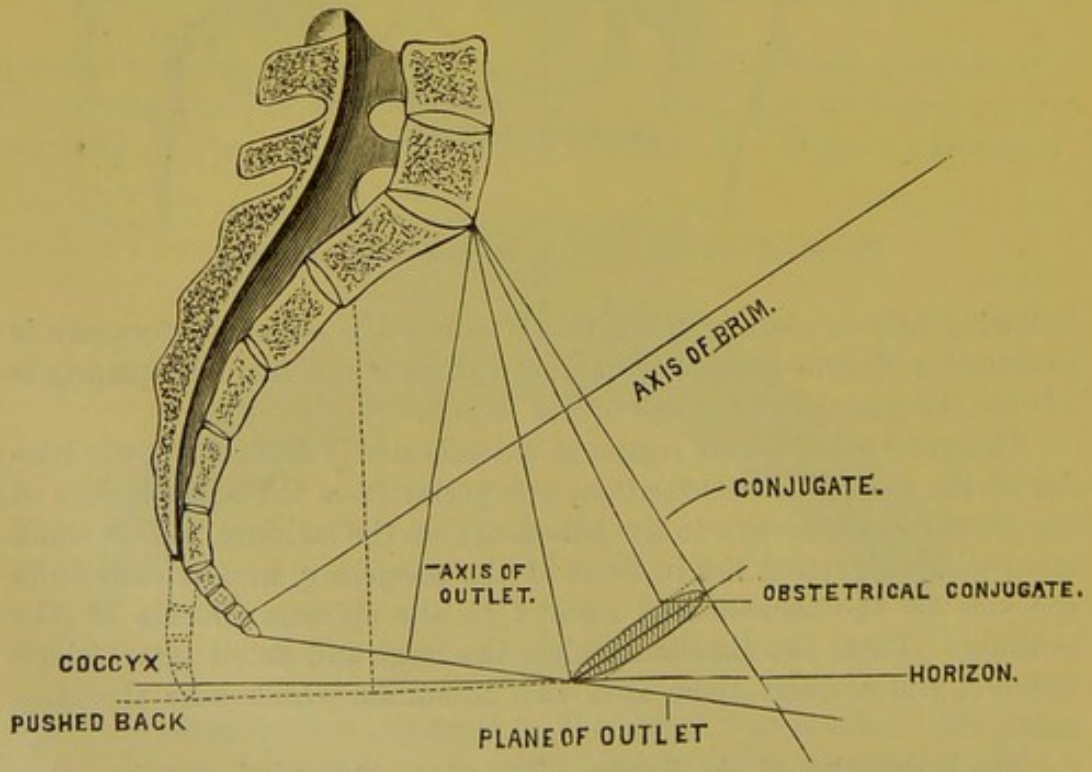


FIG. 92.—Section showing the inclination of the pelvis according to Naegele. (Tarnier et Chantreuil.)

of the pelvis backward is only prevented by the strong ilio-femoral ligaments (Fig. 90). Whatever, therefore, serves to relax the ligaments in question diminishes the angle of inclination, while positions that increase the natural tension cause the pelvis to assume a nearly vertical attitude. Experimentally Meyer found that the pelvic inclination was diminished to the greatest extent when the thighs were moderately separated and rotated slightly inward, while its increase was due to four conditions: closing the knees, stretching the legs widely apart, external rotation, and exaggerated internal rotation. Naegele endeavored to ascertain the normal inclination upon the living subject, by determining the distance between the extremity of the coccyx and an horizontal line drawn from the lower border of the symphysis, and then placing the bony pelvis in a position conforming to the measurement thus obtained. He found in this way the mean inclination was nearly 60°, a result explained by the fact that the method of measurement rendered a separation of the knees, and consequently an increase of tension of the ilio-femoral ligaments, a matter of necessity.*

Movements at the Pelvic Articulations.

At the symphysis pubis during gestation the fibers which compose its fibro-cartilage become infiltrated with serum, and the ligaments elongate, so that at term the distance between the articular surfaces of the pubic bones is increased twofold. Budin has shown that if the patient, when the finger is introduced into the vagina, and pressed upward against the lower border of the symphysis, be made to walk, an elevation of the ramus upon the side of the extremity in motion can be distinctly recognized. In the rule, this mobility is most marked in women who have borne a number of children.†

Zaglass first pointed out that, in spite of the close union at the sacro-iliac articulation, a certain degree of mobility between the sacrum and iliac bones existed. Thus, in defecation, when the body is thrown forward, the promontory is tilted toward the symphysis, and the inferior extremity of the sacrum is thrown backward, thereby enlarging the outlet of the pelvis. Matthews Duncan describes similar movements, only exaggerated in extent, during pregnancy, and points out how they practically contribute to facilitate labor. Thus, at the beginning of labor, as the head enters the brim, the woman naturally chooses to sit up, to walk about, or, if in bed, to recline with the lower extremities extended, positions which favor the rotation backward of the upper portion of the sacrum, and the consequent increase of the antero-posterior diameter at the superior strait. As the head, however, descends to the floor of the pelvis, the patient instinctively

* Schroeder, "Lehrbuch der Geburtshülfe," 6te Aufl., note, p. 7; Naegele, 8te Aufl., p. 31.

† Tarnier et Chantreuil, "Traité de l'art des accouchements," p. 239.

draws up her knees, throws the body forward, and during a pain contracts the abdominal muscles. In this way she succeeds in tilting up the pubes, in pressing the promontory forward, and in rotating the point of the sacrum backward, so as to perceptibly increase the conjugate diameter at the pelvic outlet.

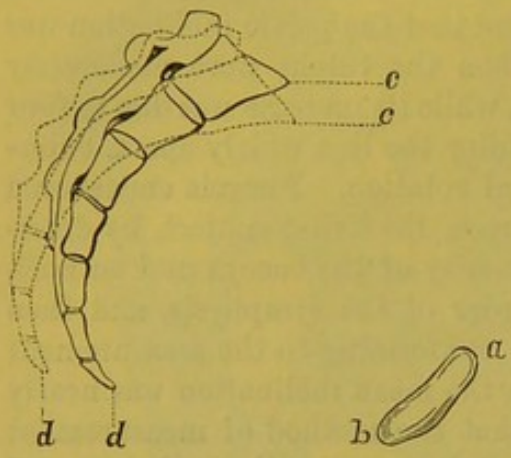


Fig. 93.—Diagram showing oscillatory movements of sacrum. (Duncan.)

The Pelvis as a Whole.—The pelvis is divided by the linea terminalis into an upper and lower portion.

The upper, or, as it is usually termed, the large pelvis, is composed of the lumbar vertebræ and the upper surfaces of the wings of the sacrum behind, the spreading portions of the ilia upon the sides, while the anterior segment is closed in by the muscles of the abdominal parietes. In shape, the bony part of the large pelvis has been compared to the rim of a barber's basin. Obstetrically the iliac fossæ are of interest, inasmuch as they furnish shelves upon which the head of the fœtus in multiparæ commonly rests during the latter part of pregnancy. The inclination of the ilia to the horizon, the shape of the crests, and the distance between them, together with the distance between the two anterior superior spinous processes, are important points for study, because they furnish data upon which valuable inferences are based in cases of pelvic deformity, relative to the shape and dimensions of the pelvic canal.

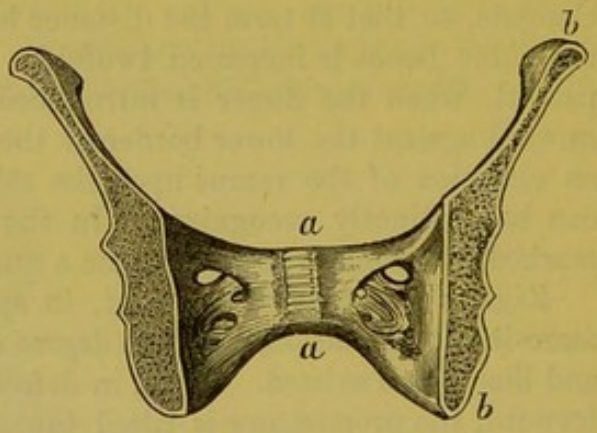


Fig. 94.—Anterior half of the pelvis.

It will be remembered that the crests of the ilia possess an S-shaped curve. Normally, the widest distances between the crests measure ten inches; the distance between the anterior superior spinous processes measures nine inches.* The slope of the inner surfaces of the ilia is such that an extension of the lines drawn from the crest to the linea terminalis would meet in the neighborhood of the fourth sacral vertebra.

* As no two pelves possess precisely the same dimensions, pelvic measurements are given somewhat differently by authors. They are obtained either by taking the mean of a large number of pelves (a method which furnishes fractions difficult to remember, but

The inferior or small pelvis comprises the portion below the linea terminalis. It is formed by the sacrum, the coccyx, the lower portion of the ilia, the ischia and pubes, the obturator membrane, and the sacro-sciatic ligaments. Together the foregoing inclose a basin-like cavity, which, though open below in the skeleton, is closed in by soft parts in the living subject. The posterior wall, formed by the sacrum and coccyx, measures five inches in a direct line from the promontory to the apex ; the anterior wall at the symphysis pubis measures one and three quarters inch; the lateral walls, from the linea terminalis to the tuberosities of the ischia, measure three and three quarters inches. The posterior wall is curved ; the symphysis pubis slopes downward and inward, so as to run nearly parallel with the two upper sacral vertebræ ; the rami of the pubes approach one another at an angle of 95° to 100° and unite beneath the symphysis in the form of an arch, the arcus pubis ; the side-walls are solid in front where they are constituted by the ischia, while behind the great sciatic notch is closed only by soft structures and the sacro-sciatic ligaments. The transverse diameter, owing to the incline of the side-walls, narrows toward the outlet.

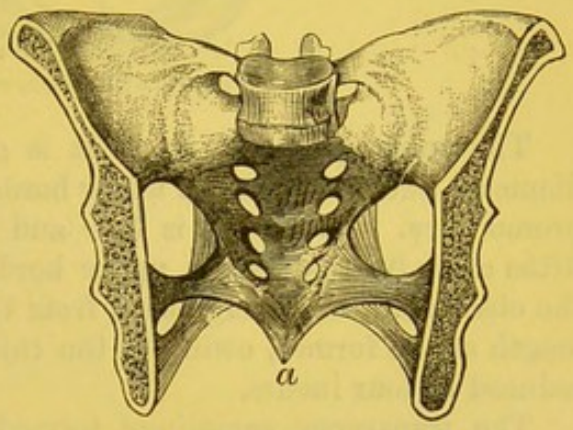


Fig. 95.—Posterior half of the pelvis.

The Planes and Axes of the Pelvis.—The eccentric forms of the pelvic bones render it extremely difficult to convey a clear impression of the nature of the pelvic inclosure. As a means to this end it is customary to study a series of planes drawn at different levels through the pelvic walls, which serve to show the changes in the shape and dimensions of the bony canal at selected points of observation. By a plane is meant simply a mathematical surface, without reference to depth or thickness.

The upper and lower openings are both somewhat contracted, and hence are termed respectively the superior and inferior straits, while the space between is denominated the cavity of the pelvis.

The first plane requiring our attention is that of the superior strait or brim. It is bounded by the linea terminalis, and has an elliptical contour, with a depression posteriorly, produced by the projection of the promontory of the sacrum.

offering no special advantages in the way of accuracy), or by selecting as the normal standard either a whole number, or, where fractions are necessary, the nearest half or quarter approximating to the mean average. The latter plan recommends itself in practice equally on the score of utility and convenience.

The dimensions of each plane are determined by measuring the antero-posterior, the transverse, and the two oblique diameters.

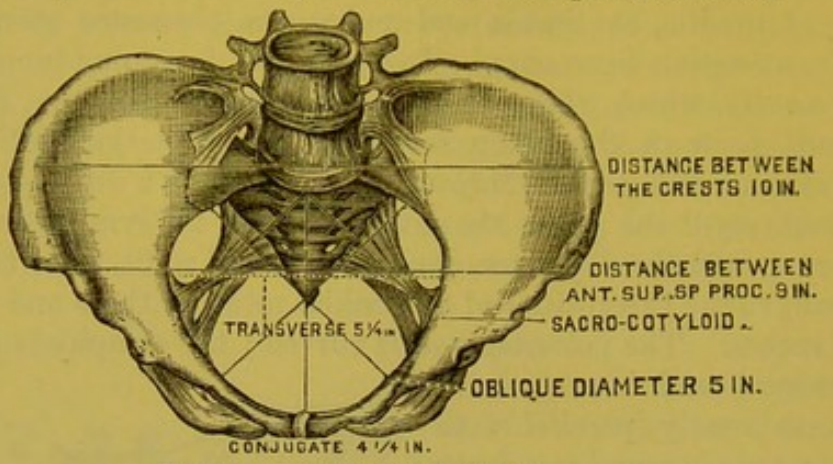


Fig. 96.—Diameters of the brim.

The antero-posterior, or, as it is generally termed, the conjugate diameter, extends from the upper border of the symphysis pubis to the promontory. Its length is four and a quarter inches. About two fifths of an inch below the upper border of the symphysis is situated the obstetrical, as distinguished from the anatomical, conjugate. The length of the former, owing to the thickening of the pubic bones, is reduced to four inches.

The transverse, sometimes termed the bis-iliac, diameter is the widest distance between the ilia. It measures five and a quarter inches.

The oblique diameters extend from the ilio-pectineal eminences to the opposite sacro-iliac articulations. The distance between the points mentioned is five inches. The right oblique diameter is the one directed to the right, and the left to the left sacro-iliac articulation.

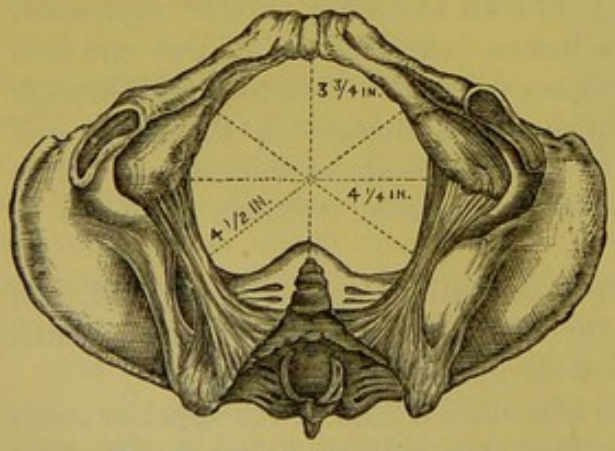


Fig. 97.—Diameters of the outlet.

The axis of the superior strait is represented by a line drawn perpendicular to the center of the plane. The extension of this line falls below upon the extremity of the coccyx, and above strikes the abdomen near the umbilicus (*vide* Fig. 94). The circumference of the brim is very nearly sixteen inches.

The inferior strait proper, or outlet of the pelvis, is bounded by the sub-pubic ligament, the pubic rami, the rami and tuberosities of the ischia, the sciatic ligaments, and the coccyx. Owing to the pro-

jection of the ischia, the surface of the pelvic outlet is rendered convex, or, perhaps, is better described by supposing it to be composed of two obtuse-angled triangles with apices at the symphysis and coccyx, and with a common base formed by a line drawn through the ischia.

The antero-posterior diameter extends from the lower border of the symphysis to the extremity of the coccyx. It measures three and three quarters inches, though, when the coccyx is pushed backward, the distance may be extended to four and a half inches.

The transverse diameter, between the inner borders of the tuberosities, measures four and a quarter inches.

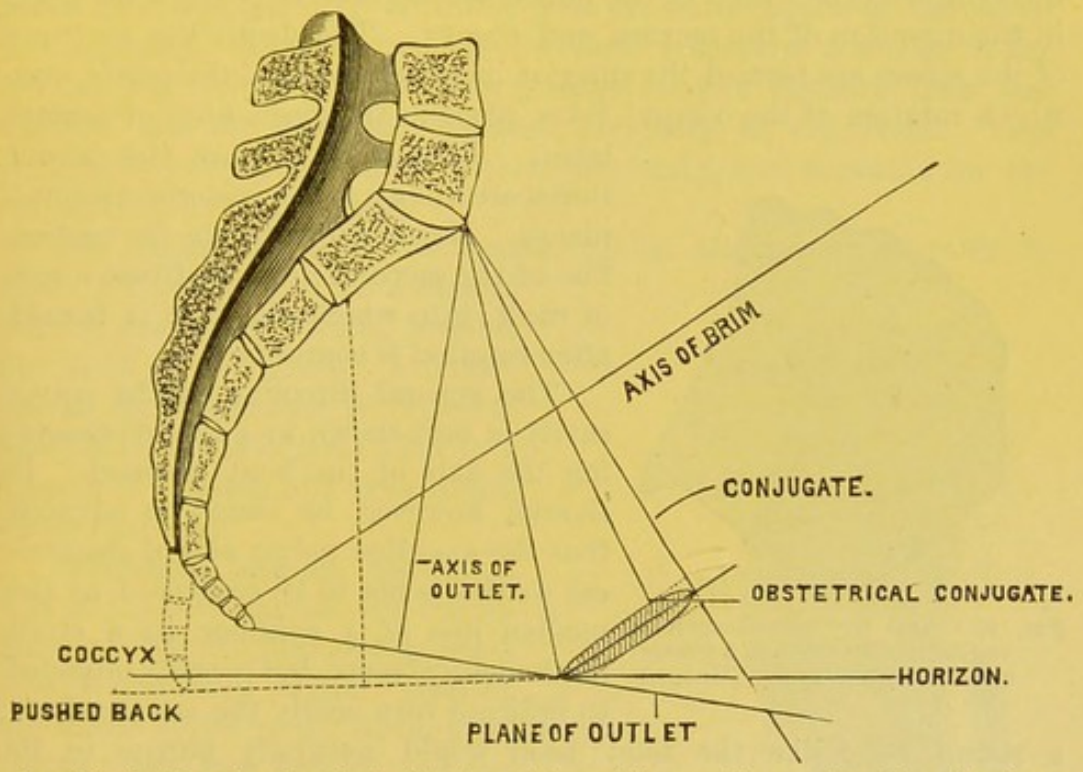


Fig. 98.—Section showing the inclination of the pelvis according to Naegele. (Tarnier et Chantreuil.)

Owing to the elasticity of the sciatic ligaments, the oblique diameters are not regarded as of obstetrical importance.

The axis of the inferior strait, when the coccyx is not disturbed, strikes the promontory. When the coccyx is pushed backward, a perpendicular line drawn from the center impinges upon the lower border of the first sacral vertebra.

The circumference of the inferior strait measures thirteen and a half inches.

The pelvic cavity or canal possesses an irregular, cylindrical shape, constricted somewhat above at the superior strait, and narrowing rapidly at the pelvic outlet. Below the brim, the dimensions are increased considerably by the concavity of the sacrum. Thus, a plane passing through the lower portion of the symphysis pubis, and across

the upper margins of the acetabula, to the junction of the second and third sacral vertebræ, gains three quarters of an inch in the conjugate, while the transverse diameter is barely one fourth of an inch less than the transverse diameter of the brim. The narrowing at the outlet is most marked in a plane drawn so as to intersect the spines of the ischia and the extremity of the sacrum. At the level indicated, the distance between the spines (transverse diameter) is but four inches, and the antero-posterior diameter four and a half inches.

The sciatic spines divide the pelvic cavity into two unequal sections. In the larger, anterior section, the lateral walls slope toward the symphysis and arch of the pubes, while posteriorly the walls slope in the direction of the sacrum and coccyx. The declivities in front of the spines are termed the anterior inclined planes of the pelvis, over which rotation of the occiput takes place in the mechanism of normal labor. Behind the spines the lateral slopes are known as the posterior inclined planes. Meeting together in the median line of the sacrum, they constitute a sort of vault, into which the face is turned after rotation is completed.

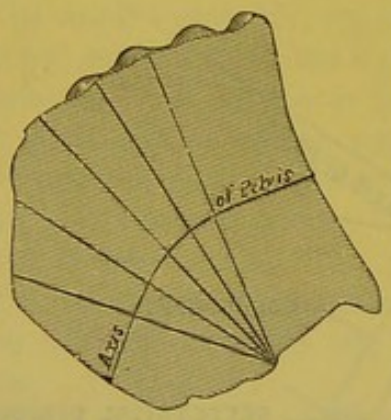


Fig. 99.—Axis represented upon a vertical section through a plaster cast of the pelvic cavity. (Hodge.)

The general direction of the pelvic cavity is best shown by a line representing the axis of the bony channel. It should, however, be stated in advance that the so-called pelvic axis of obstetrical writers is not to be construed as the median line of a cylinder in a strict mathematical sense, but is really intended to indicate very nearly the course which a round body like the fetal head would naturally pursue in its course through the parturient canal. In practice it is convenient to follow the suggestion of Hodge, and draw a plane from the supra-pubic ligament backward to the sacrum, and parallel to the plane of the superior strait. This second parallel would intersect the middle portion of the second sacral vertebra. Inasmuch as the pubic walls run nearly parallel to the upper portion of the sacrum, the axis of the cavity included between the two planes may be regarded as continuous with the axis of the brim. Below the second plane, owing to the curvature of the sacrum, the axis describes a nearly circular course, with intersecting planes radiating from the lower border of the symphysis as a center. Further on it will be shown that the axial curve is continued beyond the bony canal by the distended tissues which form the floor of the pelvic basin.

Differences between the Male and Female Pelvis.—In the male the bones of the pelvis are thick and solid; the brim is triangular in

shape; the promontory projecting; the cavity deep, and sloping inward like a funnel; the sacrum long, narrow, and moderately curved; and the arch of the pubes is formed at an angle of from 75° to 80°. In the female, on the contrary, the bones are lighter and more delicate in contour, therein corresponding to the inferior muscular development of the sex; the brim, owing to the less marked jutting inward of the promontory, has an elliptical outline; the diameters, both antero-posterior and transverse, are increased; the pelvic inclination is more pronounced; the sacrum is wider and more concave; the tuberosities of the ischia are wider apart; the angle of the arch of the pubes measures from 90° to 100°; and the entire depth of the pelvis is diminished. As a result of the increased transverse diameter in the female, the trochanters are at a greater relative distance from one another, and are directed somewhat obliquely to the front. This peculiarity brings the knees in close proximity, and accounts for the characteristic feminine gait.

The configuration of the female pelvis, though unfavorable to rapid locomotion, is, in a special degree, adapted to render possible the birth of the child. A female pelvis approximating in type to that of the male gives rise to a variety of dystocia of a very formidable character.

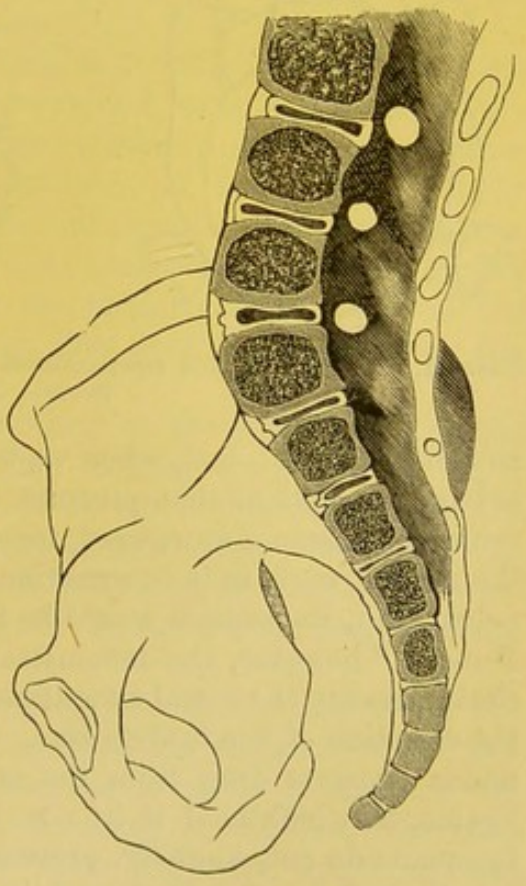


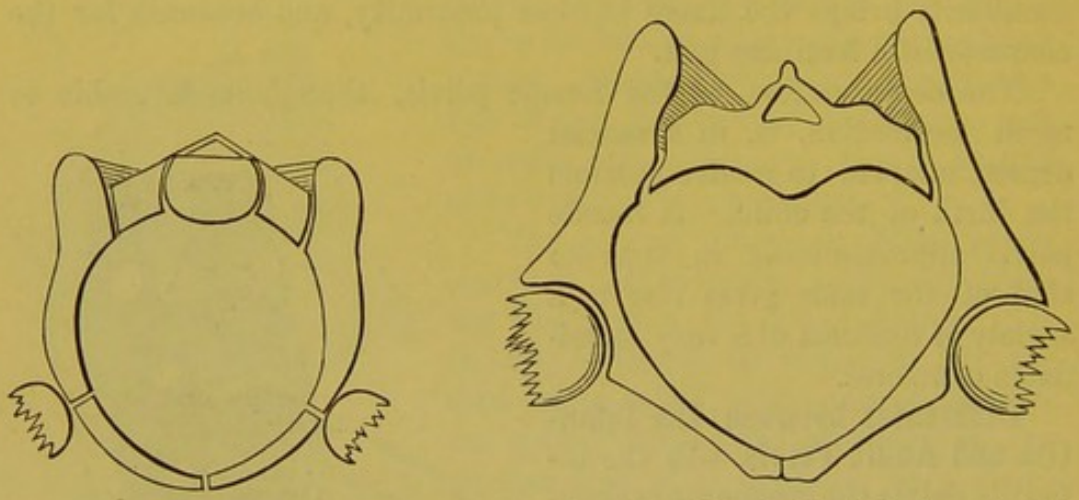
Fig. 100.—Vertical section of a female infantile pelvis. (Fehling.)

Differences between the Infantile and Adult Pelvis.—In the infantile pelvis the promontory occupies a relatively higher position above the upper border of the symphysis; the last lumbar and two upper sacral vertebræ possess a moderate convexity — i. e., the promontory does not project forward, as in the adult; the sacrum, after running a straight course, begins to curve forward first at the fourth vertebra; the alæ are slightly developed; the inclination of the ilia more nearly approaches the perpendicular; the S-shaped curve of the crests is barely indicated, there being but slight difference in the distances between the crests and anterior superior spines; the conjugate diameter in proportion to the transverse is increased; the side-walls converge toward the outlet;

the pubic arch is formed at an acute angle ; and the distance between the spines of the ischia is greater than the transverse diameter of the outlet.

Distinctions pertaining to sex are but slightly accentuated. In the female, the sacrum, owing to the smaller size of the vertebræ, is narrower than in the male ; the side-walls are higher ; the symphysis lower ; the iliac incline approaches more nearly a vertical line ; the pubic arch is less acute ; and the transverse diameter is increased.

The most important agent in effecting the changes which characterize the adult pelvis is unquestionably the weight of the trunk. Owing to the wedge-shape of the sacrum, and the shelf-like ledge which projects from the lower surface of the iliac articulation, no displacement can take place in the direction of the long axis of the au-



Figs. 101, 102.—Diagrammatic representations of sections through the infantile and adult pelves. (Schroeder.)

ricular surfaces. But, when we bear in mind the inclination of the pelvis, it is obvious that pressure from above must act upon the sacrum likewise in a downward, forward, and inward direction. Now, if the sacrum were, as it is sometimes represented, the key-stone of the pelvic arch, its position would be fixed between the ilia. We owe to Duncan,* however, the demonstration that this view is incorrect, and that in reality the sacral articulation slopes backward and inward in the direction of the median line. The fact that the sacrum does not under pressure drop from the arch is due to the strong sacro-iliac ligaments, which hold it in position as part of the bony ring. The ligaments do not, however, prevent the sacrum from sinking forward to a limited extent into the pelvic cavity, as is shown in the projection backward at maturity of the tuberosities of the ilia, whereas in the infantile pelvis the dorsal surface of the sacrum is level with the posterior superior spinous processes.

* Duncan, "Researches in Obstetrics."

As the line of gravity of the trunk falls in front of the sacrum, the weight from above presses the promontory forward and inward toward the symphysis pubis. At the same time the rotation backward of the sacral apex is restrained by the sciatic ligaments. The natural effect of these two simultaneously operative forces, acting at a period when ossification is still incomplete, is to increase the sacral curve, and consequently to shorten the distance between the upper and lower ends of the base. As a result, the height of the promontory is diminished, the pelvic brim and outlet become constricted, and the dimensions of the pelvic cavity are increased. The upper portion of the sacrum, in rotating forward, drags upon the posterior ligamentous attachments of the ilia. This traction would, were it not for their union at the symphyses, and the pressure of the heads of the thigh-bones, cause the ossa innominata to revolve around the sacral articular surfaces, like doors upon their hinges. As a result of the antagonistic action of the symphysis and the sacro-iliac ligaments, however, the ossa innominata bend at the point of least resistance in front of the sacrum, and in this way an increase takes place in the transverse at the expense of the antero-posterior diameter.

The sexual differences are attributable to differences in the character of the pelvic contents and the external sexual organs, to differences in muscular development, and to certain distinctive peculiarities of growth. Thus, in the female eunuchs of India, described by Roberts,* there were absence of vagina and complete atrophy of cellular tissue in the genital organs; at the same time the pelvis approximated to the male type, and, in place of the pubic arch, the rami of the pubes and ischia appeared as though they were in contact at the site usually occupied by the vagina.

In fetal life, the female sacrum, owing to the smaller size of the vertebræ, is narrower than in the male. Subsequently the more rapid growth of the alæ becomes the cause of the increased width which characterizes the sacrum of the female at maturity. The larger circumference of the brim in the female is due partly to this difference in the width of the sacrum and partly to the greater length of the linea innominata.

The Soft Parts of the Pelvis.—Prefatory to the history of the impregnated ovum, we have already considered the more important pelvic viscera concerned in generation and parturition. In studying the mechanism of labor, it is, however, necessary in addition to recall—1. The soft tissues which encroach upon the pelvic space; 2. The structures which close in the openings of the pelvis, and convert it into a basin-like cavity.

1. The diameters of the brim are diminished somewhat by the ilio-psoæ muscles. The iliac muscles proper occupy the entire surface

* *Vide* TILT, "Uterine and Ovarian Inflammation," p. 63.

of the internal iliac fossæ. The fibers converge below, and, passing beneath Poupart's ligament, become united to the borders of the psoas muscle. The pelvic portion affords a soft cushion for the support of

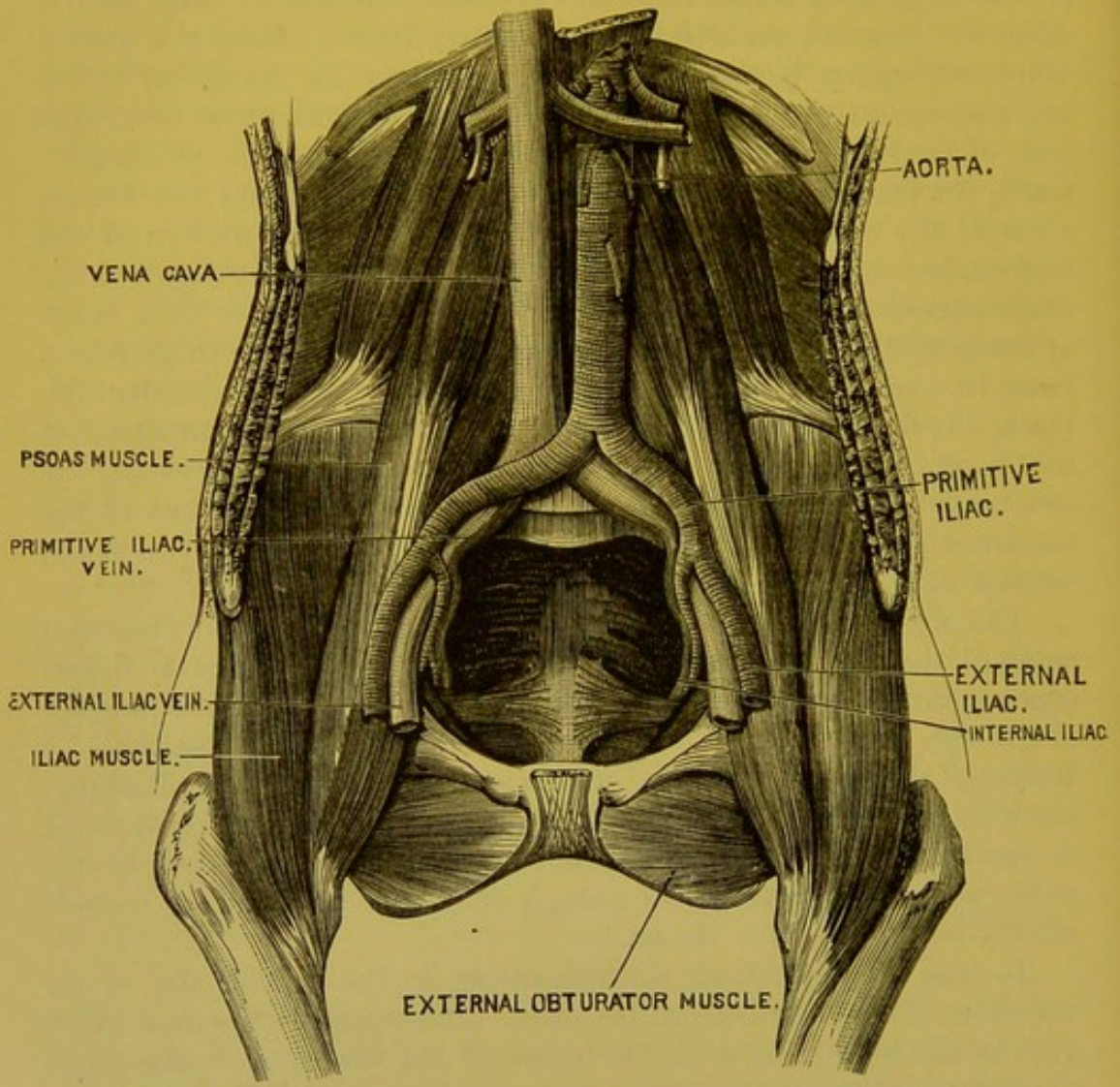


Fig. 103.—Pelvis covered with the soft parts, with removal of bladder, uterus, and rectum.

the gravid uterus. The great psoæ muscles fill out the spaces upon the sides of the promontory. They take their origin from the lateral surfaces of the bodies and transverse processes of the four upper lumbar and the last dorsal vertebræ. They cross the pelvis parallel to the linea innominata, which, however, they slightly overlap. They taper below, and, passing beneath the femoral arch, terminate in a tendon, which is inserted into the small trochanter. These two muscles flex the thighs upon the abdomen. The iliac muscle likewise acts as an abductor, and the psoas serves to flex the pelvis upon the spinal column. The ilio-psoæ muscles diminish the transverse diameter nearly a half-inch, so that the latter becomes very nearly equal in length to the oblique diameters. When the limbs are extended and the muscles

are rendered tense, the influence they exert in lessening the pelvic space is somewhat greater than when they are relaxed by flexing the legs upon the thighs.

The large arteries and veins at the pelvic brim do not undergo compression during labor under normal conditions. When, however, considerable disproportion exists between the pelvis and the child's head, the effects of pressure are sometimes manifested in the swelling of all the soft tissues within the pelvic cavity—a swelling which, in turn, enhances the difficulties of delivery.

2. The open spaces of the pelvis, which are closed in by soft parts, are the great sciatic notches, the obturator foramina, and the pelvic outlet.

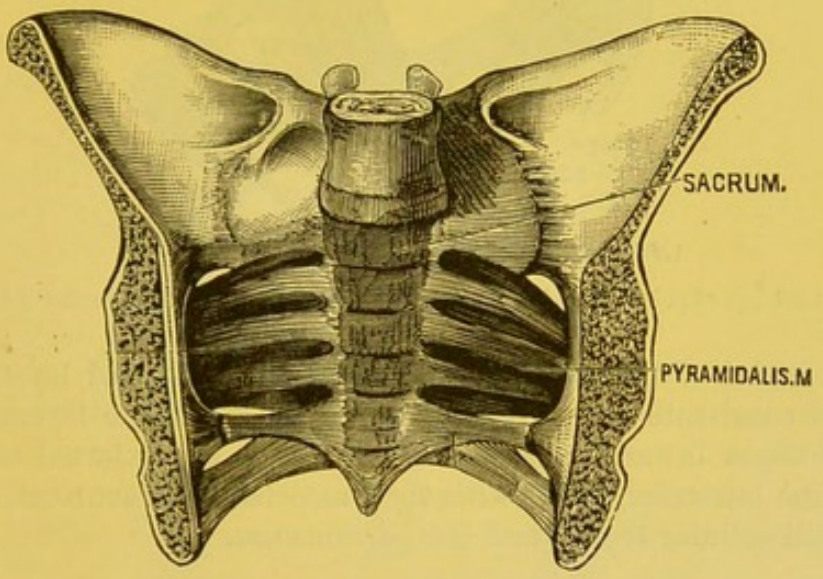


FIG. 104.—Section of pelvis, showing the pyramidal muscles. (Tarnier et Chantreuil.)

The closure of the sacro-sciatic notches is effected by the pyramidal muscles. The pyramidal muscle has a triangular shape. Its base presents a series of digitations which are inserted upon the lateral portions of the anterior surface of the sacrum, along the outer borders of the four lower sacral foramina and the upper portion of the sacro-sciatic ligament. It then crosses the large sciatic foramen, and, passing outward, terminates in a tendon, which is inserted into the large trochanter.

The obturator foramen is covered by the internal obturator muscle. The latter is attached to the quadrilateral surface which corresponds to the cotyloid cavity, to the circumference of the foramen, and to the inner surface of the obturator membrane. Its fibers converge to form a tendon, which passes through the lesser sciatic foramen, and thence is directed downward and backward to the digital cavity of the great trochanter.

Owing to their tenuity, neither the pyramidal nor the obturator muscles appreciably affect the dimensions of the pelvic cavity.

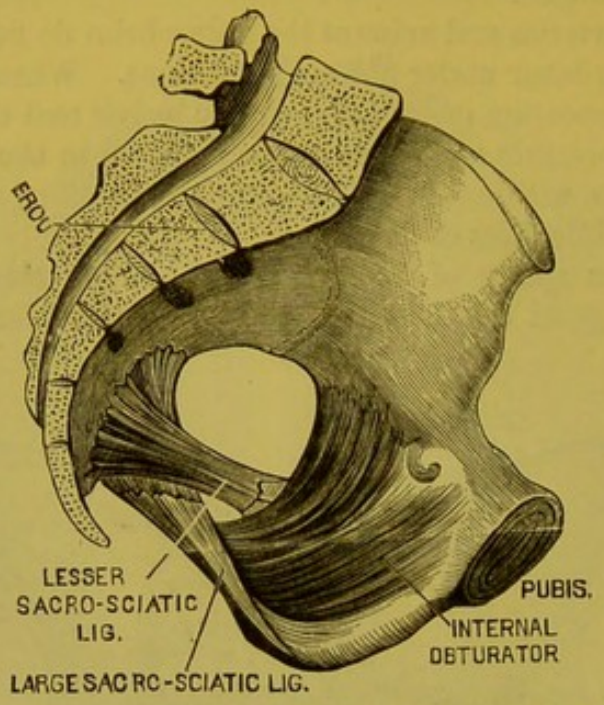


Fig. 105.—Section of pelvis, showing the internal obturator muscle. (Tarnier et Chantreuil.)

The outlet of the pelvis is closed by a succession of layers, which together constitute the perineal or pelvic floor. These layers, passing from without inward, consist respectively of the external cutaneous tissue, the muscular layers with their associated aponeuroses, the subperitoneal cellular tissue, and the peritonæum.

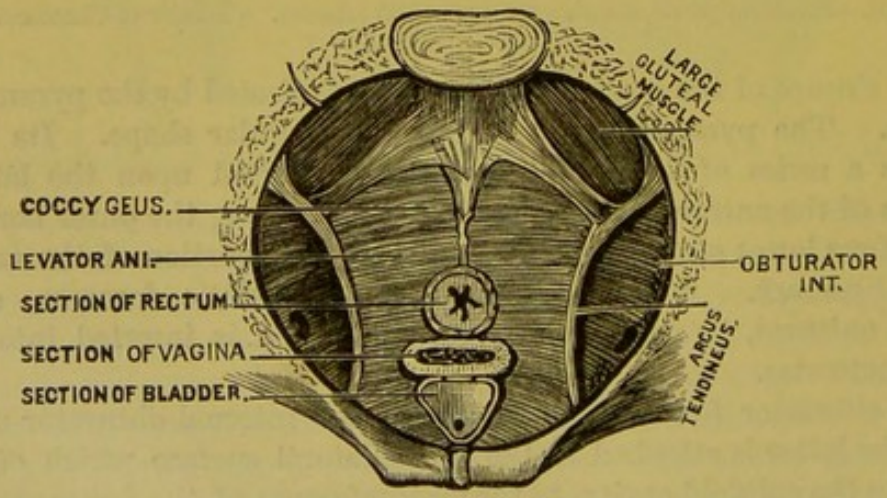


Fig. 106.—Muscles of the perineal floor, as seen from the abdominal cavity. The pyramidal muscle has been removed.

The most important structure which enters into the formation of the perineal floor is the levator-ani muscle. This muscle is composed

of two symmetrical halves, attached in front to the inner surface of the body and horizontal rami of the pubes, and laterally to the tendinous arch of the pelvic fascia which stretches from the inner border of the pubes to the spines of the ischia. Its fibers slope anteriorly downward and inward to the sides of the bladder, between and to the sides of the bladder and rectum, and posteriorly are inserted into a tendinous raphé, extending from the extremity of the coccyx to the rectum. Its rectal insertions become confounded with the upper fibers of the external sphincter; those of the vagina are situated beneath the bulbs of the vestibule and the constrictor cunni. The ischio-coccygeus is a small triangular muscle, by many included in the description of the levator ani. It is situated between the latter and the pyramidal muscle, and in front of the small sciatic ligament. Its base is attached to

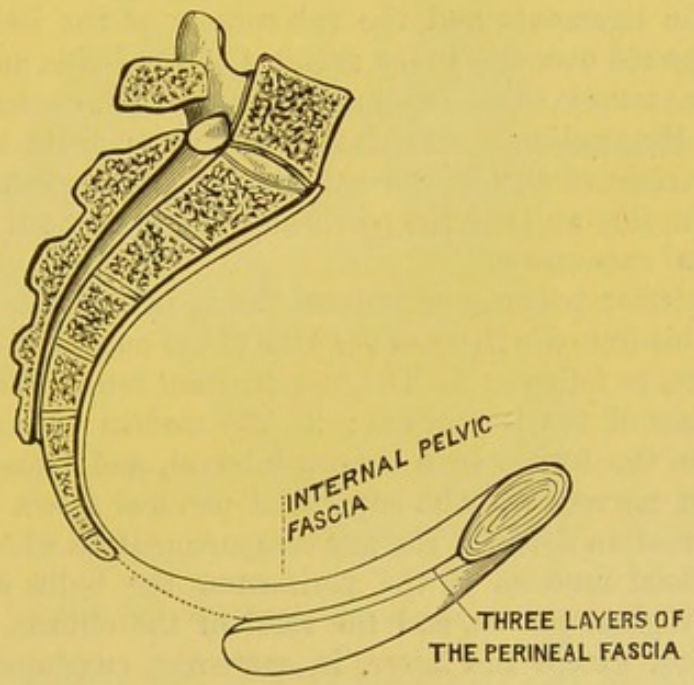


Fig. 107.—Antero-posterior section of the perineal floor. (Tarnier et Chantreuil.)

the sides of the coccyx and lower extremity of the sacrum; the insertion of the apex is at the spine of the ischium.*

The upper surface of the levator-ani and coccygeal muscles is concave. The muscles themselves are flattened, and of nearly membranous thinness. Alone they are capable of affording but feeble support to the superimposed viscera. They are, however, above closely attached to the strong tissues of the internal pelvic fascia, which possess the qualities of elasticity and toughness.

The internal pelvic fascia is attached to the upper border of the superior strait where it meets the fascia which lines the iliac fossæ,

* The coccygeus muscle is strongly developed in caudate animals, and enables them to move the tail laterally.

and the transverse fascia of the abdominal walls. It covers the pyramidal and the upper half of the obturator muscles. In front it descends from the symphysis to the neck of the bladder, and forms the pubo-vesical ligament. From the linea terminalis to the arcus tendineus the fascia upon the side-walls is firmly attached to the periosteum. The tendinous arch marks the line at which the fascia leaves the pelvic walls to form the inner lining of the levator and coccygeal muscles.

The upper surface of the internal pelvic fascia is covered by the peritonæum, with which it is connected by loose connective tissue.

The fascial coverings beneath the levator-ani muscle are divided into a posterior and anterior portion by a line drawn between the two ischia.

The posterior portion consists of a single layer. It starts from the sacro-sciatic ligaments and the tuberosities of the ischia ; thence it mounts upward over the inner surfaces of the ischia and the obturator internus muscle to the tendinous arch, which it contributes to form, and from the tendinous arch is reflected at an acute angle over the inferior surface of the levator-ani muscle. The space thus limited between the side-walls of the pelvis and the levator ani is termed the ischio-rectal excavation.

The anterior portion, or perineal fascia proper, fills the space between the bis-ischiatic line and the arch of the pubes. It is composed of three layers, as follows : 1. The deep perineal fascia, which covers the lower surface of the levator ani ; 2. The median perineal fascia, separated from the former by a narrow interval, and inclosing the pudic vessels and nerves ; 3. The superficial perineal fascia which forms, with the median layer, a shallow compartment in which are lodged the superficial muscles of the perinæum, the bulbs of the vagina, the vulvo-vaginal glands, and the rami of the clitoris. Each one of these organs, except the latter, is, moreover, enveloped in a special sheath, derived from prolongations of the upper surface of the aponeurosis.

The superficial perineal muscles are of slight obstetrical importance. They are the constrictor vaginæ, the ischio-cavernosi, and the transversi perinæi.

The constrictor vaginæ consists of two small lateral muscles, situated upon the outer sides of the vestibular bulbs, and surrounding the vulvar orifice. Posteriorly the extremities of the main muscle start from the perineal fascia at a point nearly midway between the sphincter ani and the ischia, while a small bundle only is connected with the sphincter ani itself.* Above, the convergent ends separate into a superficial and deep portion. The superficial portions terminate in a tendon which unites them together above the dorsal vein of the clito-

* Luschka, "Anatomie des menschlichen Beckens," p. 399.

ris; the deep portions pass between the upper ends of the bulbs and the clitoris, and are likewise united by an aponeurosis.

The action of the muscle consists chiefly in compressing the veins

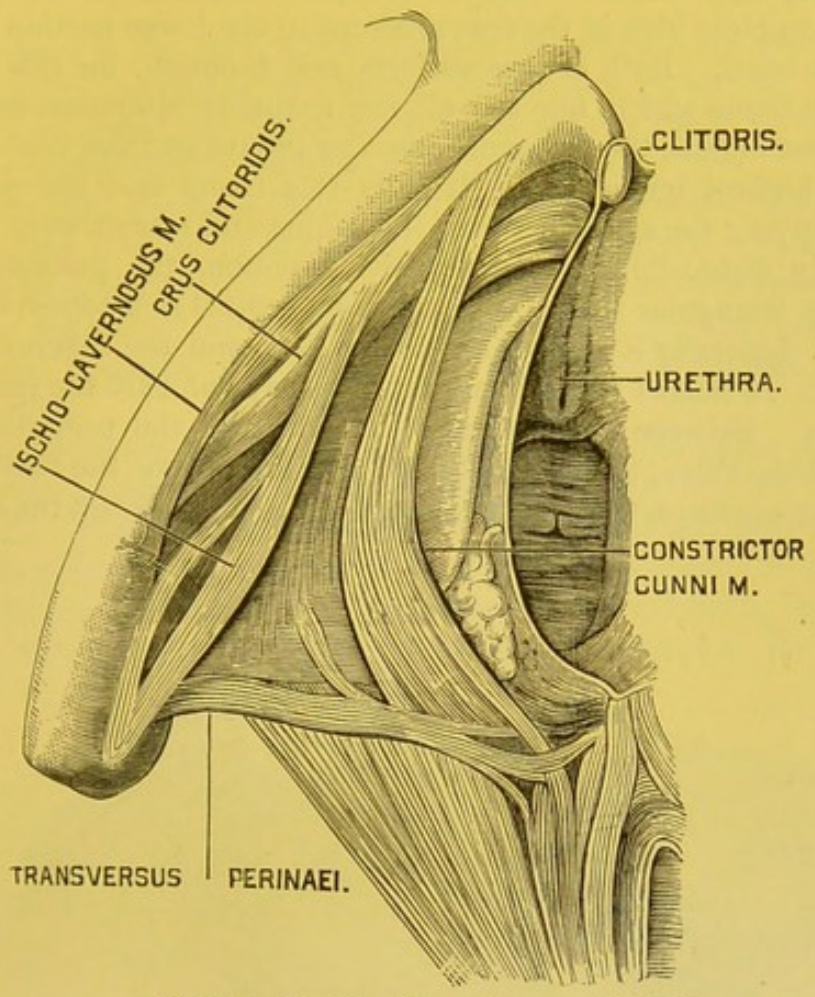


Fig. 108.—Muscles of the perinæum. (Henle.)

crossed by its tendon, and in thus enhancing the turgidity of the erectile apparatus. It is in no sense a sphincter muscle, though, by pressing the turgid bulbs inward, it may narrow the vestibule of the vagina.

The ischio-cavernosi muscles form a sort of fibro-muscular sheath about the crura of the clitoris. They are united together above by an aponeurosis which crosses the posterior extremity of the body of the clitoris. During sexual excitement these muscles are capable not only of compressing the crura, thereby forcing the blood toward the body of the clitoris, but, through the pressure exerted by the aponeurosis upon the dorsal vein, they help to retard the return of the blood from the turgescent organ.

The transversi perinæi muscles are small, triangular, flattened muscles which pass from the inner sides of the ischia, underneath the constrictor muscle, to the sides of the vagina and rectum. When the

perinæum is lacerated, these muscles tend to produce gaping of the wound, and to interfere with union by first intention.

A mere enumeration, such as has been given, of the thin, flat, muscular and aponeurotic structures of the pelvic floor affords, however, a very incomplete idea of the true anatomy of the lower portion of the parturient canal. Both as regards form and function, the *rôle* of the connective tissue which fills out all the available interstices between the different organs, the different muscular groups and the bony walls, is of the highest importance. It is to this tissue that the perineal body occupying the space between the vagina and rectum owes its extraordinary distensibility. In a sagittal section, the perineal body presents a triangular shape, with a convex vaginal and concave rectal surface.* Laterally it spreads out to the rami and the tuberosities of the ischia. In height it extends upward nearly one half the length of the vagina. Between the border of the anus and the posterior commissure of the vulva, the external portion, which forms the base of the triangle, measures on the average an inch in length.† When the head of

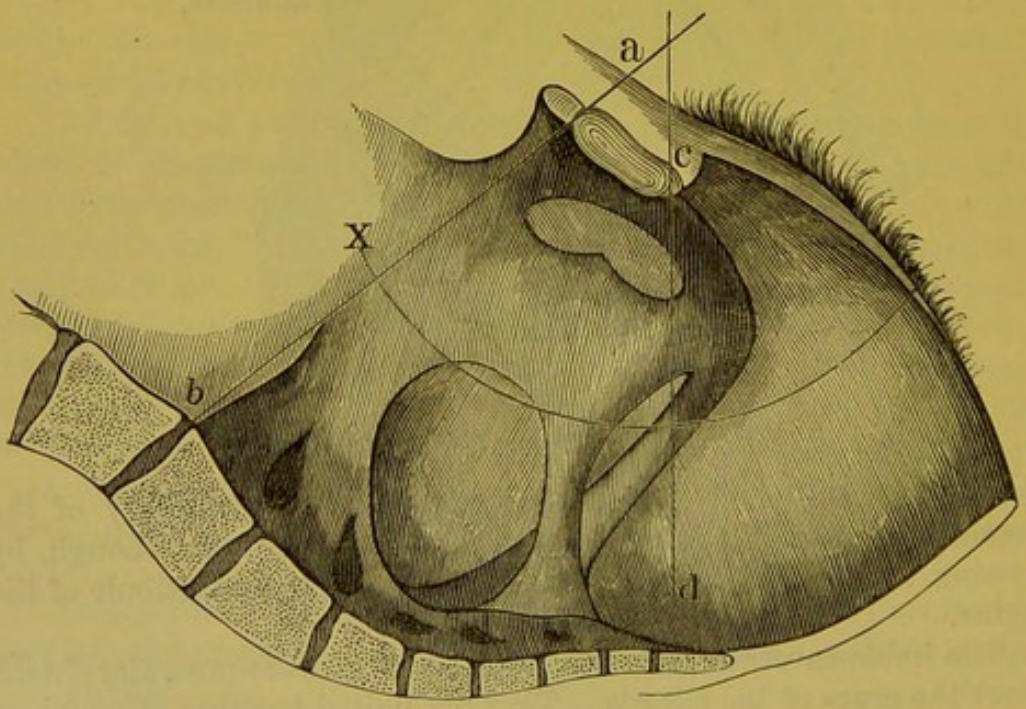


Fig. 109.—The parturient canal. (Hodge.)

the child, during labor, descends below the level of the bony walls, it bulges the perinæum and stretches it from four to five inches in the antero-posterior direction. Both the length and degree of curvature of the pelvic canal are thereby increased, the soft parts posterior to

* Thomas, "The Female Perinæum," etc., "Am. Jour. of Obstet.," April, 1880.

† Foster, F. P., "Anatomy of the Uterus and its Surroundings," "Am. Jour. of Obstet.," January, 1880.

the vulva forming a gutter-like extension, the axis of which is continuous with that of the pelvis.

The Head of the Fœtus at Term.

The head is the part which presents the greatest mechanical difficulties in the passage of the fœtus through the parturient canal. It is, therefore, important to become familiar with its shape, its diameters, and the modification it undergoes during labor.

In studying the fetal head we distinguish the face and the cranium.

The face is of little importance in normal labors. It may, however, be here incidentally noted, what is sometimes of consequence in extreme degrees of pelvic contraction, that the distance (two and a half inches) between the malar bones possesses but a slight degree of reductibility.

In the cranium we distinguish again between the upper compressible portion or vault and the lower incompressible portion or base of the skull. The vault is composed of the frontal and parietal bones and the squamous portions of the temporal and occipital bones. The base is formed by the union of the ethmoid, the sphenoid, the petrous portion of the temporal bones, and the basilar portion of the occipital bone.



Fig. 110.—Lateral view of fetal skull. (Hodge.)

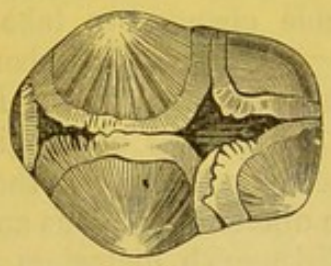


Fig. 111.—Fetal head, as seen from above. (Hodge.)

The Sutures and Fontanelles.—The flat bones which form the vault are thin and imperfectly ossified, consisting, indeed, of little more than the diploë. Instead of union by serrated osseous borders, they are held in their relative positions by the periosteum and dura mater, which come into contact with one another and form membranous commissures between the bones. Where more than two bones meet at a given point, the ossification is apt to be incomplete, and spaces are left, covered only by membranes, termed fontanelles.

The sutures to which it will be found necessary to make constant reference are the following: the frontal suture, situated between the ununited halves of the frontal bone; the coronal suture, between the frontal and parietal bones; the sagittal suture, where the parietal bones meet at the top of the cranium; the lambda suture, so called from its resemblance to the Greek letter of that name, between the triangular

portion of the occipital and the posterior borders of the parietal bones.

At the point of intersection of the frontal, the sagittal, and the coronal sutures the incomplete ossification of the frontal and parietal bones leaves a large open space of a rhomboidal shape, termed the anterior or large fontanelle, or sometimes simply the bregma. Of the four sides, the anterior are longer, often extending for some distance between the bones of the os frontis.

The posterior or small fontanelle is situated at the junction of the sagittal and lambda sutures. It is formed at the meeting of three bones, viz., the two parietal and the occipital, and possesses a triangular shape. In very many cases the ossification of the bones is complete at the time of delivery. Its site then is indicated by the angle formed by the posterior borders of the parietal bones, beneath which, as a consequence of labor, the occipital bone is usually found depressed.

Budin has recently demonstrated that the squamous or triangular portion is attached to the basilar portion of the occipital bone by means of a band of cartilaginous and fibrous tissue. A sort of hinge-joint is thus formed, which permits veritable movements of flexion and extension to take place.*

The flexibility of the cranial bones, the sutures, the fontanelles, and the fibro-cartilaginous bands of union, together enable very considerable changes to take place in the diameters of the fetal head during the progress of labor.

The Diameters of the Fetal Head.—The diameters of the child's head are a series of imaginary lines extending between fixed points, selected so as to indicate the dimensions of the largest segments which, in the different positions and presentations, engage in the pelvic canal. We distinguish diameters running in the antero-posterior, the transverse, and the vertical directions.†

The antero-posterior diameters are : 1. The occipito-mental ; 2. The occipito-frontal ; 3. The sub-occipito-bregmatic.

The occipito-mental diameter extends from the highest point of the occiput to the chin ;‡ the occipito-frontal, from the occiput to the root of the nose ; the sub-occipito-bregmatic, from the junction of the occiput with the neck to the point of intersection in the large fontanelle of the coronal and sagittal sutures.

The transverse diameters are : 1. The bi-parietal ; 2. The bi-temporal ; 3. The bi-mastoid.

* Budin, "De la Tête du Fœtus," p. 72.

† The points of departure of the following diameters have been adopted from Budin's excellent monograph, already quoted.

‡ The occipito-mental diameter is usually referred to as the longest one of the head. According to Budin, the true maximum diameter is situated between the chin and a variable point in the line of the sagittal suture above the occiput.

The bi-parietal diameter stretches between the two bosses or protuberances of the parietal bones; the bi-temporal, between the extremi-

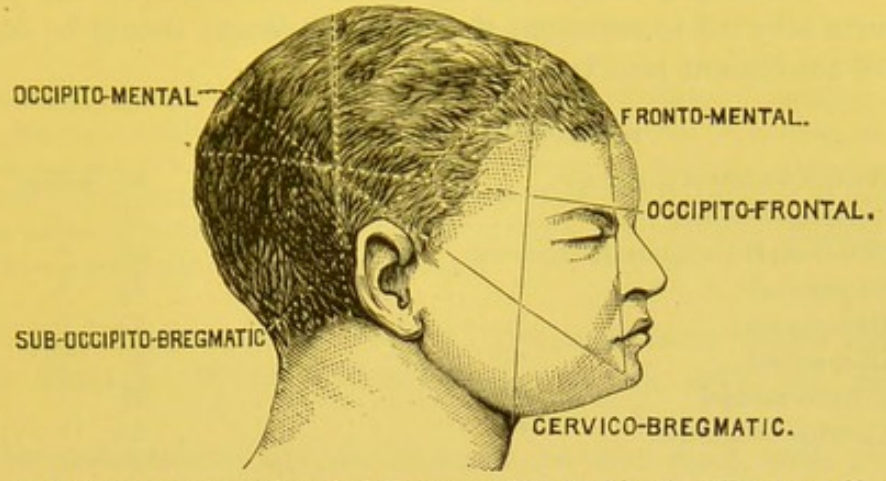


Fig. 112.—Antero-posterior and vertical diameters of the fetal head. (Tarnier et Chantreuil.)

ties of the coronal sutures; the bi-mastoid, between the mastoid processes at the base of the skull.

The vertical diameters are: 1. The fronto-mental; 2. The cervico-bregmatic.

The fronto-mental diameter extends from the top of the forehead to the point of the chin; the cervico-bregmatic, from the middle of the large fontanelle to the upper portion of the neck near the larynx.

In furnishing standard measurements of the foregoing diameters it is of course understood that no two heads present precisely the same dimensions. As a rule, as shown by Sir J. Y. Simpson, the heads of boys are larger than those of girls. In selecting type-cases it will be remembered too, that, owing to the plasticity of the head, in none are the

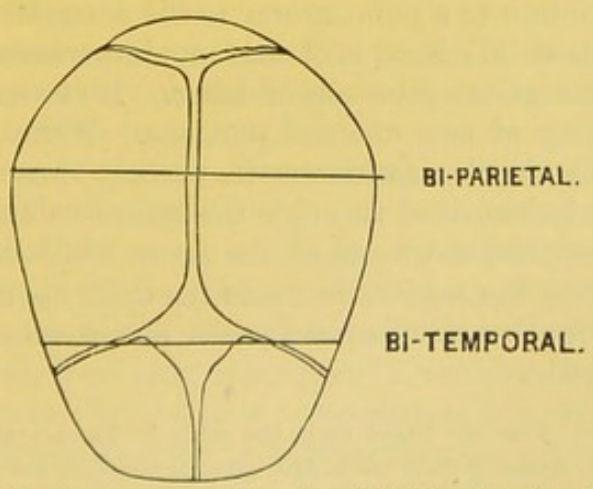


Fig. 113.—Diagram showing transverse diameters of fetal head. (Tarnier et Chantreuil.)

diameters completely normal immediately after the transit through the generative passages. Unless, therefore, the child is delivered by

Cæsarean section, sufficient time should be allowed to elapse after delivery before the measurements are made, to permit the head to return to its natural shape. Again, as in the measurements of the pelvis, the figures selected to represent the normal average should be such as admit of convenient recollection.

DIAMETERS OF FETAL HEAD.*

Occipito-mental diameter	5¼	inches.
Occipito-frontal "	4½	"
Sub-occipito-bregmatic diameter	3¾	"
Bi-parietal "	3¾	"
Bi-temporal "	3¼	"
Bi-mastoid "	3	"
Fronto-mental "	3¼	"
Cervico-bregmatic "	3¾	"

The circumference of the head, from the chin to the vertex, using the latter term to express the highest part of the skull, without reference to any fixed anatomical point, is about fourteen and three quarters inches. The circumference at the sub-occipito-bregmatic diameter is but thirteen inches.

The Articulation of the Head with the Spinal Column.—The movements of the occiput upon the atlas are extremely limited, those of extension and flexion, which the head executes so readily, taking place for the most part in the articulations of the cervical vertebræ. Movements of rotation are performed at the articulation between the axis and the atlas. In practice, the head can not be turned with safety to either side beyond a quarter of a circle, though, when rotation is performed slowly after delivery, it may sometimes be carried to such an extent as to enable the face to look directly backward. The insertion of the spinal column at a point nearer to the occipital than the frontal extremity of the child's head is of supreme importance in the furtherance of the mechanical processes of labor. It converts the head into a lever, consisting of two unequal portions. When the head, therefore, encounters circular resistance in passing through the obstetric canal, pressure transmitted through the spinal column causes the descent of the occipital short end of the lever, while the pressure upon the forehead from the side-walls flexes the chin upon the thorax, the degree of flexion depending upon the size of the canal through which the transit is made.

* The diameters given are based upon the table in Tarnier and Chantreuil, which were averaged from measurements taken with great precision in forty-four cases.

CHAPTER IX.

MECHANISM OF LABOR.—(Continued.)

Presentations: natural, unnatural, normal.—Vertex presentations: frequency, positions.—Manner in which head enters pelvis.—Positions, normal mechanism of labor.—Descent and flexion.—Rotation.—Extension.—External rotation.—Expulsion of the trunk.—Abnormal mechanism (vertex presentations).—Mechanism of occipito-posterior positions.—Configuration of the head in vertex presentations.—Molding.—Scalp-tumor.—Diagnosis of vertex presentations.

THE mechanism of labor—i. e., the manner in which the fœtus passes through the parturient canal—varies with the presentation.

The presentations are classified, in the first place, with reference to the position of the fœtus in relation to the axis of the uterus. In cases where the long diameter of the fœtus coincides with that of the uterus, we have further to distinguish presentations of the head and presentations of the pelvic extremity.

Head presentations comprise those of the vertex, brow, and face.

Pelvic presentations offer two varieties, viz., breech presentations, and foot presentations.

When the long diameter of the fœtus crosses the axis of the uterus, there is produced a transverse, or, after the operation of uterine contractions, a shoulder presentation.

Vertex, face, and pelvic presentations are included in the category of natural labors. Brow and shoulder presentations are termed unnatural, as, with few exceptions, they are not terminable except by the resources of the obstetric art.

Vertex presentations alone are to be regarded as normal, as they only realize the mechanical conditions compatible with the highest degree of safety to both mother and child.

In the following pages it is purposed to associate with the descriptions of the mechanism of labor, in the various presentations and positions, an account of the means of diagnosis, and the treatment suited to the special cases under consideration, instead of placing diagnosis, mechanism, and treatment in chapters distinct from one another. The writer believes, from long experience in teaching, that what is thus sacrificed in the way of systematic completeness is more than compensated by the clinical advantage of keeping in close proximity the principles of obstetric art and the rules of practice directly deducible from them.

Precedence of description is given to the vertex presentation as representing the normal type of labor.

Vertex Presentations.

In 93,871 births, collected from private practice, Spiegelberg found that in over ninety-seven per cent. the cranial vault presented.* The back of the child *in utero* is directed in about seventy per cent. of cases to the left, and in thirty per cent. to the right, side of the mother. The fronto-occipital diameter of the head measures four and a half inches. The diameters of the pelvic brim, after deducting the soft parts, are nearly as follows:

Transverse diameter of brim .....4¾ to 5 inches.
Oblique " " .....4¾ to 5 inches.
Antero-posterior diameter of brim (minimum diameter about one third inch below the crista pubis).....4 inches.

Thus it will be seen that the fronto-occiptal diameter of the head may, at the brim, enter the pelvis without meeting with any special resistance in either the transverse or oblique diameters. In the conjugate diameter, on the contrary, this is not possible. Transverse positions, where the conditions are normal, are of very exceptional occurrence, though they form the rule in flattened pelves. Tarnier‡ suggests that this infrequency is partially explicable on mechanical grounds. The long transverse diameter of the pelvis, he says, is, owing to the projection of the promontory, situated in a line considerably posterior to the point at which the sagittal suture normally meets the conjugate. When the head, therefore, enters the pelvis in a transverse direction with both parietal bones upon the same plane, the fronto-occipital diameter corresponds to a shortened chord subtending two points of the pelvic ring in front of the anatomical transverse diameter; in point of fact, therefore, the latter, at the site of engagement, is less than either of the oblique diameters. In flattened pelves this difficulty does not exist, as, in place of both parietal bones entering upon the same level, the posterior is turned toward the corresponding shoulder, the anterior dipping obliquely into the brim (lateral obliquity of Naegele), an arrangement by which the long diameter of the head is brought into correspondence with the long diameter of the pelvis.

At the time when the sagittal suture is accessible, and it is possible to observe with correctness, the antero-posterior diameter of the head is found to approximate to one or the other of the pelvic oblique diameters.

It is customary to classify the positions of the head with reference to the direction of the occiput. Most English authorities admit four varieties, viz.:

The right occipito-anterior (R. O. A.), the right occipito-posterior

* Spiegelberg, "Lehrbuch der Geburtshülfe," p. 148.

‡ Tarnier et Chantreuil, "Traité de l'Art des Accouchements," p. 465.

(R. O. P.), the left occipito-anterior (L. O. A.), the left occipito-posterior (L. O. P.).

Naegele first called attention to the fact that the head occupies, in an overwhelming proportion of cases, the right oblique diameter; that, therefore, when directed to the left, the occiput is turned to the cotyloid cavity, and, when directed to the right, it looks toward the sacro-iliac synchondrosis.* This peculiarity probably results from the fact that the uterus is usually rotated in such a way upon the spine that the right side inclines obliquely backward, while the left side is turned somewhat to the front.

In practice it is convenient to take simply into account, in the first place, the question whether the occiput is turned to the right or to the left, and then to observe specifically whether it occupies a position in front or to the rear of the transverse diameter.

At the beginning of labor the head, surrounded by the lower segment of the uterus, is commonly found at the brim or resting upon an iliac fossa in multiparæ, and below the brim, within the pelvic cavity, in primiparæ. The direction of the head, as regards its vertical axis, depends upon the degree of resistance afforded by the contiguous uterine tissues. In the softened, relaxed condition often observable in multiparæ toward the close of pregnancy, the two fontanelles are not infrequently situated upon the same level. Where the lower uterine walls are firm and slope toward the os internum, the weight of the child's body, transmitted through the vertebral column, depresses the occiput. At the same time the sloping uterine walls, acting upon the frontal extremity of the child's head, direct the chin toward the thorax, thus producing a state of semi-flexion.

The Normal Mechanism of Labor.

The mechanism of labor in head presentations is usually described as consisting of a series of acts, termed respectively descent, flexion, rotation, external restitution, expulsion of the trunk.

A familiarity, not with the names of the various acts, but the things the names represent, is essential to the judicious prosecution of the obstetric art.

Descent and Flexion.—Descent and flexion go hand in hand, and should be associated in thought as they are in reality. It is evident, whenever the head encounters the resistance of the obstetric canal, the force transmitted through the spine to the foramen magnum will cause the descent of the occiput, and thus flexion will result. The degree of flexion, however, is proportioned to the extent of the action of the walls upon the frontal extremity of the head, and therefore is

* When the head is said to occupy an oblique diameter, this is not intended to be understood in a mathematical sense. The expression implies simply that the head is deflected from the transverse diameter.

variable in different subjects and in different portions of the canal. This will best be shown by considering the two acts in conjunction.

The descent of the child's head through the cervix is effected by

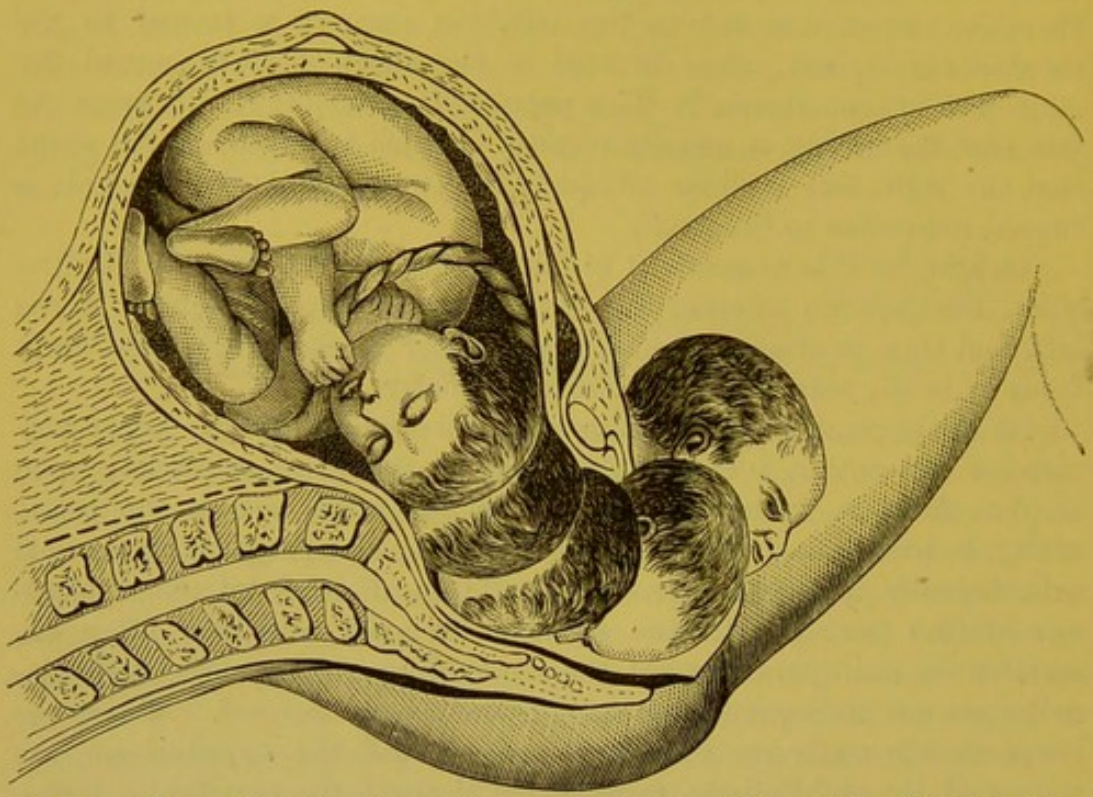


Fig. 114.—Figure illustrating the mechanism of labor in occipito-anterior deliveries (after Schultze).

the pressure of the uterus during contraction upon its entire contents. While not denying the possibility of the transmission of a certain amount of propulsive energy from the uterine walls through the trunk of the child to the head, it is necessarily of feeble force, as the flexibility of the spine and the smoothness of the breech prevent the latter from finding a suitable *point d'appui* against the vaulted fundus. The head is, however, subjected to the driving force of the fluid medium with which the fœtus is surrounded. As the pressure is proportioned to the height of the fluid, in the case of partial flexion, the force directed against the depressed occiput is greater than that expended upon the frontal extremity. This condition not only promotes the continuance of head-flexion, but contributes to its increase as the head in its descent meets with the resistance of the cervical canal.*

The head enters the pelvis in the axis of the brim, with the biparietal diameter parallel with the planes of the superior strait. This direction it maintains until arrested by the curvature of the sacrum and by the floor of the pelvis.

In its transit through the cervix, it is usual for the head-flexion to

* Lahs, "Die Theorie der Geburt," p. 199.

become complete—i. e., for the chin to sink until arrested by contact with the chest. Exceptions to this rule are found in cases where the head is unusually small, or where, as is sometimes the case in multiparæ, the cervix, after rupture of the membranes, is so softened and dilatable as to offer slight hindrance to the advancement of the head. It is well for the beginner to keep constantly in mind that flexion is not in any sense an active movement. It is always a movement of accommodation, the end of which is the successive substitution of a shorter diameter for a previous longer one, so soon as the latter has encountered sufficient resistance to arrest its further progress. The mechanical advantages of flexion are obvious when we recall that the average length of the sub-occipito-bregmatic or maximum diameter of the flexed head (three and three fourths inches) is three quarters of an inch less than the occipito-frontal or maximum diameter of the head when midway between extension and flexion. Again, the maximum circumference of the flexed head (thirteen inches) is one and three fourths inches less than one measured about the extremities of the occipito-frontal diameter. These measurements, which are representative of the natural state, are, however, far from expressing the full extent of the differences which exist after the plastic head has undergone the molding processes incident to labor (*vide* p. 186).

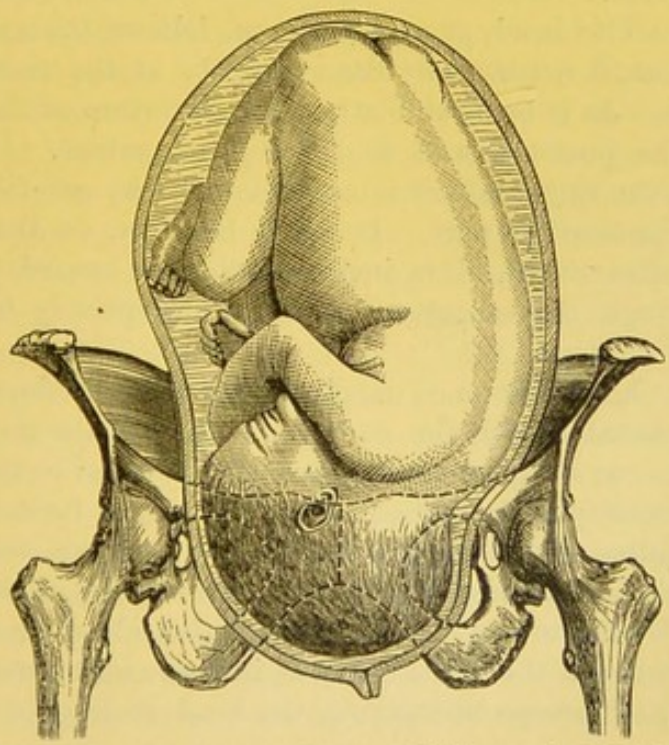


Fig. 115.—Vertex presentation; child surrounded by amniotic fluid. (Pinard.)

A further advantage of flexion is thus described by Professor Pajot: "The fœtus, in its entirety, is to be regarded as a broken, vacillating rod, possessed of mobility at the articulation of the head and trunk;

but a solid thus disposed presents conditions unfavorable to the transmission of a force acting principally upon one of its extremities; it follows, therefore, that previous to flexion the uterine action, pressing upon the pelvic extremity to promote the advance of the fœtus, is lost in great measure in its passage from the trunk to the head, by reason of the mobility of the latter; but the cephalic extremity, once fixed upon the thorax, is most advantageously disposed to participate in the impulse communicated to the general mass of the fœtus."* Now, although we have seen that, in its descent through the cervix, the head is for the most part propelled by the direct action of the fluid pressure; just in proportion to its advance into the pelvis, the propulsive force exerted during a contraction operates more and more exclusively upon the trunk, until the conditions mentioned by Professor Pajot are completely realized.

After the head is once released from the environment of the cervical canal, a slight movement of extension may follow, provided the resistance offered by the vagina is less than that of the cervix. In many cases, on the contrary, where dilatation is complete at the time of rupture of the membranes, the head may pass through the cervix with scarcely any change in its direction, flexion taking place first when the head encounters the resistance of the sloping pelvic walls and the perineal floor.

Rotation.—The head, as we have seen, follows the axis of the superior strait until arrested by the extremity of the sacrum and the perineal floor. As it nears the latter, the curvature of the sacrum approximates the posterior wall to the sagittal suture. Upon vaginal examination, the finger comes in contact with the anterior half of the head as the presenting part. It is not, however, on that account to be assumed that the head is inclined laterally toward the posterior shoulder, though the sensation produced deceptively favors such a theory.†

When the head has once reached the perineal floor, its further progress is associated with the most interesting of the mechanical acts of labor. The occiput, whether previously directed to the anterior or posterior extremity of an oblique diameter, turns forward under the arch of the pubes, until the sagittal suture occupies very nearly the antero-posterior diameter of the outlet. The utility of this movement is obvious. Owing to the inward slope of the side-walls of the pelvis, the distance between the ischia is but 4¼ inches, and between the spines 4 inches. If, in forceps operations, the head is dragged through the

* Pajot, "Dictionnaire encyclopédique des sciences médicales," t. i, p. 382, quoted by Tarnier et Chantreuil, p. 639.

† With the apparent obliquity it is probable that a certain amount of real obliquity coexists. As, even in extreme flexion, the lateral movements of the head are not interfered with, it is hardly to be expected that the head, when arrested at the perineal floor, would continue to maintain a right line with the spine.

transverse diameter of the pelvis previous to rotation, it becomes flattened and lengthened in the direction of the trachelo-bregmatic diameter, and the child's life, and the soft parts of the mother, are jeopardized. When, however, rotation is completed, the bi-parietal diameter (3¾ inches), which is capable of sustaining a considerable degree of lateral compression, engages in the transverse diameter of the pelvis; at the same time the sub-occipito-bregmatic engages in the conjugate diameter. The latter, though measuring but three and three fourths inches, may be extended to four and a half inches by the pressing backward of the tip of the coccyx.

The conditions for the forward rotation of the occiput are—1. Flexion; 2. Good labor-pains; 3. A firm perinæum.

In either of the occipito-anterior positions rotation is not difficult to understand. The convergent anterior inclined planes furnish smooth surfaces upon which the occiput glides downward and forward to the front. The rigid ischial spines direct the forehead to the sacro-sciatic ligaments, which determine the backward movement corresponding to that of the occiput in the front part of the pelvis.*

M. Pajot expresses the law which governs the rotation movements in the following terms: "When a solid body is contained within another, if the receptacle (*contenant*) is the seat of alternations of movement and repose, and its surfaces are slippery and but slightly angular, the contained body will tend increasingly to accommodate its form and dimensions to the form and capacity of the receptacle." †

In occipito-posterior positions, the rotation of the occiput forward is, at the first glance, a puzzling phenomenon, as the inclined planes of the pelvis, the ischial spines, and the law of accommodation, previously invoked by way of explanation, should determine the rotation of the occiput, not to the front, but to the sacral cavity. The following experiment of Dubois, however, throws considerable light upon the principal conditions of success: "In a woman who had died a short time previous in child-bed, the uterus, which had remained flaccid and of large size, was opened to the cervical orifice, and held by aids in a suitable position above the superior strait; the fœtus of the woman was then placed in the soft and dilated uterine orifice in the right occipito-posterior position. Several pupil-midwives, pushing the fœtus from above, readily caused it to enter the cavity of the pelvis; much greater effort was needed to make the head travel over the perinæum and clear the vulva; but it was not without astonishment that we saw, in three successive attempts, that when the head had traversed

* Prof. Henry G. Landis, in a most ingenious essay, entitled "How to use the Forceps," argues that, practically, the pelvis contains two canals, partially separate at the beginning, and identical at their termination. The right canal is the one in which the right sacro-iliac articulation is found, and the left, the one to which the left sacro-iliac articulation belongs. These canals converge from above downward, and are also mutually curved from before backward. Their direction is therefore spiral. The caliber of each canal is that of the fetal head; therefore, the head may descend in either canal, and will follow a spiral course in so doing.

† Martel, "L'accommodation en obstétrique," *vide* introduction.

the external genital organs, the occiput had turned to the right anterior position, while the face had turned to the left and to the rear; in a word, rotation had taken place as in natural labor. We repeated the experiment a fourth time, but as the head cleared the vulva the occiput remained posterior. Then we took a dead-born fœtus of the previous night, but of much larger size than the preceding; we placed it in the same conditions as the first, and twice in succession witnessed the head clear the vulva after having executed the movement of rotation. Upon the third and following essays, delivery was accomplished without the occurrence of rotation; thus the movement only ceased after the perinæum and vulva had lost the resistance which had made it necessary, or, at least, had been the provoking cause of its accomplishment." *

This interesting experiment shows that it is unnecessary to assume a rotation force in the uterus itself. A certain amount of light is thrown upon the action of the perineal floor by the clinical fact that it is always the most dependent portion of the presenting part which rotates to the front. A moment's reflection will show that rotation, therefore, takes place in such a direction that the sloping surface of the child's head is brought into correspondence with the downward slope of the perinæum. Thus it sometimes happens, in occipito-posterior positions, that moderate extension occurs, so that the large fontanelle is felt below the plane of the small one. In this case, the head rests with its entire length upon the perineal floor; its movements are of necessity restrained within narrow limits; and, if extension persists, the pressure of the opposing ischio-pubic ramus directs the forehead under the arch of the pubes. When, however, the head is well flexed it no longer corresponds to the perineal plane. The occiput then glides downward, and is projected forward by the elastic pelvic floor until the anterior parietal boss is forced between the ischio-pubic rami. As the occipital end of the flexed head descends downward and forward toward the pubic arch, the frontal extremity encounters the resistance of the pelvic wall near the ileo-pectineal eminence. If the pressure upon the head were in all parts equal, no further progress would now be possible. But it is not equal. The backward pressure applied to the frontal portion of the head is exerted upon the long end of a lever, and works, therefore, at a greater mechanical advantage than that directed against the occiput.† At the same time, if the anterior wall be divided by a line drawn on a level with the lower margin of the symphysis, we find that in the superior division the general pelvic pressure diminishes from before backward, while, below the line indicated, pressure diminishes from behind forward. Now, in accordance with the mechanical principle that, when a body is

* Martel, "De l'accommodation en obstétrique," quotation, p. 93.

† Tarnier et Chantreuil, "Traité de l'art des accouchements," p. 644.

subjected to varying pressures, the movement will take place in the direction of the least pressure,* we find that the frontal portion, which lies above the sub-pubic plane, turns backward, while the occiput, which lies below, turns under the arch of the pubis.

It must not be supposed, in imagining the results of rotation, that the movement continues until exact coincidence of the sagittal suture and the conjugate is reached. Leishman endeavored to measure the divergence between the two after the head had escaped from under the pelvic arch, by stretching a cord over the surface of the head from the lower border of the symphysis to the coccyx. He found that in left occipital positions the cord crossed the lambdoidal suture about an inch to the right of the small fontanelle, and thence extended forward to the middle of the opposite orbit, intersecting the median line at or near the anterior fontanelle.†

In emerging from the pelvis, the two tubera parietalia do not pass out at the same time. In place of this, the head rolls upon its side, so that in left occipital positions the presentation is formed by the upper and posterior part of the right parietal bone, and in right occipital positions by the corresponding territory upon the left parietal bone.

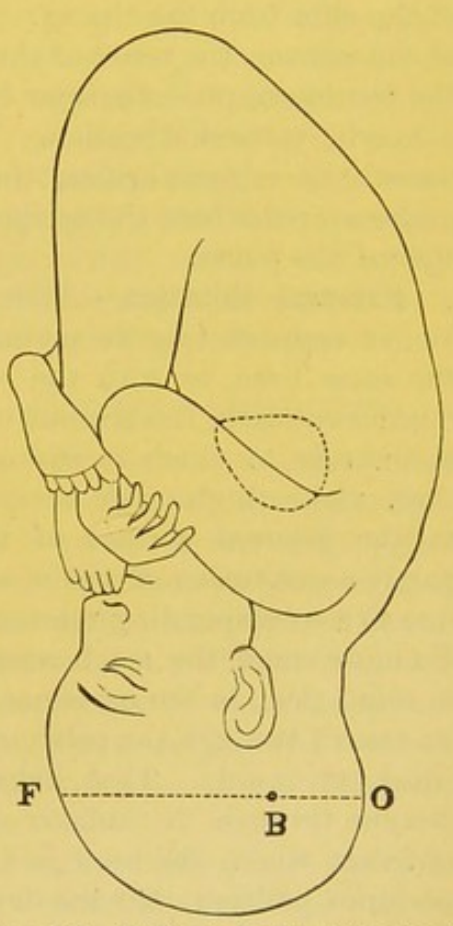


Fig. 116.—O B, short end of the head lever; B F, long end of head lever. (Tarnier et Chantreuil.)

Extension.—As the head clears the inferior strait it distends the perinæum, and converts it into a groove, which directs the occiput toward the vaginal orifice. With the descent of the head the perinæum lengthens; between the pains the perinæum retracts, and the head recedes. A gradual softening results from the continuance of this play, and, with diminished resistance from the perinæum, the occiput descends along the anterior pelvic wall, the trunk enters the cavity, and the neck finds support against the os pubis. Flexion continues until the occiput engages between the pubic rami. When the resistance of

* Stephenson, "On the Mechanism of Labor," "Obstet. Jour. of Gr. Brit. and Ire.," October, 1878, p. 405.

† Leishman, "The Mechanism of Parturition," p. 84. It will be readily understood that, in right occipital positions, the cord should pass from the left of the small fontanelle forward to the right orbit.

the anterior bony wall is no longer encountered, the surface of the child's head glides forward upon the perinæum, as upon an inclined plane, and describes a circle beneath the pelvic arch, of which the sub-occipito-bregmatic diameter forms the radius.

The extension of the head, which is an essential feature of the foregoing movement, is the resultant of two forces—derived, first, from the uterus; second, from the pelvic floor.

The uterine action is transmitted in the axis of the superior strait. With the occiput fixed beneath the pubic arch, and the neck resting against the inner surface of the pubes, the propulsive force is expended upon the frontal extremity of the head, and this causes the separation of the chin from the thorax. So soon as the forehead passes the apex of the sacrum, the recoil of the coccyx and the elastic perinæum drives the fronto-occipital diameter forward to the vulva, which now looks in a nearly vertical direction. When the bi-parietal diameter has once passed the vaginal orifice, the perinæum rapidly retracts, and, as it glides over the face, the occiput is thrown sharply and rapidly upward against the pubes.

External Rotation.—After the birth of the head, the face, no longer supported by the perinæum, sinks toward the anal region. At the same time, or with the recurrence of a pain, the head makes a quarter-rotation, the occiput turning toward the thigh corresponding to the side to which it was originally directed (right occipital position, right thigh; left occipital position, left thigh), and the face to the internal surface of the opposite thigh. This movement is partly a restitution of the head to its normal direction, and partly is due to a corresponding rotation of the shoulders in the pelvic cavity. To understand the mechanism of external rotation it must be borne in mind that, in the movement of rotation performed by the head in its transit through the pelvic canal, the trunk participates to a diminished extent only. Thus, Schatz * found, in the frozen section made by Braune through the cadaver of a woman who died in the second stage of labor, where the head had originally occupied the right occipito-posterior position, that the deviation between the pelvic extremity and the head was measured by an angle of thirty degrees, and between the head and trunk, on a line with the shoulders, by an angle of thirteen, degrees. After the release of the head from the vulva, the torsion ceases, and the fetal parts resume their natural relations to one another. The head, therefore, turns slightly to the side, as it accommodates itself to the direction of the shoulders. This first movement is termed "restitution," and is much less marked in occipito-anterior than in occipito-posterior positions. The shoulders assume an oblique position, until, encountering the sloping pelvic planes, the anterior shoulder rotates forward, and the bis-acromial diameter approximates to

* Schatz, "Arch. f. Gynæk.," Bd. vi, p. 413.

the antero-posterior diameter of the outlet. The internal rotation of the shoulders usually takes place suddenly, and is accompanied by the corresponding movement of the child's head.

Excessive rotation is sometimes observed. Thus, the shoulders, in place of turning to the antero-posterior diameter, may continue in movement until they occupy the oblique diameter of the opposing side, the posterior shoulder coming to the front. This necessarily causes faulty external rotation of the head. It occurs most frequently in occipito-posterior positions.*

Expulsion of the Trunk.—After rotation, the anterior shoulder passes under the arch of the pubes; the trunk, as it is driven down from above, becomes bent laterally, and the posterior shoulder glides forward upon the perinæum to the commissure of the vulva; both shoulders then make the exit from the vaginal canal simultaneously. In the delivery of the shoulders, the bis-acromial diameter is usually somewhat oblique. The expulsion of the trunk, owing to the previous dilatation of the passage, follows with rapidity; the body executes a spiral movement until the hips engage at the outlet; during the birth of the pelvis, however, the bis-iliac diameter rotates so as to approximate to the line extending from the coccyx to the pubes.

Abnormal Mechanism of Labor. (Vertex Presentation.)

In the proper performance of the various mechanical acts of labor, it is necessary that the diameters of the fetal head approximate to those of the canal through which it has to pass. A very large pelvis, or a very small head, may become disturbing factors by leading to imperfect flexion and rotation. In either case, with a lax perinæum and gaping vulva, the head may be born in any of the diameters of the pelvis. Head-births in either an oblique or transverse diameter are, however, extremely rare. They are attended with unusual difficulty, as the occiput has to traverse a longer course than when directed forward under the pubic arch.

The most important of the irregular forms results from the rotation of the occiput, in occipito-posterior positions, backward into the hollow of the sacrum.† The chief condition of its production is a partial extension of the head, the forehead then turning anteriorly, in accordance with the law that the most dependent portion of the presenting part is moved to the front.

The Mechanism of Occipito-posterior Positions.—When the occiput turns backward, it rests upon the anterior surface of the sacrum and upon the perinæum; the forehead and the anterior fontanelle distend

* Dohrn, "Ueber die Ursachen fehlerhaftes Drehung der Schultern," etc., "Arch. f. Gynaek.," Bd. iv, p. 363.

† Playfair states that Dr. Uvedale West found the frequency of this backward rotation was four times to the hundred in occipito-posterior positions. American edition, p. 265.

the vulva. If the rotation is incomplete, the anterior parietal, or adjacent frontal bones, are seen at the rima pudendi; and, as the frontal portion is born, the occiput sweeps forward to the perineal commissure.

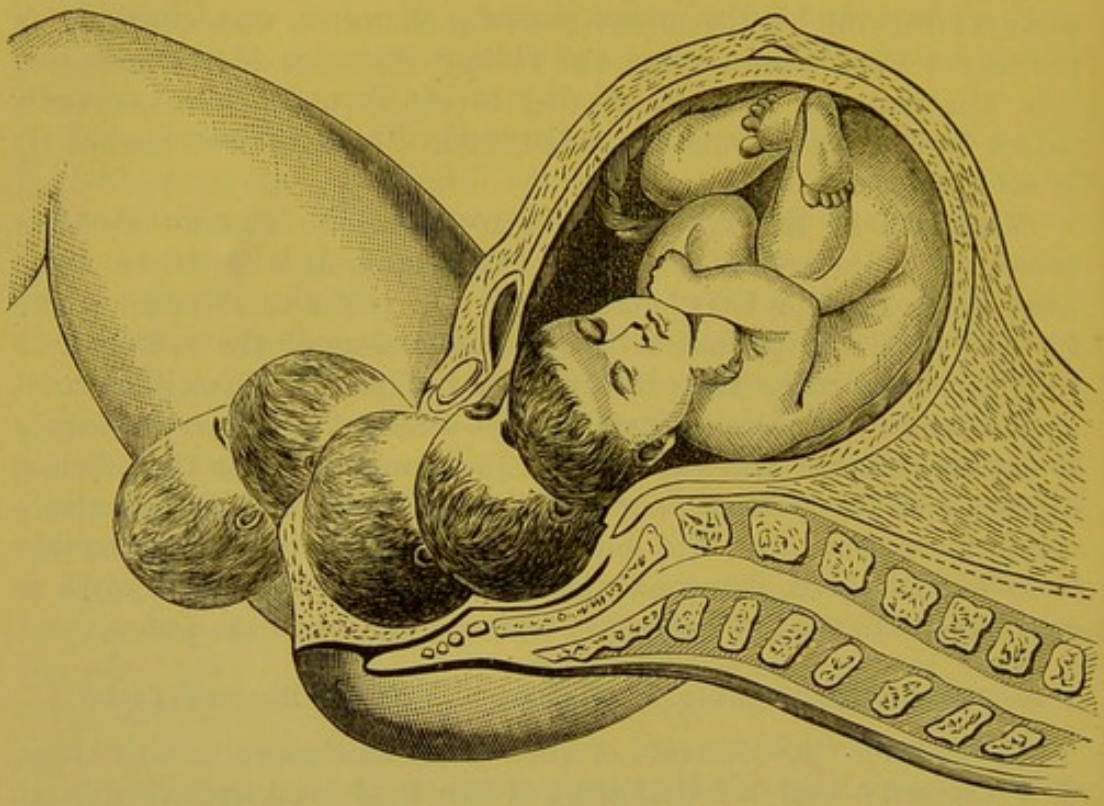


Fig. 117.—Figure illustrating the mechanism of labor in occipito-posterior positions (after Schultze).

After the occiput makes its exit, the neck rests upon the perinæum, while the head swings backward, describing a circle, of which the sub-occipito-bregmatic diameter forms the radius.

Delivery in these cases is apt to be tedious, and often demands the aid of forceps.

Configuration of the Head in Vertex Presentations.

During labor the various head diameters of the fœtus undergo extensive modification as they are subjected to the resistance of the parturient canal. Of these the most important is the diminution of the sub-occipito-bregmatic, the occipito-frontal, and the bi-temporal diameters, with compensatory elongation taking place in a line running from the chin to a point in the sagittal suture situated between the apex of the occipital bone and the large fontanelle (maximum diameter of Budin). The plastic changes mentioned are rendered possible by the presence of the fontanelles, the width of the sutures, the pliability of the sagittal borders of the parietal bones, the depressibility of the os frontis, and the joint-like movement between the squamous and basilar portions of the occipital bone. As a consequence of these ana-

tomical dispositions, pressure from above inclines the frontal bones backward, while the resistance encountered below shoves the occipital bone in a forward direction. These movements are rendered possible by

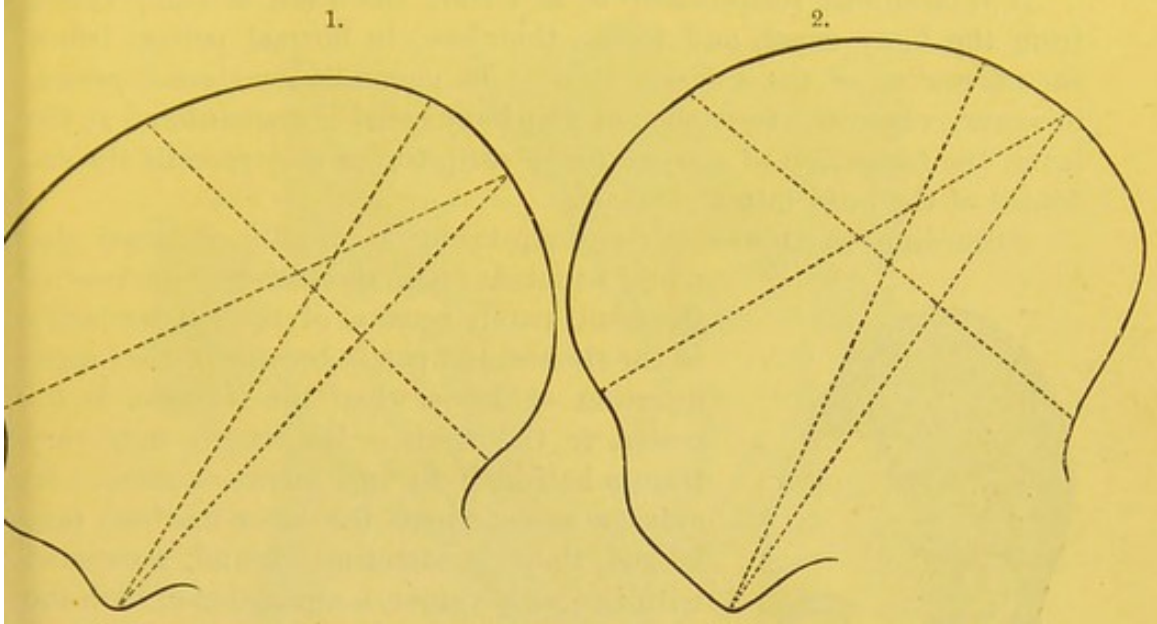


FIG. 118.—Outlines showing difference between head of child at birth (1) and four days subsequent to delivery (2). (Budin.)

the depression of both frontal and occipital bones beneath the adjacent borders of the parietal bones; at the same time the dragging thus exerted upon the latter, front and rear, increases the curve of the cranial vault along the line of the sagittal suture. The sharpness of the bend at the summit of the curve is more or less pronounced, according to the rigidity of the channel through which the head passes. In cases of birth with the occiput to the rear, the head is often drawn out to a great length, the occiput forming an almost vertical line with the neck and shoulders, while in front the forehead and parietal bones slope upward to the vertex in nearly the same plane. (Fig. 115.)

The contour of the head is still further modified by the formation of the caput succedaneum, or scalp-tumor, a swelling developing upon the portion of the presenting part which is subjected to diminished pressure from the obstetric canal, and which in consequence becomes the seat of venous hyperæmia, œdema, and extravasation. The formation of the tumor is usually preceded by a wrinkling of the scalp indicative of the stronger compression above. It may be produced within the cervical canal, but is then usually of insignificant size, and of small practical importance. Indeed, it may even form previous to rupture of the membranes in cases where the separation of the bag of waters from the contents of the uterine cavity is complete, and where, we have seen, the water-pressure below the line of cervical contact with the head is less than the intra-uterine pressure above. Usually, however, it is developed after the head reaches the pelvic floor, at the

outlet of the vagina, the situation upon the scalp often enabling one subsequent to delivery to diagnose the position the head had occupied within the pelvic canal.*

A voluminous scalp-tumor is, as a rule, the result of compression from the bony canal, and forms, therefore, in normal pelves, below the narrowing of the inferior strait. In generally contracted pelves, however, where the resistance of the bony canal is encountered at the brim, the formation of an enormous scalp-tumor may precede the entrance of the head into the pelvis.

According to Dessaut,† the scalp-tumor is usually of larger size when situated upon the anterior surface of the head, partly because of the greater laxity of the tissues, and partly because of the longer duration of labor when the forehead is directed to the front. Its length may vary from a half-inch to two inches or more. In extreme cases, where the labor has been prolonged, there is sometimes found, associated with the scalp-tumor, a separation of both the periosteum and the dura mater from the underlying segment of the cranium.



Fig. 119.—Figure showing shape of head in occipito-posterior deliveries. (Tarnier et Chantreuil.)

Diagnosis.—The diagnosis of cranial presentations by external palpation is usually not difficult. The head is recognized by its hardness, its rounded form, its separation from the trunk by the neck, and the ease with which ballottement is produced. Sometimes, by pressure upon the cranial bones, a peculiar parchment-like crackle is elicited, which is perceptible even through the abdominal parietes.‡ The breech, on the contrary, is of uneven shape, of smaller size, and of softer consistence; the feet are found in close proximity; ballottement is obscure on account of the broad connection between the breech and the trunk. Under favorable conditions the back presents upon one side of the uterus a broad, palpable

* The tumor forms in left occipito-anterior positions upon the superior posterior angle of the right parietal bone, encroaching somewhat upon the small fontanelle and the occiput; in right occipito-anterior positions, upon the corresponding point upon the left side of the cranium. In occipito-posterior deliveries the tumor develops upon the anterior superior angle of the parietal bone turned to the pubic arch, and encroaching upon the large fontanelle, and even upon the frontal suture. If the head-rotation is complete, and the head is detained for a long period at the vulva, the tumor may occupy the median line, and thus obscure the diagnosis.

† Tarnier et Chantreuil, p. 686.

‡ Fasbender, "Monatsschr. f. Geburtsk.," Bd. xxxiii, p. 435. Dr. P. F. Mundé has recently furnished an excellent *résumé* of the subject of diagnosis by external examination, in an essay termed "Obstetric Palpation."

surface without distinctive bony projections. The position of the child is determined—1. By the fetal heart, which, except in face-presentations, is heard most distinctly over the dorsal surface; 2. By the

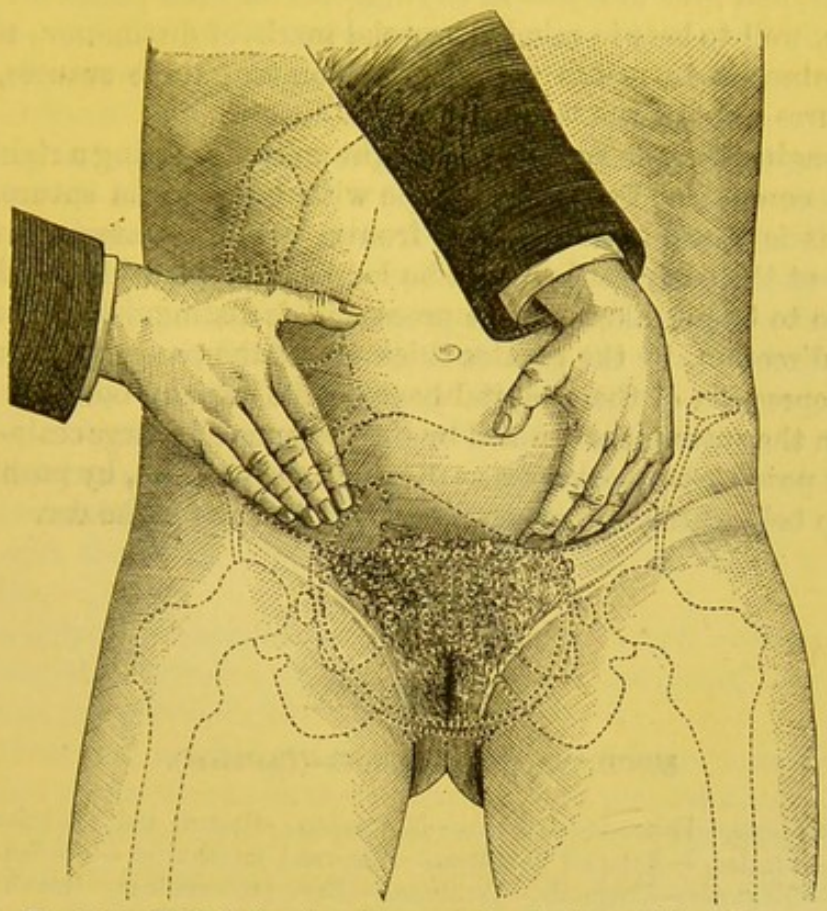


Fig. 120.—Method of performing external palpation. (Pinard.)

direction of the feet, which are situated upon the abdominal side of the child.

Upon examination made per vaginam the head is felt as a hard, round, smooth body, characterized by the sutures and fontanelles, and sufficiently large to fill the space of the pelvis. Before the rupture of the membranes, investigations should be conducted in the intervals between the pains, i. e., while the membranes are lax and depressible. If the head is high, and retreats before the examining finger, it should be steadied by counter-pressure applied to the fundus uteri through the abdominal walls.

The sutures and fontanelles are best made out after rupture of the membranes. In passing the extremity of the index-finger backward over the cranium toward the sacrum, the sagittal suture is usually encountered. At the extremities of the sagittal suture, the two fontanelles are perceived, distinguishable from one another by the differences in size and shape. In exceptional cases, the extreme compression of the bones of the skull may render the large fontanelle scarcely recognizable;

in others, again, the presence of membranous spaces in the line of the sagittal suture, fissures at the apex of the occipital bone, or the existence of ossa triquetra near the site of the small fontanelle may cause perplexity, and lead to errors in the diagnosis of head positions. It is, therefore, well to bear in mind, as special marks of distinction, that the small fontanelle furnishes the meeting-point of three sutures, while four sutures meet at the large fontanelle.

The sagittal suture pursues a straight course, forming a right angle with the coronal and an obtuse angle with the lambda suture. Anteriorly it is continuous with the frontal suture; posteriorly it ends abruptly at the occipital bone. The lambda suture, which is the only one liable to be mistaken for the preceding, is distinguished by its curvilinear direction, by the greater thickness of the parietal borders, and by the depression of the occipital beneath the parietal bones.

When the sutures are masked by the presence of a large scalp-tumor, it is still possible in most cases to diagnose the position, by pushing the finger up behind the symphysis pubis and feeling for the ear.

CHAPTER X.

MECHANISM OF LABOR—(Continued).

Face presentations.—Frequency.—Causes.—Mechanism.—Descent and extension.—Rotation.—Flexion.—External Rotation.—Abnormal mechanism.—Configuration of head.—Diagnosis.—Prognosis.—Treatment.—Brow presentations.—Breech presentations.—Causes.—Diagnosis.—Mechanism.—Irregular mechanism.—Configuration.—Prognosis.—Treatment.

Face Presentations.

In facial presentations, in place of the normal attitude of the fœtus, the chin is extended, the occiput is reflected against the neck, and the face with the frontal portion of the skull occupies the entrance to the pelvis. It is not a very common anomaly, having occurred, according to Pinard, 320 times in 81,711 confinements at the Maternité in Paris, or, in round numbers, once in 250 cases.*

Causes.—The causes of face presentations are imperfectly known. Clinical observation has, however, succeeded in connecting the extension of the head in the pelvic canal with a variety of predisposing conditions. To Ahlfeld† we are indebted for a collection of associated events derived from a careful analysis of well-observed cases. From these, the following are selected because of their more palpable connection with the phenomenon in question:

* Charpentier, "Contributions à l'étude des présentation de la face," p. 15.

† Ahlfeld, "Die Entstehung der Stirn- und Gesichtslagen."

Separation of the chin from the chest, resulting from congenital enlargement of the thyroid gland; from increased size of the chest interfering with flexion; from stricture of the cervix about the neck of the child, the uterine walls adding to the circumference of the thorax; from the mobility of the fœtus, either because of its small size or from excess of amniotic fluid; from oblique positions of the child and of the uterus, especially in cases of rapid escape of the amniotic fluid; and from coiling of the cord around the head of the fœtus. Hecker* lays great stress upon the shape of the child's head, and has endeavored to establish a connection between face presentations and unusual length of the occiput. To be sure, after birth in face presentations the hind-head is often found to nearly equal in length the anterior portion, and it is easy to see that, were such the case at the beginning of labor, the question of extension or flexion would always be in suspense; but, in most cases, the shape is the effect rather than the cause of the presentation. Still, Hecker and others have reported instances where the elongation, instead of proving temporary, persisted after delivery, and therefore it was fair to assume had existed as a pre-natal condition.

The resistance encountered by the occiput, which converts partial into complete extension of the head, may be furnished by either the uterine or the pelvic walls.

Most writers ascribe great importance to oblique positions of the fœtus and of the uterus in the etiology of face presentations. In multiparæ, the former are not uncommon during pregnancy, the head then resting upon an iliac fossa. As a rule, however, the first pains straighten the fœtus, the narrowing of the uterus in its transverse diameter serving to press the breech toward the fundus and the head into the pelvis. So long as the back of the child is directed downward, the rectification would inevitably be followed by head-flexion. When, however, the back is turned toward the fundus, and the change to the vertical attitude is not readily effected, the pressure of the adjacent uterine wall may, during contraction, act in a special degree upon the occiput, and direct it backward toward the neck, while the forehead sinks forward into the brim of the pelvis. This movement is often temporary, and, with the descent of the child, the resistance encountered by the forehead may exceed that met with from the occiput, and thus in the end flexion may follow in the ordinary manner. If, however, the extension continues, a point is finally reached at which the propelling force is exerted specially in the direction of the chin, now converted into the short end of the lever, and the face presentation becomes complete. In the same way, extension may be produced when the occiput is arrested at the linea innominata, an accident most likely to occur in transverse narrowing of the pelvis, and, again, in

* Hecker, "Ueber die Schädelform bei Gesichtslagen."

flattened pelves when the bi-parietal diameter is arrested by the contracted conjugate. The mechanism of head-flexion may likewise be interfered with by a prolapsed extremity encroaching upon the pelvic space.

In lateral obliquity of the uterus, the curvature of the uterine canal favors the production of face presentations when the back of the child conforms to the convexity of the lower surface, as the propelling force, which is transmitted in the axis of the uterus, then passes along the anterior aspect of the fœtus, and increases the tendency of the forehead to descend.

While in vertex presentations the left dorsal positions are nearly three times as frequent as the right, in face presentations the difference is very small.* Both Duncan† and Schroeder‡ ascribe this relative preponderance of face presentations with the chin directed to the left to the constancy of right lateral obliquity of the uterus.

Ahlfeld # mentions further that it is not infrequent for extension to take place within the pelvic cavity, the arrest of the occiput resulting from an unusual projection of the spines of the ischia.

The Mechanism of Face Presentations.

As in vertex presentations, the dorsum of the child may be turned to the right or the left side. The position of the face is usually designated by the direction of the chin. We distinguish, therefore :

Right mento-iliac positions (chin to right ilium) ;

Left mento-iliac positions (chin to left ilium).

Most frequently the face occupies the left oblique diameter of the pelvis. The common positions are, therefore, the right mento-iliac posterior, and the left mento-iliac anterior ; still, it is by no means rare for the face to enter the pelvis transversely, probably because of the frequent association of face presentations with a narrowing of the conjugate.

Descent and Extension.—These two movements, like descent and flexion in vertex presentations, are conjoined—not distinct from one another. At the brim, the large fontanelle is easily reached, while the chin is inaccessible. As the vertebral column is situated, in face presentations, nearer to the chin than the occiput, extension is accomplished in obedience to the same rules which produce flexion in vertex cases. With the descent of the head through the pelvic chan-

* Statistics are as yet not sufficiently numerous to determine the question as to which position actually occurs most frequently. Dubois and Désormeaux (" Dictionnaire," in thirty volumes, p. 364) reported eighty-five cases. Of these, in forty-five the chin was turned to the right, while in thirty-eight it was directed to the left. Dr. A. Walther (Winckel's " Berichte," Bd. iii, p. 312) reported from the Dresden Lying-in Institute thirty-one cases. Of these, the chin was turned to the left twenty-one times, to the right ten times.

† Duncan, " Edinburgh Obstet. Trans.," vol. ii, p. 108.

‡ Schroeder, " Lehrbuch der Geburtshülfe," p. 182.

Ahlfeld, *loc. cit.*, p. 62.

nel, the chin sinks deeper and deeper, while the occiput is pushed backward and pressed firmly against the dorsal surface of the child. The degree of extension at the different stages of the descent is measured by the relative positions of the chin and the large fontanelle.

The engagement of the head is usually slow and accomplished with difficulty, owing to the fact that the neck and posterior portion of the head enter the excavation at the same time. The descent of the head is normally limited by the length of the child's neck, as it is only in the case of a very small child, or exceptionally roomy pelvis, that the head and upper portion of the thorax can enter the pelvis simultaneously.

When the face reaches the pelvic floor, a slight degree of lateral obliquity is produced, the cheek directed toward the pubes advancing somewhat more rapidly than the one turned to the sacrum.

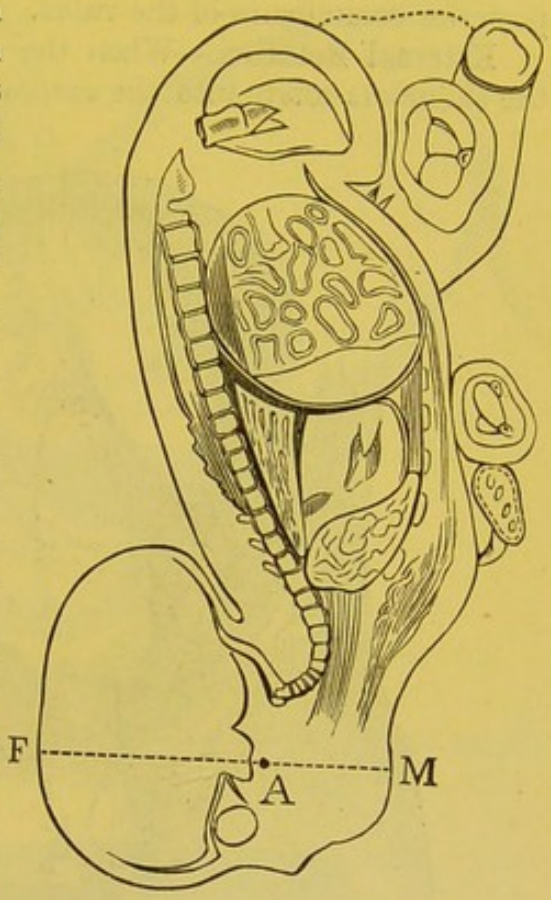


Fig. 121.—Attitude of the head in face presentations. (Ribémont.)

Rotation.—When the chin has descended along the lateral or posterior wall of the pelvis until the thorax reaches the linea innominata, further progress is only rendered possible when the chin rotates forward and engages beneath the arch of the pubes. The mechanism of chin-rotation is the same portrayed in vertex presentations. When extension is complete, the chin, as the most dependent portion, glides downward and forward upon the perinæum, and the malar bone is pressed between the pubic rami. We have seen already that the pressure above the pubic arch diminishes from before backward, while below it diminishes from behind forward. In accordance with the mechanical principle, that a body subjected to varying pressures moves in the direction of least pressure, the chin or deeper portion turns to the front, while the cranial vault rotates into the hollow of the sacrum. To this movement the unequal length of the two extremities of the lever, measuring from the malar bone to the top of the forehead on the one side, and from the malar bone to the chin upon the other, contributes in an important degree.*

* Tarnier et Chantreuil, *loc. cit.*, p. 658.

Flexion.—After rotation, the chin emerges beneath the pubic arch, the shoulders press upon the base of the skull, the perinæum becomes rounded by the cranial vault, and, finally, as the head performs the movement of flexion in obedience to the forward impulse imparted by the perinæum, the chin rounds the symphysis, while the mouth, the nose, the brow, the vertex, and the occiput appear in succession at the posterior commissure of the vulva.

External Rotation.—When the delivery of the head is complete, the shoulders rotate into the antero-posterior diameter of the pelvis,

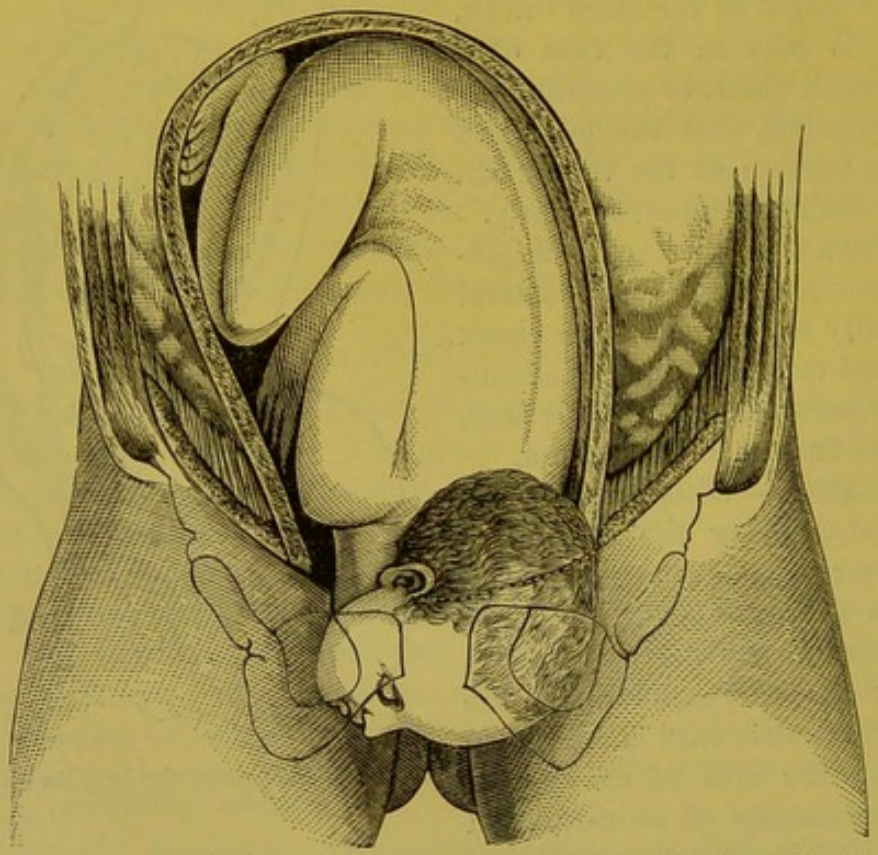


Fig. 122.—Engagement of the head in face presentations. (Tarnier et Chantreuil.)

the chin turning in correspondence, in right mento-iliac positions, to the right thigh ; in left mento-iliac positions, to the left thigh.

Abnormal Mechanism.

In a fœtus of small size, the face may, when it meets with slight resistance from the perinæum, be born in any of the pelvic diameters. Instances of spontaneous delivery without anterior rotation of the chin are, however, extremely rare. The egress of the face in the transverse diameter is possible in a shallow, rachitic pelvis, flattened in the conjugate at the brim, and wide between the ischia at the outlet. The head emerges with the chin resting upon one of the ischio-

pubic rami, around which the rotation of the mento-occipital diameter takes place. As the movement is associated with excessive stretching

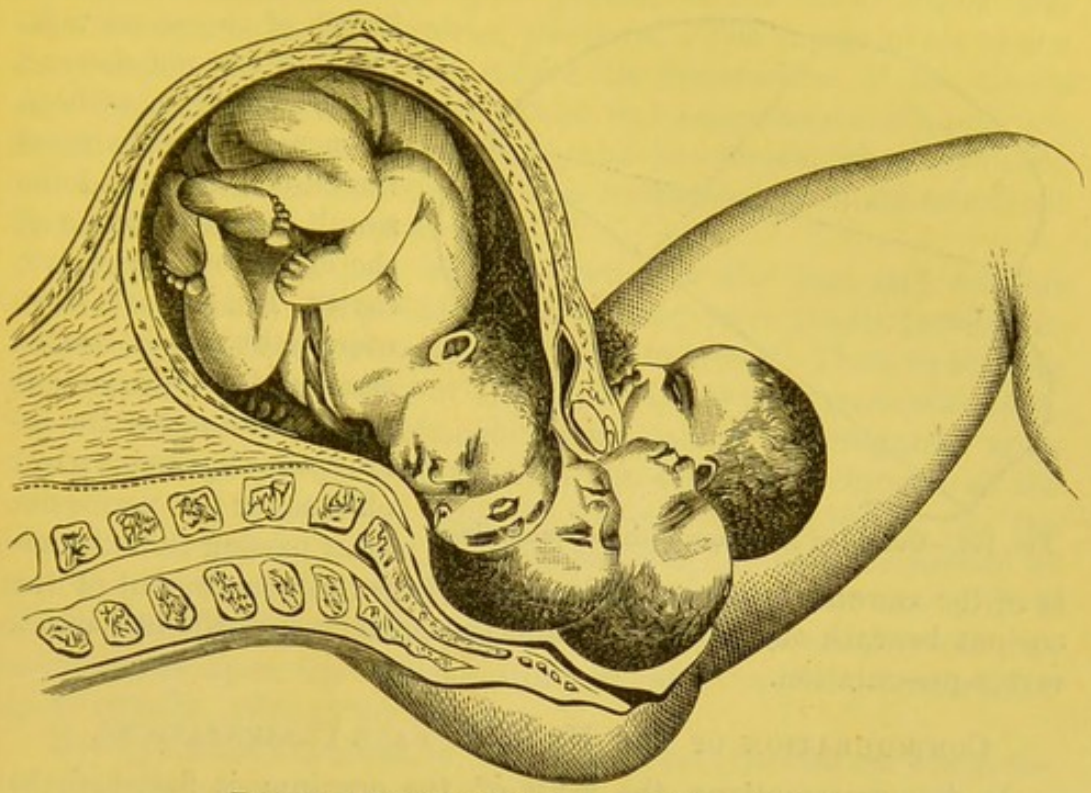


FIG. 123.—Mechanism of face presentations. (Schultze.)

of the neck, it is evident that its execution is favored by the tensile condition of the tissues which follows death of the fœtus.



FIG. 124.—Face presentation, chin to the rear. (Hodge.)

At full term, the face presenting, spontaneous delivery in mento-posterior positions is not practicable. This becomes evident when we reflect that, owing to the length of the sacral wall, the chin can not descend to the fourchette without an incredible flattening of the cranial vault and the simultaneous entrance of the chest into the pelvic cavity. It is claimed, however, that when the head is small and compressible it may stretch either the sacro-sciatic ligaments when oblique, or the perinæum after passing the extremity of the sacrum, to an extent sufficient to permit the descent of the occiput beneath the pubic arch, and the conversion of the face into a vertex-presentation.

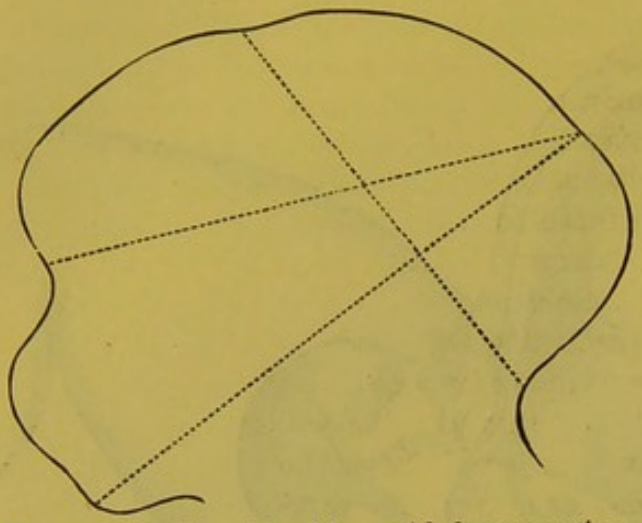


Fig. 125.—Outline of head born with face presenting.

Configuration of the Head in Face Presentations.

In face presentations, the vault of the cranium is flattened, so that the sagittal suture runs from fontanelle to fontanelle in nearly an horizontal line; the squamous portion of the occipital bone is pushed backward, while in both the occipital and frontal bones the convexity is increased. As a result, there is an augmentation of the transverse, the occipito-frontal, and occipito-mental diameters, while the sub-occipito-bregmatic is diminished. The maximum diameter either corresponds to the occipito-mental, or terminates posteriorly at a point below the apex of the occiput.*

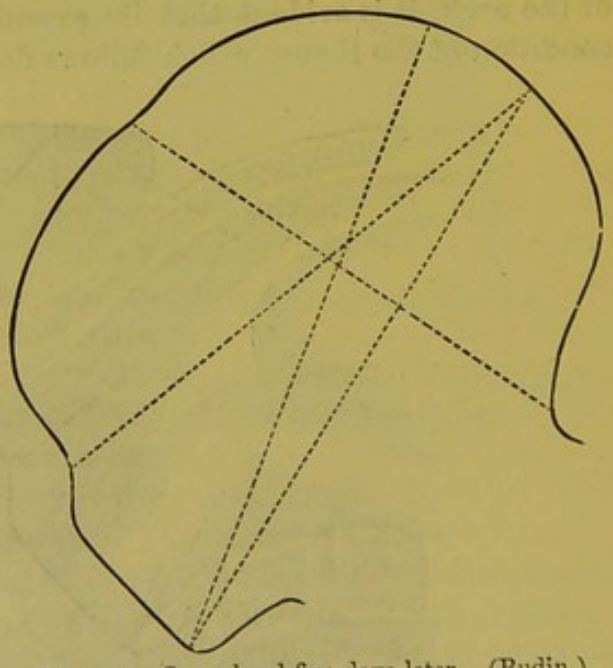


Fig. 126.—Same head five days later. (Budin.)

The sero-sanguineous tumor, which forms upon the presenting part as a consequence of the diminished pressure, occupies the lower portion

* Budin, *loc. cit.*, p. 77.

of the malar region, and the corner of the mouth (left mento-iliac position, left cheek ; right mento-iliac position, right cheek) in mento-anterior positions, and the upper portion of the malar region, and even the eye, in mento-posterior positions. The integuments of the cheek assume a blackish-blue color ; the tumefaction of the lids is such that at birth the eyes are closed, and sanguineous effusions are found upon the ocular conjunctiva ; and the mouth, when involved, becomes swollen and distorted, so that suction is sometimes interfered with for several days after birth.

Diagnosis.—At a time when a portion of the head still remains above the level of the pelvic brim, it is not infrequently possible to form a diagnosis from external manipulations alone. Thus, by making deep pressure with the tips of the fingers above the symphysis pubis, the cranium may, under favorable circumstances, be recognized upon one side of the pelvis, together with the sharp angle formed at the neck between the occiput and the dorsum of the fœtus. As the heart is heard with greatest distinctness over the anterior portion of the chest in face presentations, confirmatory evidence of the latter is afforded by detecting the presence of the fetal extremities, and the heart-sounds upon the same, instead of, as in vertex presentations, upon opposite, sides of the trunk.

Upon internal examination, the distinct peculiarities are a high position of the presenting part, a flattening of the vaginal fornix, and, through the intervening tissues, the recognition of the smooth forehead, contrasting with the uneven surface of the face. Through the dilated cervix the finger detects the forehead, the bridge of the nose, the nostrils, the orbits, the malar bones, the alveolar processes of the jaw, the mouth, and, when extension is complete, the pointed chin. Instances have, indeed, been recorded where, in advanced labor, the distorted face has been confounded with the breech, the inexperienced observer mistaking the swollen cheeks for the nates, the malar bones for the ischia, the nose for the tip of the coccyx, the œdematous eyelids for the scrotum, and the mouth for the anus. Such an error is best avoided by deliberation in exploring the presenting part. With proper care the smooth forehead, the bridge of the nose, the hard orbital borders, the chin, and especially the mouth, through which the jaws can be felt, afford sufficient data for a correct diagnosis.

Prognosis.—According to the statistics of Winckel,* the mortality of the children in face presentations amounted to thirteen per cent., while that of the mothers reached as high as six per cent. Thus, though spontaneous delivery is the rule in face presentations, the dangers to both mother and child are considerably greater than in vertex presentations. The causes of the less favorable prognosis are to be looked for in the increased peripheral head measurements, which

* Winckel, "Pathologie der Geburtshülfe," p. 89.

engage successively in the different planes of the obstetric canal, and consequently from the increased reciprocal pressure exerted between the head and the soft parts, and partly from the compression of the veins of the neck by the anterior wall of the pelvis. Though the average length of labor does not much exceed that of normal presentations,* the duration is more readily affected by minor disturbances, such as weak pains, moderately contracted pelves, and rigidity of the obstetric canal. At the same time, the prolongation of labor in these cases is attended by more disastrous consequences, and calls more frequently for the resources of art to complete the delivery.

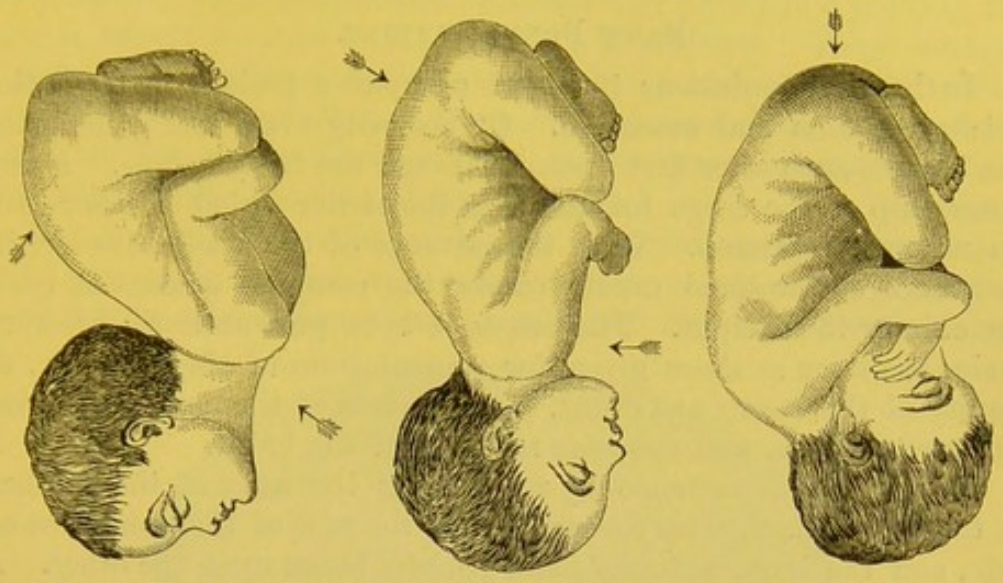
Treatment.—The first rule in the treatment of face presentations is to carefully avoid prematurely rupturing the membranes. The face is ill adapted to serve the purpose of a dilator to the cervical canal, and early rupture is apt to be followed by complete escape of the amniotic fluid—an accident always to be dreaded, but specially serious in face-presentations, where the umbilical cord is exposed to pressure between the anterior surface of the child and the uterine wall. Examinations made with a view to diagnosis should, therefore, be conducted with great care, during an interval between the pains, and their repetition should be avoided when the requisite information has once been obtained. During the progress of the first stage of labor, it is recommended to place the mother upon the side toward which the chin of the child is turned, with a view of favoring extension and rotation.

Because of the uncertainties of the prognosis in face presentations, many manœuvres have been proposed for the conversion of the latter into normal presentations. The manipulations chiefly recommended consist of either pushing up the face, or drawing down the occiput, by the fingers passed through the cervical canal. Though occasionally successful, they have been discountenanced by most obstetric writers, because experience has shown the results to be by no means commensurate with the dangers incurred. Schatz† has, however, suggested a rational plan for reducing the extended head by external manipulations only, which avoids the objections to the earlier methods. His manœuvre consists in restoring the normal attitude of the body by flexing the trunk, and leaving the head to resume spontaneously its proper position as it sinks into the pelvis. It is performed by seizing the shoulder and breast with the hand through the abdominal walls; then lifting the chest upward and pressing it backward, at the same time steadying or raising the breech with the other hand applied near the fundus, so as to make the long axis of the child conform to that of the uterus, and, finally, pressing the breech directly downward. As the child is raised, the occiput is allowed to descend,

* Walther, Winckel's "Berichte," Bd. iii, p. 315.

† Schatz, "Die Umwandlung von Gesichtslage," etc., "Arch. f. Gynaek.," Bd. v, p. 313.

and then, as the body is bent forward, head-flexion is produced by the resistance of the side-walls of the pelvis. Schatz illustrates these movements by the accompanying diagrams. If, owing to its elevation,



Figs. 127–129.—Diagrams showing Schatz's method of converting face presentations into vertex presentations.

the head tends to move to one side when backward pressure is made upon the chest, the place of the pelvic wall may be supplied by external pressure exerted by an assistant. The time for attempting this manipulation is previous to the rupture of the membranes. The requisites for success are experience in mapping out the fetal outlines by external palpation, and the absence of abdominal and uterine irritability. After rupture of the membranes, great care must be exercised in vaginal explorations, to avoid injuring the eyes, or exciting premature respiratory movements by allowing air to enter the mouth.

If the chin remains persistently directed to the rear, rotation may sometimes be promoted by either pressing forward with two fingers upon the lower jaw, or by pushing the forehead backward and upward, to produce a deep descent of the chin. To be effective, either manipulation should be executed during a pain. Hodge advocates the vectis, and others a blade of the forceps, as of use in correcting mento-posterior positions. As a rule, however, good pains and complete extension are the conditions most likely to effect the forward movement of the chin. It is practically of importance to bear in mind that tardy rotation is characteristic of face presentations. The treatment, in cases where all measures prove ineffective to secure a favorable change of position, and dangers accrue from delay to either mother or child, belongs to the domain of operative midwifery.

During head-expulsion caution must be used in supporting the perinæum, in order not to injure the neck by too strong forward pressure against the anterior wall of the pelvis.

It is safe to assure the bystanders that the distortion of the face and the extension of the head after delivery will disappear spontaneously in the course of from twenty-four to forty-eight hours.

Brow Presentations.

In brow presentations the head occupies a position intermediate between flexion and extension. Of necessity every face presentation has become such after first passing through the frontal stage. A temporary dip of the large fontanelle in the earlier period of labor is by no means uncommon. With the advance of the head, however, the resistance encountered usually causes the complete descent of either the chin or the occiput. The causes of brow presentations are, in the main, the same as those given for presentations of the face, viz., obliquity of the uterus and fœtus, enlargements of the neck and thorax, contracted pelvis, and excessive mobility of the fœtus.

The diagnosis is made by recognizing the apex of the forehead in the pelvic canal, with the orbits and the root of the nose upon one side, and the large fontanelle and parietal bones upon the other. At the brim the frontal suture is usually transverse, but becomes oblique in its progress toward the pelvic outlet.

A small head may pass through a roomy pelvis, the brow presenting, without injury to either mother or child. In the mechanism of delivery the forehead turns to the front and appears at the vulva, the upper maxilla resting against the symphysis, and the cranium lying in the hollow of the sacrum and upon the perinæum. The exit is accomplished by the cranial vault first sweeping forward over the perinæum; the upper jaw, the mouth, and the chin afterward making their appearance beneath the symphysis pubis.

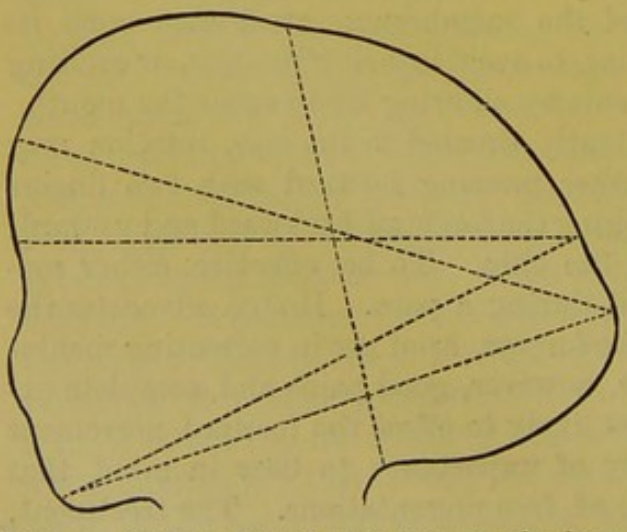


Fig. 130.—Outline of head after delivery, the brow presenting. (Budin.)

Sometimes, though usually only when the forceps is used, the head may be delivered in the transverse diameter. In spontaneous cases the superior maxilla finds a point of support against one ischio-pubic ramus, while the cranium rotates transversely through the vulva. When the face turns posteriorly, delivery of a living child is scarcely possible.

The configuration of the head is very striking. The swelling of the integuments extends from the root of the nose to the upper angle

of the large fontanelle. The forehead is nearly perpendicular, while the parietal and occipital bones form a slope which inclines downward and backward. The mento-frontal and sub-occipito-frontal diameters are increased, while the distance between the chin and a point in the sagittal suture anterior to the occiput is diminished. These changes impart to the head a triangular shape. The peculiar formation is explained by the compression of the occiput between the pelvis and the dorsal surface of the child, and the compensatory elongation which takes place in the direction of the forehead.

The prognosis is less favorable than in vertex presentations, but is by no means so sinister as is popularly supposed. Many cases of original brow presentations become converted into face or vertex pres-

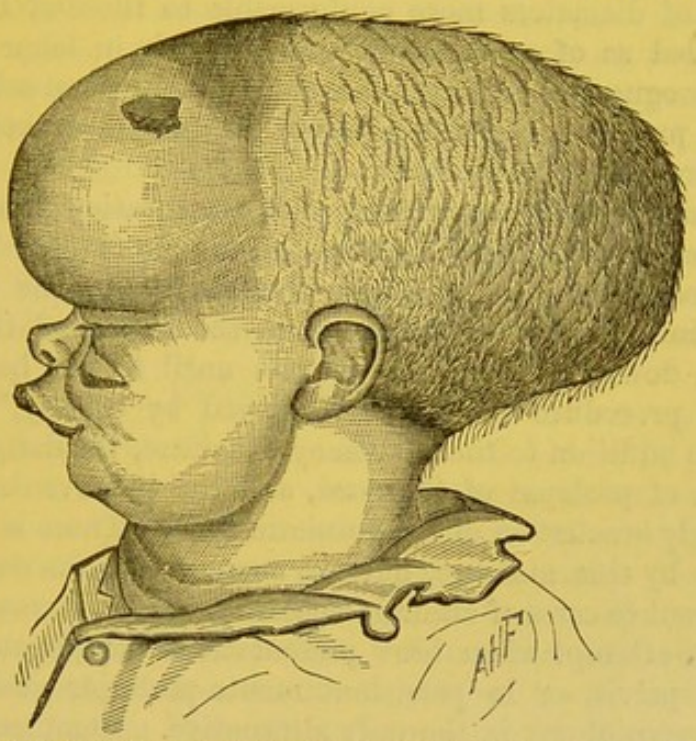


FIG. 131.—Brow presentation, subsequently converted into that of the face.* (Maternity Hospital.)

entations during the progress of labor; many are delivered spontaneously or by the aid of the forceps. Craniotomy is rarely called for.

AHLFELD ("Die Entstehung Steiss- und Gesichtslagen") furnishes twenty-six cases in which the result to both mother and child is given. FRITSCH ("Klinik der alltäglichen geburtshülflichen Operationen," p. 46) gives the histories of seven cases, and BUDIN ("Tête du Fœtus," p. 53) the history of one case. In the thirty-four deliveries there were two maternal deaths; in one of the fatal cases coxalgic oblique pelvis existed as a complication. In the other the brow spontaneously changed into a face presentation. There were ten spontaneous deliveries, the brow presenting, with four dead children, but one died previous to labor. There were ten cases of spontaneous delivery in which the brow during delivery became converted into either a face or vertex presentation. Of these one child died.

* Recovery of both mother and child. (From drawing of A. H. Fridenberg.)

Fourteen children were extracted with the forceps, nine with the brow presenting, of which two were dead, one from prolapsed funis, and one which had died before labor; five, after conversion into face or vertex presentations, with no deaths. Thus, of the thirty-four children, there were seven deaths, but of these four only could be attributed to the presentation.

From the foregoing, it is evident that the duties of the accoucheur, in the presence of brow presentation, should be confined to efforts to direct the labor to a favorable termination by one of the paths indicated by Nature. At the brim, previous to engagement, the dip of the anterior fontanelle is often temporary, in many cases simply signifying a narrowing in the upper conjugate. For this reason it is evident that version, so frequently recommended with a view to the substitution of diameters more conformable to those of the pelvis, is to be regarded as of questionable value. Early in labor it does not better the prognosis, while at an advanced stage, when self-correction is no longer probable, the difficulties of its execution exclude it from the list of practicable measures.

Manual attempts to convert a brow presentation into one of the face or vertex possess more legitimate claims to favor. The method of Baudelocque consists in seizing the head with the entire hand introduced into the vagina, lifting it to the brim, and then drawing the occiput downward with the fingers until flexion becomes complete. The procedure was bitterly opposed by Chailly,* who urged against it, in addition to the frequency of failure, the dangers of uterine rupture, of prolapse of the cord, and the inconveniences arising from the early evacuation of the amniotic fluid. There is no question of successes by this measure, but the concurrent risks ought to limit its employment to cases of absolute necessity. Thus, it would be proper to make the attempt when brow presentations complicate delivery in justo-minor pelvis, or in persistent mento-posterior positions, as in these cases craniotomy is the only alternative. Complete anæsthesia facilitates reduction; while elevating the head, firm counter-pressure should be made at the fundus uteri.†

Occasionally the conversion of the brow into a vertex or face presentation may be effected by pressure exerted during a pain upon respectively the occipital or frontal extremity of the head. In bringing down the vertex, the movement should be aided by external pressure made with the disengaged hand above the brim of the pelvis. When a face presentation is desired, the woman should be made to lie during labor upon the side to which the child's abdomen is directed, and upon the side to which the back is turned when the descent of the vertex is aimed at.

* Chailly-Honoré, "Traité pratique des accouchements," p. 783.

† *Vide* Parry, "On the Use of the Hand to correct Unfavorable Presentations," etc., "Am. Jour. of Obstet.," vol. viii, p. 138.

Schatz* recommends, with the view to the production of a face presentation, the introduction of two fingers into the child's mouth, and making traction on the superior maxilla.

When the head shows a disposition to revert to its original position so soon as pressure or traction is suspended, the forceps should be applied, and traction made in such a manner after reposition as to hold the head in the direction sought for.

In case the brow presentation is irreducible, the labor should be allowed to continue as long as compatible with the safety of the mother. Owing to its plasticity, the head often adapts itself in the most surprising manner to the unfavorable diameters of the pelvis, so that, even when spontaneous delivery fails to take place, the forceps becomes available. In mento-posterior positions, efforts should be made with the fingers, or the vectis, to rotate the chin forward. In fixed mento-posterior positions, the use of the forceps is impossible, and the conversion of the brow into a face presentation does not lessen the mechanical difficulties of delivery. The only artifice by which the life of the child can be saved consists in bringing down the occiput, and producing a vertex presentation. Failing in this manœuvre, craniotomy becomes inevitable. In all cases of brow presentation, if the child is dead, craniotomy is indicated in the interest of the mother.

Breech Presentations.

In breech presentations the attitude of the child is primarily the same as in those of the vertex, though, owing to a variety of causes, such as voluntary or reflex movements and the action of gravity, especially after rupture of the membranes, the extremities may advance in front of the breech, and give rise secondarily to presentations of the foot or knee. Sometimes one extremity may become prolapsed, while the other is retained in its normal position; again, it may happen that, after the rupture of the membranes, the feet, which had previously been in close proximity to the breech, are pushed upward, so that the limbs become extended parallel to the anterior surface of the child's body. None of these changes, however, materially affect the mechanism of delivery.

Pinard† found in 100,000 cases of confinement 3,301 presentations by the breech, or in the proportion of one to thirty, but, excluding premature births, the proportion was reduced to one in sixty-two.

Causes.—The causes of breech presentations are to be sought for mainly in the absence of the conditions which ordinarily determine the presentations of the head, or which interfere with the fixation of the fœtus. Thus, the production of breech presentations is favored

* Schatz, "Die Umwandlung von Gesichtslage zu Hinterhauptslage," etc., "Arch. f. Gynaek.," Bd. v, p. 328.

† Tarnier et Chantreuil, "Traité de l'art des ac.," p. 454.

by an excess of amniotic fluid, by lax uterine walls, and by contractions of the pelvis. They are more common in multiparæ than in primiparæ. Of the 3,301 cases collected by Pinard, there were 1,347 primiparæ and 1,954 multiparæ, though the entire number was nearly equally divided between the two classes.* Finally, they occur with greatest frequency of all in twin pregnancies, and during the expulsion of premature and dead children. Of 32,264 children from the statistics of Hegar and Spiegelberg,† 910 were the product of multiple pregnancies, and 659 were premature. Of the former, 227, or 25 per cent., and of the latter 148, or 22·4 per cent., were delivered by the breech, though we have seen that the ratio of breech presentations

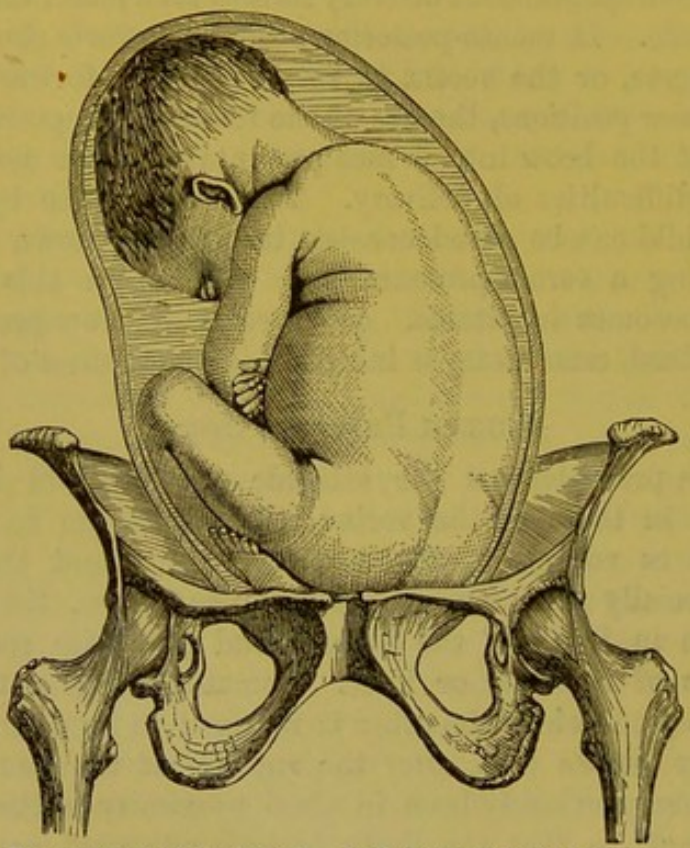


Fig. 132.—Presentation of the breech. Left dorso-anterior position. (Pinard.)

to the entire number of births does not exceed the proportion of one to thirty.

Diagnosis.—By external palpation the recognition of the head at the fundus uteri furnishes the chief diagnostic sign. Upon vaginal examination, the presenting part, as in face presentations, is usually high up, and reached with difficulty. The bag of membranes is apt to be of large size, owing to the imperfect closure of the lower uterine segment by the small breech, often descending through the canal, where the cervix is rigid, in the form of an elongated pouch. Through the membranes, upon pressing the fœtus downward during the inter-

* *Vide* Tarnier et Chantreuil, p. 455.

† Spiegelberg, *loc. cit.*, p. 171.

val between the pains, the breech is felt as a soft, irregular body, and with care it is possible to recognize the coccyx, the sacrum, the ilia, and sometimes to feel tapping movements from the feet. After rupture, the nates, the cleft between the nates, in boys the scrotum, the anus, the feet when accessible, the coccyx, the sacrum, and the ilia, furnish the necessary data for an exact diagnosis. The pressure of the uterus upon the breech frequently occasions an evacuation of meconium. The latter is thick and consistent, thereby differing from the meconium passed in vertex cases by a dying fœtus, which is ordinarily thin from admixture of amniotic fluid. When the nates are much swollen they may be confounded with the cheeks in a face presentation, an error, however, easy to avoid, if the examination be made with deliberation, and the principal points of difference between breech and face already given (*vide* "Face Presentations," p. 197) are borne in mind.

The foot, as compared with the hand, is longer and narrower, the toes are shorter, of nearly equal length, and continuous in a straight line with the sole, the ankle-joint is less flexible than the wrist, and is distinguished by the malleoli and the pointed heel. As the outer border of the foot is thin and rounded, while the inner edge is thick and hollowed, it becomes possible to recognize which of the feet is under examination.

The knee is distinguished from the elbow by its larger size, by the patella, and by the spine of the tibia.

The Mechanism of Breech Presentations.—The position in breech presentations is defined by the direction of the back. Thus, we have right and left dorsal positions. Usually the hips occupy one of the oblique diameters of the pelvis. According, therefore, as the back is turned anteriorly or posteriorly, we distinguish right and left dorso-anterior and dorso-posterior positions.

The cervix dilates slowly, especially when the feet are in close proximity to the breech, and increase the bulk of the presenting part. The latter is pressed downward into the pelvis until the perineal floor is reached. Here, owing to the shortness of the pubic wall, the anterior hip is felt with great distinctness, while the cleft of the nates lies near the curved sacrum. These anatomical relations give rise to the impression of an exaggerated degree of lateral obliquity. At the perinæum the breech glides forward and rotates upon its long axis, so that the bis-iliac diameter nearly corresponds to the lower conjugate. In the movement of rotation, it is always the anterior-lying hip, irrespective of the position of the trunk, which moves to the front. At the outlet one hip engages beneath the arch of the pubes, the other rests upon the coccyx and perinæum, while the sacrum is directed toward the tuber ischii. As the shoulders enter the pelvis in an oblique diameter, the trunk of the child becomes somewhat twisted by the

rotation of the breech. The anterior buttock makes its appearance at the vulva, while the posterior distends the perinæum. As rotation is rarely complete, the forward trochanter usually finds its point of support against the nearest ischio-pubic ramus. During the advance of the breech, the lumbar region undergoes a certain amount of lateral flexion, owing to the forward movement imparted to the posterior hip by the coccyx and elastic perinæum. The degree of flexion is, however, limited by the rigidity of the lumbar portion of the vertebral column. When the posterior trochanter reaches the commissure of the vulva, the perinæum retracts, and in gliding backward directs the breech still farther to the front.

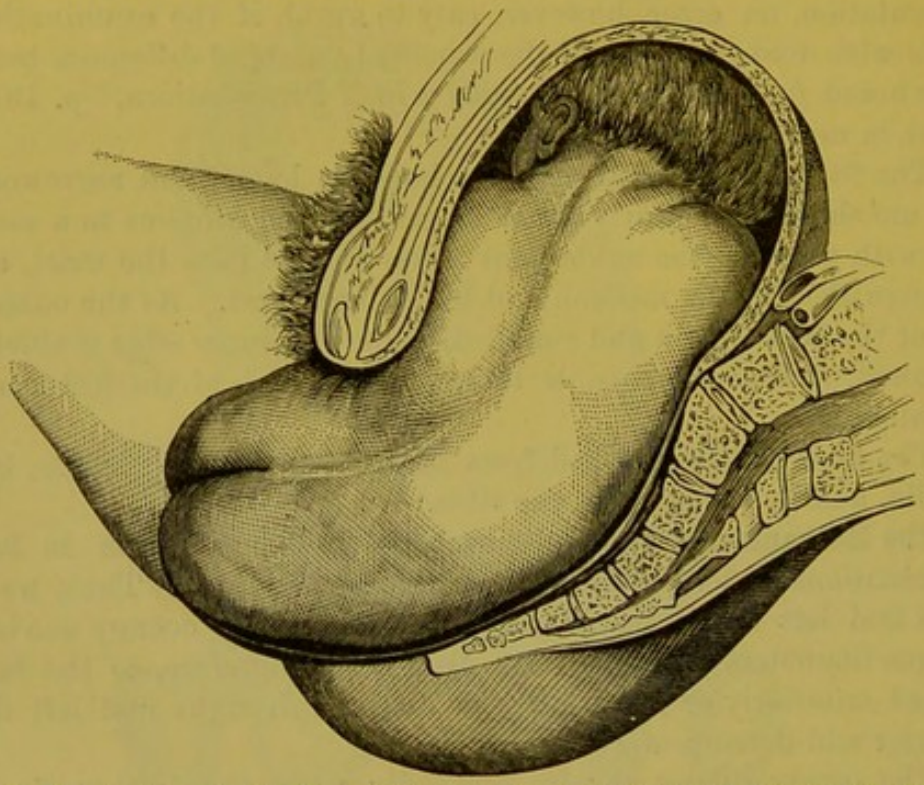


Fig. 133.—Illustration showing lateral inflexion of the trunk during delivery of the breech.

After delivery, the breech rotates into the oblique diameter it had originally occupied, this external rotation bringing the transverse diameter of the hips into correspondence with that of the shoulders. The uterine contractions continuing, the abdomen and base of the thorax slowly make their appearance ; the thighs are then delivered, and the arms, folded upon the upper portion of the thorax, emerge from the vulva. The shoulders, which enter the pelvis in an oblique diameter, are delivered in the conjugate, the anterior shoulder resting beneath the pubic arch, while the posterior shoulder sweeps over the perinæum.

The head enters the pelvis in an oblique diameter, with the chin flexed upon the thorax. The expulsive efforts as the chin reaches the perinæum are followed by the rotation of the occiput to the pubes, and

of the face into the hollow of the sacrum. At the outlet the neck is supported by the arch of the pubes, the face rests upon the perinæum, and the large fontanelle is felt at the coccyx. Under the influence of pressure from the abdomen, the brow sinks deeper and deeper, and is pushed by the soft parts of the pelvic floor still closer to the thorax. The occiput then revolves beneath the pubic arch, and the chin, the mouth, the nose, the brow, the large fontanelle, and finally the occiput, appear in succession at the commissure of the vulva.

Irregularities in the Mechanism of Breech Presentations.—Though it is by no means rare for the breech to enter the pelvis with the sacrum turned to the sacro-iliac synchondrosis, the rotation, begun with the passage of the hips through the vulva, usually continues in the same direction until the back revolves to the front; or, after a first slight retrograde movement, the rotation forward takes place as the shoulders engage at the outlet. Still, cases do sometimes occur in which the back remains posterior during the whole period occupied by the expulsion of the trunk, and in which consequently the head enters the pelvis with the face directed to the pubes. Even here, however, it is very common for the occiput to eventually rotate forward, and for delivery to follow in the ordinary manner. Should, on the contrary, the occiput remain in the hollow of the sacrum, spontaneous delivery may occur in either of two ways: 1. When no tractions have been made upon the extremities, the head reaches the outlet with the chin well flexed, the neck resting upon the commissure of the vulva, and the brow braced against the arch of the pubes. The birth of the head is then accomplished, as the neck pushes back the perinæum, by the successive descent of the face, the cranial vault, and the occiput. With a rigid perinæum, or an immovable coccyx, owing to the considerable degree of flexion which this movement necessitates, unaided delivery may be rendered impossible. 2. If, during the transit of the head through the pelvis, extension occurs, the chin may be arrested at or above the symphysis pubis. In this position pressure from above pushes back the brow, so that the face looks upward, and the occiput is turned to the bottom of the pelvic excavation. During delivery the occiput glides over the perinæum to the fourchette, and the small fontanelle, the cranial vault, and the face escape in succession through the vulva. It is only possible for this method of delivery to take place spontaneously when either the head is small or the pelvis roomy, and the soft parts are devoid of rigidity. In artificial extraction of the head, it is proper to bear in mind and to imitate the natural order in expulsion.

In presentations of the foot and knee, the breech, if of small size, may pass the vulva in an oblique or transverse diameter, rotation following later during the passage of the trunk.

Excessive rotation is not uncommon, both head and trunk sometimes describing a half-circle. This occurrence is most frequently ob-

served in cases where the posterior extremity presents, while the anterior buttock is caught above the pubic wall, the prolapsed limb then rotating, as a rule, to the front.*

The Configuration of the Fœtus in Breech Deliveries.—During the descent of the child through the genital canal, more or less swelling is developed upon that portion of the presenting part which is subjected to diminished pressure. This swelling varies, according to the duration of labor, from a slight œdema to a large, intensely discolored tumor. It is usually seated upon the anterior buttock, but often invades the genital organs, especially the scrotum, which at birth may present a bluish-black color, and be of double the usual size. The extremities, when near the breech, may also show signs of discoloration.

The head has usually a characteristic round shape. This is due, according to Spiegelberg,† to the pressure exerted by the genital canal upon the circumference of the head, while, at the same time, with the absence of pressure from above, there is produced an increase in the convexity of the cranial vault. Two cases reported by Hecker,‡ in which the length of the occiput was comparable to that found in face presentations, show, however, that the original shape of the head counts for something in the appearances presented after delivery.

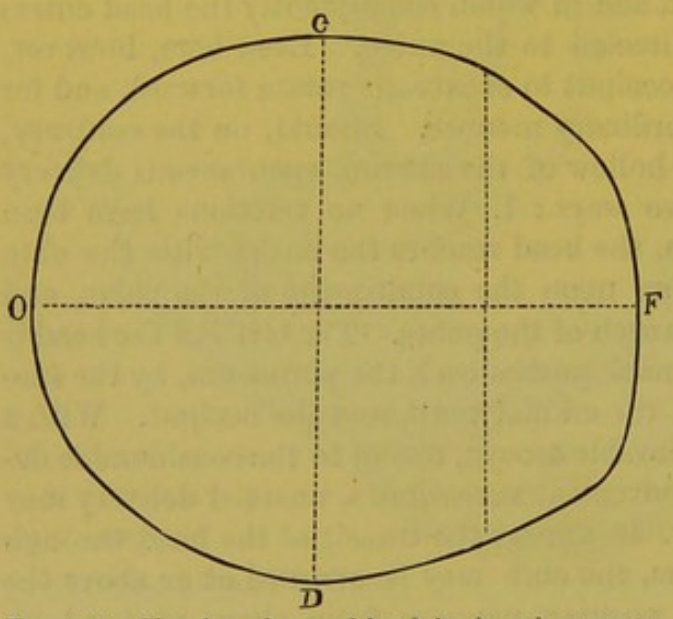


Fig. 134.—Showing shape of head in breech presentations. (Budin.)

Prognosis.—As regards the mother, the prognosis in uncomplicated cases does not differ materially from that of vertex cases. Where manual extraction becomes necessary, there is always, however, increased danger of lacerating—1. The cervix; 2. The perinæum.

Lacerations are apt to follow attempts to drag the after-coming head through an imperfectly dilated cervix. The prognosis is more favorable, therefore, in cases where the membranes do not rupture until after dilatation is completed. It is also better in pelvic presentations, where the bulk of the breech is increased by the addition of the extremities. In footling cases, when the membranes

* *Vide* Küstner, "Die Steiss- und Fusslagen," p. 21.

† Spiegelberg, *loc. cit.*, p. 176.

‡ Hecker, "Arch. f. Gynaek.," Bd. xi, p. 348.

rupture prematurely, the smaller size of the pelvis and its rapid descent through the cervix imperfectly prepare the way for the subsequent passage of the head. A stricture is, therefore, liable to form about the neck of the child, and, as the spasm does not yield to force, the result of violent tractions is to sacrifice the integrity of the cervix, the extent of the laceration being proportioned to the power exerted.

Lacerations of the perinæum occur where with rigidity of the tissues it becomes necessary to introduce the hand to release the arms, or the interest of the child demands the speedy delivery of the head.

The prognosis for the child is, on the other hand, extremely unfavorable. According to the statistics of Dubois,* the mortality in full-term children is as one to eleven, while in vertex presentations the proportion is as one to fifty. The chief cause of this large death-rate is the pressure to which the cord is subjected between the child and the surface of the utero-vaginal canal, especially after the navel appears at the vulva. The pressure is exerted principally at the orifices of the uterus and the vagina, and is raised to the point of greatest danger after the head has become engaged in the pelvis. Other sources of peril arise from prolapse of the funis and the coiling of the latter around the body of the child, and from the complete escape of the amniotic fluid in premature rupture of the membranes.

Treatment.—Early in labor, with the membranes intact, it is desirable, in consideration of the unfavorable prognosis for the child, to try and perform cephalic version by external manipulations. In case of failure to bring down the head, pains should be taken to preserve the membranes until dilatation is completed. To this end unnecessary examinations should be avoided, the patient should be placed upon her side and cautioned not to strain, and, when the membranes tend to form an elongated pouch, counter-pressure may be employed by means of a moderately distended Barnes's dilator introduced into the vagina. After rupture of the membranes it is best to remain passive. In the interest of the child, it is desirable that the expulsion of the trunk should take place slowly. Bringing down an extremity, as a prophylactic measure in order to secure a good handle in case of subsequent delay, is a questionable procedure. By this manœuvre a path is opened for the descent of the cord, and the mechanism of delivery is disturbed. When the hips appear at the vulva, the attending physician should be ready to extract in case of emergency. The patient should, therefore, if lying upon the left side, be brought near the edge of the bed; if upon the back, she should be placed across the bed with the hips well over the edge. She should be instructed to bear down during the pains. The lateral flexion of the lumbar portion of the trunk should be sustained by the hand applied to the perinæum. The trunk, as it advances through the vulva, should be wrapped in a warm

* Dubois, "Mém. de l'Acad. Roy. de Méd.," vol. iii, p. 450.

cloth and raised upward. When the cord appears, it should be drawn gently downward in the direction of one of the recesses to the side of the promontory; in case the cord passes between the thighs of the child, it should be released by slipping it over one hip. From this time on, the pulsations of the cord should be carefully watched, and, in case of failing strength, extraction should be resorted to.

With one hand the physician now supports the body of the child, while with the other he should make sustained and gradually increasing pressure upon the fundus uteri. The patient should be exhorted to strain, and bring into play all the auxiliary muscles concerned in expulsion. During the passage of the arms, the lateral flexion of the body should be promoted by raising the hips and supporting the perinæum. After the engagement of the head, it is desirable, if possible, to commit to the hands of a skilled assistant the maintenance of the supra-pubic pressure. When the face reaches the coccyx, the physician should raise the body of the child toward the abdomen of the mother. By this manœuvre the occiput is pushed upward by the pubic wall, and the chin brought forward to the vulva. The delivery of the head is then speedily accomplished by pressing the forehead forward with two fingers applied to the perinæum in front of the coccyx, or introduced into the rectum. By then keeping the head flexed, lacerations of the perinæum are best avoided.

When the occiput is turned posteriorly, the body should be raised if the chin is arrested at the symphysis, and depressed when flexion is complete.

CHAPTER XI.

CONDUCT OF NORMAL LABOR.

Preliminary preparations.—Examination of the patient.—Management of the first stage.—Management of the second stage.—Preservation of the perinæum.—Delivery of the shoulders.—Tying the cord.—Third or placental stage.—Care of patient after delivery.—Treatment of perineal lacerations.—Anæsthetics in midwifery.

It is hardly an exaggeration to state that the greater proportion of the sins of midwifery practice are committed in the management of normal labors. It is equally easy to fall into errors of commission and errors of omission. It is as necessary to know when to abstain as when to interfere. It is an old but always good rule, not to meddle with the physiological performance of a function; but the rule, when applied to obstetrics, presupposes a thorough familiarity with the physiological processes of childbirth, and the contingencies to which women in parturition are exposed. There is no sense in reposing a blind, unreasoning confidence in the powers of Nature. Indeed, legit-

imate grounds for interference are liable to arise in the simplest labors. The attitude of the medical attendant should be one of watchful expectancy. He should be ready, if needful, to assuage pain, to forestall dangers, and to limit the duration of suffering.

Preliminary Preparations.—When summoned to a patient, the physician should go armed to meet the sudden emergencies of obstetrical practice. His armamentarium should include a silver catheter, an English catheter of small size for use in asphyxia of the new-born child, a pair of forceps, needles and needle-holder, and silk or wire for sutures, a Davidson syringe, a set of Barnes's dilators, and an hypodermic syringe. He should go provided with chloroform, Magendie's solution of morphia, ergot, the perchloride or persulphate of iron, and a small vial of sulphuric ether. At the house, ice, brandy, hot and cold water, and a fountain syringe should be had in readiness.

As it is not uncommon for women, especially among the poorer classes, to test the experience of young physicians by asking details relative to the arrangement of the bed upon which the confinement is to take place, it is trusted that a few words upon the subject will not be regarded as entirely superfluous.

The bedstead should not be too low. If against the wall, it should be moved out, so as to allow easy access from both sides. The bedding should consist of a hair mattress or of a straw palliasse. Feather-beds are an abomination. Over that portion of the mattress upon which the woman expects to lie, a rubber cloth, or other impervious material, should be spread. Next to the water-proof, nurses usually lay a folded woolen comforter or blanket to absorb the fluid discharges. The whole is then covered smoothly with a sheet, and a second sheet, folded in several thicknesses, is laid beneath the hips of the patient. All these preparations are designed to limit the soiling of the bedding to a circumscribed space, and to facilitate the removal of the discharges after the termination of the delivery.

Examination of the Patient.—The first duty which devolves upon the physician in the lying-in chamber is to examine his patient, and to inform the family if "all is right"—i. e., whether the head presents, and no unusual obstacle to delivery exists. It is a good plan to employ external palpation in every case where no opposition is made, as, even where the diagnosis by ordinary vaginal exploration is clear and indisputable, no opportunity should be lost to perfect one's self in mapping out the fœtus through the abdominal and uterine walls. The ability not only to recognize the presenting part, but the position of the entire fœtus in the uterine cavity, is, in many cases of difficult labor, a possession of priceless value. During the manipulation of the abdomen, fetal movements should be carefully noted. If absent, auscultation should be practiced to ascertain whether the child is still alive. The internal examination should take cognizance of the condi-

tion of the vulva and perinæum, the state of the rectum and bladder, the length of the vagina, the degree of dilatation and softening of the cervix, the amount of cervical and vaginal secretion, the hardness of the child's head, and, if the membranes are not ruptured, the quantity of amniotic fluid. It is customary to begin the examination during an interval between the pains, but it is often convenient to continue the investigation during the pains, in order to judge of their efficacy and character.

The history of the case should embrace the length of previous labors, the health during pregnancy, the number of times the woman has been pregnant, and whether in the present instance she has advanced to full time. Inquiries should be made as to when the labor-pains commenced, as to their frequency and situation, and if the membranes have ruptured.

After the examination of the patient is ended, the physician is expected to express an opinion as to the probable duration of the labor. It is, however, necessary for the responses upon this point to be guarded and Delphic. In general terms, when the pelvis is normal, the head well flexed, the vagina short, and the cervix and perinæum are dilatable, an easy and rapid labor is to be anticipated; while, *per contra*, with a small pelvis, tardy flexion, a long vagina, and rigidity of the uterine and perineal orifices, a tedious period of waiting is to be assumed. Of course, too, labor is, as a rule, much longer in primiparæ than in women who have previously borne children. Moreover, with few exceptions, the result depends in a special degree upon the energy and persistence of the pains. The latter, however, represent always the uncertain element in the calculation. If the pains are good, therefore, the reservation should be made that, for a short labor, they must continue as at the beginning; while, if weak and powerless, it should be stated that better pains will be needed to bring the labor to a speedy conclusion.

Management of the First Stage of Labor.

The duties of the physician during the first stage of labor are, in normal cases, extremely simple. He should from time to time, say at hourly intervals, repeat the examination, with a view to inform himself of the progress of dilatation. He should caution his patient to pass her urine frequently. In case of retention, he should draw the water with a catheter. When the head is low down, the urethra often follows its convexity. The introduction of the straight female catheter may then be extremely difficult. Many recommend in such cases a silver male catheter to which a suitable curve has been given. I use by preference the English flexible catheter, which is passed easily, provided the end is guided by the index-finger, through the anterior vaginal wall, to the point of contact between the head and the symphysis

pubis. A flattening of the tube by pressure to an extent causing obliteration is not likely to take place unless the catheter be small or has become over-pliable from long use.

If, at the time of examination, the rectum is found clogged with fæces, an enema should be ordered. A disposition on the part of the patient to bear down during the first stage of labor should be discouraged, as wasting her strength without possessing any counterbalancing utility. The patient should be encouraged not to take to bed at the outset of labor. In the upright or sitting posture, gravity aids the fixation of the head and promotes dilatation.

As the end of the first stage approaches, however, the woman should undress and lie down, as the pains, after rupture, as a rule, follow one another with rapidity, and make locomotion difficult. To avoid soiling, the night-dress should be drawn well up under the arms. Tidy nurses pin a folded sheet around the hips of their patients to arrest the soaking of fluids upward.

Rupture of the membranes is, as a rule, a spontaneous act. Yet often enough something may be done in the way of shortening labor, by puncturing the membranes so soon as cervical dilatation is complete. They have then fulfilled their physiological mission, and their persistence simply retards the advance of the child's head. Artificial rupture is easily effected by means of a straightened hairpin, passed in the groove between the index and middle fingers of the examining hand to the amniotic pouch. The puncture should be made during a pain, at a time when the membranes are tense and separated from the scalp by a deep layer of fluid.

Management of the Second Stage of Labor.

The management of the second stage of labor calls for considerable tact on the part of the medical attendant. It is incumbent upon him to make frequent examinations, to determine the degree of rapidity with which the descent of the head takes place. So long as the advance is regular, he should abstain from interference. Should the pains slacken, however, he should not allow the duration of the second stage to exceed the physiological limits. It is not easy to define exactly what is implied in the expression "physiological limits." As a rule, a very rapid second stage is not physiological, as it endangers the integrity of the vagina and perinæum, and predisposes to *post-partum* hæmorrhage. Still, now and then labor is ended by a single pain after rupture of the membranes, without detriment to the mother. Of course, such cases are extremely uncommon in primiparæ. They require an unusually distensible condition of the soft parts, and an extraordinary degree of resiliency in the uterus. On the other hand, pressure of the head, after its descent into the pelvic cavity, leads, if too long continued, to pathological changes in the tissues of the canal

and of the outlet. It is usual, therefore, unless the head is small or the pelvis roomy, to use the resources of art to terminate labor when the head remains stationary at the perineal floor after two hours of effort. It is desirable, therefore, when the pains are weak and ineffective, to utilize all the simple adjuvants which experience has shown to possess real efficacy in increasing the activity of labor.

Changes of posture increase the power of the pains temporarily. When head-flexion is incomplete, it has been recommended to place the patient upon the side toward which the occiput is turned. Others, again, claim that the descent of the occiput is best effected by placing the mother upon the side toward which the chid's forehead is directed. In point of fact, either posture frequently leads to the desired result, simply because the change from the dorsal to the lateral position is apt to be followed by a temporary addition to the uterine force.*

In many women, owing to defective innervation, or to insufficient development of the muscular structures of the uterus, it is of great moment that the expulsion of the child be aided by the voluntary pressure of the abdominal walls. To be sure, in most cases, the reflex impulse to bear down is imperative ; but in others, where the impulse is feeble or held in abeyance by the dread of the patient lest she increase her sufferings, it becomes the duty of the physician, in tardy labors, to see to it that all the auxiliary forces are brought into play. To this end he should instruct his patient to fix her pelvis, either by pressing her feet against the foot-board of the bed, or by drawing up her knees and resting them against an assistant, who assumes the position best adapted to furnish the requisite support. Then the nurse, or other suitable person, should grasp the woman's hands, so as to enable her to fix her thorax and to bring all the expiratory muscles into full exercise. Often, when the agony is intense, the patient can be induced to strain with her pains, if her sufferings are first dulled by small doses of chloroform. When the head is on the perinæum, the physician may further expulsion by rubbing the abdomen to excite pains, and by pressing upon the breech through the fundus.

During the second stage the patient's posture should be left in general to her own volition. The physician should accustom himself to conduct labor with equal facility, no matter whether the woman lies upon her side or upon her back. The left lateral position, affected by English accoucheurs, is very convenient at the time of delivery, especially when there is occasion to support the perinæum, and where, owing to the flatness of the nates, the vulva is scarcely raised in the dorsal posture above the level of the bedding.

* Lahs, "Die Theorie der Geburts.," Bonn, 1877, p. 237.

The Preservation of the Perinæum.

By far the most delicate task which the physician has to fulfill toward his patient in the expulsion stage consists in so regulating the exit of the child's head as best to avoid perineal lacerations. It is needless to state that such lacerations, unless of slight extent, entail upon women a variable degree of subsequent discomfort and suffering. When the perinæum is examined with care after labor, a practice which should be invariable with a conscientious attendant, the frequent occurrence of more or less extensive rupture of its tissues is a matter of easy confirmation. Statistics of their frequency are of little value, much depending upon individual skill in management. Olshausen* reports, as the result of the preventive measures adopted at the clinic in Halle, during a period of ten years, 21·1 per cent. of perineal injuries in primiparæ and 4·7 per cent. in multiparæ. These percentages did not include slight tears confined to the frænulum. He regards 15 per cent. as not too high an estimate for the absolutely unavoidable lacerations, due to defective distensibility of the perinæum, and to the disproportionate size of the child's head.

The aim of prophylactic measures should be to develop the elasticity of the soft parts to the fullest practicable extent, and to cause the head to pass through the distended orifice of the vulva by its smallest diameters. Preliminary softening of the perinæum is best accomplished by the continuous but not too rapid descent of the presenting part. The relaxation, as a rule, begins earlier and is more complete in multiparæ than in primiparæ. In a few cases the soft parts will already have ceased, by the end of the first stage of labor, to offer any effective barrier to delivery. The distensibility of the soft parts may be fairly inferred from the presence of a copious discharge of glairy mucus.

When rupture takes place, the vaginal mucous membrane is the first structure to give way. In the ordinary form, the perineal body tears from the commissure backward to the rectum. In rare cases, a central perforation may result, and the child be expelled through a rent situated between the vulva and the anus.

When the head begins to make the perinæum bulge, the physician should be on the alert, and inform himself during each contraction of the strain to which the parts are subjected. At first it is only necessary to rest the hand lightly upon the perinæum. Direct pressure is to be avoided, except when the perinæum is stretched to a membranous thinness, and the danger of central perforation threatens. As the head begins to distend the vulva, the tension at the frænulum should be carefully gauged by a finger introduced between the labia. Measures to avert rupture may be classified under three headings, viz.:

* Olshausen, "Ueber Dammverletzung und Dammschutz," Volkmann's "Samml. klin. Vortr.," No. 41, p. 360.

1. Those designed to check the exit of the head before the fullest expansion has been secured, and to prevent expulsion during the acme of a pain, when the borders of the orifice are most rigid.

2. Measures which impart an upward movement to the head, with a view of making all unoccupied space beneath the arch of the pubes available.

3. Measures which favor expulsion during the interval between the pains, or at least after the acme has subsided.

In ordinary cases Hohl's method, recommended by Olshausen,* has rendered me excellent service. It consists in applying the support, not to the perinæum, but to the presenting part. To this end the thumb should be applied anteriorly to the occiput, and the index and middle fingers posteriorly upon that portion of the head which lies nearest to the commissure. The unconstrained position of the hand enables the operator to exercise effective pressure in the direction of the vagina, while the posterior fingers favor the rotation of the head under the pubic arch. The patient should at the same time be directed not to hold her breath during the pains, except when they are weak and powerless. Where the impulse to bear down is irresistible, chloroform should be given to annul the excessive reflex irritability. Under the most skillful management, laceration is liable to occur, unless the physician is able to control the action of the auxiliary expulsive forces.

So soon as the bi-parietal diameter passes the tense border of the vulva, the perinæum retracts rapidly over the face, and the expulsion of the head is completed. It is during this period that laceration is most apt to occur. This danger is, however, greatly lessened if the head is made to issue through the orifice after the pain has subsided, and when the soft parts are in a relaxed and dilatable condition. To accomplish this, in many instances where the resistance to be overcome is slight, it is sufficient for the woman to hold her breath during an interval between the pains, and voluntarily call into play all the muscles of expiration. In the larger proportion of cases, however, these efforts are futile, because of the comparatively feeble motor-force brought into action.

An excellent method of manual delivery we owe to Ritgen,† which consists in lifting the head upward and forward through the vulva, between the pains, by pressure made with the tips of the fingers upon the perinæum behind the anus, close to the extremity of the coccyx. Of course, the method is only available after the head has descended sufficiently for the pressure to be exerted upon the frontal region.

* Olshausen, *loc. cit.*, p. 366.

† Olshausen, "Ueber Dammverletzung und Dammschutz," Volkmann's "Sammlung.," No. 41, p. 369.

Rectal expression has lately found warm advocates in Olshausen* and Ahlfeld.† The manœuvre consists in passing two fingers into the rectum toward the close of the second stage of labor, and hooking them into the mouth or under the chin of the child through the thin recto-vaginal septum. By pressing the face forward and upward, the normal rotation of the head beneath the pubic arch can be effected, and delivery can be accomplished between the pains at the will of the operator.

When rupture is felt to be imminent, mock-modesty should be discarded, and the parts imperiled should be unhesitatingly exposed to view. If, owing to its excessive elasticity, the occiput, in place of being directed forward to the vulva by the perinæum, distends the latter so that central perforation threatens, the hand should be applied in such a way as to give direct support to the stretched tissues and to guide the head upward to the outlet. If, on the other hand, the danger arises from defective elasticity, the physician, standing to the right of the patient, with his face toward the foot of the bed, should pass the left hand between her thighs and press the head upward and inward, during each pain, with the thumb and two fingers, as previously described. At the same time, the movement of extension, should it threaten danger to the parts, should be hindered by pressing backward upon the frontal region, through the perinæum, with the disengaged hand.

Dr. Goodell‡ recommends hooking two fingers into the anus, and drawing the perinæum forward during a pain, to remove the strain from the thinned border of the vulva, and to promote the elasticity of the tissues.

Fasbender# places the patient upon the left side; then, standing behind her, he seizes the head between the index and middle fingers of the right hand, applied to the occiput, and the thumb thrust as far into the rectum as possible. By this manœuvre the head is held under complete control, the rectal wall hardly affecting the grip in any appreciable manner. During a pain the progression and extension of the head are readily prevented. During the interval between the pains, by pressure with the thumb through the rectum and the posterior portion of the perinæum, the head can be pressed forward and outward at the will of the operator.

Between pains, I have been in the habit, in cases of rigidity, of alternately drawing the chin downward through the rectum until the head distends the perinæum, and then allowing it to recede. It is as-

* See AHLFELD, "Das Dammschutz Verfahren nach Ritgen," "Arch. f. Gynack.," vi, p. 279.

† *Loc. cit.*

‡ GOODELL, "Am. Jour. of the Med. Sci.," January, 1871.

FASBENDER, "Ztschr. f. Geburtsh. und Gynack.," Bd. ii, H. 1, p. 58.

tonishing how often apparently the most obstinate resistance can be overcome by the simple repetition of this to-and-fro movement, the parts rapidly becoming soft and distensible. Of course, it should be discontinued the moment contraction begins, and care should be taken to effect delivery after uterine action has subsided.

With judicious management the number of unavoidable lacerations can be restricted to a small proportion of cases. Still there are individual peculiarities which will now and then render abortive the best prophylactic measures. In this category I have already alluded to a primitive lack of development of the maternal parts, to unusual size of the child's head, and to the excessive rigidity of the perinæum in primiparæ, especially after the thirtieth year. In addition, should be mentioned cases where the pubic arch is diminished by the approximation of the pubic rami, or where the tissues have been rendered friable from chronic œdema, from a varicose condition of the veins, from condylomata, from syphilitic sores, or from inflammatory infiltration consequent upon undue prolongation of the second stage of labor. Lacerations are more frequent in occipito-posterior positions, and in the delivery of the after-coming head, where hasty extraction is demanded in the interest of the child.

When, in the judgment of the physician, rupture of the perinæum seems inevitable, he is justified in making lateral incisions through the vulva to relieve the strain upon the recto-vaginal septum. To this operation the term episiotomy is applied. By it not only is the danger of deep laceration through the sphincter ani prevented, but, owing to their eligible position, the wounds themselves are capable of closing spontaneously ; whereas, when laceration follows the raphé, the retraction of the transversi perinæi muscles causes a gaping to take place which interferes with immediate union. As, however, every wounded surface is a source of danger in childbed, episiotomy should never be performed so long as hope exists of otherwise preserving the perinæum. It is essentially the operation of young practitioners, the occasions for its employment diminishing in frequency with increasing experience. The chief resistance encountered by the head is not at the thin border of the vulva, but is furnished by a narrow ring situated half an inch above, and composed of the constrictor cunni, the transversi perinæi, and sometimes of the levator ani muscles. Incisions should be made during a pain, when the ring becomes tense and rigid, and is easily recognized with the finger. As it is not desirable that the head should be driven suddenly through the vulva during the act of operating, the time selected for performing episiotomy should be at the commencement or close of a contraction. The division of the rigid fibers may be accomplished by means of a blunt-pointed bistoury, or a pair of angular scissors. So far as practicable, the incisions should be confined to the vagina, and should not exceed three quarters of an inch

in length. In cases where the head is on the eve of expulsion, the bistoury may be introduced flat between it and the vagina, half an inch anterior to the commissure, and the section made from within outward. Care, however, should be taken at the same time to avoid severing the external skin, by drawing it as far back as possible.* In central perforation it is best to divide the band left attached to the vulva, as its preservation is of no advantage.

The Delivery of the Shoulders.—After the expulsion of the head, mucus should be wiped from the mouth and nose, and cleared from the throat with the finger should laryngeal *râles* indicate an embarrassment of the respiration. If the cord is found coiled around the neck, it should be loosened by drawing upon the placental end until the shoulders can pass readily through the loop. Should this be found impossible, either because the cord is unusually short, or because it is wound several times around the body, a ligature should be applied, the cord should be cut between the ligature and the placenta, and delivery should be hastened by manual efforts.†

In the majority of cases the shoulders are expelled spontaneously. Still, it is a good plan to expedite the descent by pressure made with the left hand at the fundus of the uterus. Care must be taken lest the lower shoulder convert a slight tear in the perinæum into an extensive laceration. The right hand should therefore be applied to the perinæum in such a way as to lift the shoulder upward, and at the same time furnish a bridge over which it can glide in its movement forward. Sometimes after the passage of the head a deep vaginal laceration coexists with an intact condition of the external parts. The shoulder then tears through the skin, and a complete rupture ensues. Olshausen recommends, in cases where rupture is imminent, to turn the shoulders so that they clear the vulva in an oblique or transverse diameter.

If, after birth of the head, the child does not breathe, and asphyxia threatens, the physician should rub the uterus with the hand through the abdominal wall, to excite a pain, during which he should urge the patient to press down, and thus aid expulsion. The most common hindrance to delivery consists in an arrest of the upper shoulder beneath the pubes. Usually its release is readily effected by seizing the sides of the head with the two hands and drawing directly downward. It is rarely necessary to raise the head subsequently, or to hook the finger into the armpit to extract the posterior shoulder.

Tying the Cord.—When the cord is torn across, as sometimes happens in street-births, no hæmorrhage takes place from the lacerated vessels. Of course, this occurrence deprives the physician of the

* Olshausen, *loc. cit.*, pp. 372, 373.

† Tarnier recommends dividing the cord, and then compressing the proximal end between the thumb and the index-finger. The proximal end is distinguished by the spouting of the two umbilical arteries.

power of choosing the point at which the division shall be made. As it is desirable, for the sake of convenience, to sever the cord about two inches from the navel, it is the custom in all civilized countries to cut it with scissors, and to prevent hæmorrhage by the application of a ligature. Almost any material may be employed for the latter purpose, though nothing is so handy as the narrow flat bobbin which most nurses keep in readiness. Budin recommends the elastic ligature as a security against hæmorrhage. The ligature should be applied tightly, and the cut surface should subsequently be examined once or twice by the physician before leaving, to make sure that the arteries are sufficiently compressed to prevent oozing from taking place. The cord should be held in the hollow of the hand at the time of its division, to avoid the possibility of including accidentally any portion of the child between the blades of the scissors. Commonly two ligatures are applied, and the cord is severed between them, though the question of one or two ligatures is, except in twin pregnancies, of trifling importance.

In practice it is very desirable that the physician should understand the physiological difference between the effects of the early and those of the late application of the ligature. The custom, as regards this point, has been by no means uniform. The ancients deferred the ligature until after the expulsion of the placenta. Mauriceau, Clément, and Deventer followed the same plan, but employed artificial expedients to complete the third stage of labor rapidly.* The common practice at the present day is to tie the cord immediately after the birth of the child. Still, there have not been wanting in recent times warning voices against precipitate action. Nägele advised waiting until the pulsation of the cord had ceased ; Braun † first describes the changes from the fetal to the post-natal circulation, and then says : "This stupendous process should be taken into consideration in the treatment of every case of labor, and because of it the cord should never be severed or tied so long as pronounced pulsations can be felt near the navel." Stoltz ‡ noticed that, "after the child has respired

* Budin, "À quel moment doit-on opérer la ligature du cordon ombilical ?" "Publications du 'Progrès Médical,'" 1876. † Braun, "Lehrbuch der Geburtshülfe," p. 192.

‡ Stoltz, art. "Accouchement naturel," "Nouveau Dictionnaire," p. 283. So, too, White wrote, in 1773 : "The common method of tying and cutting the navel-string the instant the child is born is likewise one of those errors in practice that has nothing to plead in its favor but custom. Can it be supposed that this important event, this great change which takes place in the lungs, the heart, and the liver, from the state of a fœtus kept alive by the umbilical cord to that state when life can not be carried on without respiration, whereby the lungs must be fully expanded with air, and the whole mass of blood, instead of one fourth part, be circulated through them, the ductus venosus, foramen ovale, ductus arteriosus, and the umbilical arteries and veins must all be closed, and the mode of circulation in the principal vessels entirely altered—is it possible that this wonderful alteration in the human machine should be properly brought about in one instant of time, and at the will of a bystander ? Let us but leave the affair to Nature, and watch her operations, and it will soon appear that she stands not in need of our feeble assistance, but will

well, division of the cord is followed by an insignificant loss of blood, while, after immediate section, blood escapes in abundance." Winkler,* from anatomical observation alone, recommended not to tie the cord until the expulsion of the placenta, or at least until the cord had become pale and had ceased to pulsate, giving as his reason that by delay a certain quantity of blood would pass from the placenta to the child, and that every plus is a gain to the child, which would increase its powers of resistance. He finally expressed it as almost his belief that the practice recommended would tend to diminish the familiar loss of weight in the new-born during the first days of existence.

In 1875 Budin, at that time interne at the Maternité of Paris, undertook the following experiments at the suggestion of Professor Tarnier: In one series, the cord was tied immediately after the birth of the child, and the blood which escaped from the placental extremity was measured; in the other, the quantity of blood was determined in cases where the cord was not tied until several minutes after delivery. By a comparison of the results thus obtained, he found that the average amount of placental blood was three ounces greater in the first than in the second series of experiments.† Welcker estimated the entire quantity of the blood in the infant at one nineteenth the weight of the body, which would amount, in a child of seven pounds, to six ounces. To tie the cord immediately after birth would therefore be equivalent to robbing the child of three ounces of blood which would otherwise pass into its circulation. This startling result has in the main been abundantly confirmed by subsequent observers. Two years later (1877), Schücking, extending Budin's experiments by weighing the child at birth, and then observing the changes that took place up to the time of the cessation of the placental circulation, found that the child gained from one to three ounces in weight by delay. It is certain that these amounts do not represent the entire increase, as a portion necessarily escapes observation in the interval that must elapse before the weight can be ascertained.

There is a difference of opinion as to the mechanism by which the transfer of the blood from the placenta to the child takes place. According to Budin, the principal factor in the accomplishment of the result is thoracic aspiration. With the first breath, the afflux of blood to the lungs develops a "negative pressure" in the vessels of the larger circulation, so that a suction force is exerted upon the placental blood, which continues until the equilibrium is restored. To tie the cord prematurely, therefore, is to cut off from the child a supply of blood

do the work herself at a proper time and in a better manner. In a few minutes the lungs will be gradually expanded, and the great alterations in the heart and blood-vessels will take place. As soon as this is perfectly done, the circulation in the navel-string will cease of itself, and then if it be cut no hæmorrhage will ensue from either end. . . ." "A Treatise on the Management of Pregnant and Lying-in Women," by Charles White. London, 1873, p. 107.

* Winkler, "Arch. f. Gynaek.," vol. iv, p. 256 (1872).

† Budin, *loc. cit.*

for which the establishment of the pulmonary circulation had created a physiological need.

Schücking,* on the contrary, maintains that, after the first inspiration, thoracic expansion ceases to operate as an active force, and that the main agent which drives the blood from the placenta through the umbilical vein is the compression exerted by the retraction, and, at intervals, by the contractions of the uterus.

The difference in the theoretical standpoint of these two observers is of practical importance, for, if the movement of blood to the child results from thoracic aspiration, the quantity which enters its circulation will not exceed its requirements ; while, if the movement is due to uterine compression, the question arises as to whether the forcible transfusion thus accomplished is compatible with the child's safety and welfare. The ultimate decision will depend partly upon experimental and partly upon clinical observations. Provisionally, the case stands as follows : The manometric observations of Ribémont † show that the pressure in the umbilical arteries is uniformly greater than that in the umbilical vein ; during a series of deep inspirations and expirations, the blood in the umbilical vein is subject to marked oscillations : after the pulsations of the cord have ceased, the uterine contractions alone are insufficient to propel the placental blood through the umbilical vein to the infant. Again, Budin (discussion upon Ribémont's paper), in a breech-delivery, compressed the cord at the vulva as far as possible from the navel ; at birth, the vein was distended with blood, but with the first inspiration it was instantly emptied. Thoracic aspiration does, therefore, exist as an operative force. On the other hand, Schücking found that when the placenta was rapidly expelled by Credé's method, so as to remove it from the influence of uterine retraction, the pressure in the vein was slightly lessened, and the total amount of blood transferred to the infant was greatly restricted.

According to the clinical observations of Budin, Ribémont, and Schücking, infants which have had the benefit of late ligation of the cord are red, vigorous, and active, whereas those in which the cord is tied early are apt to be pale and apathetic. Hofmeier,‡ Ribémont, Budin, and Zweifel # have shown that the loss of weight which occurs in the first few days following confinement is less in amount and of shorter duration when the cord is not tied until after the pulsations have ceased.

There appear to be no harmful results to the child, growing out of

* Schücking, "Zur Physiologie der Nachgeburtsperiode," "Berl. klin. Woch.," Nos. 1 and 2, 1877.

† Ribémont, "Recherches sur la tension du sang dans les vaisseaux du fœtus et du nouveau-né," "Arch. de Tocol.," October, 1879.

‡ "Der Zeitpunkt der Abnabelung," etc., "Ztschr. f. Geburtsh. u. Gynaek.," iv, 1, p. 114.

Zweifel, "Centralbl. f. Gynaek.," No. 1.

the practice of late ligation. Porak, indeed, reports two cases of dark vomiting, two of melæna, and two with sanguineous discharges from the vagina, which he is convinced were the result of the practice ; but the extensive trial to which it has since been subjected in the principal lying-in institutions of the Continent have sufficiently demonstrated that it is exempt from danger.

In late ligation, the amount of blood retained in the placenta and the increase in the weight of the child differ materially in different cases,* a difference which seems to indicate that, so long as the placental circulation is left undisturbed, the amount of blood passing to the child will be measured by its needs. In a case of Illing's,† on the other hand, after the placenta had been expressed from the uterus, its contents and that of the cord were forcibly squeezed into the circulation of the child, and death followed from over-distention of the heart. Porak and Georg Violet‡ claim that there is a special predisposition to icterus in children when the cord is tied after the placental circulation has ceased. Violet attributes the discoloration, not to bile-pigment, but to a rapid disintegration of the excess of blood-corpuscles. Helot, he says, found, on the first day after the birth, a difference of nine hundred thousand corpuscles to the cubic millimetre between cases of late and those of early ligation, while on the ninth day the difference fell to three hundred thousand. Others have failed to notice any characteristic icteric discoloration peculiar to late ligation. Neither Porak nor Violet attaches any pathological significance to the symptom.

The outcome of the foregoing observations may fairly be stated as follows :

1. The cord should not be tied until the child has breathed vigorously a few times. When there is no occasion for haste arising out of the condition of the mother, it is safer to wait until the pulsations of the cord have ceased altogether.

2. Late ligation is not dangerous to the child. From the excess of blood contained in the fetal portion of the placenta, the child receives into its system only the amount requisite to supply the needs created by the opening up of the pulmonary circulation.

3. Until further observations have been made, the practice of employing uterine expression previous to tying the cord is questionable.

4. In children born pale and anæmic, suffering at birth from syncope, late ligation furnishes an invaluable means of restoring the equilibrium of the fetal circulation.

* See Wiener, "Ueber den Einfluss der Abnabelungszeit auf den Blutgehalt der Placenta," "Arch. f. Gynaek.," xiv, 1, p. 34 ; also, Meyer, "Centralbl. f. Gynaek.," 1878, No. 10.

† "Inaug. Diss.," Kiel, 1877.

‡ Georg Violet, "Ueber die Gelbsucht der Neugeborenen und die Zeit der Abnabelung," Virchow's "Archiv," lxxx, 2, p. 353.

Management of the Third or Placental Stage of Labor.

The duties of the physician in the third stage are to guard against hæmorrhage, to promote uterine contractions, and to further the expulsion of the placenta. These objects are best fulfilled by manipulations through the abdominal walls. Tractions upon the cord should not be resorted to before the placenta begins its descent into the vagina. The method, at present in vogue, of expressing the placenta by seizing the uterus through the abdominal coverings, is associated indissolubly with the name of Credé, for, though the value of friction, of kneading and compression, was appreciated, as their writings show, by Mauriceau, Robert Wallace Johnson, Joseph Clarke, Busch, Mayer, and others,* it remained for Credé to elevate placental expression to the rank of a recognized procedure of obstetric practice.

Credé's method consists essentially in applying at first light and afterward stronger friction to the fundus of the uterus until an energetic contraction is obtained; at its height the uterus is grasped so that the fundus rests in the palm of the hand, compressed between the thumb and fingers. The exercise of circular compression forces the placenta from the uterus, or in case of failure the process may be repeated until the object is accomplished. In practiced hands the expression of the placenta is usually effected during the third or fourth pain, in about five minutes after the birth of the child. An inexperienced operator may not succeed before the fifth, sixth, seventh, or even a still later pain, in accomplishing his object. Credé lays great stress upon the avoidance of violence in the practice of his method. It is true that the expulsion of the placenta will, as a rule, occur spontaneously. The unaided uterus is, however, liable to relax, and become the source of hæmorrhage; or, where the delivery does not take place speedily, it may, on the other hand, close down, so as to imprison the placenta within its cavity. The great merit of Credé's method is, that by maintaining retraction it prevents hæmorrhage, and by promoting speedy expulsion it guards against the dangers of retention.

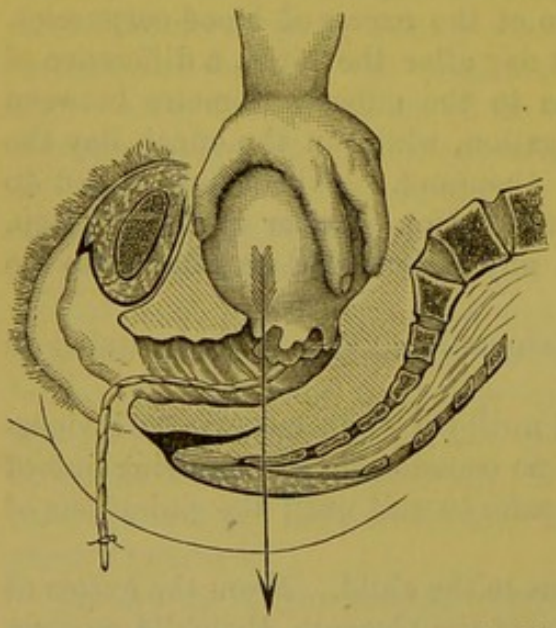


Fig. 135.—Expression of the placenta. (Credé.)

* For historical references, *vide* Riol, "Délivrance par expression," G. Masson, 1880; Mundé, "Obstetric Palpation," p. 103.

When systematically practiced, the bugbear known as adherent placenta is the rarest of accidents. The practice is not difficult, and is devoid of danger. To be successful, however, expression should be practiced only during the acme of a contraction, and the propulsive force should be directed from the fundus downward in the axis of the uterus. Spiegelberg * lays great stress on exercising compression of the uterus from the moment the head emerges from the vulva, and not waiting until the delivery of the child is ended. By so doing, general contractions are maintained, and the detachment of the placenta promoted. †

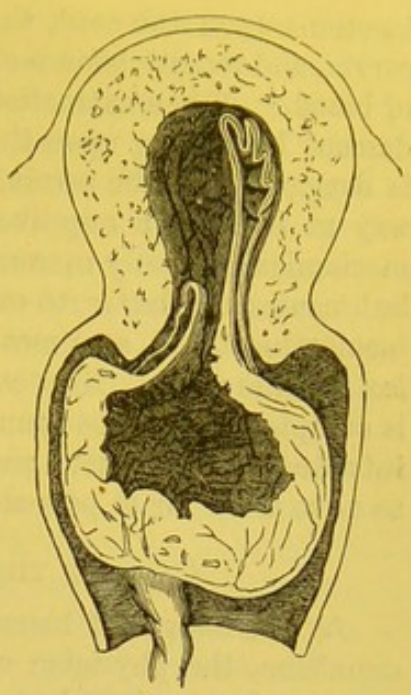


Fig. 136.—Showing the effect of premature tractions upon the cord. (Schultze.)

The evidence of the expulsion of the placenta is furnished to the operator by his feeling the anterior and posterior uterine walls in contact with one another. By then pressing the uterus downward in the axis of the brim, it is often possible to drive the placenta into the vagina and through the vulva. There is no objection, however, at this stage, to expediting delivery by drawing upon the cord downward and backward, while at the same time the uterine pressure is maintained. The extraction of the placenta should take place slowly, to avoid tearing the membranes. As the placenta passes the vulva, it should be made to revolve so as to twist the membranes into a cord, which should be withdrawn slowly and with the utmost care. If the membranes are felt to give way at any point, the fingers should be introduced, if necessary, into the vagina to seize them above the site of the laceration, and the removal should be proceeded with by gentle manipulations.

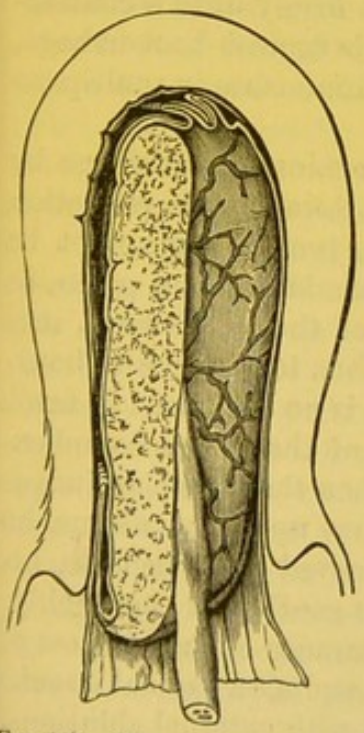


Fig. 137.—Showing normal position of placenta. (Duncan.)

When the mechanism of placental delivery is not interfered with by premature

* Spiegelberg, "Lehrbuch," p. 192.

† I have not thought it worth while to discuss the recent criticisms made upon Credé's method. The objections urged against its employment are completely at variance with my own experience.

tractions upon the cord, the placenta descends edgewise through the cervix, and its expulsion is effected with the loss of but a trifling amount of blood.* When extraction, on the contrary, is attempted previous to descent by pulling upon the cord, the central portion of the placenta is dragged into the cervix, while the borders are inverted in such a way as to form a cup-like cavity. This disturbance of the normal mechanism not only increases the difficulty of delivering the placenta, but causes the latter to exercise a suction force which increases the hæmorrhage, and at times even is capable of partially inverting the lax uterine walls. Now and then, where the occlusion of the cervix is complete, it may be found impossible to effect delivery without first introducing two fingers, and hooking down the margin of the placenta, so as to allow air to pass above into the uterine cavity.

Care of the Patient after Delivery.

As the danger of hæmorrhage does not always end with placental expulsion, the physician should be ready to sacrifice, even in simple cases, at least a half-hour to close observation of the subsequent behavior of the uterus. The weight of the hand laid above the symphysis pubis is usually sufficient to maintain a safe degree of retraction. Should, however, the uterus become lax, and lose its outline, the physician should grasp it in his hand and knead it firmly until a contraction is excited. In this way he not only guards against hæmorrhage, but, by preventing the formation of clots, he diminishes in multiparæ the severity of the after-pains.

Most physicians seek additional security against hæmorrhage by administering ergot, which, as is well known, favors tonic retraction of the uterus. To this there is no objection, provided the ergot be given subsequent to the expulsion of the placenta. When given, as is commonly done, at the time of the passage of the child's head, it is liable to produce its effect prematurely, and thus to give rise to hour-glass contraction. The rarity of the accident is no argument in favor of the popularity of the practice, in the face of the serious complication to which it is capable of giving rise. When the physician judges it is safe to suspend the prophylactic pressure upon the uterus, he should see that all the soiled clothing be removed from beneath his patient, and that the nurse wash the genitalia gently but thoroughly. Nothing does so much to cause speedy disappearance of the soreness of the external parts as perfect cleanliness. In hospitals a vaginal douche of warm carbolized water should be combined with external ablutions. The perinæum should then be carefully examined, and, if lacerations are discovered, the physician should make himself acquainted with their extent and importance.

The application of the binder after delivery is one of those points

* Matthews Duncan, "Edinburgh Med. Jour.," April, 1871.

in practice about which men of large experience entertain a difference of opinion. In my student-days in the Hôpital des Cliniques in Paris, the binder was dispensed with. A folded sheet was, however, laid across the abdomen, it having been found that a certain amount of pressure was necessary for the comfort of the patient. This plan compelled her to lie upon her back, and thus had the disadvantage of restricting freedom of movement. Careful observation has failed, however, to show me a single good reason why the binder should be discarded. When properly applied, it adds greatly to the woman's comfort, and enables her to turn at will upon her side. My own preference is for a piece of unbleached muslin wide enough to reach below the hips.

In adjusting the binder, the physician should place himself to the right of the woman; he should seize the near end between the thumb and two fingers of the left hand, while with the right hand he draws the farther portion smoothly over it. The two ends should then be held with the left hand, and the pins, which should preferably be of large size, should be inserted with the right. The process should begin below, and be followed upward at intervals of about two inches. These details are given because the writer remembers his own embarrassment arising from his inability to get information upon this trivial subject in the early days of his practice. Moreover, as many women are somewhat tenacious of having the binder first applied by the physician, to know how to do it with address is not an indifferent accomplishment. Many place a compress made of a folded towel above the symphysis pubis. This addition usually serves no better purpose than to displace the uterus to one side. The toilet of the patient is finally completed by laying a warm folded napkin at the vulva to receive the lochial discharge.

Treatment of Perineal and Cervical Lacerations.—It is needless, as we have already stated, to invade the domain of gynæcology to explain the serious after-results of neglected perineal and cervical lacerations. During childbed, open wounds in the course of the genital canal are a source of danger from septic infection, and, even when kept clean by frequent carbolized douches, retard the progress of recovery. The art of closing lacerations of significant extent by suture deserves, therefore, to be acquired by every obstetric practitioner. While in hospital practice the results as regards immediate union are widely variable, and often, in consequence of atmospheric conditions, are negative, in properly conducted labors occurring in private practice, where the hygienic conditions are favorable, failure to obtain union is a rare exception. The details of the operative procedures will be given in connection with the pathology of labor.

Anæsthetics in Midwifery.

The value of anæsthetics in certain irregularities of the labor-pains, in eclampsia, and in most midwifery operations, is no longer a

matter of discussion. The benefits from their employment in such cases are palpable and beyond dispute. As to the right, however, of a woman to have her sufferings assuaged in ordinary normal labor, there is by no means unanimity of opinion. To be sure, the old objections raised in Sir James Simpson's day that labor-pain is a salutary manifestation of life-force, that anæsthesia gives rise to paralysis, to peritonitis, to puerperal mania, to hæmorrhage, to pericardial adhesions, to indecencies of language and behavior, and that it contravenes the word of God, are now known to be unfounded or imaginary. Still, there is no doubt that the vast majority of medical men refrain from the use of anæsthetics in ordinary labor, either from vain apprehensions or because some incident in their practice has led them to suspect that, in spite of statistics, they are not devoid of objectionable or dangerous properties. In my own experience during the last sixteen years there have been comparatively few cases in which I have not used chloroform or ether in some stage of labor. The result of my experience has been to make me a warm advocate of their wider employment on the one hand, while proclaiming the necessity of caution in their use upon the other. It seems to me that the hesitancy manifested regarding their general adoption is due, in large measure, to the fact that few practitioners give themselves the trouble to master the necessary *modus operandi*, to study the limitations of their usefulness, or to learn the conditions of their safe administration. It should be steadfastly borne in mind that the giving of anæsthetics in labor is an art to be acquired—a very simple one, perhaps, but the practice of which admits of neither ignorance nor carelessness.

As in ordinary surgical practice, anæsthetics are contraindicated by organic affections of the heart and lungs.

Except in the prolonged insensibility required for difficult obstetrical operations, I think the preference should be accorded to chloroform rather than to ether. The former possesses the advantage of being more agreeable, more manageable, and more rapid in its action.

Anæsthesia, not narcosis, is the object aimed at, and the dulling of the sensibility is much more readily effected by chloroform than by ether.

As a rule, chloroform should not be administered during the first stage of labor, partly because of its tendency, when given at too early a period, to weaken the contractions of the uterus, and partly because protracted anæsthesia has a tendency to impair the cardiac force. To this rule there are, however, numerous exceptions, to which we shall have occasion to revert in connection with the consideration of irregular labor-pains.

If the pains in the second stage are of feeble intensity, it is best to withhold the anæsthetic ; if of normal strength, chloroform may be given, but at first only in small doses and during the continuance of a

pain. The anæsthetic should not be pushed to the stage of complete unconsciousness until the head begins to emerge at the vulva.

Chloroform can be conveniently given upon a folded handkerchief. The latter should be held near to, but not in contact with, the respiratory passages. The best diluent for chloroform, as was long ago stated by Sir James Simpson, is atmospheric air. If the handkerchief be laid directly across the nose, instant suspension of respiration may result. A minor evil is the cutaneous irritation produced by placing the chloroform in direct contact with the lips and mouth.

At the beginning of each pain the patient should be directed to take a number of deep inspirations. During the acme of the pain the expiratory efforts which are then called into play prevent the inhalation of any considerable amount of the anæsthetic.

When the head presses upon the perinæum, the handkerchief should be intrusted to the nurse, but the administration to the end should be directed and strictly supervised by the physician.

When chloroform is first given, it is common for the pains to become weakened; but this suspensive influence upon the uterus is usually temporary. Exceptionally, however, the weakness of the pains may continue, and render it necessary to withhold the anæsthetic. In still rarer cases the pains remain inefficient after the anæsthesia has subsided. On this account it seems to me certain that those who use chloroform habitually will find themselves compelled to resort to the forceps with somewhat increased frequency. A tardy labor, due to uterine inertia, will likewise call for additional vigilance during the stage of placental expulsion, to forestall the occurrence of hæmorrhage.

The immunity enjoyed by women in childbirth against the accidents which sometimes occur from anæsthesia in surgical practice is not absolute, but dependent upon its cautious and intelligent administration. I once narrowly escaped losing a patient in the Bellevue Hospital, upon whom I designed to perform version, in consequence of my house-physician suddenly crowding a paper funnel containing a towel wet with chloroform over the respiratory passages.

Chloroform should not be given in the third stage of labor. The relative safety of chloroform in parturition ceases with the birth of the child. After delivery it favors the relaxation of the uterus, and predisposes to hæmorrhage. Moreover, after the uterus has been emptied there is always an increase of blood in the large vessels of the abdomen, and a corresponding recession of blood from the head. Now, it is known that the quantity of chloroform which one day is perfectly tolerated by an individual in health may prove fatal on the succeeding day, in case of the intervention of any considerable loss of blood. Cerebral anæmia, from any cause, increases the risk of anæsthesia.

In lengthy operations requiring prolonged anæsthesia, ether, as has already been intimated, should be preferred to chloroform.

CHAPTER XII.

MULTIPLE PREGNANCIES AND THEIR MANAGEMENT.

Frequency.—Origin.—Varieties.—Acardia.—Weight.—Unequal development.—Superfetation.—Diagnosis.—Labor.—Presentations.—Simultaneous entrance of both children into the pelvis.—Locking.—Prognosis.—Conduct of labor.

The term *multiple pregnancy* is used when more than one germ are simultaneously developed. Twins, the most common form, occur in the proportion of one to between eighty and ninety births; triplets in about the proportion of one to seven thousand; quadruplets and quintuplets are of extreme rarity. No authentic example of over five children at a birth is on record. An instance of quintuplets I have once witnessed. In the Prussian statistics of Von Hemsbach and Veit, based upon thirteen million births, the number of twin pregnancies amounted to 150,000. Of these, in 50,000 both children were boys; in 46,000 both were girls; and in 54,000 the children consisted of a boy and a girl.

Twins may develop either from two distinct ova, discharged from the same or from distinct Graafian follicles, or may both originate from a single ovum. If two Graafian follicles rupture, the ovaries will offer two corpora lutea. In some instances a corpus luteum has been found in each ovary; in others, both are situated in the same ovary.

In the case where twins develop from two ova, each fœtus is contained in its own chorion. If the ova are imbedded in the decidua at sufficiently distant points, the placentæ will be separate, and each ovum will have its distinct reflexa. If near one another, the placentæ are often united at their borders, each, however, maintaining its independent circulation. In some cases the two ova lie so close together that they are encircled by a common reflexa.

When twins are developed from two centers of development contained in the same ovum, the placenta, the chorion, and reflexa are, of course, common to both. In most instances, each fœtus is contained in its own amnion. Occasionally, however, twins are furnished with but one amnion, a peculiarity which, in some cases at least, is not primary, but the result of an absorption of the party-wall between two originally distinct cavities.*

Twins from the same ovum are always of the same sex. Anastomoses of greater or less extent exist between the placental vessels of the two embryos. The consequences of these communications are of the utmost importance, for, when extensive, the heart's action in one fœtus counterbalances that of the other; the stronger blood-current in the placenta pushes back the weaker one, at first impeding the circula-

* Ahlfeld, "Beiträge zur Lehre von den Zwillingen," "Arch. f. Gynaek.," Bd. vii, p. 281.

tion of the less favored fœtus, then arresting it, and finally causing it to reverse its direction. The heart atrophies, and an acardia is produced, which is simply an appendage to the healthy fœtus. The circulation in the acardia takes place as follows: Venous blood from the healthy fœtus is conveyed by the umbilical arteries to the placenta; the force of the fetal heart drives the stream through the communicating branches to the umbilical arteries of the less favored twin; this force is, however, insufficient to carry the current to the upper parts of the body, which are, therefore, not developed. The favorable position of the lower extremities for receiving the blood from the umbili-

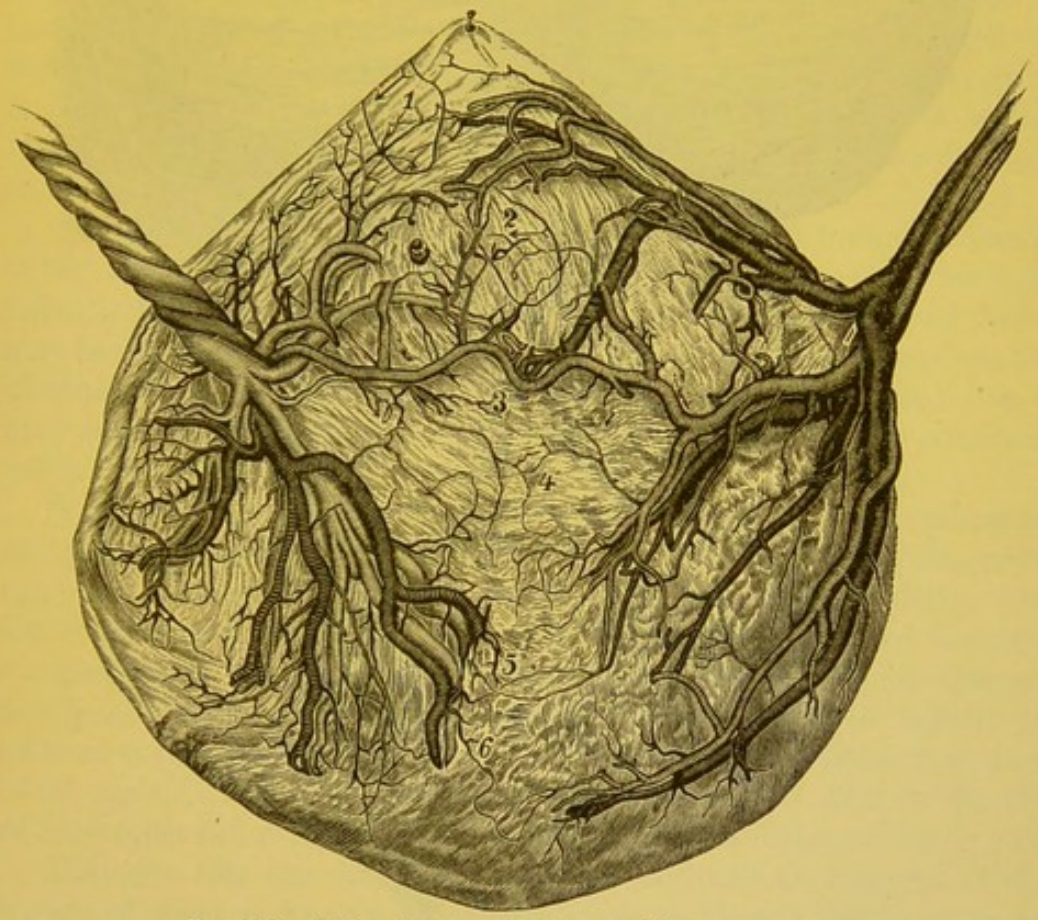


FIG. 138.—Twin placenta, showing arterial anastomosis.

cal vessels explains their continued though imperfect growth and development. The blood carried to the fœtus by the umbilical arteries is returned by the umbilical vein.

According to Ahlfeld,* a division may take place in the formative material contained within a single area germinativa. This division may be complete, and thus produce separate twins inclosed in the same amnion, which not only are of the same sex, but bear to one another through life the most striking similarity as regards appear-

* AHLFELD, "Die Entstehung der Doppelbildung und der homologen Zwillinge," "Arch. f. Gynaek.," Bd. ix, p. 196.

ance, physical peculiarities, and both mental and moral characteristics; or it may be incomplete, and thus give rise to conjoined twins, or one of the numerous forms of double monsters.*

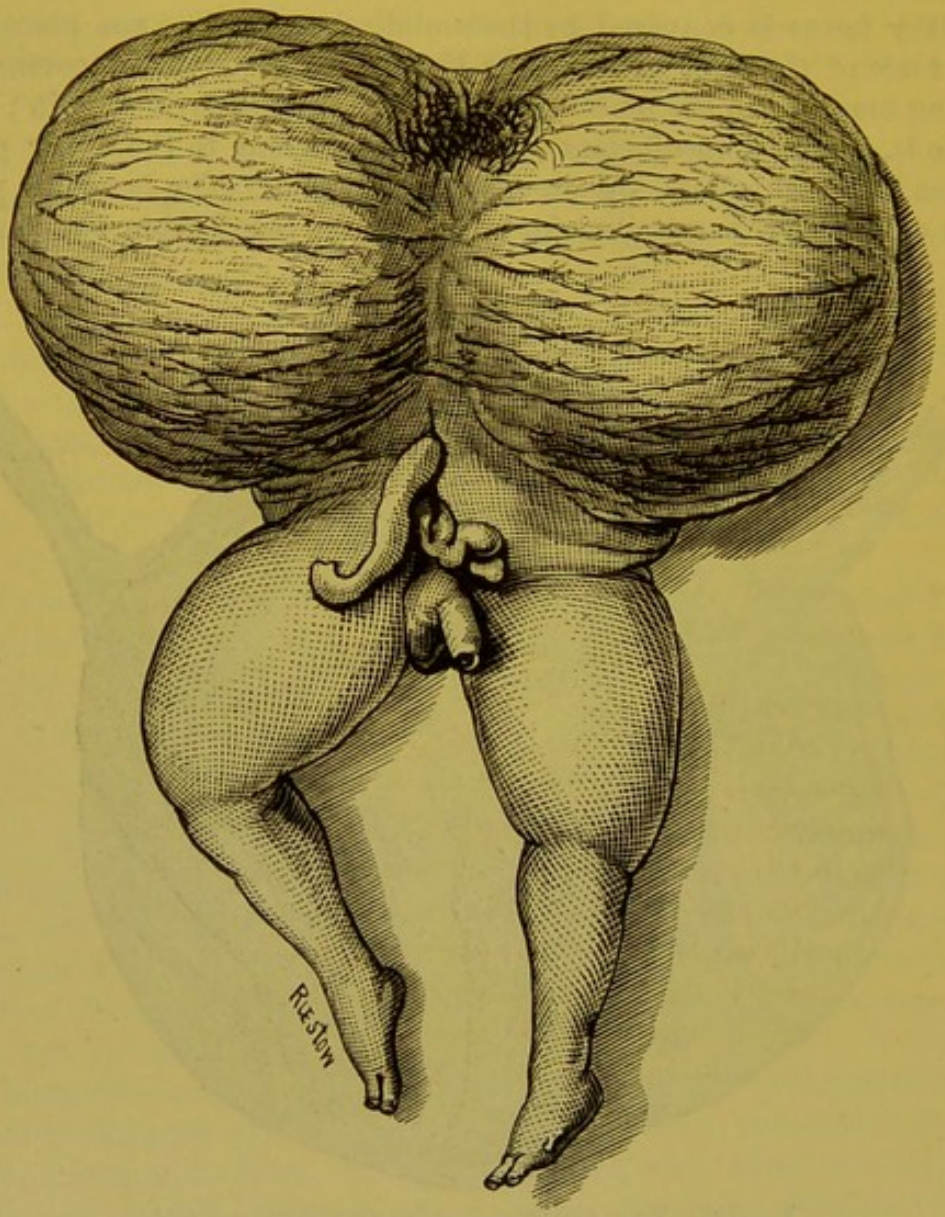


Fig. 139.—Author's case of acardia; the monstrosity weighed three pounds nine ounces; there were no traces of heart, lungs, pancreas, liver, spleen, or sternum.

In triplets it is common to find one child derived from an independent ovum, and two from a single ovum. In a case of quadruplets reported by P. Müller,† two ova were simple, while the third contained

* Schultze, on the other hand, contends that the double monsters are derived from the fusion of two embryos developed upon the blastodermic vesicle at points close to one another. Schultze, "Ueber Zwillingsschwangerschaft," Volkmann's "Samm. klin. Vortr.," No. 34.

† P. Müller, "Eine Vierling's Geburt," "Ztschr. f. Geburtsh. und Gynaek.," Bd. iii, p. 166.

two embryos. The children in the single ova were of the female, while those in the double ovum were of the male sex.

The average weight of the individual children in multiple pregnancies is less than that of children born single. This is partly due to the frequency with which the excessive distention of the uterus becomes the exciting cause of premature delivery, and partly to the obvious fact that the maternal organism is rarely capable of furnishing the nutritive material requisite for the complete growth of more than a single child.

Twins often exhibit at birth a remarkable disparity as regards both size and development, a disparity unquestionably due to local conditions. A striking example of this is shown in a case related by Schultze.* One child, at the time of delivery, was nearly if not quite mature, while the other presented the appearances of a six weeks' fœtus. As both ova were enveloped in the same reflexa, their development must have begun at nearly the same time.

Sometimes one fœtus dies, and yields to the more fortunate brother the space and the nutritive material which would otherwise have fallen to his share. In such a case the ovum and the contained fœtus may be compressed by the surviving twin, and be flattened against the uterine wall, giving rise to the so-called "fœtus papyraceus"; or it may degenerate into a mole; or the aborted ovum may be expelled, while the living fœtus advances to the full term of gestation.

Very rarely, where the twins are both living, but have undergone unequal development, the stronger child may be delivered first, while the other remains in the uterus, and is born after weeks of delay, during which, under more favorable conditions, it makes good the deficiencies due to its retarded evolution. The most remarkable cases of this kind occur in the uterus duplex. Professor Fordyce Barker relates an instance in his practice where, in a double uterus, a mature living male child was born on the 10th of July, 1855, and on the 22d of September following the mother gave birth to a full-term living girl.

Histories like the foregoing are often adduced in support of the theory of what is known as superfetation, a theory which supposes that, after conception has once occurred, a second gestation may result from a subsequent coitus. That this is possible, if two ova are detached during the same menstrual period, seems to be established by authentic accounts of negro women giving birth to twins, showing the evidences of a paternity derived in one from the black and in the other from the white race. That impregnation can take place at two periods distant from one another must be regarded as an inadmissible hypothesis, until physiologists shall succeed in demonstrating in a single instance, by the presence of corpora lutea of different ages, that ovulation ever occurs during pregnancy.

* Schultze, *loc. cit.*, p. 308.

Diagnosis.—The diagnosis of multiple pregnancy is rarely to be made out with absolute certainty. Unusual size of the uterus, with exaggeration of the symptoms which result from pressure, would naturally lead to inquiry on the part of the physician, as it is certain to excite apprehensions in the mind of the pregnant female. Size, however, furnishes but an uncertain criterion, as it may be equally due to the presence of a very large child, or to an excess of amniotic fluid. More trustworthy information is to be obtained from palpation and auscultation. Thus the recognition of a number of distinct fetal parts and the exclusion of hydramnion would render the diagnosis of twin pregnancy probable. The outlining of two fetal heads at a distance from one another would make the diagnosis certain. When the fetal heart is heard at two remote points, and the sound is found to die away in the intervening space, it is justifiable to conclude that the sound at each point has a separate origin. If the two heart-beats are counted at the same time by different observers, and are found not to correspond in frequency, a twin pregnancy is established beyond dispute. After the birth of the first child, the presence of the second is determined by the size and consistence of the uterus, and the perception of fetal parts both through the abdominal walls and the vagina.

The recognition of triplets and quadruplets is, of course, attended with even greater difficulties than that of twins.

Labor in Multiple Pregnancies.—We have already noticed the frequency of premature labor in multiple pregnancies. Of one hundred and ninety-two twin births reported by Reuss* from the Würzburg clinic, fifty-one did not complete the full term of gestation. In one of these abortion resulted from small-pox, in another from syphilis, in two cases premature labor was induced artificially, in the others labor occurred spontaneously—in one instance at the seventh month, in the others in the ninth and tenth months.

Twin labors are usually easy. The first child is delivered as in simple labors, and, except in faulty presentations, is followed shortly by the second. The interval varied, in seventy-four of Reuss's cases which terminated spontaneously, from five minutes to one and a half hour. In seventy-nine per cent. the interval was less than an hour. As the stage of dilatation is completed at the time of the expulsion of the first twin, a protracted interval is occasioned purely by weakness and inefficiency of the pains.

The placentæ are usually expelled after the birth of the second child ; now and then the placenta of the first child precedes the birth of the second ; again, the second child may not be born until after the delivery of its placenta. When the placentæ are united, a portion may be torn off and expelled with the first child, while the remainder is not

* Reuss, "Zur Lehre von den Zwillingen," "Arch. f. Gynaek.," Bd. iv, p. 123.

thrown off until after the birth of the second.* The placental stage is, owing to the relaxed state of the uterine walls, apt to be of longer duration than in simple labors, and calls for the exercise of special care to guard against the occurrence of hæmorrhage.

Presentations in Twin Labors.—Spiegelberg† furnishes the following table, derived from 1,138 deliveries, of which 899 were taken from Kleinwächter and 203 from Reuss :

Both heads presenting	558	or 49 per cent.
Head and breech presenting	361	" 31·7 "
Both pelvic presentations	98	" 8·6 "
Head and transverse presentations	71	" 6·18 "
Breech and transverse	46	" 4·14 "
Both transverse	4	" 0·35 "

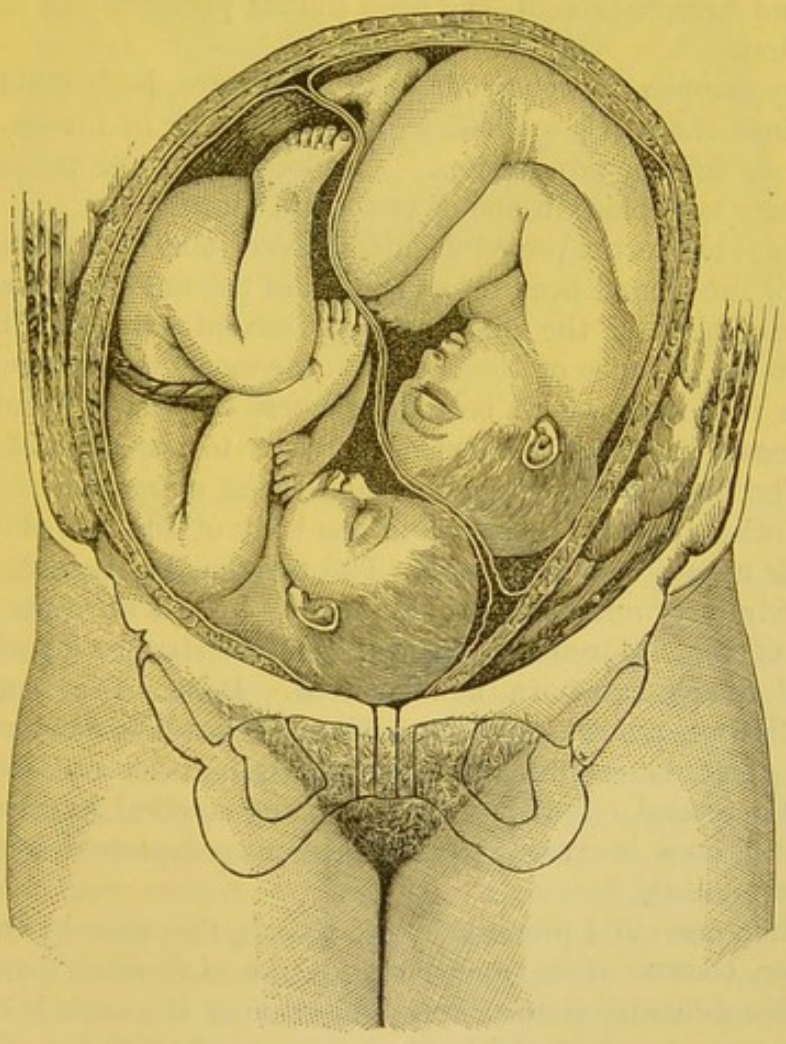


FIG. 140.—Twin pregnancy, both heads presenting. (Tarnier et Chantreuil).

The transverse presentations are mostly secondary, consequent upon the roominess of the uterine cavity and the sudden escape of the amniotic fluid. Version is, of course, in such cases easily performed.

* *Vide* SPIEGELBERG, "Lehrbuch der Geburtshülfe," Bd. i, p. 203. † *Ibid.*

The Simultaneous Entrance of Both Children into the Pelvis.—The consideration of the various complications to which this anomaly gives rise belongs to the domain of pathology. To avoid, however, needless repetitions, they may, for convenience' sake, be properly considered in the present connection.

When both children present at the brim previous to the rupture of the membranes, it usually happens that, with the escape of the amniotic fluid, one of the twins descends into the pelvis, while the second glides to one side. The result is identical, whether the twins are contained in a single or in separate sacs. If interference is called for because of delay, the amnion, or one amnion in case there are two, should be ruptured, and the nearest presenting part brought into the pelvis, while the other is, at the same time, pushed out of the way. If head and breech present, the head should preferably be allowed to descend first.

It may happen, however, that, after rupture, both children may descend into the pelvis so close to one another as to hinder each the other in its further progression. This locking of the twins, as it is termed, may take place in one of two ways, viz.:

1. In double vertex presentations, delivery may be impeded by the pressing of the second head into the neck of the more advanced fœtus, or, after the birth of the first head, the second may enter the pelvis and arrest the advance of the thorax. Obviously this difficulty could only arise in a case where both heads were of unusually small size. The diagnosis has rarely been made previous to the birth of the first head. The treatment consists in the artificial extraction of one head after the other, and then delivering the body of the first child. Craniotomy is usually not necessary. The prognosis as regards the children is extremely unfavorable. Reimann * reports six cases in which the fate of the children was known. Of the six first-born, one survived; of the six last-born, two survived. Reimann, in commenting on these figures, remarks, "The child whose head first enters the pelvis is in great danger, because, not only is its neck squeezed by the head of the second child, thereby producing cerebral hyperæmia, but its umbilical cord is exceedingly liable to be compressed by the body of the second child."

2. When one child presents by the breech, the other by the vertex, the former, because of its smaller size, is apt to descend first into the pelvis. No difficulty is then experienced until the neck is born. In case, however, meantime the head of the second child has entered the pelvis, further progress may be rendered impossible, a lock resulting either from the overlapping of the chins, or of the occipital portions of the two heads, or from the pressure of the face of one child into the neck beneath the occiput of the other. By lifting the body of the

* Reimann, "Am. Jour. of Obstet.," 1877, vol. i, p. 58.

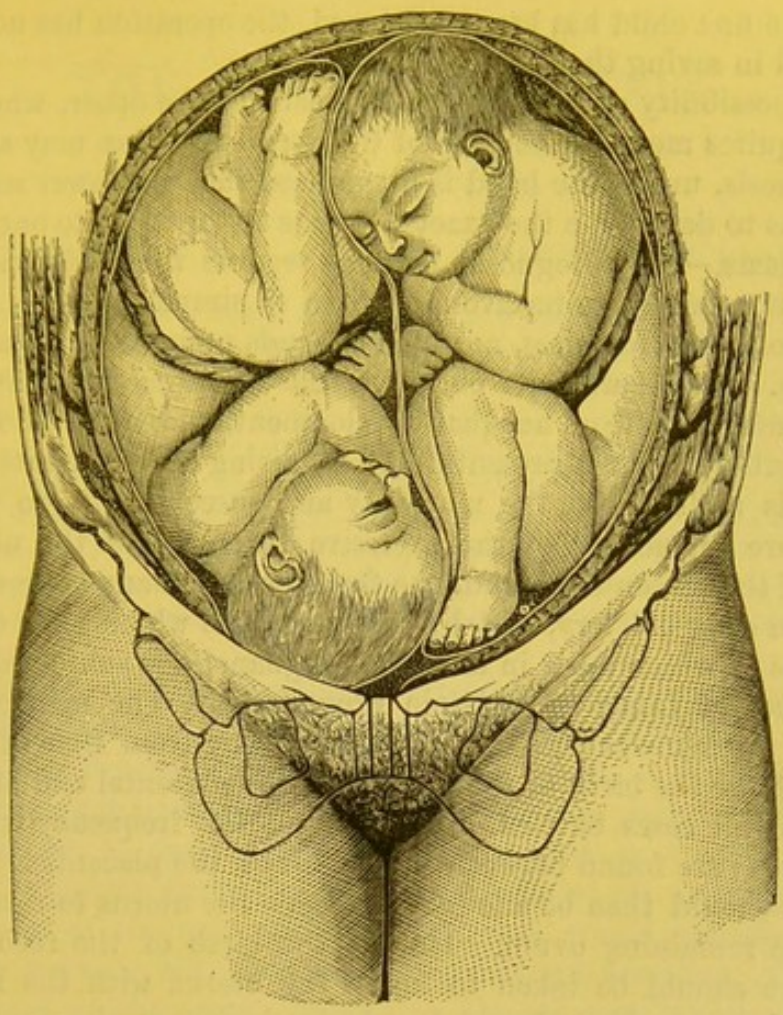


FIG. 141.—Twin pregnancy, head and breech presenting. (Tarnier et Chantreuil.)

child, and introducing the half-hand into the vagina, the diagnosis is rendered easy.

In a large, roomy pelvis, if the pains are good and the children small, spontaneous delivery may take place. In a number of cases of this kind which have been reported, the head of the second child was born first. In a few instances, it has been found possible to push up the second head. Operative measures consist in applying the forceps and extracting the second head, and afterward, if necessary, the first. In case of failure, craniotomy remains as an ultimate resort. The first child is rarely born living. Of twenty-six children, the fate of which was ascertained by Reimann, only three survived. The prognosis of the second child is more favorable. Of twenty-nine cases, Reimann reports nineteen survivals. Naturally, therefore, the perforation of the first head would be preferred, were the matter one purely of election, but the operation is very difficult, and does not remove the obstacle, for even the diminished head can not pass the one already occupying the pelvis.* In the cases so far reported, where decapita-

* REIMANN, *loc. cit.*, p. 61.

tion of the first child has been performed, the operation has not proved successful in saving the life of the second.

The possibility of one twin sitting astride the other, when transverse, requires mention, because of the perplexity that may arise as to the diagnosis, unless the hand is introduced into the lower segment of the uterus to determine the exact relations of the twins to one another.

Prognosis.—The prognosis, both as regards the children and the mother, is much more unfavorable than in simple labors. Statistics on this point are valueless, as much depends upon the conduct of the physician. As regards the children, the increased mortality results from prematurity, from unequal development, and from the frequency of malpositions and malpresentations, requiring operative interference; as regards the mother, the mortality and susceptibility to puerperal diseases are augmented by the excessive distention of the uterus, the extent of the placental wound, the feebleness in many cases of uterine retraction after delivery, and by the operations which grow out of the anomalies to which labor in multiple pregnancies is subjected.

Conduct of Labor in Multiple Pregnancies.—The management of multiple pregnancies does not differ essentially from that of ordinary labor. After the birth of the first child, the placental end of the cord should in all cases be tied, on account of the frequency with which anastomoses are found between the vessels of the placentæ. A period of repose should then be allowed, to enable the uterus to retract down upon the remaining ovum. During the birth of the second child, every care should be taken to follow the uterus with the hand, and redoubled precautions should be observed against the occurrence of hæmorrhage, to which the woman is exposed both on account of the large size of the placental wound and the disposition to relaxation. Expression should be employed to force the placentæ into the vagina. When both descend at once, if it is necessary to make tractions, both cords should be drawn upon, simultaneously or in alternation, to find which placenta is most easily removed. When the placenta follows the birth of the first child, it should be left untouched until the advent of the second. Vigilance after delivery should be long observed.

We have already noticed that the length of time between the expulsion of twins situated in separate membranes rarely exceeds an hour. When, therefore, there is a longer delay in the delivery of the second child, measures should be employed to excite pains, and the membranes should be ruptured. In case of a premature child delivered with its own placenta, cases of continued development, *in utero*, of the remaining child, would point to the policy of abstention. In instances where more than two children are contained in the uterus, the anomalies of position are more frequent, and the danger of hæmorrhage is still further enhanced.*

* Spiegelberg, "Lehrbuch," pp. 206, 207.

THE PUERPERAL STATE.

CHAPTER XIII.

THE PHYSIOLOGY AND MANAGEMENT OF CHILDBED.

The puerperal state borders closely upon pathological conditions.—Post-partum chill.—Temperature.—The pulse.—General functions.—Retention of urine.—Loss of weight.—Involution.—Separation of the decidua.—Closure of the sinuses.—The cervix.—The vagina.—Position of uterus.—After-pains.—The lochia.—The secretion of milk.—Anatomical considerations.—Milk-fever.—Composition of milk.—Diagnosis of the puerperal state.—The new-born infant.—Changes in circulation.—The navel.—Tumor upon the presenting part.—Digestion.—Skin.—Icterus.—Loss of weight.—Management of puerperal state.—Sleep.—Passing urine.—Visits of physician.—Washing the vagina.—Diet.—Laxatives.—Nursing.—Duration of lying-in period.—Care of new-born infant.—Bath.—Cord.—Nursing.—Wet-nurses.—Artificial feeding.

THE puerperal state occupies the border-land between health and disease. Though in a strict sense physiological, it offers a variety of conditions, as Schroeder* has pointed out, which, at other times, and under other circumstances, would be regarded as pathological. Thus, the exfoliation of the decidua, and the copious serous transudation, with the abundant formation of young cells which accompanies the development of the new mucous membrane, would elsewhere be regarded as characteristic features of catarrhal inflammation. The acute degeneration of the uterus presents a phenomenon which, when repeated in any other organ of the body, would prove speedily fatal. The thrombus formation in the open placental vessels possesses no corresponding physiological analogue. Again, the torn vessels may lead to hæmorrhage, while the traumata which even in normal labor result from parturition, the ease with which deleterious materials are absorbed by the wide lymphatic interspaces, the serous infiltration of the pelvic tissues, the exaggerated size of the lymphatics and veins, create a predisposition to innumerable forms of disease. The nicety of the balance between normal and morbid conditions renders it peculiarly necessary for the practitioner to make himself familiar with the physiological limits of the phenomena of childbed.

Post-partum Chill.—The exertion of labor is followed by a sense of comfort and repose. Often after the birth of the child, a chill sets in of greater or less intensity, but of short duration, and of no prognostic importance. It is to be accounted for by the disturbance of the equilibrium between the internal temperature and that of the external surface. Thus, toward the end of labor, and for a short period subsequent to delivery, the loss of heat is increased by the evaporation

* SCHROEDER, "Handbuch der Geburtshülfe," 6te Aufl., p. 216.

from the lungs and skin, and the cessation of muscular effort. This cooling process is, however, speedily arrested by the contraction of the cutaneous arterioles. During the period which intervenes until the external and internal temperatures rise to relatively equal levels, the patient experiences chilly sensations, or a distinct, well-defined chill.* This phenomenon is more frequent in hyperæsthetic women and in those whose skins are bathed in profuse perspiration, especially where there has been some necessary exposure of the person during the expulsion of the head or of the placenta. Under the influence of a warm, dry bed, the chill at once subsides.

Temperature.—A rise of temperature follows the parturient act, averaging one and a half degree in primiparæ, and one degree in multiparæ. This elevation continues during the first six days, with, however, morning remissions and slight evening exacerbations. It is most pronounced in the first twelve hours, especially when they coincide with the normal evening increment. In the following days the highest point is usually reached at five in the afternoon, while the lowest temperature is found between eleven and one in the early morning. A temperature of 100½° belongs within physiological limits. My own temperature-tables confirm amply the opinion of Schroeder, that a rise above 100½° is by no means incompatible with a generally satisfactory condition of the patient. Schroeder attributes the increased heat production to the combustion of organic substances which attends the involution of the uterus. To this are to be added, as provoking causes, the reaction of small wounds in the course of the genital canal, and the disturbances attendant upon the establishment of lactation.†

The Pulse.—In contrast to the increase in the temperature, the pulse often exhibits a remarkable diminution in frequency, in perfectly normal cases ranging between sixty and seventy beats, but not unfrequently dropping to a still lower level, and may even sink to less than forty pulsations in the minute. This slowing of the pulse is of favorable prognostic import. It is known to be associated with diminished arterial tension,‡ and has been attributed to a variety of not very satisfactory reasons, such as the sudden removal of the utero-placental vessels from the circulation, entailing a less degree of labor upon the heart, repose in bed, and disturbed action of the pneumogastric nerves. It is usually most marked on the second or third day, and does not appear to be specially influenced by the establishment of lactation.

General Functions.—During the first week the skin is active and moist; the patient is, therefore, sensitive to temperature changes, and

* Fehling, "Klin. Beobachtungen über den Einfluss der todten Früchte auf die Mütter," "Arch. f. Gynaek.," Bd. vii, p. 151.

† *Vide* Schroeder, "Schwangerschaft, Geburt und Wochenbett," pp. 168–177; Spiegelberg, "Lehrbuch," p. 210.

‡ Meyberg, "Ueber die Pulse der Wöchnerinnen," "Arch. f. Gynaek.," Bd. xii, p. 114.

is subject to profuse perspiration when warmly covered or during sleep. The appetite is lessened, the thirst is increased, the bowels are sluggish, and the urine abundant. In spite of the light diet and repose in bed, the amount of urea eliminated is but slightly diminished. Sugar in the urine is observed at the time of the establishment of lactation. It disappears soon afterward, to reappear, however, whenever the milk production is in excess of its consumption.* The diabetes is, therefore, due to absorption.†

Retention of Urine.—In the first day or two following confinement, retention of urine is a common occurrence. It results, according to Schroeder, from the increased capacity of the bladder following the removal of pressure from the gravid uterus. Many women, who suffer from retention when reclining, are able to voluntarily urinate when raised to a sitting posture, probably because of the greater facility with which, in the latter case, the pressure of the lax abdominal parietes can be exerted upon the bladder.

Loss of Weight.—Owing to the rapid retrograde changes in the pelvic organs, the discharges from the genital passage, the increased secretions of the skin and kidneys, combined with limited ingestion of food, the loss of weight in the first week amounts to from nine to ten pounds, or, roughly speaking, to about one twelfth the weight of the body.‡

Involution.—The processes by means of which the uterus returns to its non-puerperal condition are inaugurated at the commencement of labor. During the rapidly following contractions of the uterus the cell-elements are consumed, while, at the same time, the compression of the nutrient vessels cuts off fresh supplies from the oxidized protoplasm. The fatty degeneration of the muscular fibers continues after the expulsion of the ovum. The contractions which bear the name of after-pains point to the continuance of muscular cells capable for a time of functional performance. Gradually, however, the proteine substances are converted into fats, which undergo absorption. Whether the enormously enlarged cells of pregnancy ever entirely disappear is still an open question. In the fourth week young cells of new formation make their appearance upon the external layer of the uterus, from which eventually a new uterus is developed. Thus destruction and reparation go hand in hand. In from six to eight weeks, the process described reaches its completion. The lochia then cease, and, in women who do not nurse, menstruation returns (Schroeder).

Immediately after birth the uterus weighs upward of two pounds; in two days the weight falls to a pound and a half; the uterus is seven

* Johannovsky, "Ueber den Zuckergehalt im Harne der Wöchnerinnen," "Arch. f. Gynaek.," Bd. vii, p. 448.

† Spiegelberg, *loc. cit.*, p. 212.

‡ Gassner, "Monatsschr. f. Geburtsk.," Bd. xix, p. 47.

to eight inches in length and about four and a half inches broad; the walls are from an inch to an inch and a half in thickness; at the end of a week the uterus weighs a pound, and is five to six and a half inches long; at the end of two weeks the weight is three fourths of a pound, the length five inches, and the walls hardly a half-inch in thickness. Of course the individual variations from these averages are very great.* In six weeks the process usually reaches the end, though the uterus remains ever after somewhat larger and more rounded than in nulliparæ (Spiegelberg).

Reparation of the Decidua.—With the expulsion of the ovum the outer portion of the decidua vera for the most part adheres closely to the reflexa, while the meshy portion, with the fundi of the glands, remains attached to the uterus. The adherent portion consists of empty areolar spaces, of gland septa, of lymphatic spaces and blood-vessels, while only the fundal extremities are lined with glandular epithelium.† As, however, the line of demarkation rarely takes place throughout the entire decidua at any fixed level, fragments of the outer, more compact layer may frequently be found here and there clinging to the inner surface of the residual membrane.‡

The uterine cavity is covered and in part filled with at first a bloody and subsequently a muco-sanguinolent fluid containing blood and mucus corpuscles, and decidua-cells in various stages of degeneration.

At the end of a week the mucous membrane measures at most from a half to three quarters of a line in thickness; the inner surface has become smoother from the disintegration and exfoliation of adherent shreds; the glands, owing to diminished size of the uterus, are pressed closer together, and assume a more nearly perpendicular direction; the gland-epithelium extends upward along the gland-walls to the surface of the membrane; the interglandular spaces are filled with lymphoid cells, with blood-corpuscles, fat-granules, and epithelial cells, in a state of fatty degeneration. As the regenerative process goes on, fine capillaries without walls form in the interglandular substance, so that the latter presents the appearance of granulation-tissue. By the third week these vessels of new formation stretch upward to the surface of the mucous membrane, and by the sixth week the development of the vascular network is complete. In the second week the lymphoid cells begin to dissolve, and thus the glands are brought into near contact with one another. Spindle-shaped cells of young connective tissue are found between the glands in the second week, and with continued connec-

* Börner, "Ueber den puerperalen Uterus"; Sinclair, "Measurements of the Uterine Cavity," "Trans. of the Am. Gynaec. Soc.," vol. iv, p. 231.

† Leopold, "Studien über die Uterusschleimhaut," etc., "Arch. f. Gynaek.," Bd. xii, p. 180.

‡ Küstner, "Die Lösung der mütterlichen Eihäute," "Arch. f. Gynaek.," Bd. xiii, p. 422.

tive-tissue proliferation the flattened tubules are drawn upward, and assume a perpendicular direction. The epithelial cells at the mouths of the glands, which at first formed separate islets, approach one another as the glands assume their normal positions, and by actively multiplying spread from the circumference until they form a continuous lining to the wounded surface.

As regards the principal features, the changes which take place at the placental site are the same as those described elsewhere within the uterine cavity. Immediately after delivery, however, the surface possesses an uneven aspect, with elevations where the septa of the serotina had penetrated between the placental cotyledons, and with intervening depressions. The mouths of the torn vessels are closed by thrombi, and large vessels are irregularly distributed beneath the attached residue of the mucous membrane. The process of regeneration at the placental site takes place somewhat more slowly than elsewhere within the uterus.

Closure of the Sinuses.—By the eighth month of pregnancy, as has been mentioned, a portion of the sinuses beneath the placenta are obliterated by the emigration of giant-cells which cause coagulation of the blood circulating through them. After delivery, the blood stagnates in the intact vessels in such a way that at first the inner walls are covered with fibrine, while the center contains fresh red blood. The walls then thicken by proliferation of the endothelium, and lymph- and blood-corpuscles penetrate into the coagulated layer. Finally, the thrombus fills the entire vessel, spindle-shaped cells radiate from the endothelium, and with the development of young connective tissue a gradual shrinkage takes place, which, however, proceeds slowly, so that four to five months after birth the placental site is still distinguishable.* According to Engelmann, pigmentary deposits in the tissue of the mucous membrane are almost conclusive evidence of recent delivery, as after menstruation they are not found, probably on account of the superficial character of the hæmorrhage.

The Cervix.—The cervix speedily resumes after delivery its normal size. At first it has a soft and pulpy feel. The os internum forms a resistant ring, which constitutes a well-defined boundary between the corpus and cervix uteri. This ring varies in size in different subjects, but is always sufficiently open to permit the introduction of two fingers. Beneath, the walls are thrown into transverse and longitudinal folds. The os externum is usually torn, especially upon the sides, and the thickened labia roll outward. The length of

* Leopold, "Studien über die Uterusschleimhaut," etc., "Arch. f. Gynaek.," Bd. xii, p. 169; Engelmann, "The Mucous Membrane of the Uterus," "Am. Jour. of Obstet.," May, 1875; Spiegelberg, "Lehrbuch," p. 214; Schroeder, "Lehrbuch," p. 222; Küstner, "Die Lösung der mütterlichen Eihäute," etc., "Arch. f. Gynaek.," Bd. xiii, p. 422; Friedländer, "Arch. f. Gynaek.," Bd. ix, p. 22.

the canal measures two and three quarters inches, and upward. At the end of twelve hours the distinction between the cervix and vagina is clearly marked, and the os internum is so far closed that a certain amount of force is requisite to pass two fingers into the uterine cavity. The contraction of the os internum renders the longitudinal folds more pronounced in the upper portion of the canal. From this time on, the involution of the cervix advances rapidly. At the end of twelve days the canal is shortened to an inch in length. As the longitudinal muscles contract, the plicæ palmatæ become distinct as transverse ridges. The longitudinal folds, with the exception of the anterior and posterior ridge which belong to the plicæ palmatæ, disappear with the retrograde changes which take place in the mucous membrane. The os externum long remains patulous, and permits the finger to pass to the os internum for a period varying between the seventh and fourteenth days. The anterior lip is thicker than the posterior, and is frequently the seat of erosions and granulations. The involution of the vaginal portion is not completed until after the expiration of five to six weeks.*

The Vagina.—The vagina during the first few days is soft, smooth, and relaxed, and requires from three to four weeks to regain its normal dimensions. The contraction and involution proceed more rapidly at the introitus than above in the neighborhood of the fornix, though, owing to the presence of lacerations, it remains, with few exceptions, permanently wider than in women who have never borne children.

Position of the Uterus.—Immediately after the expulsion of the placenta the contracted uterus is felt through the abdominal walls as a firm, solid body, of a flattened, pyriform shape. When both hips are on the same level, and both bladder and rectum are empty, the uterus is found in the median line with the fundus between the symphysis and the navel. At the same time the weight of the body and the laxity of the abdominal walls lead to a moderate degree of anteflexion. Urine in the bladder and fæces in the rectum give rise to a certain amount of lateral displacement, and now and then to a torsion of the uterus upon its long axis. As in pregnancy, the fundus of the uterus is thus generally, though not always, directed to the right, and the left border looks to the front. The mean elevation of the fundus above the symphysis is about four and one third inches, the width of the fundus is upward of four and a half inches, and the length of the entire uterine cavity, as measured by the sound, is in the neighborhood of six inches. The dimensions of the uterus are somewhat less in primiparæ

* Lott, "Zur Anatomie und Physiologie der Cervix Uteri," pp. 87 *et seq.*; Börner, "Ueber den puerperalen Uterus," p. 47, states that at the end of the second week the os internum permits the passage of the finger in about half the cases, but is closed in all by the end of the third week.

than in multiparæ. A full bladder pushes the fundus upward, and increases the longitudinal diameter of the organ. Börner has observed an increase from this cause amounting to three and a half inches.

A diminution in the size of the uterus is apparent in most cases in the course of the first twenty-four hours. An actual increase is either pathological or due to the above-mentioned influence of the bladder. The diminution is most marked in the first twenty days, but afterward progresses at a slow rate. About the tenth day the fundus sinks below the level of the symphysis pubis, and the posterior surface of the anteflected uterus occupies the plane of the brim.*

After-Pains.—The reduction of the uterus in the first few days of the childbed period is in the main the result of contractions, termed after-pains, resembling those of labor both as regards the hardening of the uterine walls perceptible through the abdominal coverings, and the nature of the dolorous sensations which they evoke. The after-pains stretch over a period varying from one to four days. Their duration and intensity are in inverse proportion to the duration and activity of the preceding labor. On this account they are more pronounced in multiparæ, while they are often absent subsequent to a first delivery. They are intimately associated with the permanent retraction of the uterus, and are therefore to be regarded as a normal and favorable phenomenon. They are especially prominent in cases of over-distention of the uterus, as, for instance, in cases of twin pregnancies and hydramnios. Suckling the infant produces reflex contractions of a somewhat intense character.

The Lochia.—The discharges from the genital passage consequent upon delivery are termed the lochia. At first the latter are composed of pure blood with coagula of fibrine, but after a few hours the wounded surface of the uterus furnishes an abundant exudation of a serous, alkaline fluid, which washes away in its descent the secretion from the cervix and the vaginal mucus. For the first two or three days the lochia are of a red color (*lochia rubra*) from the commingling of blood, while upon the third, fourth, and sometimes upon the fifth day, as the sanguineous elements diminish, they present a pale-red color (*lochia serosa*). As constituents we find under the microscope cervical and vaginal epithelium, blood and mucus corpuscles, bits of decidua, and sometimes shreds of membranes and of the placenta. The organic constituents consist of albumen, mucine, the saponified fats, and a variety of saline matters. From the fifth to the seventh or eighth day the discharge continues thin, but the blood-corpuscles become less abundant, while there is an increase in the pus-cells and fatty globules. In the

* Börner, *loc. cit.*; Credé, "Beiträge zur Bestimmung der normalen Lage der gesunden Gebärmutter," "Arch. f. Gynaek.," Bd. i, 1870, p. 84; Pfannkuch, "Ueber die Einfluss der Nachbar-Organe auf die Lage und Involution der puerperalen Uterus," "Arch. f. Gynaek.," Bd. iii, 1872, p. 327.

second week the discharge becomes of a grayish-white or greenish-yellow color (*lochia alba seu lactea*), and of a creamy consistence. It contains chiefly pus-corpuscles, young epithelial cells, spindle-shaped connective-tissue cells, fat-granules, free fat, and crystals of cholesterine. The reaction is neutral or acid. Gradually the discharge diminishes, becomes transparent, and finally assumes a normal appearance. After the fourth day the odor is recognizable, and the lochia are found to contain bacteria, indicative of decomposition. In the vaginal secretion the trichomonas vaginalis is likewise present. Toward the end of the first week, and especially after leaving the bed, fresh blood often makes its appearance.*

The quantity of the lochia varies with the peculiarities of the individual. It is, as a rule, greater in multiparæ, in women who do not nurse their children, and in those of flabby fiber, who habitually menstruate abundantly. The mean quantity, according to Gassner, of the lochia cruenta or rubra (to fourth day) amounts to nearly two and a fourth pounds; of the lochia serosa (to sixth day) to rather more than nine ounces; and of the lochia alba (to ninth day) to six and two thirds ounces: so that the entire amount lost during the first eight days reached the total amount of nearly three and a quarter pounds.

The Secretion of Milk.

Anatomical Considerations.—The breasts, which furnish the secretion of the milk, are two large glands of the compound racemose variety. They are covered by a fine, supple skin and a layer of adipose tissue, which increases in thickness toward the periphery of the organ. The mass of the glandular substance is composed of from fifteen to twenty-four lobes, which in turn are subdivided into lobules made up of a greater or less number of acini, or *culs-de-sac*. Fine canaliculi start from the latter, and unite together to form the canals of the lobules. These again anastomose, to form a principal canal for each lobe, termed the lactiferous duct. The lactiferous ducts terminate at the nipple by small openings measuring only from one sixtieth to one fortieth of an inch. Each duct, as it passes downward, enlarges in the nipple to one twenty-fifth or one twelfth of an inch in diameter, and beneath the areola it presents an elongated dilatation, from one sixth to one third of an inch in diameter, called the sinus of the duct (Flint). The spaces between the lobes are filled with adipose tissue, and the various elements which constitute the mammary glands are united into a single mass by a dense connective tissue continuous with that of the subcutaneous layer. The acini, which are merely rudimentary in the non-pregnant state, are lined with a single layer of small polyhedral cells, assuming a more cylindrical character in the neighbor-

* *Vide* Schroeder, "Lehrbuch," etc., 6te Aufl., p. 226; Spiegelberg, "Lehrbuch," p 218.

hood of the canalicular ducts. The main ducts are lined with low cylindrical cells, and contain in their walls non-striated muscular fibers, the contractions of which are the cause of the spurting of the milk in lactation.

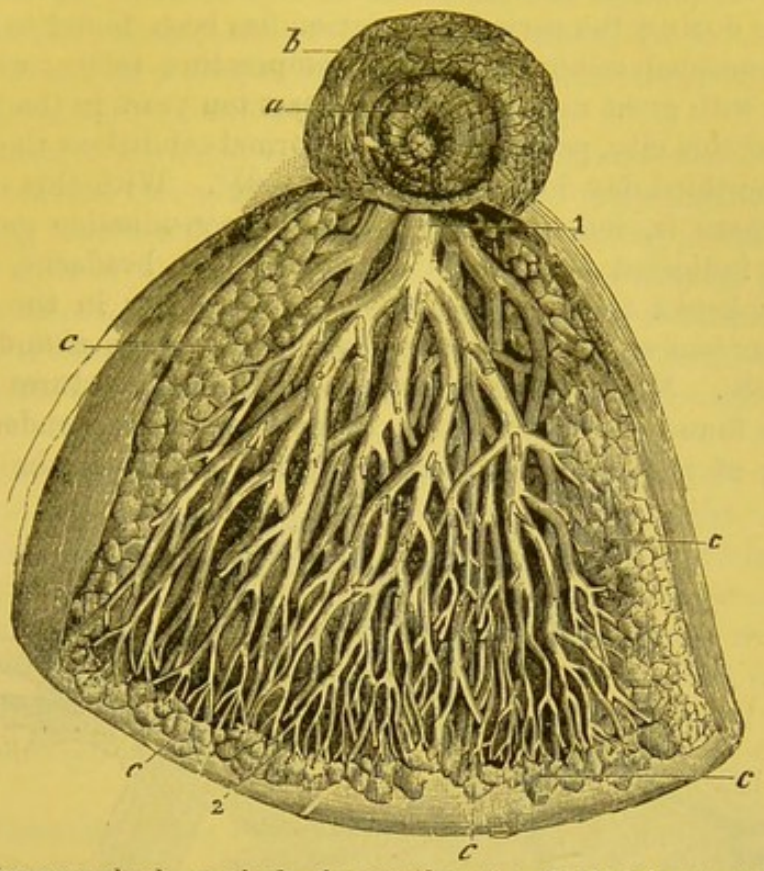


FIG. 142.—Mammary gland. *a*, nipple, the central portion of which is retracted; *b*, areola; *c*, *c*, *c*, *c*, *c*, lobules of the gland: 1, sinus, or dilated portion of one of the lactiferous ducts; 2, extremities of the lactiferous ducts. (Liegeois.)

During pregnancy the breasts enlarge in consequence of the swelling and increase of the connective tissue, the accumulation of fat between the lobes, and the multiplication of the acini, which fill with fatty globules resulting from the disintegration of the lining epithelial cells. The changes in the secretory apparatus give rise to irregularly distributed nodular cords, which, however, at first are most distinct at the periphery, and thence advance toward the center of the organ. With continued development a lactescent fluid is produced, which either exudes spontaneously from the nipple or is discharged by pressure.

Milk-Fever.—About the third or fourth day of the childbed period, the turgescence of the breasts is suddenly increased, and they become full, tense, nodular, and sensitive to the touch. The axillary glands enlarge, and radiating pains are experienced in the arm and shoulder. The intensity of the mammary congestion varies in different individuals. It is more pronounced in women who postpone nursing their children until after the secretion of milk is fully established. In ex-

ceptional cases it may be absent altogether. Since the general introduction of the thermometer into practice, and the better understanding of the causes of febrile temperatures in the puerperal state, the existence of a distinct milk-fever referable to functional disturbances in the breasts during the period in question has been found to be an entirely exceptional occurrence. The temperature tables, which have been kept with great regularity for the past ten years in the Maternity Hospital of this city, prove that under normal conditions the temperatures of the third day do not rise above 100½°. With this sub-febrile increase there is, indeed, often conjoined considerable general disturbance, indicated by slight chilly sensations, headache, anorexia, and a quickened pulse, which, however, disappear in the course of twenty-four hours, with profuse perspiration, and an abundant secretion of milk. Most writers regard the higher temperatures which are sometimes found associated with extreme turgescence, tenderness, and reddening of the mammæ, and which subside when the latter are

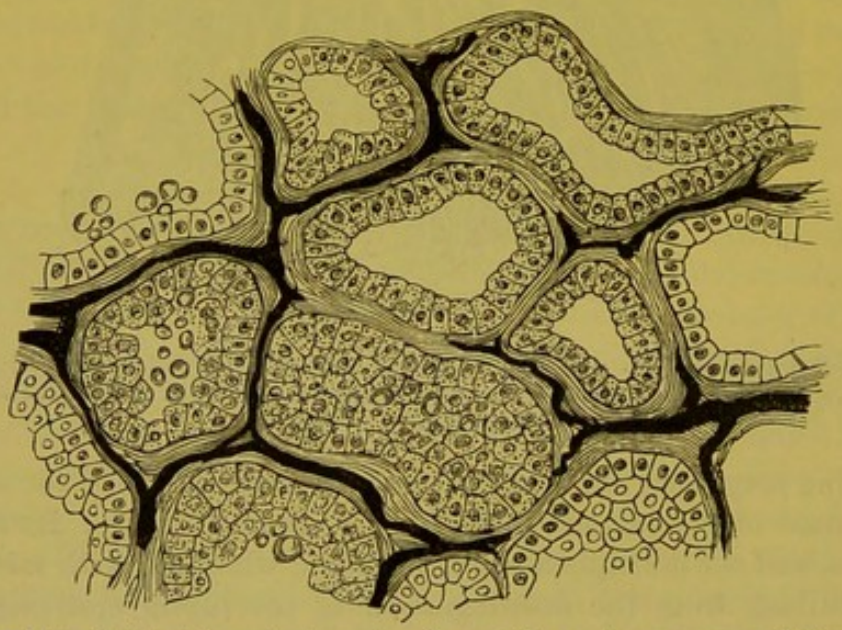


Fig. 143.—Section through acinus from breast of a nursing woman. (Billroth.)

partially unloaded, as dependent upon a non-suppurative form of parenchymatous inflammation.

Composition of Milk.—Milk is composed of a fluid portion, and of formed constituents, the first derived from the blood, and the second, termed the milk-globules, from the epithelial contents of the acini. In the production of the milk-globules, the gland-cells actively multiply, and become filled with granular particles, which gradually coalesce to form drops of fat. Subsequently the nuclei and the contours of the cells disappear, so that the latter consist of mulberry-shaped aggregations of fat-drops held together by the remains of the cell-protoplasm. The epithelial elements thus metamorphosed are termed

colostrum-corpuscles. They are found sparingly distributed in the crude, imperfectly formed secretion known as colostrum, which is furnished by the breasts of women who have been but recently confined. Finally, the fat-globules of large and small size separate from one another, and form an emulsion with the fluid transuded from the blood, a process aided, according to Kehrer, by the diffusion through the fluid of the residual protoplasm of the cells.*

Colostrum is a watery, semi-opaque, mucilaginous fluid, containing yellowish streaks composed of fat-globules and fatty-degenerated cells which hang together in stringy masses. It is distinguished from true milk not only in the physical characteristics mentioned, but in the greater proportion of sugar and inorganic salts it contains, and in the fact that it coagulates upon boiling. It possesses laxative qualities, which render it of use to the infant in aiding the removal of the meconium.

Perfectly formed milk contains from 2·5 per cent. to 7·6 per cent. butter in emulsion, and from 3·2 per cent. to six per cent. milk-sugar in solution. Both of these substances are directly manufactured by the gland-structures. It possesses likewise a proteine substance termed caseine, which fluctuates in quantity between one, three, and four per cent. Kehrer maintains that it is not held in the milk in solution, but is composed of particles derived from cell-protoplasm which are diffused through the fluid. The salts in the milk amount to 0·14 per cent.†

The Diagnosis of the Puerperal State.—The diagnosis of recent delivery is based upon the physiological conditions which, we have seen, characterize the puerperal state. Thus, the abdomen is flabby and wrinkled, with pigmented linea alba, and is traversed by white and red lines; the breasts are full, tense, and nodular, and secrete milk or colostrum; the areola about the nipple is discolored; the uterus is enlarged, anteflexed, palpable through the abdominal wall, and is excited to contract by pressure; the vulva is swollen, the labia gape apart, the hymen is ragged, the perinæum is distensible, and in recent cases lacerations, in older ones ulcers or granulating wounds, are found about the vaginal orifice; in the smooth, lax vagina there is observable the absence of the columnæ rugarum; the cervix is soft, wide below and narrowing above, with the labia often torn and contused; when the finger can be passed into the uterine cavity, thrombi may be felt at the placental site; finally, the lochia are hardly likely to be confounded with hæmorrhages or discharges from non-puerperal causes.

During the first two weeks an approximative estimate may be made as to the date of confinement by bearing in mind that just after delivery colostrum is found in the breasts, the lochia are bloody, and the lacera-

* Kehrer, "Zur Morphologie des Milch-Caseins," "Arch. f. Gynaek.," Bd. ii, p. 1.

† Spiegelberg, *loc. cit.*, p. 221.

tions about the vulva present a fresh appearance ; that during the following days the lochial secretion changes first to a serous and then to a purulent character ; that the uterus gradually diminishes in size, the fundus at the tenth day sinking below the upper border of the symphysis, while the os internum remains patulous to the tenth day, and is usually impassable for the finger after the twelfth day.

The New-born Infant.

With the first inspiration the thorax expands, and air fills the alveoli of the lungs ; at the same time the blood passes from the right side of the heart to the capillaries of the pulmonary organs, and is returned arterialized to the left side of the heart. As a consequence of the establishment of the pulmonary circulation, the ductus arteriosus contracts, the foramen ovale closes, and the left ventricle undergoes eccentric hypertrophy. As a consequence of the diversion of a part of the blood-currents to the lungs, the pressure in the aorta sinks, and the circulation in that portion of the umbilical arteries which lies outside the navel ceases, while thoracic aspiration empties the umbilical vein. The cord dries from the cut surface toward the navel, and drops off on the fourth or fifth day. The line of demarkation forms at the termination of a capillary network which extends upward upon the cord to a distance of from three to four lines from the skin. When the cord drops off, a wounded surface is left, which heals in a few days.

The swelling upon the presenting part subsides mostly in twenty-four to forty-eight hours. The head slowly resumes its normal shape—a process completed, probably, in the course of two to three weeks.

Soon after birth the meconium is discharged from the intestines, and in a few days the evacuations assume a feculent character. The production of pepsin in the stomach, and the secretion by the pancreas of a fluid capable of emulsifying fats and digesting albuminoid substances, render the assimilation of milk practicable. The kidneys excrete an abundance of urine of a low specific gravity.

About the third day an exfoliation of the epithelium begins, which is maintained for a week, or even a longer period. During this time the hyperæmia of the skin is very marked, and imparts to it a red color, which as it fades passes into a yellowish tint. The breasts in both sexes swell very commonly, become red and sensitive, and yield upon pressure a serous, milky fluid.

Icterus of the new-born infant is a pretty common affection. Its occurrence is, however, largely influenced by local conditions. Thus, Porak placed the frequency at eighty per cent. among the children born in the Hôpital Cochin in Paris ; Kehrer, in the vast maternities of Vienna, at sixty-eight per cent. ; Ebstein, in Prague, at forty-

two per cent. ; while West declares it is a rare phenomenon at the Rotunda Hospital in Dublin. It develops usually upon the second or third day, and ends, as a rule, by the sixth to eighth day. Kehrer* has shown statistically that it occurs more frequently in boys, in premature infants, in the children of primiparæ, and as a consequence of malpresentations. It is likewise promoted by atelectasis, by intestinal affections, by depressing the temperature of the child, by insufficient feeding, and, in a word, by all the various pathological conditions and unfavorable hygienic influences intensifying or giving an abnormal direction to the ordinary changes which take place in the blood (Ebstein). Its frequency in lying-in hospitals is probably connected with a septic infection, for which the wounded surface at the navel furnishes the point of entry. It is rarely dependent upon gastro-duodenal catarrh, upon a narrowing of the bile-duct, or upon retention of meconium. The fæces are stained with bile. In all the tissues of the body, and most abundantly in the kidneys, pigment-crystals and yellowish-red amorphous granules are found deposited in greater or less quantities. It is as yet an unsettled question as to whether these pigment-bodies are the products of the liver, or result from the disintegration of the blood-corpuscles. A very considerable destruction of the latter is found in all cases of icterus of the new-born. The tissue waste is likewise marked. Hofmeier† found the average loss of weight in icteric children on the third day after birth was 9·3 per cent. of the original weight, whereas in non-icteric children it was but 5·69 per cent. The urine contained an excess of urea and uric acid, and pigment-bodies proportioned to the intensity of the icterus. The pigment-bodies, he claims, furnished the characteristic color reaction with nitric acid of the acids of the bile. An expectant treatment is the only rational one. Laxatives are unnecessary, and perhaps harmful.‡

Owing to the discharge of meconium and urine, and the limited amount of sustenance at its disposal, the new-born infant experiences a loss of weight in the first two to three days, estimated at from seven to eight ounces. After the second or third day the loss is gradually recovered, so that between the fifth and eighth day the weight at birth is reached. The loss of weight is greater in the children of primiparæ than in those of multiparæ, in artificially nourished infants, and where the immediate application of the ligature to the cord at birth has been resorted to.

* Kehrer, "Studien über den Icterus Neonatorum," "Jahrbuch f. Paediatrik," Bd. ii, p. 71, 1871.

† Hofmeier, "Die Gelbsucht der neugeborenen," "Ztschr. für Geburtsh. und Gynaek.," vol. vii, p. 287.

‡ Ebstein, "Ueber die Gelbsucht bei neugeborenen Kindern," Volkmann's "Samml. klin. Vortr.," No. 180.

The Management of the Puerperal State.

Sleep.—After every precaution has been taken against hæmorrhage, after the patient has been washed carefully and placed upon clean, dry bedding, and after the baby has been bathed and dressed, it is very desirable that the mother should enjoy a few hours of refreshing sleep. To this end the room should be darkened, and absolute stillness enforced. The crying of the baby, the affectionate salutation of friends, or the tidying of the room by household Marthas, often becomes the starting-point of nervous restlessness, which is with difficulty overcome by the aid of the strongest soporifics. Should the mother feel faint and exhausted, she should be allowed a cup of hot tea or bouillon.

In multiparæ it is well to leave with the nurse some form of anodyne, to be administered in case sleep is interrupted by the frequent recurrence and severity of the after-pains. Opiates, while they lull the pain, do not, after labor, arrest those physiological changes in the uterus with which the after-pains are associated.

Passing Urine.—As the natural impulse to urinate after delivery is very feeble, even when the bladder is full, the nurse should be instructed to solicit the patient to pass water in the course of eight or ten hours. The act of urination should be performed upon the back, which of course necessitates the use of the bed-pan. To be sure, there are a good many women who are able to pass water without difficulty in the sitting posture, who fail in the attempt when recumbent. Still, the risk of exciting hæmorrhage by placing the patient upright, during the first four or five days after delivery, is always sufficient to control the action of the careful physician. The physician should make it a rule to visit his patient within twelve hours from the time of confinement. He should then inquire, not only whether she has passed water, but ascertain the quantity voided. If the quantity has not exceeded three to four ounces, he should introduce the catheter and make sure that the bladder is completely emptied. In cases of retention, the urine should be drawn at least three times in the twenty-four hours. Before using the catheter, the external parts should be carefully washed, to avoid conveying the lochia into the bladder, as the lochial discharge after the first day is liable to excite cystitis. In introducing the catheter beneath the bedclothes, the urethral orifice can readily be detected by first feeling for the tumefied urethra with the index-finger of the right hand through the anterior vaginal wall, and then following it in a forward direction until the meatus is reached.

Visits of the Physician.—The physician should see his patient at least once daily during the first week following confinement. During the first four days it is my custom to make both a morning and evening visit, not only for the purpose of noting carefully the pulse and

temperature, but to be sure that my patient is not made a victim to the traditional prejudices and superstitions of the monthly nurse. If the physician will take the trouble to call occasionally upon his patient subsequent to the first week, to insure the unretarded progress of puerperal convalescence, he will do much to circumscribe the field of gynæcological practice.

General Directions.—Great pains should be taken to keep the air of the lying-in chamber fresh and pure. If the room is warm, the patient should be lightly covered, owing to the tendency during childbed to profuse perspirations. There is no foundation for the prevalent belief that it is dangerous to comb the hair of a puerperal woman. Nothing contributes so much to the removal of soreness, and the healing of wounds in the genital canal, as cleanliness. Every morning the external parts should be washed carefully, and at least twice daily the vagina should be syringed with some warm disinfectant lotion. My own favorites are, for the first three days, an infusion of camomile or a saturated solution of boracic acid. After the third day, when decomposition of the lochia is apparent to the sense of smell, carbolic acid (℥j ad Oj) should receive the preference.

Diet.—The diet should be selected with reference to the physiological requirements of the patient. Thus, during the first three days, when, as a rule, the patient is thirsty, and is indifferent to solid food, the diet should consist of gruel, milk, milk-toast, and tea, to which may be added clear soups and bouillon should more stimulating aliments be called for. It is equally desirable on the one hand to avoid exciting colics and catarrhal affections of the stomach by too early resorting to a substantial regimen, and on the other to remember that the speedy establishment of an abundant milk secretion is apt to be hindered by subjecting women to a process of semi-starvation. After the bowels have moved on the third or fourth day, the normal appetite usually returns. All easily digested articles of food, such as soft-boiled eggs, chicken-broth, small birds, steak, chops, and the like, according to the taste of the patient, should then be allowed. Cooked fruits are of service in overcoming the natural constipation of the puerperal period. The popular prejudice against fish and vegetables containing a large amount of nitrogenized substances seems to me well founded.

Laxatives.—The canonical practice of administering a laxative on the third day is of unquestionable utility. Very few women escape from an accumulation of fecal matter during the last weeks of pregnancy—an accumulation which is often enormous in quantity, and which creates a predisposition to puerperal affections. The remedies selected should, however, be adapted to the peculiarities of the individual. In some women an ordinary injection of soap and olive-oil in water suffices to procure an adequate evacuation ; in others the ob-

ject is fulfilled by the milder laxatives, such as the compound rhubarb pill, a claret-glass of Hunyadi-János water, or the compound licorice powder of the German pharmacopœia; while in obstinate cases a calomel purge, or some such combination as the *post-partum* pill of my friend Professor Barker,* will be found requisite. Castor-oil I give only in cases of severe colic, either alone or combined with fifteen drops of laudanum. In hæmorrhoids complicating puerperal convalescence, I can add my testimony to that already given by Professor Barker as to the specific curative effect of half-grain doses of aloes administered night and morning.

Nursing.—Every healthy woman should nurse her child at least through the puerperal period.† The advisability of continuing lactation subsequent to the resumption of household duties must depend upon the question as to whether the mother is in a position to make the necessary sacrifices to the interests of the child. When the domestic and social demands upon her time and thoughts are numerous and pressing, lactation is apt to be imperfect, and the child will not thrive. Humanity, in such cases, requires that the child be surrendered to a wet-nurse. Nursing may be rendered impossible by a lack of milk, by flattened, misshapen nipples, and by the health of the mother. It should be prohibited in phthisis, in epilepsy, and in cases of syphilis contracted shortly before the birth of the child.

The child should be applied to the breast after the mother has rested, and within the first twelve hours following the end of labor. Soon after birth the child seizes the nipple eagerly, and, though the quantity of nourishment obtained is small, it is infinitely better adapted to the child's needs than the catnip-teas and sweet-oil which monthly nurses employ as substitutes. The early application of the child to the breast benefits the mother by promoting the contractions and the involution of the uterus, and by lessening the painful distention of the breasts which occurs at the time when the function of lactation is fully established.

As the child sleeps for the most part during the first few days of existence, no rule can be laid down with regard to the frequency with which it should be placed to the breast. Afterward it should be accustomed to some regular routine. So long as the stomach is of small capacity and regurgitates a portion of its food, the interval should not exceed a couple of hours. From an early period, however, the child

* Ext. colocynth. comp., ℈j; ext. hyoscyami, gr. xv; pulv. aloes soc., gr. x; ext. nuc. vom., gr. v; podophyllin, ipecacuanha, āā, gr. j. M. Ft. pil. (argent.) No. xii. Of these, two usually act efficiently and without causing pain.

† The quantity of milk daily consumed by the infant during the first nine days increases, according to Deneke, gradually from one ounce and a half on the first day to about fourteen ounces on the ninth day. "Ueber Ernährung des Säuglings," "Arch. f. Gynaek.," vol. xv, p. 340.

should be accustomed to sleep six hours at night, which gives an opportunity for the mother to recuperate her strength. This discipline is of course not practicable where the child sleeps in the same bed with the mother. After six months the child should not nurse oftener than five or six times in the twenty-four hours.

The breasts should be suckled in alternation. The nipples should be carefully washed both before and after nursing. The addition of boracic acid to the water prevents the development of fungi. The extreme sensitiveness of the nipples at the commencement of lactation can be greatly relieved by applying constantly to them a rag wet with the *liquor plumbi subacetat.*, in the proportion of a teaspoonful to a tumbler of water. For a few days a metallic shield over the nipples, to prevent the rubbing of the night-dress or the bedclothes, is a source of comfort.

Duration of Lying-in Period.—Most women expect permission to be given them to sit up upon the tenth day. There should, however, be no fixed rule about leaving the bed which does not take into account the individuality of the specific case. Not to leave the bed before the tenth day is a safe rule in normal puerperal convalescence; but, where there are wounds to heal by granulation, a much longer period of time may be necessary. Garrigues * expressed his conviction that "the upright and sitting postures ought to be carefully avoided until involution has proceeded so far that the uterus has receded from the anterior wall of the abdomen and returned to the pelvic cavity"—a rule which would allow one woman to sit up in a week, while another would be kept in bed two weeks, or even longer. The continuance of the lochia rubra should serve as a warning against a change to the upright position. The first attempt at getting up should be tentative. The resumption of household duties should be postponed until the patient can walk about without fatigue or backache. When the abdominal walls are greatly relaxed, a well-fitted bandage should be worn for weeks subsequent to delivery.

The Care of the New-born Infant.

As the new-born infant possesses feeble powers of resistance to cold, the first bath should be ninety-eight degrees, or nearly that of the body. The vernix caseosa should be softened by oil or fat-inunction, and gentleness employed in its removal. The child should then be gently dried in soft, warm cloths, and carefully examined with reference to any possible defect of formation or development. The cord should be wrapped in absorbent cotton,† and held in place upon

* Garrigues, "Rest after Delivery," "Am. Jour. of Obstet.," October, 1880, p. 861.

† This plan, which I first saw recommended by Dr. W. D. Babcock, of Evansville, Indiana ("Am. Jour. of Obstet.," October, 1883, p. 1055), has since been warmly praised by Credé and Weber, "Arch. f. Gynaek.," vol. xxxiii, p. 73.

the left side by a flannel bandage. After the cord has separated, the wounded surface should be dressed with a carbolic salve until the discharge ceases.* The dressing of the child is the province of the nurse, and varies considerably in the different social ranks. Cleanliness and fresh air are essential to healthy development. To avoid sprue, the mouth of the child should be washed with cool water each time after nursing.

Selecting a Wet-Nurse.—Should the mother be unable to nurse her child, a wet-nurse should be urgently recommended. In selecting the latter, an examination should be made with regard to her constitution and health. The physician should, by inspecting the throat, the legs, the glands of the neck, and, if possible, the genital organs, exclude the existence of a syphilitic or strumous taint. A nurse should be between twenty and thirty-five years of age, and should present all the appearances of good health. The gums should be red and firm; the breasts should preferably possess a pyriform shape, and should be marbled with blue veins; it is not necessary that they should be large, but they should be firm, elastic, and nodular from abundance of glandular structure; the nipples should be well formed, prominent, and free from cracks and erosions; the milk should flow easily, and not be too bluish in color. The age of the milk should bear some correspondence to that of the child to be suckled. Aside from the question of adaptability, it is obvious that, where a great discrepancy exists, the milk of the nurse is liable to fail before the time of weaning is reached. One of the best tests of a nurse's capacity is the appearance of her own child. If the latter is plump, with well-rounded limbs, and with a healthy skin and mucous membranes, the presumptions are in her favor, even if she does not present in her own person, as Jacobi sportively suggests, "a combination of Aphrodite, Athene, and Psyche." When a choice has once been made, a change should not be recommended without a fair trial. It is by no means uncommon for a nurse but recently separated from her child, placed among strangers, and introduced to a foreign mode of life, to temporarily suffer from a diminution of the lacteal secretion, the milk returning in a brief period under the influence of kindness, habit, and a nourishing regimen. Moderate exercise is necessary for the maintenance of health. The nurse should be allowed to drink milk freely, but malt liquors should be prohibited, at least until toward the close of lactation.

* Dr. Goodell seizes the cord, after it has been cut as usual, between the thumb and forefinger of the left hand, near the navel, and then strips off the gelatine of Wharton with the thumb and forefinger of the right hand. The pressure at the navel is next temporarily suspended where the internal portions of the vessels collapse. The cord is thereupon subjected to a second stripping, tied in the usual manner, and left free without any dressing whatever. The result is, that it separates without any bad smell. (*Vide* Parry's note, Leishman's "Midwifery," third American edition, p. 608.)

Artificial Feeding.—If it is impossible to procure the services of a wet-nurse, or if the aversion of the parents to wet-nurses as a class proves unconquerable, artificial alimentation must be tried. It is unquestionable that many babies thrive fairly when brought up on the bottle. For success, scrupulous cleanliness, punctuality, intelligence, and experience are requisite. The beautiful roundness of outline, the *bien aise*, and the easy dentition of infants at the breast are, however, rarely attainable by those who are brought up by hand. Bottle-fed infants are apt to be lean, to be subject to attacks of indigestion, and to suffer from nervous disturbances when teething. If cow's milk is used as a substitute for human milk, the experiment is more likely to prove a success in the country, where the milk can be obtained fresh morning and evening, than in the city, where milk is, of necessity, at least twelve hours old at the time of delivery, and thirty-six hours old before a fresh supply can be obtained. My own experience inclines me to favor employing, where it is practicable, milk from one cow, especially if the cow is selected with reference to the child's individuality, precisely in the same manner as a wet-nurse would be selected. The fitness of the milk to the child is to be determined rather by experiment than by analysis. In a general way, however, it is well to remember that the milk of a very young cow is deficient in fat-globules, while that of an old cow is apt to err on the side of excessive richness, and that either extreme is equally liable to tax the infantile organs of digestion.

The difference in the digestibility of human and cow's milk is dependent upon a difference in the molecular arrangement of the caseine varieties they respectively contain. The acid of the stomach precipitates human caseine in the form of flocculent shreds, while that of the cow's milk is converted into firm, solid masses. Now, of the two forms it has been experimentally proved that the former is much more soluble in the gastric juice than the latter. With many physicians the favorite plan for neutralizing this objection consists in substituting cream for milk (diluted at first with three and afterward with two parts water [Biedert]), and thus to reduce the quantity of caseine to minimum proportions; but this diet, by confining the child almost entirely to the hydrocarbons, to the exclusion of the proteine constituents, has never seemed to me in practice, even when well borne, to meet the full tissue requirements of a growing child. After many trials of this mixture, which found a warm advocate in the late Professor Childs, of this city, I have finally returned to milk of good standard quality, stirring it before using to distribute the fat-globules evenly between the different layers, and adding to it water proportioned to the age of the child, beginning with eight tablespoonfuls of milk to eight of water, increasing the one and diminishing the other a tablespoonful at a time as rapidly as the digestive organs exhibit a

toleration of the change. The water does not, of course, alter the chemical constitution of the caseine, but aids digestion by provoking an increased flow of the gastric juice, and incidentally contributes to alleviate thirst (Jacobi).

City milk should be boiled to prevent fermentation, an unnecessary practice when milk can be obtained fresh night and morning. Instead of plain water, Jacobi has pointed out the utility of using some substance "which by its physical consistence is able to hold the caseine-clots in suspension, thus protecting the stomach from irritation, while they are being prepared for dissolution." I have been in the habit of following out to this end his earlier suggestion to employ an indifferent substance, as gum-arabic or isinglass for very young children, and afterward a thin decoction of oatmeal or barley, according to the tendency of the child to constipation or diarrhœa.

Condensed milk is popular with many physicians, because children with whom it agrees fatten upon it, and suffer but little from indigestion and loose passages. The large amount of sugar it contains unfits it, however, for prolonged use. I have seen a number of children, exclusively fed upon it, after passing through apparently a blooming infancy, develop symptoms of rickets at the end of their first year. I have, however, been in the habit of allowing its habitual use during the first three months of existence, and in the city during the hot months of summer.

Whatever the preparation selected, it should be warmed, before it is given to the child, to blood-heat. A small quantity of salt, and a grain or two of bicarbonate of soda, or a tablespoonful of lime-water, should be added to the infant's food, the former to promote assimilation, and the latter to neutralize any free acid the milk may chance to contain. When artificially reared, many children do not gain flesh, in spite of apparently healthy digestion. I have often derived great benefit after the third month from the addition to each bottle of a tablespoonful of Löfflund's Liebig's food for infants. Presumably the various forms of malt extracts now so popular in this country would serve the same purpose equally well.

The bottle from which the child is fed should be scalded each time that it is used, and should then be filled with cold water to which a little soda has been added. The tube and mouth-piece should both be washed, cleaned with a brush, and allowed to soak in cold water, in the intervals of feeding. Unless every precaution is taken to prevent the development of fungi, a bottle-fed infant will never prosper.

THE PATHOLOGY OF PREGNANCY.

CHAPTER XIV.

ACCIDENTAL COMPLICATIONS.—ABNORMALITIES OF THE UTERUS.

Variola.—Rubeola.—Scarlatina.—Scarlatina puerperalis.—Cholera.—Typhus, typhoid, and relapsing fever.—Malarial fever.—Icterus.—Cardiac diseases.—Pneumonia.—Emphysema, chronic pleurisy, and empyema.—Phthisis.—Syphilis.—Chorea.—Surgical operations during pregnancy.—Double uterus.—Anteversion and anteflexion.—Retroversion.—Retroflexion.—Prolapse of uterus and vagina.—Hernias.

The pathology of pregnancy includes the various morbid conditions which exercise an unfavorable influence upon pregnancy, whether of maternal or fetal origin.

The maternal diseases comprehended under this title may consist of simple exaggerations of normal disturbances, a class which has, however, already received attention in connection with the chapter on the management of pregnancy; accidental complications which materially influence the circulation or the integrity of the pelvic organs; and, finally, diseases of the uterus and the uterine appendages which endanger the health of the ovum, or pave the way to its expulsion.

The pathological processes which affect the ovum may be primary, or may result secondarily from maternal disturbances.

The hæmorrhages of the first half of pregnancy and the premature expulsion of the ovum are ordinarily the result of fetal or maternal disease. Their consideration, therefore, forms a fitting conclusion to the subject-matter in hand.

The management of the hæmorrhages occurring in the second half of pregnancy requires a preliminary knowledge of the operative procedures of midwifery. Its consideration will therefore be postponed until the principles governing the conduct of difficult labor have undergone discussion.

Morbid states which exercise an unfavorable influence less during pregnancy than after the development of labor will, to avoid double mention, be considered in connection with the pathology of the latter process.

Accidental Complications of Pregnancy.

Variola attacks pregnant women more frequently than any other eruptive fever, and, although it manifests a preference for those in whom pregnancy is not far advanced, its type is severer and its prognosis graver when it affects women near their confinement.

Variola is, unless of a mild form, a peculiarly dangerous complica-

tion of pregnancy, greatly imperiling the life of both mother and fœtus,* through its tendency to metrorrhagia and abortion.

When the disease pursues its course without producing abortion, the child may present characteristic variolous cicatrices, or the latter may be absent. Occasionally the child remains unaffected by the disease until after birth, and may, sometimes, escape it altogether. During epidemics of variola, women may, without manifesting other symptoms of infection from the variolous poison, give birth to premature children, who remain unaffected with the disease. Children sometimes suffer from variola either before or soon after birth, while their mothers enjoy complete immunity from the disease.†

The healthy child of a mother affected with variola, or of one vaccinated during pregnancy, may be insusceptible to vaccinia for some time after birth.‡

It is advisable that all women, becoming pregnant during an epidemic of variola, should be immediately vaccinated.

Rubeola is an infrequent complication of pregnancy, but is serious on account of its tendency to become hæmorrhagic and to produce metrorrhagia, fatal alike to mother and child. Pneumonitis is a very frequent and dangerous complication of puerperal rubeola.

Scarlatina is a less frequent complication of pregnancy than variola, attacks primiparæ by preference, although not exclusively, and manifests a decided tendency to develop itself in the puerperal state, even when infection has taken place in the earlier months of pregnancy. Olshausen# was able to collect from all the medical literature at his disposal only seven cases of scarlatina occurring during pregnancy, while the number of cases taking place in the puerperal state amounted to one hundred and thirty-four.

In the majority of recorded cases infection is known to have been only possible at a time more or less remote from the confinement, and the tardy development of the disease is, therefore, most rationally referred to a prolonged period of incubation, extending in some instances over weeks or months.

Assuming the correctness of this theory, we must infer that some unknown condition unfavorable to the development of the scarlatinous poison exists during pregnancy and is removed by parturition.

The mortality of scarlatina, occurring in pregnancy and in the

* Meyer, "Ueber Pocken, beim weiblichen Geschlecht," Berlin. "Beitr. z. Geburtsh.," ii, 1873, p. 197.

† Schroeder, "Lehrbuch d. Geburtsh.," p. 364.

‡ Spiegelberg, "Geburtsh.," p. 259; Max Runge, "Die acute Infectionskrankheiten in ätiologische Beziehung zur Schwangerschaftsunterbrechung," Volkmann's "Samml. klin. Vortr.," No. 174, p. 1376.

Olshausen, "Untersuch. üb. d. Complic. des Puerp. m. Scarlat. u. d. sogenannte S. puerperalis," "Arch. f. Gynaek.," ix, 1876, p. 169; Braxton Hicks, "Trans. of the Obstet. Soc. of London," vol. xvii.

puerperal state, varies notably in different epidemics, although it is usually high.* Attacks occurring immediately after confinement are more fatal than those developed later.

The stage of invasion may be entirely absent or may exist for one or two days before the appearance of the eruption. When present, it is characterized by intense febrile movement, emesis, and notable congestion of the face. Usually, however, the earliest announcement of the attack consists in the sudden development of the eruption on all parts of the body. The eruption soon assumes a characteristic livid color, which is usually retained until the fatal issue, should the latter occur within a week.

The pharyngitis and tonsillitis are either very mild or entirely absent. Diarrhœa is a frequent and dangerous complication. Aside from the above-mentioned peculiarities, puerperal scarlatina presents no important variations from the clinical history of ordinary scarlet fever. The lochial discharge, the lacteal secretion, and the uterine involution are unaffected by the disease.

Antipyretic measures, particularly cool baths, are indicated in proportion to the intensity of the febrile movement. Cathartics are to be avoided, because of the inherent tendency to diarrhœa, alluded to above. Stimulants are to be fearlessly employed when asthenic symptoms are developed.

Scarlatina Puerperalis.—Some authors have applied the designation "scarlatina puerperalis" to an infectious disease which, although resembling scarlatina, is still said to be identical with or closely related to puerperal fever. The theory advocated by them is based upon the fact that, in the cases upon which their deductions are founded, the angina was trivial in character; the attacks occurred, usually, within three days after confinement; infection with scarlatinous poison could not, in the majority of cases, be established; the rate of mortality was very high, and peritonitis and cellulitis were often revealed on autopsy. Olshausen† concludes with apparent justice, after a careful review of the reasons for and against the introduction of this new disease into obstetric nosology, that the grounds for its establishment are insufficient, and that the cases of so-called "scarlatina puerperalis" are nothing more than ordinary cases of scarlet fever, modified by the concomitant puerperal condition, but in no way akin to puerperal pyæmia or septicæmia. It is worthy of note that scarlatina and puerperal fever may, in rare instances, occur in combination without mutually affecting their respective signs and symptoms. Braxton Hicks‡ advocates the extreme theory that a puerperal woman, when infected with

* Denham saw only one recovery in eight and Hicks only four recoveries in eighteen cases, while McClintock had but ten fatal results in thirty-four cases.

† R. Olshausen, *loc. cit.*

‡ Braxton Hicks, "Trans. of the Obstet. Soc. of London," 1871, pp. 44, 75.

scarlatina, develops puerperal fever, and that persons other than lying-in women, contracting the disease through intercourse with the puerperal patients, are attacked by scarlatina of the usual form.

Cholera.—The predisposition, on the part of pregnant and puerperal women, to cholera Asiatica is not usually decided, but varies with different epidemics, and is more marked in cities than in the country. Women are most liable to an attack of cholera in the latter half of pregnancy, particularly in the seventh and eighth months, and the prognosis is gravest for cases occurring at those periods. The prognosis is almost necessarily fatal in the case of children born before the ninth month.* The intensity of the disease is somewhat mitigated by the existence of the puerperal state. Slight attacks of cholera may take their natural course without prejudicial effects upon mother or fœtus, but the disease frequently results in abortion or premature delivery, due, in part, to hæmorrhagic metritis. The pathological uterine conditions observed in the cases recorded by Slavjansky† comprised roughening of the inner surface of the uterus by dark-violet shreds of the decidua vera, numerous extravasations permeating the mucous membrane, which remained intact in some places and was ulcerated at others, besides the presence in the uterine cavity of coagulated blood, pus, and shreds of the uterine mucous membrane.

The placenta fœtalis presented granular degeneration and almost complete disintegration of the epithelium covering the villi. Both pathological processes above described conspire to induce the death of the fœtus, which then, in common with coagula and inflammatory products in the uterine cavity, acts as a foreign body and produces abortion. Schroeder‡ refers the death of the fœtus to asphyxia produced by changes in the maternal blood which interfere with the placental respiratory function. The clinical history of cholera is not materially affected by coexisting pregnancy, except in so far as uterine symptoms are concerned. Eclampsia sometimes occurs, and irregular uterine pains may persist for several days without producing abortion.# Cholera does not specially predispose to puerperal diseases, nor does it afford protection against them. Lactation, whether commencing or already established, is not markedly affected by cholera, although the lochia are often almost suppressed.

The treatment is conducted upon general principles. The artificial induction of premature delivery has had many advocates on account of its supposed tendency to ameliorate the prognosis, but has

* "Ueb. d. Einfluss d. C. auf Schw. u. Wochenbett," "Monatsschr. f. Geburtsh.," 1868, xxxii, p. 60.

† Slavjansky, "Endometrit. decidualis hæm. bei Cholerakranken," "Arch. f. Gynaek.," iv, 1872, p. 293.

‡ Schroeder, "Lehrb. d. Geburtsh.," 1872, p. 365.

Hennig, *loc. cit.*

now fallen into disrepute, although judicious measures to hasten parturition, already begun by Nature, are regarded as justifiable.

Typhus, Typhoid, and Relapsing Fevers.—These fevers more frequently complicate the earlier than the later months of pregnancy, and affect the prognosis more seriously at the former epoch, owing to the greater tendency then existing to protracted *post-partum* hæmorrhage.* They may also, rarely, complicate the puerperal state.

Typhus fever manifests a less marked tendency to the induction of abortion or of premature delivery than either typhoid or relapsing fever, probably because it is less frequently accompanied by metrorrhagia.† It, however, occasionally produces these results, thereby essentially increasing the danger of a lethal termination. ‡

Typhoid fever is frequently, and relapsing fever almost constantly, accompanied by abortion or by premature delivery induced by profuse uterine hæmorrhages,# and thus greatly endanger life. The clinical history and the treatment of the fevers in question are unaffected by coexisting pregnancy except in so far as symptoms and indications having reference to the occurrence of metrorrhagia, abortion, or premature delivery, are concerned.

Malarial Fever.—Malarial fever is not a very frequent complication of pregnancy, perhaps because the latter secures a certain freedom from exposure to the malarial poison. Women who have previously experienced malarial fever, and who have been considered cured of the disease for several years, often suffer a relapse during subsequent pregnancies. ‖ Attacks occurring under these circumstances may be regarded as acute exacerbations of a chronic malarial disease which has remained latent for a certain time. Malarial fever, according to Runge,^ does not produce abortion except in rare instances, even when the febrile phenomena persist up to the termination of pregnancy, but Göth ◊ has more recently reported forty-six cases, in nineteen of which either abortion or premature delivery took place. Parturition usually suspends the periodic paroxysms, supposing them to have continued up to confinement, possibly owing to the loss of blood dependent on delivery, but the rule is not without exceptions. During the puerperal state, however, particularly in the second and third weeks, the paroxysms usually return or a latent malarial cachexia may manifest itself in the manner previously alluded to.‡ The disease may be communi-

* Wallichs, "Monatsschr. f. Geburtsk.," xxx, II. iv, 1867, p. 253; Spiegelberg, "Handb. d. Geburtsh.," p. 260.

† Zuelzer, "Monatsschr. f. Geburtsk.," xxxi, II. vi, 1868, p. 419.

‡ Wallichs, *op. cit.*, p. 261. # Zuelzer, *op. cit.*, p. 424.

‖ Robert Barnes, "Trans. of the Am. Gyn. Soc.," 1876, p. 144.

^ Max Runge, Volkmann's "Samml. klin. Vortr.," No. 174, p. 10.

◊ Göth, "Ueber den Einfluss der Malaria-Infection auf Schwangerschaft, Geb. und Wochenbett," "Ztschr. f. Gebh. und Gynack.," vol. vi, p. 17.

‡ Spiegelberg, "Geburtsh.," p. 261.

cated to the fœtus, as has been proved by the detection of the characteristic pathological appearances induced by malarial poisoning in the spleen, and by the discovery of malarial pigment-granules in the blood and skin of children dying before or immediately after birth.*

Hubbard † reported an interesting case of intra-uterine malarial fever of the tertian type, in which the fetal movements were entirely suspended during the maternal paroxysms, and returned during the intermissions. The woman was confined during an intermission. On the following day the mother and child had a simultaneous paroxysm. Quinia was now administered, with the result of curing both mother and child—the latter obtaining the antiperiodic through the medium of the mother's milk.

The usual course of malarial fever is altered by coexisting pregnancy. Intermissions are usually wanting, and the fever becomes continued or remittent, the chills occurring irregularly. ‡ Even those cases which most nearly approximate the usual malarial course show a tendency to anticipation or retardation of the paroxysms. The fever may assume a pernicious character, its tendency in this direction being accounted for by the nervous prostration and anæmia attendant upon the puerperal condition. Quinia best controls the febrile phenomena, but must be given in large doses, since the powers of digestion and of assimilation are seriously impaired by the puerperal state.#

Icterus.—Icterus, although a phenomenon of rare occurrence during pregnancy, is interesting and important on account of its tendency to precede or to accompany the fatal pathological changes and symptomatic events connected with acute yellow atrophy of the liver. It is ordinarily assumed that this grave general disease is developed from a form of icterus which, when complicating pregnancy, usually has etiological relations identical with those of simple obstructive or so-called hepatic jaundice, although the causative condition frequently eludes observation. The development in pregnancy of icterus terminating fatally is, also, sometimes due to the lesions of phosphorus-poisoning. Davidson ‖ attributes the fatal influence of pregnancy upon the course of simple icterus to the three following causes: 1. The impairment of the renal excretory function, due to the passive congestion produced by uterine pressure upon the renal veins. This etiological factor operates by causing the retention in the blood of the reabsorbed biliary acids, which, according to the investigations of Traube and others, are of themselves capable, even when present in

* Max Runge, *loc. cit.* † Hubbard, "Edinburgh Med. Jour.," June, 1866.

‡ Mendel, "Intermittens während Schwangerschaft und Wochenbett," "Monatsschr. f. Geburtsk.," Bd. xxxii, H. i, p. 10.

Barker, in a paper termed "Puerperal Malarial Fever" ("Am. Jour. of Obstet.," April, 1880), furnishes a most valuable addition to our knowledge of the symptoms and treatment of this disease.

‖ Davidson, "Monatsschr. f. Geburtsk.," Bd. xxx, H. vi, 1867, p. 465.

the blood in moderate quantity, of producing acute yellow atrophy. 2. The hydræmia of pregnancy, which renders the system less capable of resistance to toxic agencies. 3. The impairment of cardiac activity, due to the retention of the biliary acids, which still further compromises renal eliminative action. Icterus often produces abortion by destroying the life of the fœtus. The causative connection between icterus and fetal death has been proved by the intense icterus of the dead fœtus, by the detection of biliary acids in its blood, and by the exclusion of other causes. After abortion a previously benign icterus may speedily develop all the characteristic lesions and symptoms of acute yellow atrophy.* Under these circumstances, the sudden advent of the fatal symptoms may be accounted for by the anæmia and hydræmia induced by the hæmorrhage accompanying parturition. Assuming the correctness of the above-mentioned deductions with reference to the usual etiology of fatal icterus complicating pregnancy, we must admit the urgent indication in these cases for measures calculated to facilitate the elimination of the biliary acids from the blood by restoring the normal excretory function of the kidneys. An *early* resort to appropriate measures might, partially or entirely, prevent the accumulation of the poison upon whose presence such baneful results are believed to depend.

Cardiac Diseases.—The various effects produced upon pregnancy by coexisting heart-disease depend entirely upon the seat and character of the cardiac affection. While the results of myocarditis are serious, because of its interference with the development of cardiac hypertrophy adequate for the compensation of existing valvular lesions, and acute endocarditis, occurring during pregnancy, shows a marked tendency to assume the fatal ulcerative form, † pericarditis has no perceptible effect upon the normal course of utero-gestation. ‡ *Chronic* endocarditis often produces disastrous results, which may, in general terms, be accounted for by the fact that an amount of cardiac hypertrophy completely compensatory for preëxisting valvular lesions is no longer able to overcome the increased arterial and venous pressure prevailing during pregnancy, or to adapt itself to the sudden variations in vascular tension due to the parturient act. The augmented arterial pressure which calls for increased cardiac activity is referable, in part, to the newly developed utero-placental circulation. It is also attributed by some authors to the actual pressure of the gravid uterus upon the aorta; while Spiegelberg # believes it to be measurably due to the plethora of pregnancy, and to the limitation of the intra-thoracic

* Schroeder, "Lehrbuch der Geburtsh.," p. 366.

† Lebert, "Beitr. zur Casuistik der Herz- und Gefässkrankheiten im Puerperium," "Arch. f. Gynaek.," Bd. iii, 1872, p. 39.

‡ Porak, "De l'infl. récip. de la grossesse et des mal. de cœur," 1880, p. 92.

Spiegelberg, "Arch. f. Gynaek.," ii, 1871, p. 236.

space by the encroachments of the diaphragm. An important source of varying and perturbed heart-action is, moreover, found during labor in the suddenly changing conditions of pressure produced by the alternating uterine contractions and relaxations with the corresponding violent respiratory efforts.

Spiegelberg* refers the symptoms of aortic insufficiency or stenosis, which are usually most marked in the later months of pregnancy, solely to cardiac disturbances due to increased arterial tension, and the disappearance of these symptoms, after birth, to the restitution of the normal pressure. McDonald† refers the improvement not so much to the diminution of the arterial tension as to the absence of the extra tension associated with the bearing-down effort. Spiegelberg considers the grave symptoms of mitral disease, often presenting themselves soon after confinement, as referable to excessive distention of the right heart with blood forced into it from the contracted uterus. Fritsch‡ opposes this view, and attributes the morbid phenomena of mitral disease to the accumulation of blood in the abdominal vessels recently released from the pressure of the gravid uterus, and to the cardiac paralysis resulting from an insufficient blood-supply and consequent defective nutrition of the heart.

The hydræmia of the puerperal state may contribute to the impairment of nutrition, and thus coöperate with the above causative agencies in the production of cardiac paralysis.

Fresh inflammatory affections may attack the valves and endocardium of a heart already weakened by disease. This occurs by preference in cardiac cases of more recent origin. In all cases of heart disease, and especially in those with acute symptoms, there is great danger of embolism. Slight exposure to cold and exertion, in pregnant patients with cardiac diseases, is liable to occasion pulmonary disturbances. These appear usually in the second half of pregnancy.#

The symptoms of aortic valvular disease are usually manifested during the latter half of pregnancy. They consist in palpitations, dyspnœa, and, in extreme cases, in abortion or premature delivery. Should pregnancy proceed to a normal termination, the symptoms are aggravated by parturition, and syncope is of common occurrence, but the symptoms disappear speedily after labor is ended. Mitral valvular lesions, if slight or completely compensated for, may not manifest their existence by any rational symptoms. If, however, the compensation be inadequate, the patient's life may be greatly and sometimes suddenly endangered by the occurrence, either before or after confinement, of extreme pulmonary congestion and œdema, ascites, albumi-

* Spiegelberg, "Ueber d. Comp. des Puerp. m. chron. Herzkr.," ibid., ii, 1871, p. 233.

† McDonald, "Heart Disease during Pregnancy, Parturition, and Childbed," p. 47.

‡ Fritsch, "Die Gefahren d. Mitralisfehler," ibid., viii, 1875, p. 381.

McDonald, *l. c.*, pp. 199–200.

nuria or metrorrhagia. The fœtus may die *in utero*, as the result of metrorrhagia or of impaired nutrition due to deficient oxygenation of the maternal blood. Children whose mothers are the victims of cardiac disease are often imperfectly developed, and predisposed to untimely death. The prognosis is based upon the general condition of the patient. In seventeen of the thirty-one cases collected by McDonald the patients died. The prognosis is impaired by coexisting pulmonary lesions, tending to obstruct the circulation in the lungs, as well as by diseases of other vital organs. Mitral lesions are of more grave significance than those at the aortic orifice, and mitral stenosis is particularly dangerous,* because of its tendency to produce dilatation of the left auricle and the heart.

Women with cardiac disease of any considerable gravity should be dissuaded from marriage. The indications for medicinal treatment are the same as for cardiac diseases uncomplicated by pregnancy. Chloroform should be administered with special caution during parturition. McDonald, however, believes that, cautiously administered in the second stage, chloroform is useful by diminishing the down-bearing efforts. In order to lessen the down-bearing efforts, the same author urges as of extreme importance the timely application of the forceps, or the performance of version in suitable cases, should the second stage be in any way prolonged. The artificial induction of abortion or of premature delivery is justified only, according to McDonald, in cases where, as in hydramnion, the abdomen is unduly distended.

Acute Lobar Pneumonia.—Pneumonia attacks women less frequently than men. Its rate of mortality is, however, much larger among the former. These facts should be remembered by investigators of the reciprocal relations between pneumonia and pregnancy, in order that the influence excited by the former upon the latter be not exaggerated. Pneumonia is an infrequent complication of the pregnant state, but affects the course of the latter very prejudicially.† Although a pneumonia of large extent may terminate in complete recovery, without having endangered the life of mother or fœtus,‡ it often produces abortion or premature delivery, the frequency of these results increasing in direct proportion to the duration of pregnancy. The type of the pulmonary inflammation is also more severe in the later stages of utero-gestation, and parturition exerts an unfavorable effect upon women in proportion as their pregnancy is far advanced.#

It was formerly believed that pneumonia, occurring during pregnancy, owed its fatal character chiefly to the encroachments of the

* Porak, *op. cit.*, p. 113; Fritsch, *op. cit.*, p. 383.

† Fasbender, "Ueber P. als Schwangersch. Complicat.," etc., "Beiträg. z. Geburtsh.," iii, 1874, Sitzgsber., p. 54.

‡ Gusserow, "Pn. b. Schwangeren," "Monatsschr. f. Geburtsk.," xxxii, H. ii, 1868, p. 93.

Wernich, "Beiträg. z. Geburtsh.," iii, 1874, Sitzgsb., p. 56.

gravid uterus upon the intra-thoracic space, and to the consequent interference with the necessary compensatory increase of functional activity on the part of the healthy lung-tissue. Later investigations having not only shown the fallacy of this theory,* but even rendered probable an actual increase in the intra-thoracic space during pregnancy, † the fatal character of intercurrent pneumonia is referred to coexisting hydræmia, and to the inability of the poorly nourished heart to restore the balance of a pulmonary circulation disturbed by the consolidation of lung-tissue and by the consequent impermeability of large capillary areas. Pulmonary œdema, resulting from progressive cardiac asthenia, directly induces the fatal issue. Parturition itself, whether naturally or artificially produced, greatly imperils the woman's life ‡ by making exorbitant demands upon the already failing heart-power and by aggravating existing hydræmia. Abortion, when occurring under these circumstances, is referred to fetal death caused by deficient oxygenation of the maternal blood, by placental anæmia produced through an inadequate supply of blood to the left heart, and by the abnormally elevated maternal temperature.# From the fatal results of parturition in pneumonia we conclude that the induction of abortion or of premature delivery, in ordinary cases, is unjustifiable. ‖ Should labor, however, have already begun, its termination must be hastened by all available means. Our further treatment must consist in efforts at strengthening the heart's action. Brandy and carbonate of ammonia, digitalis and quinia, deserve the most confidence for the fulfillment of these indications. Wernich recommends cautious venesection, for the relief of extreme dyspnœa or cyanosis, and proposes that the collapse to which bloodletting may lead be combated by transfusion.^

Emphysema, Chronic Pleurisy, and Empyema.—These affections are dangerous complications of pregnancy, in that they produce cardiac dilatation, and prevent the heart from successfully adapting its activity to the varying conditions of vascular tension obtaining in parturition and the puerperal state. The induction of abortion or of premature delivery may be indicated by the existence of these diseases, provided the mother's strength has become so impaired as to incapacitate her for continued utero-gestation.

Phthisis.—It was formerly erroneously held that pregnancy afforded immunity against *pulmonary phthisis*. This view may have been based upon the clinical fact that the progress of preëxistent phthisis is sometimes retarded by the supervention of pregnancy.◊ This re-

* Gusserow, *op. cit.*, p. 88.
† Wernich, Berlin. "Beiträg. z. Geburtsh.," ii, 1873, p. 249.
‡ Fasbender, *op. cit.*, p. 55.
‖ Wernich, *op. cit.*, p. 261.
Spiegelberg, "Lehrb. d. Geburtsh.," p. 265.
^ Schroeder, "Lehrb. d. Geburtsh.," p. 364.
◊ Wernich, Berlin. "Beiträg. z. Geb.," ii, 1873, p. 251.

sult is observed, according to Lebert,* in only a small proportion of cases. In the majority of instances pregnancy not only hastens the progress of actually existing phthisis, but precipitates its development. The latter result is of especially frequent occurrence in those hereditarily predisposed to the disease, or in such persons as may have recovered from a previous attack. These effects of pregnancy upon the development and course of phthisis are most manifest between the ages of twenty and thirty years, although they are not infrequent between the ages of thirty and forty. The advanced stages of phthisis prevent conception, but the same is not true of its earlier periods. The puerperal state often favors the development of phthisis, particularly in those hereditarily predisposed to it, and usually hastens the fatal issue of the disease if it have already manifested itself. In very exceptional instances, however, parturition and the *post-partum* state exert a favorable influence upon the course of phthisis. It often happens that women with inherited tendencies to phthisis may escape it during their first pregnancy, only to become its victims in a later one.† Although women with progressing phthisis may pass through the parturient and puerperal states in safety, they are greatly prostrated thereby, and rarely have sufficient milk to nurse their children. They, moreover, often experience abortion or premature delivery. The children of such women are usually puny and feeble. They are slowly and imperfectly developed and are predisposed to pulmonary disease. Prophylactic treatment affords the only encouraging prospects of success in the cases under consideration. Girls with suspected hereditary predisposition to phthisis should, accordingly, not marry, as they should not become mothers. If they do bear children, they must never nurse them.

Syphilis.—When syphilis, which is a frequent complication of pregnancy, is contracted at the beginning or during the course of the latter, it is characterized by intense initial and by unusually mild consecutive symptoms.‡ The duration of the incubation is, ordinarily, about two weeks, but may be protracted to six weeks. The initial lesions, which are more extensive than in women who are not pregnant, may involve the vagina, cervix, labia, nates, and thighs. They embrace swelling, reddening and excoriation of the mucous membrane and skin, œdema, eczema, follicular abscesses, and even necrosis of connective tissue. These intense inflammatory processes may be referred to increased nutrition of the parts, and to the mechanical results of friction between them. The secondary symptoms are of a mild type, consisting chiefly

* Lebert, "Ueber Tab. d. weiblich. Geschlechtsorgane," "Arch. f. Gynaek.," iv, 1872, p. 469.

† Spiegelberg, "Lehrb. d. Geburtsh.," p. 266.

‡ Sigmund, "Ueber d. Verlauf d. S. bei Schwangerschaft," "Wien. med. Presse," xiv, 1873, No. 1.

of general glandular induration, papules on and around the genitals, and scales on the palms and soles. Mewis* states that the occurrence of parturition has a favorable effect upon these lesions, usually resulting in their disappearance. Erythema, pharyngitis, alopecia, iritis, and febrile movement are either absent or slightly marked. Pregnant women owe the mildness of their secondary symptoms to amelioration of their general nutrition. Syphilis exerts a very prejudicial influence upon the product of conception. If either parent be affected with general syphilis at the time of the coition resulting in impregnation, syphilis is communicated to the fœtus. It is almost equally impossible for a fœtus poisoned by the paternal reproductive element to infect a healthy mother. Provided the mother were untainted at the time of conception, syphilis contracted by her during pregnancy is rarely communicated to the fœtus. If the father be syphilitic, the infection of the ovum is accomplished by the diseased spermatozoids. If the mother be constitutionally tainted, the ovum is already poisoned. Should both parents be the victims of general syphilis, each equally bequeaths the disease to the offspring. The syphilitic poison, therefore, will not traverse the septa intervening between the fetal and the maternal vascular systems.† In rare exceptions to this general rule the mother contracts the disease by the so-called *choc en retour*.

A progressive and continuous diminution in the intensity of fetal syphilis, directly proportionate to the length of time which has elapsed since the contraction of the disease by the parent who communicated it, is observed in cases unmodified by treatment. Parents whose syphilis is allowed to pursue its natural course retain the capability of transmitting the disease to their offspring for varying periods, the average length of which is ten years. Latency of the parental syphilis does not secure immunity of the fœtus from the disease, although it diminishes the probability of its transmission. Parents with tertiary syphilitic symptoms may or may not communicate the disease to their children, according as the poison whose original presence produced the gummata is still retained in the system, or has been eliminated by nature or by mercurials. In accordance with the varying intensity of the hereditary influence, the fœtus may either perish *in utero*, its death resulting in abortion or premature delivery, may be born alive but destined to die early, or may manifest the disease only at the expiration of periods varying from weeks to months. Conception occurring during the first years after the parents' infection with syphilis almost invariably terminates in abortion or prema-

* Mewis, "Syphilis congenita," "Ztschr. f. Geburtsh. u. Gynaek.," iv, 1879, 1, p. 62.

† Professor McLane, of this city, has recently reported to me the history of a well-observed case, where error was hardly possible, in which the mother, previously healthy, was infected in the fourth month, and gave birth in the ninth month to a dead child with well-marked syphilitic lesions. The rule is, therefore, probably not absolute.

ture delivery, the causes of which are either the vitiated nutritive processes of the fœtus, the increased maternal temperature due to syphilitic fever, or syphilitic degeneration of the fetal placenta, consisting, according to Mewis,* of inflammatory changes in the tunica intima of the blood-vessels. Similar pathological changes are said, by the same author, to occur in the intima of the umbilical vessels. The pathological conditions observed in syphilitic disease of the placenta are either granular degeneration of the placental villi, with obliteration of the blood-vessels, or the morbid changes designated by the names endometritis placentaris gummosa and endometritis decidualis.† (For a more detailed account of placental syphilis, *vide* chapter on placental diseases.)

Every pregnant woman who, at the time of conception, is or has been affected with constitutional syphilis, should be promptly subjected to a thorough mercurial treatment, preferably by the method of inunction. This is desirable, even when no present symptoms are detected, with reference to the prevention of the frequently disastrous influences of latent syphilis. If, however, the disease be contracted during the later months of pregnancy, the treatment may consist of palliative measures, until after parturition, since no harm will result from the maternal syphilis to the fetal life. Local primary or secondary disease of the genitals should receive appropriate treatment, in order that the child be not infected during delivery.

Diabetes in Pregnancy.—Dr. Matthews Duncan‡ has recently called attention to the very serious consequences of diabetes complicating pregnancy and the puerperal state. But few cases have been recorded. Diabetes may occur during pregnancy, and, in some cases, during pregnancy only. It may cease after the termination of pregnancy, and may not return in pregnancy after its cure. Pregnancy may occur during diabetes, and in that case may be apparently unaffected in its healthy progress by the disease.

In twenty-two pregnancies, occurring in fifteen mothers, four terminated fatally. In several, death was by collapse, rather than by coma. Hydramnios was frequent, and in one case sugar was found in the fluid.

In seven out of nineteen pregnancies, occurring in fifteen mothers, the child died in pregnancy, having, in all of them, reached a viable age. In two more the child was feeble at birth, and died a few hours after. In one case the child was diabetic.

With one exception, all the mothers were multiparæ.

Chorea in Pregnancy.—Chorea, which is a rare complication of pregnancy, affects primiparæ by preference, particularly those possessing an hereditary predisposition. Barnes# was able to collect only

* Mewis, *loc. cit.*, p. 42.

† Fränkel, *op. cit.*, p. 52.

‡ Matthews Duncan, "On Puerperal Diabetes," "Obstet. Trans.," vol. xxiv, p. 256.

Barnes, "Trans. of the Obstet. Soc. of London," x, 1869, p. 147.

fifty-six and Fehling * only twelve additional cases from the whole domain of obstetrical literature.

Organic cerebral lesions are assumed by Spiegelberg † as established causes of the disease. In regard to other etiological agencies wide diversities of opinion prevail. According to Goodell,‡ the choreic movements are of reflex nature, and are referable to impaired nutrition of the central nervous system, incident to the hydræmia of pregnancy. The association of chorea and organic cardiac disease has been frequently observed, and the discovery, in certain cases, of fibrous vegetations upon the mitral and aortic valves accounts for the assumption, by some authors, of embolism as a cause of chorea. Barnes # discountenances this view, and calls attention to the probable causative agency of myelitis. Terror and other intense emotions may act as exciting causes of chorea.

Choreic movements occurring in pregnancy do not differ from those attending the disease in the unimpregnated state. They are usually bilateral. In most cases the muscular contractions manifest themselves in the earlier months of pregnancy, and continue until delivery is accomplished. In rare instances they are arrested at the beginning of parturition. In still more exceptional cases the contractions may either cease before delivery or persist during the *post-partum* state. Transitory albuminuria and diabetes mellitus are occasional unexplained complications of chorea gravidarum, and the phosphates and urates of the urine are present in abnormal abundance. Abortion and premature delivery, due to the repeated succussion of the uterus, are of very frequent occurrence.

Chorea exerts a prejudicial influence upon the course of pregnancy,‖ having interrupted it in about one half the recorded cases. Death of the mother resulted in seventeen of the fifty-six cases collected by Barnes.△ The lethal termination was usually referable to the exhaustion consequent upon protracted muscular exertion, or to hemiplegia secondary to grave cerebral or spinal lesions. The life of the child is less frequently sacrificed, but it is itself often affected with chorea.

The treatment consists in the administration of iron and quinine, and the lowering of the reflex excitability by the prolonged use of the bromide of potassium. During the attack, chloroform, chloral, and the subcutaneous injection of morphia have proved serviceable. When palliative remedies prove fruitless, in view of the perilous nature of the affection, artificial labor or even abortion is indicated.

* Fehling, "Arch. f. Gynaek.," vi, 1874, p. 137. † Spiegelberg, "Lehrb.," p. 255.

‡ Goodell, "Am. Jour. of Obstet.," May, 1870, p. 149.

Barnes, *loc. cit.*, p. 179.

‖ Goodell, "Am. Jour. of Obstet.," vol. viii, p. 168.

△ Barnes, "Trans. of the Obstet. Soc. of London," x, 1869.

Relaxation of the Pelvic Symphyses.*—This condition, which consists in an excess of the ordinary physiological softening at the pelvic articulations, may permit of such a degree of mobility between the pelvic bones as to effectually hinder locomotion. This is usually accompanied by pains in the ligaments of the joints affected, in the thighs, and in the lumbar region. Its existence is easily recognized. Thus, motion at the symphysis pubis becomes apparent if, with the patient in an upright position, she be made to throw the weight of the body upon each leg in alternation, while the accoucheur holds the symphysis between the thumb and two fingers placed within the vagina. Motion in the sacro-iliac joint is perceived by seizing the crests of the ilium and getting the patient to move forward. In the recumbent posture, movements at either the pubic or sacro-iliac joints may be recognized by means of the vaginal touch, upon extending or flexing the femur.

The great relief afforded to all the symptoms in such cases by means of a firm binder makes it most desirable that the possibility of its occurrence should be always borne in mind where the patient walks with difficulty during the latter months of pregnancy, or subsequent to the childbed period. The first case I witnessed at the Bellevue Hospital was altogether a mystery to me, until the nature of the disability was pointed out by Professor Barker. The patient was in the last month of pregnancy, had been six weeks in bed, unable to move, though apparently otherwise in perfect health. A rude bandage, constructed of canvas and made to lace in front, furnished a good support, and enabled my patient to stand and move around without inconvenience. She had, at the end of gestation, a good confinement, and subsequently recovered without a trace of her previous difficulty.

In childbed a towel-binder is capable of rendering good service. During pregnancy, or during the period of puerperal convalescence, where frequent changes of the bandage are not necessary, Martin's girdle, consisting of a solid metal ring surrounding the whole pelvis, has been strongly recommended. In a case I have recently had to treat, where the relaxation became manifest after delivery, I employed a pair of strong breeches, furnished me by Philip Schmidt, instrument-maker, of this city, which were carefully fitted to the thighs and hips of the patient, and were made to buckle in front and lace behind. The apparatus proved to be light, comfortable, and answered every requirement.

Surgical Operations during Pregnancy.—Massot † concludes, from the observation of a considerable number of cases, that ordinary *surgi-*

* Snelling, "On Relaxation of the Female Pelvic Symphyses," "American Journal of Obstetrics," February, 1870; Barker, "Puerperal Diseases," p. 192.

† Massot, "Ueber d. Einfluss traumat. Einwirk. auf d. Verlauf der Schwangerschaft," Schmidt's "Jahrb.," 1874, 164, p. 266.

cal operations do not interfere with pregnancy unless they materially and permanently disturb the uterine circulation, or call into activity the uterine muscular force by reflex irritation. Cohnstein * states, as the result of his researches, that, after operations and injuries, pregnancy reaches a normal termination in 54·5 per cent. of all cases. Interruption of pregnancy was, in his cases, determined: (*a*) by the period of pregnancy when the operation took place, occurring more frequently as the result of surgical measures resorted to in the third, fourth, and eighth months; (*b*) upon the seat of the operation, resulting, in two thirds of all cases, from operations upon the genito-urinary organs; (*c*) upon the extent of the wound, following amputations, exarticulations, and ovariotomies with great relative frequency; (*d*) upon the number of children, occurring in multiple pregnancy with uniform regularity. Age seemed to exert no causative influence. Abortion directly results, under these circumstances, from reflex irritation, or from fetal death referable to hæmorrhage or to septic poisoning on the mother's part. The prognosis, so far as the mother is concerned, depends upon the time when delivery occurs. The mortality ordinarily attending delivery, if at term, is insignificant; for abortions and premature deliveries it amounts, according to Cohnstein, to thirty-three per cent. The most frequent causes of the mother's death are shock, peritonitis, septicæmia, hæmorrhage, and œdema pulmonalis. In ninety cases of minor operations upon the pelvic organs collected by Professor Mann, † of Buffalo, there were twenty abortions and four deaths. They included the removal of a caruncle, of epitheliomata, of condylomata and of polypi, the opening of cysts and abscesses, the dilatation of the urethra for stone, the plastic operations upon the vulva, cervix, and vagina, etc. He concludes that during pregnancy the union of denuded surfaces is the rule, that the most risky operations are those upon the rectum, and that vaginal operations are apt to be attended by severe hæmorrhage, though not otherwise dangerous. In view of the manifest danger from operations of any magnitude, it may be stated as a general law that surgical measures not absolutely indicated by the existence of pathological conditions liable to aggravation by delayed interference should be postponed until after confinement. Those morbid conditions, however, whose development is hastened by pregnancy, or whose existence offers mechanical obstacles to parturition, must be early subjected to operative interference. This remark applies with special force to carcinomatous growths in any part of the body and to intra-pelvic tumors.

The time of operation should not coincide with the menstrual

* Cohnstein, "Ueber chirurg. Op. bei Schwangeren," Volkmann's "Samml. klin. Vortr.," No. 59, 1873, p. 493.

† Mann, "Surgical Operations on the Pelvic Organs of Pregnant Women," "Gynæcological Trans.," 1883.

epoch of pregnant women, as abortion is more likely to occur at that period.* For a similar reason it is recommended that the third, fourth, and eighth months should be avoided. Massot is of the opinion † that anæsthetics, when employed during operations on pregnant women, exert rather a favorable than a prejudicial effect upon fetal life by diminishing reflex irritation.

Abnormal Conditions of the Uterus.

Double Uterus.—Double uterus occurs under various forms. The uterus and cervix may be double, the vagina remaining single. The double uterus may have a single cervix opening into an undivided vagina. The uterus, although double, may have a single cervix opening into a double vagina, the septum beginning at the os internum; or uterus, cervix, and vagina may be double throughout.

All these forms permit of normal utero-gestation on either side or on both sides simultaneously, provided that each half of the genital canal be sufficiently developed. If, however, the dividing septum extends quite to the vaginal entrance, simultaneous pregnancy in each horn is exceedingly rare.‡

If pregnancy occur in only one side of a double uterus, a decidua vera is developed in the other side, and expelled at the end of pregnancy. Double uterus is less readily diagnosticated during pregnancy than after or before it, but is usually recognized with facility. A double vagina is not necessarily indicative of double uterus, but if two vaginæ are found, each containing a cervix, the presence of double uterus may be safely assumed. If a double cervix terminate in an undivided vagina, the uterus may or may not be double. When pregnancy exists in only one horn, the uterine development is manifestly unilateral, and the existence of an unimpregnated half may be determined by combined manipulation or by the uterine sound. In these cases presenting a double uterus with a single cervix and vagina, the diagnosis rests chiefly upon unilateral uterine development and depression of the fundus and body corresponding to the septum. The form of a double uterus is most plainly manifest during the contractions accompanying and succeeding parturition.# It is still undecided whether double uterus be a cause of abortion and of premature delivery. Ordinarily, however, the symptoms and course of pregnancy are unaffected by this malformation. The complete functional independence of the two segments is demonstrated by the fact that in twin pregnancies parturition is frequently not simultaneously accom-

* Spiegelberg, "Lehrb. d. Geburtsh.," p. 268.

† Massot, *loc. cit.*, p. 267.

‡ Schroeder, "Lehrb. d. Geburtsh.," p. 376.

Schatz, "Mitth. aus d. Leipz. Geb.-Klinik u. Polyklinik," "Arch. f. Gynaek.," ii, 1871, p. 297.

plished by them. In the case of unilateral pregnancy, the ratio of head to breech presentations is, according to Schatz, as twenty-one to two. Tedious labor may result in cases of double uterus, from uterine atony, referable either to imperfect muscular development of the pregnant horn, to its deviation from the normal pelvic axis, or to obstruction produced by the unimpregnated horn. *Post-partum* hæmorrhage may result from uterine atony or from attachment of the placenta to the septum, whose imperfect development prevents its firm and thorough contraction.

Anteversion and Anteflexion.—The normal anteversion of the unimpregnated uterus is exaggerated by the increased weight of the gravid uterine body, but this deviation is usually rectified by the gradual development and upward movement of the uterus. In exceptional cases the anteversion persists after the fourth month, and produces vesical tenesmus, dysuria, or incontinence. No evidences of uterine incarceration are, however, observed, and the comparatively trivial symptoms are relieved by regulating defecation, replacing the fundus, causing the patient to assume the dorsal decubitus, or by adjusting an appropriate pessary.

In the later stages of utero-gestation, anteversion combined with anteflexion may again occur, and produce the deformity known as pendulous abdomen. It is, then, chiefly due to the inadequate support afforded to the uterus by the abdominal parietes. The failure of their sustaining power is referable to their relaxation—which is most marked in multiparæ—to separation of the recti muscles, or to the yielding of old cicatrices produced by operations or injuries. The displacement is also favored by lordosis of the lumbar vertebræ, and by contracted pelvis, which prevent the normal descent of the uterus. In extreme cases of pendulous abdomen, the uterus, having separated the recti, descends, covered by fascia and skin, almost or quite to the knees, and seriously interferes with locomotion. Its pressure also produces œdema of the abdominal wall, vesical tenesmus, and pain in the distended cutaneous tissues. These symptoms are relieved by reposition of the uterus, and by the application of a suitable abdominal bandage.

Retroversion.—Retroversion, a comparatively infrequent form of displacement in the unimpregnated uterus, usually rectifies itself during the earlier months of pregnancy. Should spontaneous restitution not occur, the fundus being detained below the promontory until after the third month, the cervix bends upon itself at an acute angle, and the retroversion is transformed into a retroflexion.

Retroflexion.—Retroflexion occurs infrequently in women who have not borne children, but often renders sterile those who are thus affected. It is one of the most common uterine displacements in women who have borne children, though it does not, in their case, ordinarily

prevent conception. When conception occurs in a retroflexed uterus, the latter usually rises from the pelvis, and assumes a position of anteversion at the fourth month. In many cases, however, the displacement produces congestion of the uterine mucous membrane, metritis, and abortion. In still other cases the fundus does not ascend above the promontory at the usual time, and either the symptoms of retroflexion with incarceration are slowly developed, or that form of retroflexion known as partial retroflexion, or retroflexion in the second half of pregnancy, occurs. This consists in the division of the uterine cavity into an anterior and a posterior diverticulum or pouch. The anterior diverticulum is produced by the more rapid upward development of the anterior uterine wall, which is subjected to comparatively slight pressure and contains the larger part of the fœtus. The posterior uterine wall enters predominantly into the formation of the posterior diverticulum, and usually contains the fetal head. This peculiar form of uterine displacement may be spontaneously rectified during pregnancy, or may persist until delivery, producing no important symptoms except vesical and rectal tenesmus, with dysuria and painful defecation. In the latter case it materially interferes with parturition, inasmuch as the cervix, which is displaced upward and forward behind the symphysis, is not situated in the pelvic axis, and the posterior diverticulum is forced by the uterine contractions against the perinæum and posterior vaginal wall. Even at this stage Nature may restore the uterus to its normal position ; but, in default of spontaneous restitution, it must be replaced by forcing up the posterior diverticulum with the hand introduced into the rectum, while the anterior pouch is displaced downward by pressure upon the abdomen and by traction applied to the cervix ; or, where version is practicable, by bringing down the breech, room may be made for the release of the imprisoned head.

Retroflexion of the Gravid Uterus, with Incarceration.—Although this form of retroflexion is usually developed in the gradual manner above described, it may, in rare instances, be rapidly produced by sudden abdominal compression or concussion.

The symptoms, which are in either case essentially the same, differ chiefly in the varying rapidity of their development, and result from the pressure of the displaced uterus upon the intra-pelvic viscera and tissues. They embrace dysuria, eventuating sometimes in complete retention of urine from urethral compression, vesical tenesmus, incontinence of urine, painful defecation, constipation, or obstipation, violent sacral and lumbar pains, which radiate into the thighs, and in grave cases emesis, with all the other symptoms of ileus. Abortion, followed by spontaneous restitution and recovery, may occur even at this stage. Should incarceration, however, persist, violent metritis, parametritis, and peritonitis may lead to a fatal issue. In rare cases,

gangrene of the uterus or vagina may be induced. A lethal termination may also indirectly result from pathological processes in the bladder occasioned by retained and decomposing urine. These morbid processes consist in cystitis, sometimes complicated by diphtheritic and gangrenous inflammation of the mucous membrane and of the deeper vesical tissues, which may lead to septicæmia or to rupture of the bladder. Death may, moreover, result from passive renal congestion and uræmia.

The diagnosis of uterine retroflexion with incarceration is based upon the foregoing clinical history ; the fluctuating abdominal tumor, from which large quantities of urine may be obtained by the catheter or by puncture ; the œdema of the vulva ; the presence in Douglas's *cul-de-sac* of a tumor presenting the characteristic consistence of uterine tissue ; the position of the cervix and meatus urinarius behind the symphysis ; and the distention of the perinæum by the fundus uteri.

The distinction between an incarcerated uterus and an extra-uterine pregnancy is sometimes difficult, necessitating a thorough bimanual examination, aided, in cases of abdominal tenderness, by the employment of an anæsthetic.

The replacement of the uterus, which, of course, is the objective point of treatment, should in all cases be preceded by the evacuation of the bladder. This is usually accomplished without much trouble by means of a sharply curved male catheter, and by remembering that the urethra is ordinarily deflected somewhat to one side. Veit,* in an experience of from seventy to eighty cases, found catheterization always practicable. Where intelligent effort is attended by failure, puncture is allowable. To this end an aspirator needle, which, however, should not be of too small caliber, should be passed through the abdominal walls at a point about three inches above the symphysis. In practice this operation has thus far proved devoid of danger, though the possible risk from infiltration of urine should act as a check to its rash employment.

After emptying the bladder, spontaneous reposition may take place. If this does not speedily occur, the patient should be put in the knee-elbow position, and steady pressure should be made with two or four fingers upon the fundus, through the vagina. With a little patience this method rarely fails. E. Martin† reports sixteen cases, in four of which spontaneous reposition followed the evacuation of the bladder, and in eleven reposition was accomplished in the knee-elbow position. In my own practice the latter method has so far invariably proved successful. If anæsthesia is required, the replacement

* Veit, "Ueber die Retroflexion der Gebärmutter in den späteren Schwangerschaftsmonaten," Volkmann's "Samml. klin. Vortr.," No. 170, p. 1363.

† E. Martin, "Rückwärt's-Neigung der schwangeren Gebärmutter," "Ztschr. f. Geburtsh. und Frauenkrankheiten," vol. i, p. 1.

of the uterus should be attempted with the patient in the Sims latero-prone position. Pressure upon the fundus should be exerted by four fingers introduced into the vagina or rectum. Barnes* recommends tilting the fundus to one side, so as to disengage it from the projection of the promontory. It may happen that the first attempt may be only partially successful, while a renewal of the manipulation after twelve to twenty-four hours may lead to complete reduction (Veit).

In exceptional cases the replacement of the uterus may be prevented by inflammatory adhesions, or by the secondary swelling of the displaced organ. The induction of abortion then becomes imperative, either by the ordinary methods or by puncture of the uterine walls.

The introduction of a uterine sound or a flexible catheter is rarely practicable. In a case reported by P. Müller,† where the retroversion was complete, with the fundus upon the perinæum and the cervix looking directly upward, Müller resorted to the following ingenious expedient: He cut off the end of a male silver catheter, and then bent the extremity into a hook. Having succeeded in passing the latter into the cervix, he introduced a piece of catgut through the tube between the membranes and the uterus. After twelve hours, during which the catgut was left *in situ*, the fœtus was expelled. If catheterization can not be accomplished by either of the foregoing methods, puncture of the uterus with a fine trocar, and with antiseptic precautions, has proved a tolerably safe procedure, and, by the withdrawal of a portion of the amniotic fluid, a certain means of provoking abortion.

Prolapse of the Pregnant Uterus.—In rare instances the normal pregnant uterus becomes prolapsed during the early months, through mechanical violence, and its sudden displacement may lead to abortion through uterine congestion and hæmorrhage. Ordinarily, however, procidentia uteri is only observed, during pregnancy, when it has antedated conception, and it is most frequent in multiparæ. A slight prolapse disappears temporarily with the ascent of the uterus. A well-marked procidentia, however, as a result of which a part or the whole of the uterus has been extruded from the vagina, is often attended by symptoms of incarceration terminating in abortion. There is no recorded instance of procidentia in which pregnancy persisted until the time of normal delivery, in a uterus lying wholly without the vagina. Procidentia uteri is simulated by hypertrophy, either of the supravaginal or of the infravaginal portion of the cervix. This pathological condition is unattended by grave results, unless it lead to rigidity of the os uteri, tedious delivery, and uterine inertia. If excessively developed, however, the portio vaginalis may be transformed into a pulpy, polyp-like mass, which, by its constant friction

* Barnes, "Obstetric Operations," third American edition, p. 276.

† P. Müller, "Zur Therapie der Retroversio Uteri gravidi," "Beitr. zur Geburtsh.," Bd. iii, p. 67.

and irritation, produces abortion. It should not be mistaken for prolapse of the uterus, as efforts at reposition may produce irritation sufficiently severe to induce premature delivery. Amputation of the hypertrophied cervix performed during the third month does not necessarily disturb pregnancy, and is indicated, in aggravated cases, because of the possible prejudicial influence of cervical hypertrophy, unmodified by treatment, upon utero-gestation and parturition.

When prolapse, even of slight extent, exists in a pregnant uterus, the normal ascent of the organ should be encouraged by the avoidance of exertion, and by careful regulation of defecation and micturition. In more pronounced cases the uterus must be replaced and sustained by a suitable tampon. Spiegelberg * advises the use of a cotton tampon, soaked in glycerine, and held in position by a perineal bandage, and renewed at short intervals. Caution is necessary in the reduction of the uterus, lest the fundus be caught beneath the symphysis and the procidentia converted into a retroflexion. When incarceration has occurred, and the parts are much swollen, their volume may be reduced by scarification, after which reposition must be attempted. Should it fail, abortion should be induced before the incarceration has irreparably compromised the vitality of the pelvic tissues.

Prolapse of the Vagina.—A slight degree of vaginal prolapse occurs more frequently in pregnant women than does uterine prolapse. Cases of more complete prolapse of the vagina are, however, almost invariably attended with procidentia uteri. The anterior vaginal wall is usually alone involved in the prolapse, although the posterior wall may descend alone, or both walls become simultaneously prolapsed. This displacement produces traction upon the bladder and rectum, resulting in irritation of these organs and of the vulva. During parturition, moreover, the prolapsed vagina offers an impediment to delivery, and may, therefore, be subjected to an amount of pressure incompatible with the maintenance of its vitality. The treatment consists in producing regular alvine evacuations, and in sustaining the vagina with cotton tampons and a perineal band, or with the latter alone. During labor, persistent efforts at reposition of the prolapsed vagina must be made between the pains. Should these attempts prove effectual, the vagina must be sustained in proper position, until the descent of the head has occurred. If reposition be impossible, the forceps must be resorted to in order to prevent the disastrous results of excessive pressure on the vaginal tissues, and traction must be so applied as to avoid injury of the anterior vaginal wall.

Hernias of the Pregnant Uterus.—Although hernias of the unimpregnated uterus are very rare, they still occur much more frequently than those of the gravid uterus. The most frequent forms under which they present themselves are the umbilical and the ventral.

* Spiegelberg, "Geburtshülfe," p. 278.

Femoral and inguinal uterine hernias, as well as hernias through the foramen ovale and the great sacro-sciatic foramen, also occur. The sac of a ventral hernia is often formed by the yielding and dilatation of extensive cicatrices in the abdominal wall, such as result from ovariotomies and gastrotomies, or by the separation of the recti muscles.

Femoral and inguinal uterine hernias are either congenital or are produced by ovarian or omental hernias, between which and the uterus adhesions exist. Pregnancy has been observed to occur most frequently in inguinal uterine hernias, next in umbilical, and least frequently in femoral hernias.* It has never been discovered in a uterus which had escaped through the foramen ovale or the greater sacro-sciatic foramen. Pregnancy occurring in inguinal or femoral uterine hernias is uniformly terminated by abortion or by premature delivery. The diagnosis is readily made if due regard be paid to the absence of the uterus from its natural situation, to the shape and consistence of the hernial tumor, to the physical signs furnished by auscultation and percussion over it, and to the displacement of the vagina toward the site of the hernia.

When the hernia is recognized at an early date, the uterus must, if possible, be restored to its normal position, and there retained by an appropriate truss. Should attempts at reposition be unsuccessful, artificial abortion should be induced, as it will otherwise occur spontaneously at a later date, and under less favorable conditions. When the product of conception has already attained a large size, reposition and delivery, whether spontaneous or artificial, are rarely accomplished unless the constricting hernial ring be previously divided. Even the latter procedure may prove ineffectual, in which case hysterotomy is the last resort.

CHAPTER XV.

DISEASES OF THE DECIDUA.—DISEASES OF THE OVUM.

Endometritis decidua: 1. Chronica; 2. Tuberosa; 3. Catarrhalis.—Anomalies of the placenta.—Anomalies of form; of position; of development; of circulation.—Placentitis.—Degenerations.—Syphilis.—Anomalies of the amnion and of the amniotic fluid.—Hydramnion.—Deficiency of amniotic fluid.—Anomalies of the umbilical cord; torsion; knots; hernias; coiling of the cord; cysts; stenoses of vessels; marginal implantations.—Hydatidiform mole.

Endometritis decidua.—The normal congestion of the uterine mucous membrane attendant upon conception, and resulting in the formation of the decidua, may, under the irritating influence of various exciting causes, develop into endometritis. The inflammation may be

* Spiegelberg, "Geburtsh.," p. 280.

either acute in character, as is often the case in cholera Asiatica and other infectious diseases,* or may pursue a chronic course, presenting itself in the three distinct forms about to be considered :

I. **Endometritis decidua chronica diffusa.**—The causes of this form of endometritis are not usually readily discoverable. It is believed to be sometimes developed from an endometritis antedating conception. It is also referred to syphilitic infection,† to excessive physical exertion, ‡ and to secondary inflammation resulting from the death of the fœtus and its retention in the uterine cavity.#

The anatomical changes characteristic of this form of endometritis consist essentially in thickening and induration of the decidua, due to a more or less diffuse development of new connective tissue, and to proliferation of the decidual cells. Cysts have been observed in the hypertrophied decidua by Hegar and Maier.‖ Kaschewarowa discovered newly developed and hypertrophied involuntary muscular fibers in the substance of the decidua.^ Extravasations into the hypertrophied decidual tissue are of frequent occurrence.◊ The decidua vera or the decidua reflexa may be separately or jointly involved in these pathological processes, and may be affected throughout a part or the whole of their extent. When the hyperplasia of the mucous membrane is developed in the later months of utero-gestation, pursues a notably chronic course, is limited in extent, or does not involve the placental decidua, pregnancy may proceed to a normal termination. When, however, the endometritis appears early, assumes an acute or hæmorrhagic type, is attended by partial separation of the decidua, or involves the placental decidua, it frequently induces abortion or premature delivery, either by causing the death of the fœtus through interference with its nutrition,‡ or by exciting reflex uterine contractions. Parturition may, in either case, be protracted by the slow separation of the decidua, between which and the deeper uterine tissues adhesions have been formed by the newly developed connective tissue and muscular fibers. If the placental decidua be involved in the morbid process, the placenta may be separated with difficulty, and its slow expulsion be attended by copious hæmorrhages. Another consequence of the hyperplasia of the decidua in the later months of pregnancy, according to Kaltenbach,‡ consists in the non-separation

* Slavjanksy, "Arch. f. Gynack.," iv, p. 285.

† Fränkel, "Arch. f. Gynaek.," v, 1873, p. 53.

‡ Kaschewarowa, Virchow's "Arch.," 1868, vol. xliv, p. 113.

Schroeder, "Geburtsh.," sixth edition, p. 392.

‖ Spiegelberg, "Geburtsh.," p. 301.

^ Kaschewarowa, *loc. cit.*, p. 111.

◊ Eigenbrod und Hegar, "Monatsschr. f. Geburtsk.," vol. xxii, 1863, p. 161.

‡ Klebs, "Monatsschr. f. Geburtsk.," 1866, vol. xxvii, p. 402.

‡ Kaltenbach, "Diffuse Hyperplasie der Decidua am Ende der Gravidität," "Zeitschr. für Geburtsh. und Gynack.," vol. ii, p. 225.

of the decidua vera at the time of parturition. The thickened membrane is either rapidly detached after childbirth, forming a sac to which blood coagula adhere, and which in turn become the occasion of hæmorrhage, or it is slowly eliminated, giving rise to a putrid discharge, and furnishing materials for auto-infection. He advises, therefore, in cases of syphilis in either parent, that a careful examination be made of the membranes at childbirth; and, if no traces of the decidua are to be found upon their surface, to introduce the hand into the uterus, and to remove retained portions, or, should this not be done, to promote their expulsion by ergotin, and to employ prophylactic antiseptic injections.

II. **Endometritis decidua tuberosa et polyposa.**—The etiology of this variety of decidual inflammation is involved in obscurity. Syphilis was regarded as a causative agent by Virchow, who first described the degenerative changes under consideration,* and preëxistent endometritis is also supposed to occupy a causative relation to them. Gusserow† suggests that conception occurring soon after delivery may excite the recently formed vascular uterine mucous membrane to abnormal proliferative processes. It is doubtful whether the latter are ever secondary to irritation produced by the death of the fœtus.‡ In Ahlfeld's cases the inflammation was apparently idiopathic.

The pathological processes peculiar to this variety of endometritis are usually observed in the decidua vera alone, and manifest a preference for those portions of the decidua corresponding to the anterior and posterior uterine surfaces. In some cases, characterized by absence of the decidua vera, the decidua reflexa is found involved in the morbid changes. The latter consist in marked thickening of the entire decidua referable to proliferation of the interstitial connective tissue and to extensive hypertrophy of the decidual cells, which are provided with nuclei of enormous size. Occasional free nuclei occur.# The uterine surface of the decidua is rough and covered with coagulated blood, while the entire mucous membrane is exceedingly vascular. Upon that surface of the decidua which is directed toward the ovum are situated large excrescences or elevations, the prevailing shape of which is polypoid. They may, however, appear in the form of nodules, of cones, or of boss-like projections provided with a broad, non-pedunculated base. Their height is from one quarter to one half an inch, and their surface is smooth, very vascular, and devoid of uterine follicles. The latter are, however, plainly visible on the mucous membrane intervening between the polypoid outgrowths, but they are compressed and their orifices constricted or obliterated by the pressure

* Ahlfeld, "Arch. f. Gynaek.," vol. x, 1876, p. 173.

† Gusserow, "Monatsschr. f. Gynaek.," vol. xxvii, 1866, p. 323.

‡ Schroeder, "Geburtsh.," sixth edition, p. 393.

Gusserow, *loc. cit.*, p. 322.

of whitish, contracting bands of newly developed connective tissue. Similar fibrous bands surround the blood-vessels. On section, the larger prominences sometimes appear permeated with coagulated blood, and narrow, cord-like bands of hypertrophied decidual tissue occasionally form bridge-like connections between neighboring polypi. The uterine follicles are, in some cases, filled with blood-clots. The epithelium is often absent from the uterine surface of the decidua except around the orifices of the follicular glands,* and the deeper decidual tissues contain large numbers of lymphoid cells. The cells of the decidua reflexa frequently undergo fatty degeneration. The placental villi may show hypertrophy of their club-shaped ends, or be the seat of myxomatous growths, in which case their cells are granular and cloudy. The fœtus is generally dead and partially disintegrated. This form of endometritis decidua is, consequently, usually accompanied by abortion, which occurs predominantly at an early stage of pregnancy.

III. **Endometritis decidua catarrhalis.—Hydrorrhœa gravidarum.**—This form of uterine inflammation is less intense than the two varieties just described, affects pluriparæ more frequently than primiparæ, and seems to stand in etiological relations with hydræmia. The pathological processes involved in the disease are vascularity, hyperæmia, and hypertrophy of the interstitial connective tissue and of the glandular elements of the decidua. The inflammation involves the decidua vera by preference, but may simultaneously affect the decidua reflexa. The most striking symptomatic occurrence is due to the glandular hypertrophy, and consists in the escape from the uterine cavity of a thin, watery, muco-purulent or sero-sanguinolent liquid, which resembles the amniotic fluid both in color and in odor. Provided that free exit be afforded to the secretion, its discharge is effected gradually and in small quantities. Should, however, obstacles to its continuous evacuation be encountered, either in the usual adhesions between the decidua vera and reflexa or in impenetrability of the os internum, the secretion, having accumulated between the decidua and the chorion, forces a passage through the decidua reflexa and is discharged in considerable quantities. In some cases even a pound or more of the liquid is thus suddenly evacuated. Small quantities of the secretion are often observed as early as the third month. The more abundant discharges occur only in the later periods of pregnancy, and are often attended by slight uterine contractions, which may, in exceptional cases, become so severe as to induce abortion or premature delivery.

The diagnosis involves differentiation between a discharge emanating from the hypertrophied decidual glands and the *ante-partum* escape of a fluid which sometimes accumulates between the amnion and

* Hegar, "Monatsschr. f. Geburtsk.," vol. xxii, 1863, pp. 300, 429.

chorion. The latter discharge, the quantity of which may be so large as to simulate hydramnion, differs from that of hydrorrhœa gravidarum in that it occurs only once.* The escape of the decidual secretion might be mistaken for that of the amniotic fluid, which may be easily distinguished by the fact that it immediately precedes delivery. The treatment should embrace analeptic and tonic measures as well as the careful avoidance of vaginal douches and of all local irritation tending to produce abortion. Should uterine contractions accompany the escape of the decidual fluid, appropriate anodyne treatment must be adopted.

Anomalies of the Placenta.

1. **Anomalies of Form.**—The usually round or oval placenta may be of a horseshoe or other irregular shape. The superficies depends upon the extent to which the villi form vascular connections with the decidua. In general terms it may be stated that the thickness of the placenta is in inverse proportion to its surface extension. Placentæ succenturiatæ, small accessory placental developments, are due to the persistence of isolated villous groups, which form vascular connections with the decidua vera. Placentæ spuriæ consist of circumscribed developments of villi, the decidua not participating in the growth. A placenta membranacea is a broad and thin vascular membrane produced by a diffuse proliferation of the villi over the entire ovum, forming vascular connections with the reflexa or, where the latter is absent, with the vera.

2. **Anomalies of Position.**—The placenta may be attached over the os internum, thus constituting placenta prævia, over the orifice of the Fallopian tube, or, in connection with extra-uterine pregnancy, at various points in the abdominal cavity.

3. **Anomalies of Development.**—An hypertrophied placenta is abnormally large in proportion to the size of the fœtus, occurs chiefly in connection with hydramnion, and consists of a genuine parenchymatous hyperplasia. A small placenta is referable either to defective development, to premature involution, or to hyperplasia of its connective tissue, with subsequent contraction.†

4. **Anomalies of Circulation.**—Hæmorrhage into the placenta is sometimes produced by congestion of the utero-placental vessels, due to disturbances in the mother's vascular system.‡ The extravasation may, rarely, be intra-placental, may occur into the serotina, thus constituting utero-placental apoplexy, or may take place into the uterine sinuses. In the last case, thrombosis of the placental sinuses is said to have occurred.# Placental hæmatomata are the above-mentioned

* Spiegelberg, *op. cit.*, p. 303.

† Whittaker, "Am. Jour. of Obstet.," August, 1870, p. 229.

‡ "Nouv. Dict. de Méd. et de Chirurg. Prat.," vol. xxviii, "Placenta," p. 63.

Slavjansky, "Arch. f. Gynaek.," v, 1873, p. 360.

collections of coagulated blood in various stages of disintegration. The causes of the hæmorrhage are, chiefly, morbid changes in the decidual vessels, often referable to placentitis. The extravasated blood usually experiences the ordinary retrogressive metamorphoses. It sometimes undergoes cystic, fatty, or calcareous degeneration. The pressure upon the villi produced by the hæmatomata impairs the nutrition of the fœtus, and may cause the death of the latter.

Œdema of the placenta, a morbid condition usually attributed to derangement of the fetal or umbilical circulation, is characterized by abnormal pallor, with increased size, friability, and succulence of the placenta, due to serous infiltration. The morbid anatomical changes consist essentially in cystic dilatation in and between the villi, accompanied sometimes by extravasations.

5. **Placentitis.**—The subject of placental inflammation is still involved in obscurity. Many authors dispute its very existence, contending that the morbid changes hitherto referred to placentitis are simply due to retrogressive metamorphoses in extravasations.* Other writers affirm its existence, assign to it etiological relations with metritis and endometritis,† and describe its pathology under the following heads : (*a*) Congestion ; (*b*) Hepatization and induration ; (*c*) Suppuration.‡ According to the latter view, the inflammation originates in the cells of the serotina or in the adventitia of the fetal arteries, and results generally in the formation of new granulation tissue, either nodular or diffuse, which, by contractions, leads to compression or obliteration of placental vessels and to consequent fatty degeneration of the villi. Hæmorrhages also occur upon the fetal placental surface, and fibrous adhesions, forming between the decidua and the uterine wall, may lead to the retention of the placenta after delivery. Should the inflammatory process be of recent date, the friability of the new granulation tissue may cause separation and retention within the uterus of small parts of the placenta. The hæmorrhages sometimes attending placentitis may destroy the fœtus and induce abortion. Suppuration, circumscribed or diffuse, is a rare result of placentitis.

6. **Degenerations and New Formations.**—(*a*) Fatty degeneration of the placenta, circumscribed or diffused, may result from retrograde changes in extravasations. When developed early in pregnancy, it is sometimes regarded as a premature completion of the fatty degeneration normally occurring at the end of pregnancy, and may be due to syphilis or scrofula. (*b*) Amorphous calcareous deposits are frequent, and are almost invariably found on the uterine placental surface, in the decidua serotina. Thence the process may extend to the fetal portion of the placenta. When the calcareous change begins in the

* Whittaker, *loc. cit.*, p. 240.

† Schroeder, "Geburtsh.," 6te Aufl., 1880.

‡ "Nouv. Dict. de Méd. et de Chir.," *loc. cit.*, p. 61.

fetal tissues it is confined to these, and affects the small blood-vessels of the villi, beginning in their terminal ramifications and gradually involving their trunks. (*c*) Pigment deposits, resulting usually from alterations in the hæmoglobine of extravasations, are found in both healthy and diseased placentæ within the blood-sinuses or villi. (*d*) Cysts are of frequent occurrence in the placenta. They are found near the center of its concave surface, and vary from a few lines to several inches in diameter. The cyst-wall is covered by the protruding surface of the amnion. The fluid in the cysts contains albumen and mucin. Fenomenow * regards these cysts as the product of the placental villi. The latter, he supposes, in consequence of irritative changes, swell and undergo a partial loss of epithelium. The denuded surfaces adhere, and thus spaces are formed. The fluid he regards as an excessive physiological secretion from that portion of the epithelium which remains intact upon the villi. (*e*) *Tumors.* Circumscribed tumors, fibromatous or sarcomatous in nature,† are found on the fetal side of the placenta, beneath the amnion. They are produced either by fibroid transformations in the villi, or by cell proliferation in the decidua. Myxoma of the placenta, consisting in hyperplasia of the villi, and myxoma fibrosum placentæ, characterized by the fibroid degeneration of the basement-tissue in isolated villi, are the chief remaining varieties of placental neoplasms.

7. **Syphilis of the Placenta.**—Placental syphilis, which only exists, according to Fränkel,‡ in connection with congenital or hereditary fetal syphilis, involves the maternal portion of the placenta, when the mother was infected either before or soon after conception, and produces gummatous proliferation of the decidua, characterized by the development of large-celled connective tissue, with occasional accumulations of younger cells.

When the infection is conveyed by the father to the fœtus alone, or to both mother and fœtus, pathological changes occur as the result of a chronic inflammatory process, embracing proliferation of the cells and connective tissue in the villi, with subsequent obliteration of the vessels, often complicated by the marked proliferation and hardening of their epithelial covering.

The affected villi become swollen, cloudy, and thickened, while their epithelium undergoes proliferation and cloudy swelling. The parenchyma of the villi is filled with lymph-cells, and the vessels are either compressed or obliterated. The blood-sinuses are gradually encroached upon by the villi, the fœtus dies from lack of adequate nutrition, and the villi undergo fatty degeneration. Portions of the healthy placental tissue, which often intervene between the diseased parts, may be the seat of extravasations.

* Fenomenow, "Zur Pathologie der Placenta," "Arch. f. Gynaek.," vol. xv, p. 343.

† Spiegelberg, *op. cit.*, p. 345. ‡ Fränkel, "Arch. f. Gynaek.," v, 1873, p. 52.

Anomalies of the Amnion and of the Amniotic Fluid.

I. Hydramnion.—Inasmuch as the amount of the liquor amnii varies considerably within normal limits, the term hydramnion should be restricted to those cases in which the amount of fluid is so large as to produce morbid symptoms by its pressure upon the uterus, the abdominal and thoracic viscera. When the quantity exceeds two to three pints, inconveniences are often experienced. It is, however, usually only when the higher degrees—viz., five pints and upward—are reached that the symptoms possess such an intensity as to constitute a special malady.

It is customary to distinguish an acute and a chronic form, in the former a rapid increase in the size of the abdomen taking place in a few days, or even, as in a case reported by Sentex, in a single night; whereas in the latter the progress is slow, extending over months, and occasioning infinitely less disturbance of function.

Etiology.—The causes of hydramnion are hardly to be found in a single morbid condition. In a limited number of cases—and this is especially true of the rare acute form, though even in these not in all reported instances—the excessive production of fluid was found to be associated with inflammation of the amnion. In by far the largest proportion of cases, however, the evidence is strong that the excess of fluid is of fetal origin. Sallinger's* experiments show that when a liquid is injected into the umbilical vein it transudes with great rapidity into the amniotic sac, and that the amount of transudation is proportioned to the pressure exerted, and to the size of the cord. Jungbluth described, during the first half of pregnancy, a capillary net-work (*vasa propria*), connected with the vessels of the umbilical cord, developed just beneath the amnion, in that portion of the chorion which covers the placenta. Levison† found that this capillary net-work was persistent at term in hydramnion, but not in normal pregnancy. Between these vessels and the inner surface of the amnion, canalicular spaces furnished a series of communicating passages. Lebedjew‡ concluded that, in certain abnormal conditions of the fœtus found associated with hydramnion, the capillary net-work of Jungbluth was persistent to the end of pregnancy. With these anatomical conditions an increased secretion, due to stasis in the *vasa propria*, would result from any condition causing stenosis of the umbilical vein, from obstructions to the hepatic circulation, and from diseases of the fetal heart and lungs. In this connection it is proper to observe that syphilis, and especially syphilitic affections of the liver, are frequently associated with hydramnion.

* Sallinger, "Dissert. Inaugural," Zurich, 1875.

† Levison, summary in "Arch. f. Gynaek.," vol. ix, p. 517.

‡ Lebedjew, *vide* "Traité pratique des accouchements," par Dr. A. Charpentier, p. 886.

Charpentier found that, in one hundred and twenty-three cases of multiple pregnancy, fifty-two were cases of hydramnion. Küstner,* Schatz,† and Werth ‡ have recently drawn attention to the occurrence of hydramnion affecting one amniotic sac only in twins developed from the same ovum—i. e., with a single chorion, the sac of the second fœtus containing less than the normal quantity of fluid. In all these cases, in the fœtus contained in the hydramniotic sac both heart and kidneys were hypertrophied, and the amniotic fluid contained an unusual amount of urea. The cardiac hypertrophy Küstner ascribes to the appropriation by the stronger fœtus of the placental territory, which, in twin pregnancies from a single ovum, is primarily common to both fœtuses. The increased work thus entailed upon the heart leads to a thickening of its walls, which in turn is followed by increased growth and activity of the kidneys. In Küstner's cases there was likewise hepatic obstruction. Werth suggests that the activity of the fetal circulation leads to more active absorption on the part of the placental villi, and that the insufficient action of the kidneys, in their attempt to maintain the necessary equilibrium in the fetal circulation, explains the outpouring of fluid, not only into the amnion, but into the serous cavities of the fœtus, as is often observed in hydramnion.

The question as to how far the amniotic fluid may be of maternal origin is still an undecided one. Ahlfeld and Leopold maintain that serum may pass through the pores in the chorion and amnion from the vessels of the decidua reflexa (and later from those of the ova) directly into the amnion. Zuntz, Wiener, and Bar state that substances, experimentally injected into the maternal veins, may be found in the amniotic fluid without having first traversed the body of the fœtus.#

Symptoms and Signs.—The distention of the uterus, and the consequent abnormal expansion of the abdomen, produced by hydramnion, results in an impediment to locomotion, and produces discomfort or actual pain by traction upon the abdominal parietes. The diaphragm is forced upward, and, encroaching upon the thoracic space, compresses the lungs and displaces the heart, thus producing dyspnœa and cardiac palpitation. The urine may become scanty and albuminous from impeded renal circulation. Neuralgic pains and œdema of the abdominal walls, of the labia and lower extremities, are produced by compression of the pelvic nerves and vessels. Vomiting and dyspeptic symptoms result from direct compression of the digestive organs or from reflex irritation of them. Ascites may be produced by obstruction of the portal circulation. Insomnia results from the patient's

* Küstner, "Arch. f. Gynaek.," vol. xxi, p. 1.

† Schatz, "Arch. f. Gynaek.," vol. xix, p. 329.

‡ Werth, "Arch. f. Gynaek.," vol. xx, p. 353.

Vide Charpentier, "Traité pratique des accouchements," p. 890.

general discomfort and the deterioration of her health. In the acute form, vomiting is often incessant, the pain is intense, and febrile symptoms develop. Physical examination reveals, in advanced cases, an immensely distended abdomen. The uterus, which can be easily mapped out by palpation and percussion, is tense, elastic, and obscurely fluctuating. The fetal cardiac sounds are faint or imperceptible. The fœtus changes its position with unusual rapidity and facility. Combined manipulation shows the lower segment of the uterus to be elastic and tense, while the fœtus can not be readily felt by the finger placed in contact with the cervix. Pregnancy accompanied by hydramnion seldom reaches its normal termination, delivery being prematurely induced by death of the fœtus, by separation of the placenta, or by over-distention of the uterus. The first stage of labor is abnormally prolonged, because of the comparatively feeble contractions of the expanded uterine walls. Labor may become precipitate in the second stage, owing to the sudden escape of the amniotic fluid ; and uterine inertia, in the third stage, frequently results in *post-partum* hæmorrhage. Involution is apt to be protracted and incomplete.

Diagnosis.—Hydramnion may be mistaken for twin pregnancy, but is easily excluded by the rational symptoms, by the tenseness of the uterine walls, by the feebleness or absence of fetal heart-sounds, and by the difficulty experienced in perceiving the fœtus on palpation.

Prognosis —The prognosis for the child is fatal in nearly one fourth of the cases. For the mother it is favorable, although the risk of *post-partum* hæmorrhage is considerable. This high mortality is due to malformations of the fœtus, to dropsical affections, to prematurity, and the frequency of faulty presentations. Thus, of one hundred and thirteen cases collected by Charpentier, twenty-one presented by the breech, twenty by the shoulder, and two by the face.

Treatment.—The treatment embraces the application of an abdominal supporter and the injunction to refrain from active physical exertion. Grave disturbances of the mother's heart indicate the induction of premature delivery, which should, however, in the interest of the child, be delayed as long as is consistent with maternal safety. In parturition, the membranes should be punctured if the accumulated liquor amnii retard the dilatation of the cervix. Puncture must be performed in the interval of the pains, in order that the waters may escape gradually and leave the position of the child unchanged. After the expulsion of the placenta, the usual prophylactic measures against *post-partum* hæmorrhage must be promptly adopted.

II. **Abnormally Small Amount of Amniotic Fluid.**—The quantity of amniotic fluid may, even in some cases of advanced pregnancy, be so limited as to render the uterus unusually small and firm, and to limit the freedom of the fetal movements. Under these circumstances,

the movements are so plainly perceptible to the mother as to be the source of positive discomfort.

An abnormally small quantity of liquor amnii is, however, only of importance in the earlier stages of fetal development. If the amnion be not then separated from the fœtus by an adequate amount of fluid, abnormal amniotic foldings and adhesions between the amnion and the surface of the fœtus may take place.

The so-called fœto-amniotic bands * thus formed may, by mechanical compression, result in various fetal deformities, or in spontaneous, intra-uterine amputation.

Anomalies of the Umbilical Cord.

I. **Torsion.**—Torsion consists in such a rotation of the umbilical cord upon its longitudinal axis that its vessels are thereby rendered nearly or quite impermeable. It occurs most frequently in fœtuses which have advanced beyond the middle period of normal utero-gestation, particularly, according to Spiegelberg,† in those of the seventh month. It is, however, often met with in fœtuses of an earlier age. Until a comparatively recent period, authors have unreservedly attributed torsion to active movements on the part of the fœtus, and regarded it as the cause of the latter's death. Martin ‡ has shown that this theory is untenable for the majority of cases, because the pathological conditions which result from fetal death induced by torsion, whether rapidly or slowly produced, are almost invariably absent. These morbid anatomical processes embrace rupture of the umbilical blood-vessels, and extravasations, for cases of sudden origin, and congestion, with œdema, for those more gradually developed. Martin, therefore, concluded that torsion was a *post-mortem* event, resulting from rotation of the fœtus produced by maternal movements. Ruge # earnestly advocated the same view, and suggested the various morbid changes due to syphilis, endometritis placentaris, and sub-placental hæmorrhage as the cause of fetal death in cases which subsequently developed numerous torsions. Schauta ‖ appears as a recent champion of the same theory, although he admits that loose torsions, incapable of producing actual stenosis of the umbilical vessels, may often occur during the life of the fœtus. He bases his belief in the *post-mortem* occurrence of torsion—1. Upon the large number of twists often presenting themselves, any one of which would have involved the death of the fœtus. Even granting the original torsion to have been of *ante-mortem* origin, the others must then have occurred after death. 2.

* Fürst, "Arch. f. Gynaek.," Bd. ii, 171, p. 318.

† Spiegelberg, "Lehrbuch," p. 350.

‡ Martin, "Ztschr. f. Geburtsh. u. Gynaek.," Bd. ii, Heft 2, 1878, p. 346.

Ruge, *ibid.*, Bd. iii, Heft 2, 1878, p. 417.

‖ Schauta, "Arch. f. Gynaek.," Bd. xvii, Heft 1, 1881, p. 20.

Upon the improbability of the formation of very numerous torsions in a healthy cord, inasmuch as its elasticity would lead to compensatory

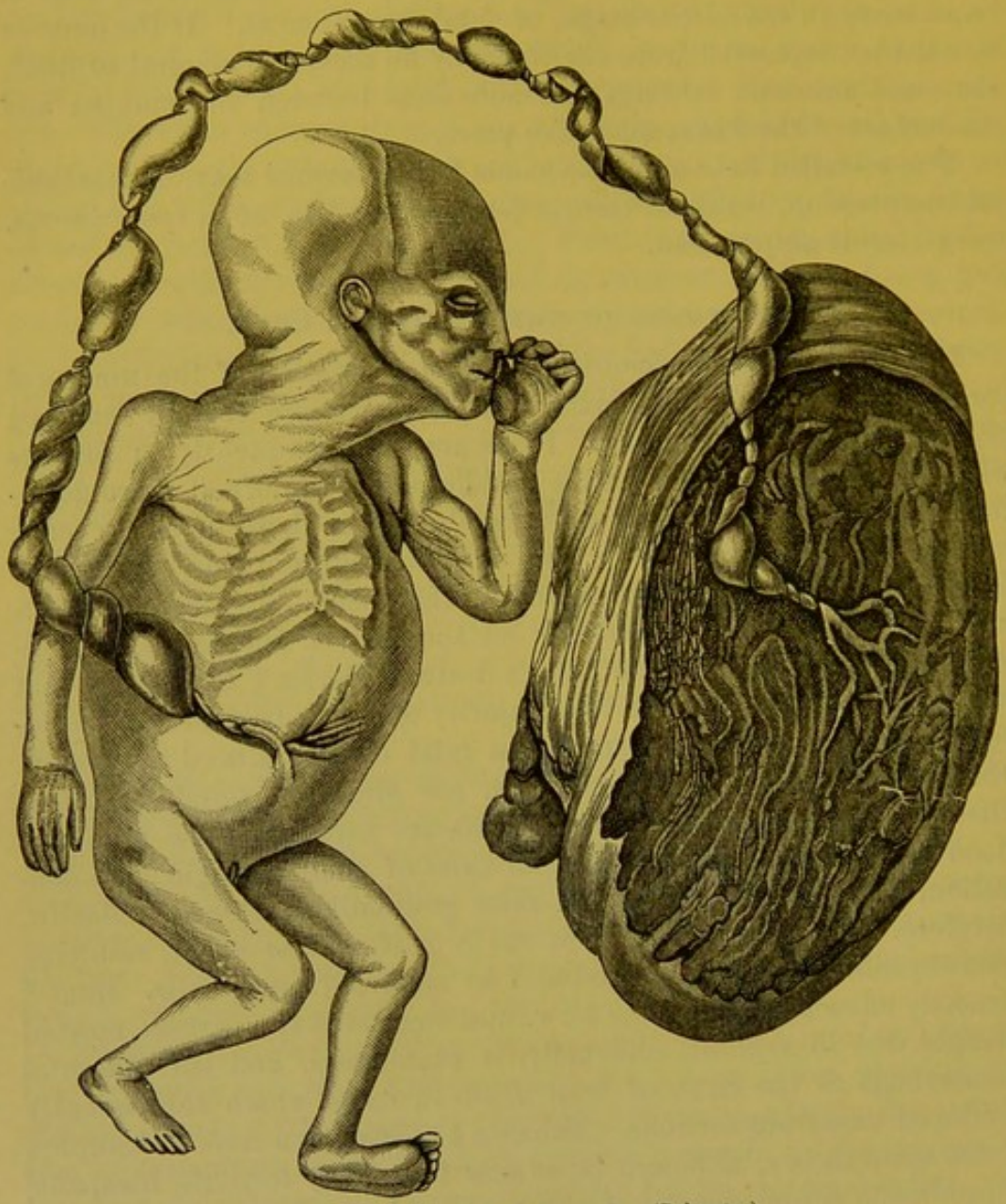


Fig. 144.—Torsion of the cord. (Schauta.)

reverse rotation. 3. Upon the fact that even twenty-five artificially induced torsions resulted in rupture of the normal cord from excessive tension. Schauta regards the cysts found in connection with some torsions as insufficient proof of their *ante-mortem* occurrence. Torsions are more frequently present in the umbilical cords of male than in those of female fœtuses, and are sometimes surprisingly numerous. Schauta reports a case in which he observed three hundred and eighty rotations of the cord on its longitudinal axis. It occurs by preference in multiparæ, probably on account of the greater latitude afforded for

fetal movements. Unusual length of the cord favors its occurrence, for a similar reason. The seat of the torsion is ordinarily in close proximity to the umbilicus. It occurs but rarely at the placental end or in the center of the cord. The umbilical vessels are usually nearly occluded at the seat of the torsion, but still permeable. Thrombi of varying consistency are often found in the vessels. Sero-sanguinolent fluid in the abdominal cavity of the fœtus, œdema, and cystic degeneration of the cord, are also pathological conditions frequently attending torsion.

II. **Knots.**—Knots in the umbilical cord, which occur once in two hundred cases, may result from the passage of the fœtus through a twisted loop of the cord, whether the passage be effected during pregnancy, by the spontaneous fetal movements, or at term, by the uterine expulsive efforts or by the manipulations of the *accoucheur*. Knots formed during parturition are loose and easily untied. They are unattended by any diminution in the gelatine of Wharton. Those occurring during pregnancy are more closely and firmly drawn, and more difficult to loosen, than the former variety. The cord is partly or completely denuded of the gelatine at the seat of the knot, and plainly shows the location of the latter, after its solution, by well-marked indentations. Knots in the cord, of either variety, are comparatively insignificant, although a tightly contracted one, in a thin cord, may occasion grave or even fatal disturbance of the umbilical circulation.

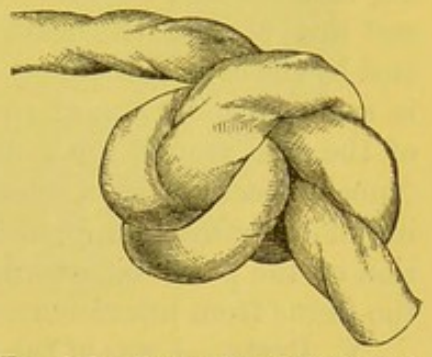


Fig. 145.—Knot of umbilical cord. (Leyman.)

III. **Hernia.**—Hernia of the umbilical cord consists in the escape from the abdomen, at the point of insertion of the cord, of some or all of the fetal abdominal viscera. It is due either to arrested embryonic development, which prevents the complete closure of the abdominal cavity, or to the failure of the fetal intestines, originally situated outside the abdomen, to enter the same. Hernia of the cord may occur alone, in otherwise normally developed fœtuses, but is usually accompanied by other deformities, such as stricture of the rectum, imperforate anus, or distortions of the lower limbs and of the genitals, produced by traction of the displaced viscera upon adjoining parts. The contents of the hernial sac, which is composed of the amnion and of the peritonæum, are usually convolutions of the intestine, or these with a portion of the liver, although the kidneys, stomach, and spleen are sometimes also extruded, leaving the fetal abdomen nearly empty.

IV. **Coiling of the Cord.**—Windings of the umbilical cord around the fœtus, occurring during pregnancy, vary in their results with the

rapidity of their formation. When rapidly developed they may, in rare cases, lead to sudden interruption of the umbilical circulation, and to consequent death of the fœtus. Should the coils be gradually formed and firm, the extremity embraced by the cord increases, by its own growth, the tightness of the constricting ligature. The latter slowly lessens the caliber of the vessels supplying the extremity concerned, and finally, occluding them, produces death of the limb. Absorption of the soft and hard parts of the extremity may result from the cord's unyielding pressure, and the limb be thus completely severed from the trunk by so-called spontaneous amputation. In certain cases the combined pressure of the cord and of the slowly growing member may suffice to completely arrest the umbilical circulation, and thus produce the death of the fœtus. Should the neck be encircled by the cord, death may ensue from strangulation, and be followed, in some cases, by almost complete amputation of the head. Coilings of the cord around the fœtus occurring at birth are of little importance unless they be numerous. In that case they lead to a shortening of the cord, and produce anomalous positions, premature separation of the placenta, retarded second stage of labor, and even death of the fœtus from interference of the umbilical circulation.

V. **Cysts.**—Cysts of the umbilical cord, within the amniotic sheath, are either produced by liquefaction of mucoid tissue or by accumulation of serum between the epithelial layers of the allantois.

VI. **Stenosis of Umbilical Vessels.**—Partial occlusion of the umbilical vein, at the placental insertion, produced by new connective tissue resulting from circumscribed periphlebitis, is sometimes observed, but is not sufficiently marked to impede the umbilical circulation. Stenosis of the umbilical arteries is occasionally produced by atheroma and subsequent thrombosis. Stenosis of the umbilical vein, and, more rarely, of the arteries, may also result from chronic phlebitis characterized pathologically by the growth in the intima of spindle-shaped and round cells which, later, develop into new connective tissue. This process, which is usually referred to hereditary syphilis,* may extend into the muscularis, and even invade the adventitia. The result of the stenosis of the uterine vessels is, of course, prejudicial to the fœtus in direct proportion to its grade of development.

VII. **Calcareous Degeneration.**—Calcareous deposits have been observed in the cords of syphilitic fœtuses.

VIII. **Marginal Insertion of the Cord.**—This anomaly is sometimes called the battledoor placenta, while the term insertio velamentosa is applied to cases where the vessels of the cord pursue their course for some distance through the membranes before reaching the placenta. To comprehend their origin, it is necessary to recall the main physiological processes involved in the normal development of the placental

* Mewis, "Ztschr. f. Geburtsh. u. Gynack.," Bd. iv, Heft 1, 1879, p. 62.

organ. The vessels of the allantois are not invariably carried at the outset to the point in the periphery of the ovum which the placenta will ultimately occupy. The vessels at first penetrate all the villi in-

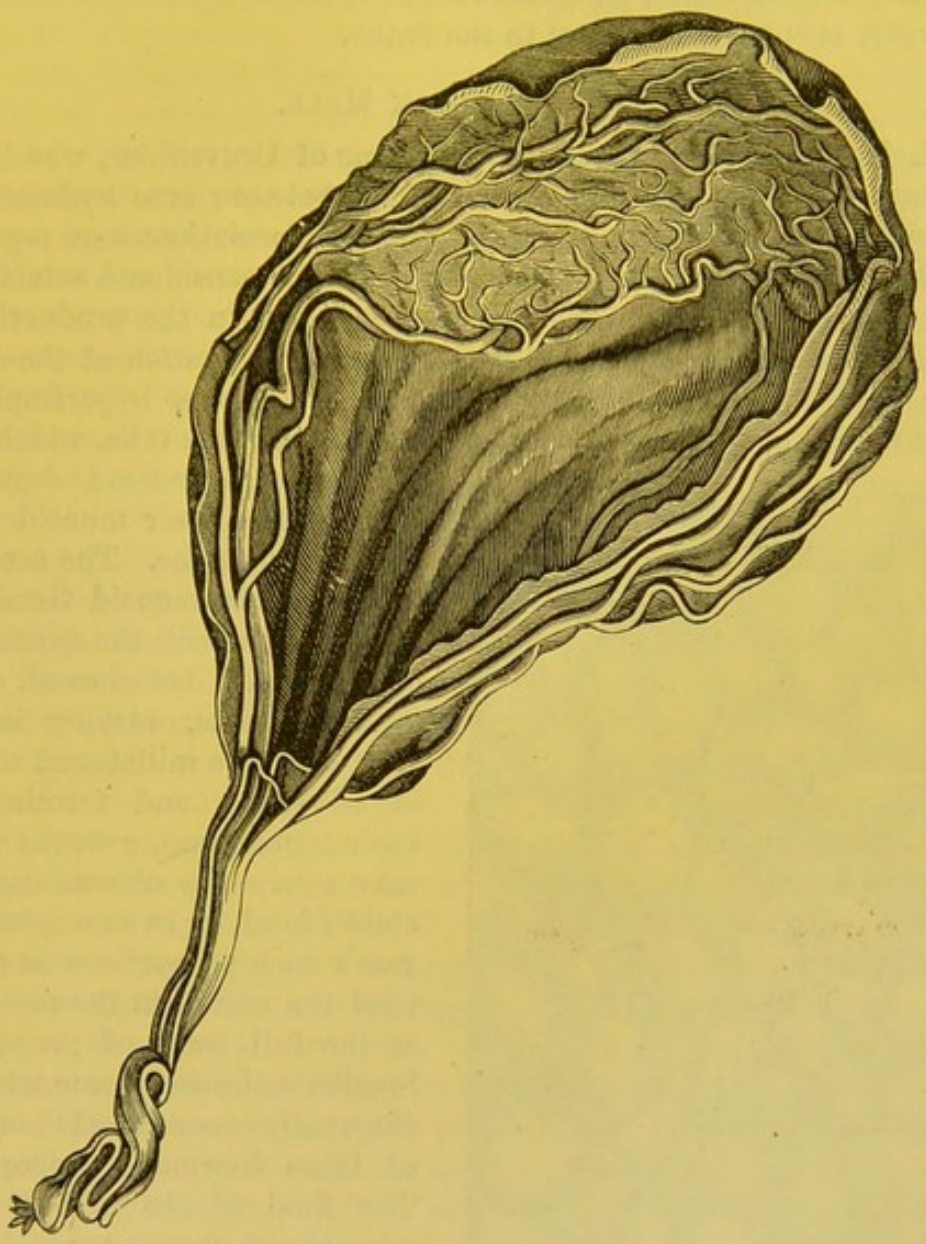


Fig. 146.—Insertio velamentosa. (Lobstein.)

discriminately, but, as the process of obliteration advances in those villi not destined to participate in the formation of the placenta, vascular connections are only preserved between the vessels of the newly formed cord and the villi attached to the serotina. As the amniotic sheath forms around the rudimentary cord, the fœtus performs a movement of rotation in such a way that the umbilical vessels are made to pursue a direct course toward their placental insertion. If, owing to adhesions between the rudimentary cord and either the chorion or the amnion, the formation of the sheath is incomplete, the

vessels diverge, and are distributed to points more or less distant from the placenta (Schultze). In the insertio velamentosa, hæmorrhage sometimes results from a rupture of a vessel at the time of the breaking of the membranes, an accident which, unless speedily followed by delivery, is apt to prove fatal to the fœtus.

Hydatidiform Mole.

I. **Morbid Anatomy.**—Before the time of Cruveilhier, who is said to have first demonstrated the difference between true hydatids and the uterine hydatidiform mole, these morbid formations were regarded as identical. Since his researches, it has been considered established that the essential pathological process involved in the production of the hydatid mole consists in a proliferative degeneration of the chorionic villi. This degeneration of the villi embraces hypertrophy of their investing epithelium, of their connective-tissue cells, which may also undergo mucoid degeneration, and of their mucoid intercellular substance. The accumulation of the mucoid tissue imparts to the villi the appearance of cysts with translucent, semi-fluid contents, varying in size from that of a millet-seed to that of a walnut, and forming, by their aggregation, growths which may attain the dimensions of a child's head, or in rare cases may reach such proportions as to distend the uterus to the size usual at the full term of pregnancy. Smaller collections are much more frequently encountered than those of these enormous proportions. The fluid of the cysts is albuminous and closely resembles the liquor amnii, but contains in the earlier stages a larger proportion of mucin than the latter. At a later period the mucin is less abundant, while the albumen increases in quantity. The larger cysts are richer in water, but contain less mucin, than the smaller ones. Inasmuch as the degenerative process does not attack the entire villus, portions of normal tissue intervene between the cysts, and impart to the degenerated mass the appearance of grape-clusters—the cysts representing the individual berries, and the unaltered tissues their connecting stems. A certain number of cysts are, however, attached to a

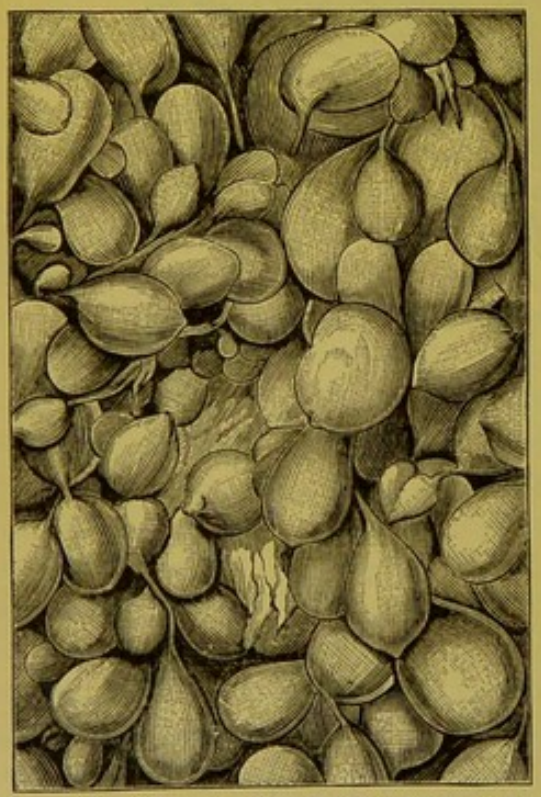


Fig. 147.—Specimen from hydatidiform mole, in the Wood Museum.

single, continuous pedicle, instead of possessing a separate stem connected with a common trunk, as is the case in the grape-cluster. If the mole be formed, as is usually the case, during the first month, while the villi are equally developed upon the entire periphery of the ovum, the degeneration will involve its whole surface. In this case the fœtus, dying and becoming disintegrated, may undergo complete absorption, leaving the amniotic cavity empty. The vessels of the villi are, under such circumstances, completely obliterated, while numerous blood-coagula are found between the cysts. If, however, the placenta be already formed at the beginning of the cystic degeneration, the villi having already become atrophied upon that part of the chorion not participating in the development of the placenta, the neoplasm is confined as a rule to the latter, although cysts, evidently owing their origin to villi which have not undergone atrophy, sometimes occur upon the smooth surface of the chorion. Should the hydatidiform mole be of sufficient extent, under these circumstances, to destroy the fœtus, the more or less disintegrated remains of the latter are found in the amniotic cavity, which sometimes contains an excess of liquor amnii. If only a few of the placental lobes or single cotyledons be implicated, the growth of the fœtus may not be disturbed. A healthy fœtus is occasionally developed side by side with a hydatid mole.* The hydatidiform mole is usually contained within the decidua. In an interesting case reported by Volkmann, however,† the degenerated villi had invaded the uterine blood-sinuses, and by pressure led to so extensive an atrophy and absorption of the uterine walls as to leave only a thin, transparent septum between the mole and the peritoneal covering of the organ. The cavity formed by this process of erosion in the uterine parenchyma was larger than the uterine cavity proper, and presented numerous intersecting trabeculæ resembling the columnæ carneæ of the cardiac ventricles. The destructive character of the cystic degeneration is attributed in such cases to some unknown morbid condition of the uterine walls, probably the result of malnutrition. Schroeder‡ refers to two similar cases, in one of which the cystic degeneration was attended by fatal peritonitis and the other by rupture of the uterus, and death from hæmorrhage into the peritoneal cavity.

II. **Etiology.**—Primiparæ are less frequently affected by the hydatidiform mole than multiparæ, although the actual number of pregnancies seems to exert a less marked predisposing influence than advancing age. The cystic degeneration usually occurs during the first month of utero-gestation. According to Underhill,# the latter part of the third month is the limit within which the disease can originate.

* Spiegelberg, "Lehrbuch," p. 332.

† Volkmann, Virchow's "Archiv," Bd. xli, p. 528.

‡ Schroeder, "Lehrbuch," p. 429.

Underhill, "The Hydatidiform Mole," "Obstet. Gaz.," January, 1879, p. 16.

That the exciting cause of the hydatidiform mole may be a morbid maternal condition is rendered probable by the repeated recurrence of the disease in the same patient, by its coexistence with inflammatory decidual disease, or with extensive uterine fibroids, and by the presence, in the majority of cases, according to Underhill, of a cancerous or syphilitic dyscrasia on the part of the mother. If the origin of the degeneration be maternal, as it probably is in most instances, the degeneration of the chorion antedates and produces the death of the fœtus. On the other hand, the fact that the morbid growth may owe its inception to fetal disease seems demonstrated by those cases in which, as has been already stated, a healthy fœtus may be developed in the same amniotic cavity with a hydatidiform mole. This view is further supported by those cases in which death of the fœtus is attended by so insignificant an amount of chorionic disease as to render its active causative agency in the death of the fœtus highly improbable. Spiegelberg * is of the opinion that the hydatidiform mole does not result from death of the embryo, and that its cause is often to be sought in an abnormal development of the allantois. The establishment of the true pathological relations of the hydatidiform mole have led to the abandonment of the once prevalent opinion that the neoplasm might be developed independent of conception. The theory that a portion of retained placenta might become affected with the hydatidiform disease has also been refuted by accumulated clinical evidence.

III. **Symptomatology.**—A leading sign of the hydatidiform mole consists in a failure of correspondence between the uterine enlargement and the computed period of utero-gestation. The uterus is usually larger at any given stage of pregnancy than it naturally would be in the course of normal gestation, but may be decidedly smaller in those cases attended by early demise of the embryo. Lumbar and sacral pains are prominent and distressing in proportion to the rapidity of uterine development. The uterus imparts a peculiar doughy feeling to the palpating fingers, and in rare instances plainly perceptible fluctuation. Individual parts of the fœtus can not be distinguished through the uterine walls. The lower segment of the uterus is remarkably tense. Ballottement yields negative results and fetal movements are absent, although they may be closely simulated by uterine contractions. The fetal cardiac sounds are diminished in intensity or are quite imperceptible. There is a discharge from the uterus, either constant or intermittent, consisting of disintegrated and unruptured cysts, cystic fluid, and blood, which, although usually not excessive, may be so much increased by uterine contractions, induced by over-distention, as to seriously impair the general strength, or even to induce death from exhaustion.

* Spiegelberg, "Lehrbuch," p. 333.

Abortion is usually produced by the mole before the sixth month, but the expulsion of the neoplasm may be delayed until the normal period of parturition, or even until a later season. The hæmorrhage and the characteristic discharge cease after the complete expulsion of the tumor, but retained portions of the same may give rise to protracted bleeding. It is often impossible to distinguish the local signs produced by the expulsion of a large hydatidiform mass from those observed after normal delivery.

Diagnosis.—In cases of limited cystic degeneration it is often impossible to diagnosticate hydatidiform mole. The symptoms upon which, in well-marked cases, the diagnosis is to be based are rapid increase in the dimensions of the uterus, the presence of obscure fluctuation, the impossibility of obtaining the fetal heart-sounds, or of grasping any of the fetal members, negative result of *ballottement*, and uterine contractions, attended by the mucous or muco-sanguinolent discharge containing the characteristic cysts.

Prognosis.—The prognosis of hydatidiform mole is determined chiefly by the frequency and the violence of the attending hæmorrhages. It is not extremely unfavorable in the majority of cases. The existence of the peculiar form of cystic degeneration described as the interstitial, intra-parietal, or eroding variety would, however, naturally render the prognosis exceedingly grave. The fatality of this class of cases results from their tendency to produce a rupture of the uterus complicated by intra-peritoneal hæmorrhage, peritonitis, or septicæmia. The life of the fœtus is almost invariably sacrificed.

Treatment.—The treatment is restricted to measures calculated to control hæmorrhage, and to promote the expulsion of the diseased mass. Most writers recommend non-interference so long as the uterus remains passive. When, however, contractions set in, the vagina should be tamponed, and ergot given in full and repeated doses, until the mole is expelled entire. The expectant plan is, however, not devoid of danger. In one case, where the patient suffered from labor-pains for several hours before I saw her, the loss of blood was excessive. I succeeded in removing, with the hand, through the patulous cervix, an enormous quantity of cysts, sufficient to fill a wooden pail. This was followed by good contraction of the uterus and arrest of the hæmorrhage, but the patient died two hours later from shock and anæmia. Unless, therefore, the patient is so placed that professional assistance can be obtained at a moment's notice, the propriety of dilating the cervix so soon as the diagnosis has been established may well be considered. Dilatation should be effected by the finger, or by the dilators of Barnes or of Tarnier, rather than by tents, because of the tendency of the latter to increase the dangers of septicæmia.

After expulsion, or after the manual removal of the hydatidiform cysts, the uterus should be washed out with antiseptic fluids, or, in case of hæmorrhage, its inner surface should be swabbed with the perchloride of iron. The irrigation of the uterine cavity with water, to which only sufficient perchloride of iron has been added to give it a wine-color, has often a powerful styptic effect. Underhill recommends the continued employment of ergot after delivery, and, in cases of persistent hæmorrhage, the occasional introduction of the laminaria tent, and, if necessary, the employment of Thomas's dull-wire curette.

Retention, in Utero, of the Dead Fœtus.

In the normal uterus the causative conditions producing retention of the dead fœtus are not invariably identical. If the placenta remain adherent to the uterus after the demise of the fœtus, the continued vitality and uninterrupted development of the placenta sufficiently explain the fetal retention. When, however, all connection between the placenta and the uterus has been severed, retention is probably referable to the diminished irritability of those reflex nervous centers which control the expulsive uterine efforts. The duration of retention produced by adhesion of the placenta, in cases of single pregnancy, is protracted until such time as morbid placental processes impair the vitality of that organ and induce its separation. In multiple pregnancies, attended by death of one or more of the fœtuses, the latter are usually expelled with the healthy fœtus at term. They are, however, sometimes expelled earlier, and, in rare instances, later than the normal fœtus, and it may in general terms be stated that retention produced by placental adhesion very rarely exceeds the natural period of gestation. Retention due to diminished irritability of the reflex centers may be indefinitely prolonged. Liebmann * is of the opinion that all cases of retention protracted beyond the normal term of pregnancy belong in this category.

The pathological changes which the fœtus undergoes when retained in the uterus after its death vary with the condition of the membranes: 1. If their integrity be preserved, the most important pathological fetal conditions resulting from the retention are mummification, maceration, and fatty degeneration. 2. If the membranes be ruptured soon after the death of the fœtus, or if their rupture be the cause of the termination of fetal life, mummification may ensue; or, in the event of the entrance of air into the uterine cavity, the fetal tissues may undergo putrefactive changes. If mummification has already occurred, putrefaction does not take place.†

Mummification.—Mummification is most frequently observed in fœ-

* Liebmann, "Beitrag z. Geburtsh. u. Gynaek.," Bd. iii, 1874, pp. 59, 63.

† Spiegelberg, "Lehrb.," p. 367.

tuses whose death has apparently been the gradual result of inanition from inadequate blood-supply, this insufficiency of the nutritive fluid being often referable to torsion or constriction of the umbilical cord. Mummification affects, by preference, fœtuses dying during the middle stages of gestation. Liebmann * suggests that this fact may be connected with the augmented rapidity of endosmosis, due to the larger percentage of saline ingredients then present in the amniotic fluid, or to the fact that torsion and stenosis of the cord are most liable to occur at that period of pregnancy. Mummification occurs chiefly in connection with twin pregnancies, one fœtus being fully developed while the other becomes mummified. In this case the presence of the dead fœtus does not usually excite expulsory uterine efforts before the normal termination of pregnancy is reached, when both fœtuses are simultaneously delivered. In certain rare instances the mummified fœtus may be expelled either before or after the healthy one, but its delivery is unattended by hæmorrhage or other unpleasant complication. When mummification affects a single fœtus, the retention is supposed to be due to abnormally intimate connection between the placenta and the uterus. Symptoms closely simulating those of abortion occur, but they subside before the product of conception is expelled, and probably even before the rupture of the membranes. The fœtus then becomes mummified, while the vitality of the placenta is not impaired. Under these circumstances the retention is never prolonged beyond the normal period of gestation, and is thus distinguished from those cases of retention owing their origin to so-called "missed labor."

A mummified fœtus is flattened from compression. Its viscera are of soft consistency and of small dimensions. Its surface is shrunken. The peritoneal and pleural cavities contain a scanty and discolored fluid. The subcutaneous areolar tissue has disappeared, and the skin lies in direct contact with the muscles. The placenta, which is dry, yellowish, and tough, is the seat of fatty degeneration, and contains the residue of old extravasations.

Maceration.—The placenta of a macerated fœtus is anæmic, soft, and friable. The cord, in which the vessels are permeable, is cylindrical, smooth, spongy, and inelastic. Its coils have disappeared. It is club-shaped at the fetal extremity, and its color is brownish-red. The amniotic fluid has a peculiarly repulsive, sweetish, and sickening odor, unlike that of putrefaction. The fluid is rendered turbid and of a greenish-yellow color by the admixture with it of sero-sanguinolent fluid, and of meconium. The membranes, which retain their normal consistence for a long time, finally become friable, swollen, and discolored. A fœtus of only one to two months may be completely dissolved by the process of maceration. If the fœtus be more mature, its

* Liebmann, *op. cit.*, p. 54.

general form and the outline of its organs are preserved, but granular degeneration and disintegration of their anatomical elements are everywhere present. The epidermis is first affected by the process of maceration. It is separated from the corium by the formation of vesicles, similar to those of pemphigus, which contain either a reddish, serosanguinolent, or a clear serous fluid. The corium is infiltrated with the same fluid, and presents the appearance of brownish-red macerated parchment. The subcutaneous areolar and adipose tissues are reddish and œdematous. The œdema is most apparent over the cranium, the abdomen, the feet, hands, and sternum. The entire body is flaccid, and assumes, under the influence of external pressure, curiously distorted shapes, being distended at some points, and depressed or flattened at others. The cranial sutures are separated, the joints are disarticulated, and the periosteum has become detached from the long bones. The vessels are filled with dark, grumous blood. The serous cavities are distended with bloody serum. The brain is transformed into a grayish-red pulp. All the viscera are infiltrated and friable, the uterus and lungs preserving their normal consistence longer than the other organs. Pigment masses and fat-crystals are deposited in many organs. In rare instances the fetal organs become covered with a greasy substance composed of cholesterin, and the margarates of soda, potassa, and lime. These saponified products are sometimes termed, collectively, *adipocére*. No trustworthy inferences can be drawn from the appearance of macerated fœtuses as to the cause of their decease, since the gross pathological conditions are identical under all circumstances.* Apparent variations are due to the respective periods of retention. The rapidity with which the process of maceration occurs is variable, and its extent is, therefore, no criterion of the time at which the fetal demise took place.

Seventy-five per cent. of macerated fœtuses are expelled, according to Ruge,† before the thirty-first week, and transverse or breech-presentations occur in nearly one half of all the cases.

The term *missed labor* was applied by Oldham to those cases in which, the uterine expulsive efforts having been ineffectually made at full term, without other result than the escape of the waters, the uterine contractions finally subside, leaving the fœtus *in utero*. The causes of missed labor usually cited are abnormal absence of uterine irritability, or of that residing in the reflex nervous centers, obstructed labor, and unusually close adhesions of the placenta.

Note.—The occurrence of missed labor has recently been disputed by Müller ("De la grossesse utérine prolongée indéfiniment," Paris, 1878), who would refer all such cases to gestations occurring external to the uterine cavity. Certainly the criticisms of Müller have greatly restricted the number of cases which formerly were unquestionably as-

* Ruge, "Zeit. f. Geb. u. Gyn.," Bd. i, Heft 1, 1877, p. 58. † *Ibid.*, p. 70.

signed to this category. In certain of them the fœtus appears secondarily to have made its way into the uterus through a communicating passage, while in others the pregnancy may have been primarily of tubo-uterine or of mural origin. Still, Barnes has since related the history of a case ("On the So-called 'Missed Labor,'" "Obst. Trans.," vol. xxiii, p. 81) which affords strong affirmative evidence of the possibility of the prolonged retention of a fœtus dying before the end of gestation was reached. The circumstances were briefly as follows: Mrs. B——, aged thirty-nine, had borne three stillborn children. Five years later, in the month of October, the catamenia ceased. The movements of the child were felt between the third and fourth month. Between the eighth and ninth months there was a flow of blood from the vagina, which, however, ceased in a few days under the use of cold and styptics. At the end of three weeks the bleeding returned, but became lighter at the end of a week, and then gradually disappeared. At no time were there labor pains. At the end of January pieces of bone began to come away, and portions of bone were removed by the finger and forceps after partial dilatation of the cervix. In February, under chloroform, Dr. Barnes proceeded to empty the uterus. As the hand could not be got through the uterus, Dr. Barnes extracted the fœtus with his craniotomy forceps. The fœtus was a compressed mass, bones emerging in the surface, the fleshy part greasy, soft, and putrid. It presented the appearance of having reached the eighth or ninth month of gestation. The patient showed considerable shock after the operation, but rallied the next day, and eventually recovered. Dr. Barnes was convinced, not only by examinations made during the extraction of the fœtus, but by the subsequent daily introduction of the sound, that the cavity was continuous with the cervix, and that the dense wall felt in no respect differed from the characters of uterine wall. To his mind, even a *post-mortem* examination could hardly have made the case clearer. In the discussion which followed Dr. Barnes's report, it was, however, suggested by Sir Spencer Wells and others that the case was really one of mural pregnancy.

Dr. Stanley P. Warren, of Portland, Maine, sends me the following history, which seems conclusive: The patient menstruated last in January, 1884. In the following May she was attacked with general peritonitis. The 28th of October was computed as the probable terminus of gestation. At that time continuous cramp-like pains were felt by the patient. The presentation of the child was transverse. The cervix was not reached. For several days the pains recurred at night. By the second week in November it was ascertained that the child was dead. There was no further expulsive action. On December 30th, after vain attempts at dilatation of the cervix, Cæsarean section was performed, and a female child, weighing eight and a half pounds, was removed from the uterine cavity. The patient died from shock twenty-eight hours after the operation.

According to Küchenmeister ("Ueber Lithopädien," "Arch. f. Gynaek.," vol. xvii, p. 153), retention may result from obstruction due to hardening of the cervix, to carcinoma, to fibroids in the lower segment, and where pregnancy takes place in the rudimentary cornu of a one-horned uterus. Retention due to obliteration of the cervical canal he rejects, but I have witnessed three cases of complete occlusion of the vaginal vault where it was necessary to dissect up a long passage to permit the birth of the child, and where, without artificial aid, either rupture of the uterus or retention of the child must have resulted.

The pathological processes presenting themselves in case of long-continued retention and of missed labor vary with the entrance of air into or exclusion of air from the uterine cavity. If the atmosphere have free access to the uterus, the fœtus undergoes putrefactive changes. The soft parts, having been liquefied, escape, leaving the osseous framework of the fœtus *in utero*. This may also be gradually

and partially disintegrated, liquefied, and expelled, but its complete evacuation is not often effected by Nature's processes. If, however, the cervix be narrow or unyielding, the continuous pressure of some projecting and pointed bone may penetrate its tissues and force an exit through the vagina, rectum, or anterior abdominal wall. A similar irritation and penetration may induce suppurative metritis, and, eventually, fatal peritonitis, or septicæmia.

If the air be excluded from the uterus, in cases of retention indefinitely prolonged, the fœtus either becomes mummified, and, forming intimate connections with the uterus through the medium of inflammatory products, remains *in utero* without giving rise to any symptoms, or it may produce by constant irritation suppurative metritis, with abscess formation and the escape of pus externally. Access having been thus afforded to the air, putrefaction and its consequences will then ensue.

In rare cases of prolonged retention, the fœtus becomes the seat of adipocerous changes.* Calcification of the fœtus (lithopædion formation) occurs probably in cases of extra-uterine pregnancy only.

The retention of the dead fœtus is comparatively devoid of danger. Even if decomposition, or putrefaction, of the fœtus occurs, it is common for the products of disintegration to be eventually eliminated, without a fatal result, by natural efforts or by the intervention of obstetrical art. There is good evidence, however, that the dead fœtus may, even if the access of air has been prevented, seriously impair the patient's health. Lately I have witnessed the development of albuminuria subsequent to the death of the fœtus, which disappeared upon the induction of premature labor.†

Unless, therefore, labor sets in within two or three weeks after the death of the fœtus, the induction of labor is indicated. The exception to this rule would be in cases of twin pregnancy, where one fœtus was still living. In prolonged retention, the elimination of pieces of bone should, as far as possible, be aided by the hand. If necessary to dilate the cervix with tents, care should be taken lest spiculæ of bone be pressed by the expanding body into the uterine tissues.

* *Vide* Case of Professor T. G. Thomas, "N. Y. Med. Journal," vol. xxi, p. 163.

† *Vide*, also, Barker, "On Puerperal Disease," p. 402. Kemper, "Retention *in Utero* of the Dead Fœtus."

CHAPTER XVI.

THE PREMATURE EXPULSION OF THE OVUM.

Causes of abortion.—Disposition to abortion.—Immediate causes.—Symptoms.—Moles.—Incomplete abortions. — Diagnosis.—Prognosis.—Treatment.—Prophylaxis.—Arrest of threatened abortion.—Treatment of inevitable abortion.—Treatment of neglected abortion.—Removal of fibrinous polypi.—Treatment of miscarriage.

When pregnancy is interrupted, during the first three months, by uterine contractions leading to the expulsion of the ovum, the term abortion is used; in the fourth, fifth, sixth, and seventh months, i. e., from the formation of the placenta to the time the child becomes viable, it is proper to speak of the accident as immature delivery, or miscarriage; and, finally, a confinement occurring from the twenty-eighth week, the earliest period of viability, to the thirty-eighth week, when the fœtus possesses every indication of maturity, is distinguished as premature delivery.

This purely artificial division is justified by practical differences in the symptomatology and treatment of the groups thus separately designated.

Causes which lead to the Premature Interruption of Pregnancy.

The underlying causes of abortion, miscarriage, and premature delivery are the same. Causes of abortion are rarely of sudden occurrence. Usually the way is prepared, either by changes taking place in the ovum, or by certain pathological conditions affecting the mother. In either of these ways a disposition to abortion is produced. When once, as the result of morbid changes, the attachment of the ovum to the uterus has been rendered insecure, causes usually inoperative suffice to determine uterine contractions and the time at which the expulsion takes place.

The Disposition to Abortion.—The disposition may be due primarily to any disease of the chorion, of which we have an example in syphilitic degeneration of the villi (*vide* p. 287). In most cases, however, death of the fœtus precedes and leads to disease of the chorion. The causes of abortion resolve themselves, therefore, in large measure, into the causes which produce death of the fœtus.

The death of the fœtus may be due to direct violence, as kicks and blows upon the abdominal walls; to diseases of the fetal appendages (cord, amnion, chorion, placenta); to diseases of the decidua, especially those which give rise to hæmorrhage (before the complete formation of the placenta, the separation of the decidua from the uterus interferes with the nutritive supplies which go to the fœtus); to febrile

affections, in which death results either from the high temperature, from associated diseased conditions of the decidua, or, as in certain acute infectious diseases, to the direct transfer of the poison from the mother to the fœtus; and, finally, to excessive anæmia. Anæmia developed by pregnancy rarely affects the child. In acute anæmia from profuse hæmorrhage, the child may die from asphyxia. In times of famine great numbers of women abort. The disposition to abort observed in corpulent women is probably due to the fact that the blood is insufficient in quantity and quality to supply the wants of the growing child.

The death of the fœtus is followed by the expulsion of the ovum, not usually at once, but after a longer or shorter period of time. Before the third month, in such cases of delay, the embryo, which consists of hardly more than a heap of cells, may become macerated, and absorption may take place after the death of the embryo. Except in cases of hydramnion, partial collapse of the ovum ensues. As soon as the fœtus dies, the circulation which passes from the fœtus to the chorion and placenta is suspended. The villi then become obliterated, and undergo fatty degeneration. The decidua is affected by the same process. With the diminution in the volume of the ovum, contractions begin. The villi, loosened in their attachments to the decidua, are drawn out; and the decidual vessels, exposed and subjected to increased pressure, rupture, and hæmorrhage results. The uterine contractions are awakened and exercise an expulsive force upon the ovum, which in its descent expands the cervix from above downward, and passes finally into the vagina. In the first three months the ovum is not infrequently expelled with membranes unruptured. From the end of the third month onward such an occurrence is rare, though I have seen an instance which happened in the sixth month. In the early months the expulsion of an intact ovum is associated with inconsiderable hæmorrhage. When the membranes give way, the embryo and the fluid contents of the amnion escape first. With the removal of the compression exercised by the ovum upon the inner surface of the uterine walls, hæmorrhage occurs, which continues, as a rule, until the complete expulsion or removal of the membranes and placenta.

Aside from the death of the fœtus, with consecutive changes in the chorion and decidua, and diseases of the fetal appendages leading to death of the fœtus, the predisposition to abortion may be the result of primary defects or changes in the decidua alone. Of these changes we recognize:

1. *Atrophy of the Uterine Mucous Membrane.* — The insufficient development of the mucous membrane exercises an injurious influence upon the development of the ovum in cases only in which the serotina and the reflexa are involved. An abnormally small and undeveloped serotinal surface may give rise to a small placenta, or the serotinal

attachment may be of such limited extent that the mere weight of the ovum drags it downward and converts it into a long, narrow pedicle. At other times, the reflexa may be but partially developed, or may fail altogether, and then the ovum, covered only by the chorion, hangs by a pediculated attachment to the serotina.

In both these cases, the uterine contractions, in place of at once effecting the expulsion of the ovum, may force the ovum into the cervix, where it may remain for a time, nourished by the long pedicle, but arrested in its further descent by a contracted os externum. To these cases the term cervical pregnancy has been applied. The cervix, according to the month of pregnancy, is more or less spherically distended, and the corpus uteri above contracts down to nearly normal dimensions. As the cause of this condition lies chiefly in rigidity of the os externum, it occurs most frequently in primiparæ. Even with a patulous os, though rarely, a cervical pregnancy may be produced by the resistance and firmness of the pedicle attaching the ovum to the uterus.*

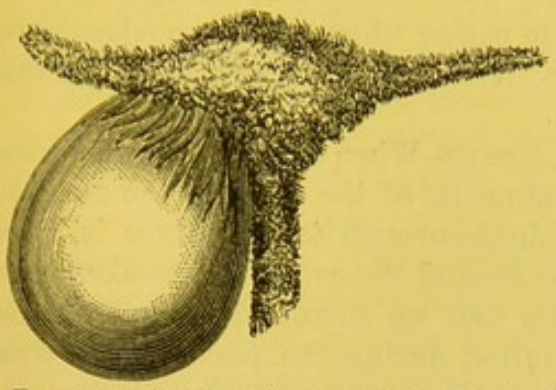


Fig. 148.—Ovum, with imperfectly developed decidua; outer surface of vera. (Duncan.)

2. *Hypertrophy of the Mucous Membrane.*—Thickening of the mucous membrane is the result of endometritis, and may lead to abortion in either of the following ways: The several forms of endometritis (*vide* p. 270) may give rise to affections of the placenta, and thus prove fatal to the fœtus, or the thinned, dilated vessels of the diseased decidua may rupture, and produce sanguineous effusions between the membranes.

The frequency of abortion in displacements of the uterus is principally dependent upon associated endometritis. In anteflexion of the uterus, sterility is common, but endometritis and abortion are rare. In retroflexion, on the contrary, while there is slight obstacle to conception, the congestion of the uterine walls and the altered conditions of the uterine mucous membrane render abortion a frequent occurrence.

Rigidity of the uterine walls, which interferes with their due expansion, may lead to premature uterine contractions. In this way an imbedded fibroid or carcinoma may ultimately become sources of abortion. Expansion of the uterus may likewise be hindered by old peritoneal adhesions or pelvic cellulitis.

* W. Schulein, "Ueber cervical Schwangerschaft," "Ztschr. f. Geburtsh. und Gynaek.," Bd. iii, H. 2, p. 408.

Finally, there remains a class of women in whose cases it is impossible to detect either disease of the ovum or of the genital organs, yet in whom abortion occurs, dependent, so far as our present knowledge goes, upon certain personal conditions of nerve irritability. Physical and psychical sources of excitement, which would be of small moment in some women, in them suffice to interrupt pregnancy.

Immediate Causes of Abortion.—Changes in the ovum, other than rupture and escape of the amniotic fluid, rarely lead at once and directly to abortion. The proximate causes which induce contractions, and the throwing off of the ovum, reside for the most part in the maternal system. They consist of :

1. *Hyperæmia of the Gravid Uterus.*—When the predisposing causes have operated to weaken the attachments of the ovum to the decidua, anything which determines the blood-currents to the uterus is liable to produce extravasations of blood around the ovum, and awaken uterine contractions. Because of this fact we surround patients predisposed to abort with every precaution during the periodic menstrual congestion that not even pregnancy altogether suspends. Fevers, inflammatory affections of the genital organs, excesses in coitus, hot foot-baths, valvular heart-lesions, obstructions to the circulation of the lungs and liver, may each lead to rupture of the decidual vessels. More frequently rupture follows jars to the body from vomiting, coughing, and straining, from railroad-journeys, from violent exercise, from falls, and the like.

The importance of separating the predisposing from the immediate causes of abortion is shown by the impunity with which often perfectly healthy women, with no abnormal conditions of the generative organs, set all the usual restraints at defiance with the intent to interrupt an undesired pregnancy. M. Brillaud Laujardière relates the case of a peasant who took his wife, while *enceinte*, behind him on horseback, and started off with her at full gallop with the view of causing her to miscarry. Having thus thoroughly shaken her, he dropped her suddenly to the ground without slackening his speed. This brutal manœuvre he repeated twice without the least success.* On the other hand, women, eager for offspring, after an abortion, sometimes lay undue stress upon slight imprudences, and make them the sources of morbid self-reproaches, which it becomes one of the functions of the physician to allay.

2. *Uterine Contractions, produced by Influences which act directly through the Nerves.*—Of this we have examples in the contractions awakened by frictions of the uterus through the abdominal walls, in the reflex contractions produced by stimuli applied to the breasts, and in those excited by strong mental emotions.

Symptoms.—As the detachment and expulsion of the ovum can not

* T. Gallard, "De l'avortement au point de vue médico-légal," Paris, p. 24.

possibly take place without rupture of the decidual or placental vessels, hæmorrhage becomes the constant and necessary result of every abortion. In the first two months the hæmorrhage resembles that of a profuse menstruation. Pain is present, in part due to uterine congestion, in part to the expulsion of blood-clots through the imperfectly expanded cervix. The latter pains resemble those of obstructive dysmenorrhœa. These symptoms last from four to five days. As the ovum passes away unnoticed, enveloped in the clots, or piecemeal with the decidua, women are apt to regard these early abortions as the normal recurrence of a retarded menstrual period.

After the third month prodromal symptoms are rarely wanting. Among these may be mentioned fullness and weight in the pelvis, sacral pains, frequent micturition, periodic labor-like pains, and a mucous or watery discharge. These, followed by hæmorrhage, indicate a threatened abortion. The hæmorrhage, if slight, may cease, and the pregnancy go on undisturbed. Usually, however, the hæmorrhage increases in amount, or after a brief cessation recurs. Contractions set in, which become more and more pronounced, until finally the ovum is expelled.

In a typical case of abortion, in which the ovum is thrown off entire, uterine retraction and hæmorrhage unite to effect the progressive separation from below upward of the decidua from the uterine walls. The ovum then, covered by the reflexa and the detached decidua, is gradually pressed downward, and dilates first the os internum, next the cervix, and finally the os externum. The ovum passes into the vagina, covered by the decidua vera, or drags the inverted decidua after it. The emptied uterus then retracts down, and the hæmorrhage ceases. The aborted ovum is surrounded with coagulated blood. In the first three months, when the death of the embryo has preceded by a little time the completion of the abortion, every vestige of the embryo may be found to have disappeared. Sometimes, in the third month, a small placenta with shrunken umbilical vessels may now and then be met with.

When the extravasation of blood upon the uterine surface of the vera is considerable in amount, the vera is sometimes broken through, and the blood effused between the vera and reflexa. Extravasation may likewise take place between the reflexa and chorion, either in consequence of the rupture of the reflexa, or from a hæmorrhage starting from the placenta, which finds its way along the outer surface of the chorion, and dissects away the reflexa. The pressure upon the ovum, unless it has previously undergone collapse as a result of the death of the embryo, leads to rupture and escape of the amniotic fluid. The retained fetal and maternal membranes, with the intervening layers of coagulated blood, form a mass termed a mole. When the blood coagula are fresh, the mass is termed the *mola sanguinea* (blood-

mole), and when of older date the *mola carnosa* (fleshy mole). The cavity, which is lined by the amnion, has usually an irregular surface. It is very exceptional for extravasations to break through both chorion and amnion, and thus form clots in the amniotic cavity itself. Moles seldom exceed an orange in size, and usually are expelled between the third and fifth month.

In cases where abnormal adhesions attach the vera and serotina to the walls of the uterus, retained portions of the maternal membranes may remain after the ovum is expelled. In another class, and this is the rule after the third month, the fetal membranes rupture, and the embryo escapes with the liquor amnii. While ordinarily the retained portions quickly follow the discharge of the ovum or embryo, it frequently happens that the uterus retracts upon its contents, the cervix closes, and a period of repose follows. There is then produced what is commonly known as an incomplete abortion.

Incomplete Abortion.—The various contingencies arising from these cases of incomplete abortion are thus truthfully depicted by Spiegelberg :*

1. Most frequently hæmorrhage continues at intervals, spontaneous elimination gradually taking place as, through retrograde changes, portions of the retained membranes become successively loosened in their attachments to the uterus.

2. In exceptional cases the hæmorrhage ceases for a time entirely. For days, weeks, and even months, the woman appears quite well. Then suddenly strong contractions, accompanied by profuse hæmorrhage, usher in the elimination of the fetal dependencies. In a case of my own, three months elapsed from the occurrence of the first hæmorrhage, which took place toward the end of the third month, and was quite insignificant in amount, before the abortion was completed. Meantime, as there were progressive abdominal enlargement, supposed quickening, and milk in the breasts, the threatened abortion was believed to have been arrested. Total retention, with a long interval of repose, is thought to be due to complete adherence of the placenta, which continues to receive nutrient supplies from the uterus. Spiegelberg believes that a menstrual period is the usual time at which the discharge of the retained membranes takes place.

3. Of more frequent occurrence than the foregoing is the putrid decomposition of the retained portions. It occurs chiefly in cases where there is more or less complete loss of organic connection between the placenta and the uterus. Decomposition in the non-adherent portions is produced by the introduction of air during the escape of the embryo, or through the subsequent passage of the finger into the uterus, or, where portions of the ovum hang down into the vagina, by absorption of septic matter from the vagina upward into the uterus.

* Spiegelberg, "Lehrbuch der Geburtshülfe," Jahr 1877, p. 377.

As a result of putrid decomposition, the woman is exposed to septicæmia, and infection of thrombi at the placental site. Fatal results are, however, rare, as decomposition is usually a late occurrence, setting in, as a rule, only after protective granulations have formed upon the uterine mucous membrane, and after the complete closure of the uterine sinuses. Continuous fever, with intercurrent attacks of hæmorrhage, is, however, set up, but passes away finally with the gradual discharge of the decomposed particles, while the threatening symptoms subside. Still, now and then septic processes lead to an unfavorable termination. Local perimetritic inflammation is a common event.

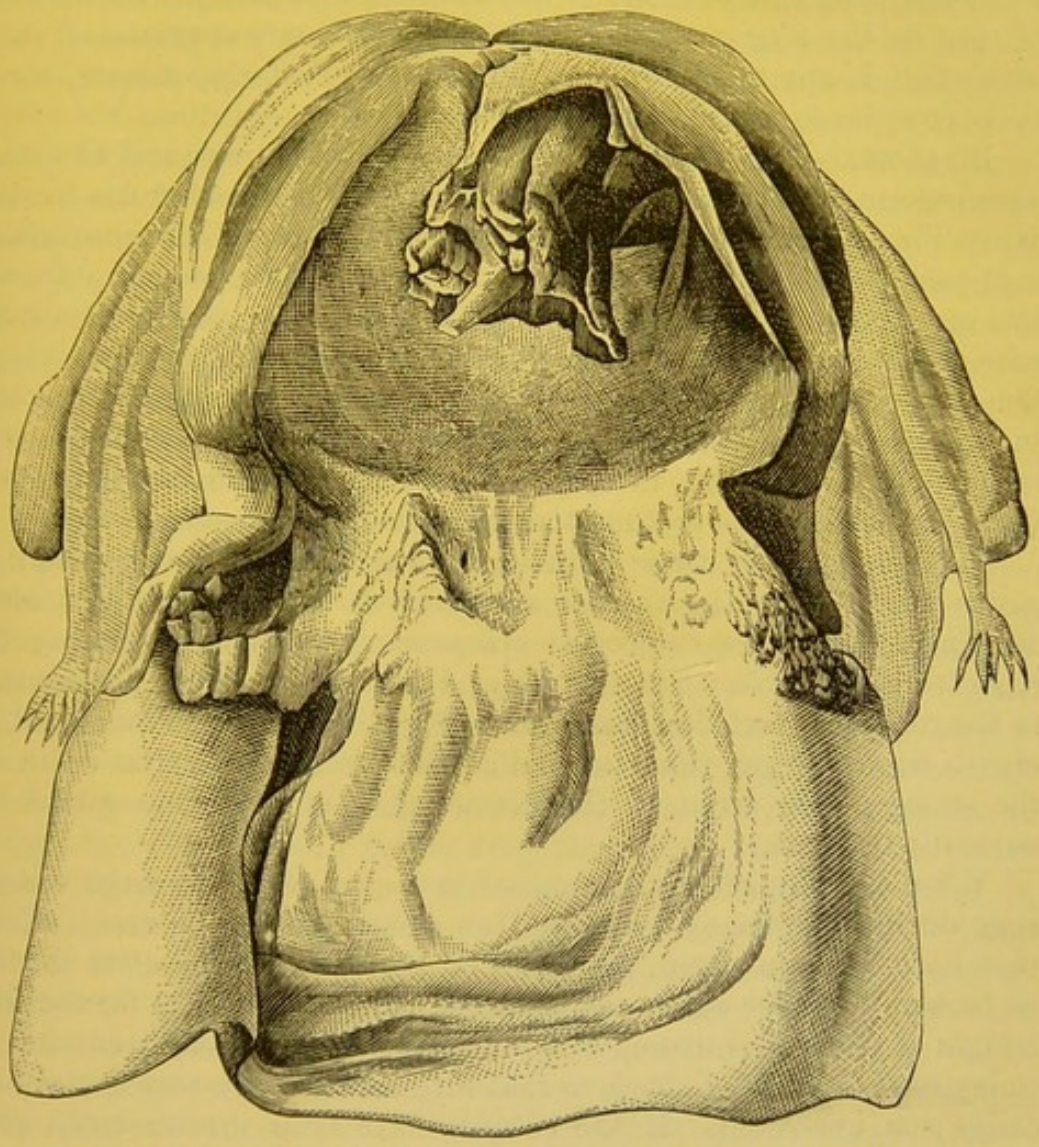


Fig. 149.—Uterus, with basis of a fibrinous polypus after an abortion. (Fränkel.)

4. Where there is a certain degree of relaxation with enlargement of the uterine cavity, the fibrine of the extravasated blood may become deposited about any uneven surface within the uterus, and give rise to a polypus-shaped body, suggestive in its mode of development of the

stalactite formations in calcareous caverns.* These so-called fibrinous polypi generally develop around the *débris* of an abortion, such as retained bits of decidua, placental remains, and portions of the fetal membranes. In some cases, likewise, thrombi projecting from the placental site become the base of a loose fibrinous attachment. Placental polypi give rise ultimately to bearing-down pains, and intercurrent hæmorrhages. They may even decompose, and endanger life by septic absorption.

The retrograde changes that take place in a uterus after an abortion correspond to those which occur in deliveries at full term. Where a suitable plan of treatment is not adopted, or where the importance of care in the after-management is not adequately appreciated, subinvolution is apt to follow. Of all sources of uterine disease, none takes precedence of a mismanaged abortion.

Diagnosis.—The diagnosis is based upon the presence of pain, hæmorrhage, dilatation of the cervix, and the descent of the ovum. When the ovum can be felt through the patulous os, the demonstration is of course complete. A soft polypus may, however, present a deceptive resemblance to a small ovum. In all cases of pregnancy the existence of hæmorrhage alone, even when disassociated from other symptoms, renders the probabilities of abortion sufficiently great to call for the exercise of every precaution. It is not easy to recognize pregnancy in the early months, but in doubtful cases the cessation of the menses should be regarded as presumptive evidence of its existence.

The diagnosis of these pathological changes in the ovum and deciduæ which pave the way for abortion can not be made out with certainty from mere subjective symptoms. Such changes may be regarded as probable when the size of the uterus does not correspond to the supposed period of gestation. Thus, if the uterus at the fifth month was no larger than is usual at the third month, the death of the embryo with arrest in the development of the ovum would be naturally inferred.

When the physician is summoned to a case of hæmorrhage occurring during pregnancy, he should at once examine the clots, where they have been preserved, for traces of the ovum. The clots should be broken up under water, and a careful examination made for floating fringes of villi. The ovum, when expelled entire, is usually enveloped in layers of coagulated blood, so that without thorough search it would easily pass unnoticed. If the coagula have been thrown away, and the physician finds upon his arrival the cervix closed, so that he can not pass his finger into the uterus to explore its cavity, it may be impossible at once to determine whether the abortion has taken place wholly or in part, or whether the entire ovum still remains *in utero*.

* Fränkel, "Beitrag zur Lehre von fibrinösen Polypen," "Arch. f. Gynaek.," Bd. ii, p. 76.

The subsidence of all symptoms points, as a rule, to a complete emptying of the uterus, or to an arrest of the abortion, though in some cases it precedes mole-formation. A renewal of the hæmorrhage and the absence of normal involution indicate the continuance of the ovum in the uterus, or an incomplete abortion.

Prognosis.—The prognosis takes cognizance of course of the results to the mother only. In the first place, it may be laid down in the way of broad general statement that all cases of spontaneous abortion (i. e., excluding criminal cases), not complicated with other morbid conditions, are, under suitable medical guidance, devoid of danger. But, in the second place, it must be borne in mind that the statement is only true with the reservations that limit it, for in point of fact the actual number of deaths from abortion is by no means inconsiderable. Thus, the deaths from this cause reported to the Bureau of Vital Statistics of New York City, between the years 1867 and 1875, inclusive, were one hundred and ninety-seven,* a number which falls short in all probability of the truth, by reason of the many circumstances which precisely in this condition tempt to concealment. The total number of deaths during the same period from metria was, according to the reports rendered, 1,947. Hegar † reckons one abortion to every eight to ten full-time deliveries. If this proportion be correct, it would seem to show that the mortality from abortion is hardly second to that from puerperal fever itself.

Death, as a consequence of criminal abortion, is especially frequent. M. Tardieu found that in one hundred and sixteen such cases, of which he was able to ascertain the termination, sixty women died.‡ But even in spontaneous cases death may take place from hæmorrhage, from septicæmia, or from peritonitis. In many instances the fatal termination is fairly attributable to the ignorance, the imprudence, or the willfulness of the patient. How far the dangers of abortion may be neutralized by proper medical assistance is best shown by the statistics of large hospitals. Thus, I gather from the reports issued by Dr. Johnston, during his seven years mastership of the Rotunda Hospital, in Dublin, that in two hundred and thirty-four cases of abortion treated in that institution there was but one death, and that not from puerperal trouble, but from mitral disease of the heart. Bellevue Hospital is the receptacle annually of a tolerably large number of women suffering from incomplete abortions, many of whom enter the hospital in a very unpromising condition from either excessive hæmorrhage or septic decomposition of the retained portions of the ovum. Yet, of the many

* Lusk, "Nature, Origin, and Prevention of Puerperal Fever," "Transactions of the International Medical Congress," Philadelphia, p. 830.

† Hegar, "Beiträge zur Pathologie des Eies," "Monatsschr. f. Geburtsk.," Bd. xxi (supplement), p. 34.

‡ T. Gallard, "De l'avortement au point de vue médico-légal," Paris, 1878, p. 45.

cases whose histories I find in the record-books of the hospital, all have ended in recovery.

Treatment.—The treatment is divided into—1. Prophylaxis in cases of habitual abortion; 2. Arrest of threatened abortion; 3. Means adopted to avert the dangers of a progressing abortion.

Prophylaxis.—Prophylaxis considers the cause which underlies, in each case, the disposition to repeated abortion. One of the principal of these causes is syphilis in one or both parents. It is just in these cases that the triumph of the mercurial treatment has been most complete. The treatment should be addressed to the parent affected, or both parents should be subjected to the same treatment.

Among local conditions amenable to treatment may be mentioned endometritis, displacements, and perimetritic inflammations. In retroflexions and retroversions, the best results often follow the replacement of the uterus and the employment of a suitable pessary. No harm results from the use of pessaries during pregnancy. They should, however, be watched, on account of possible vaginal irritation. After the completion of the third month they should be removed, as the uterus then remains in place without artificial assistance. When backward displacement of the uterus follows abortion, reposition aids normal involution.

In carcinoma and large fibroids, treatment is powerless. Where, in such cases, sterility does not exist, happily for the mother, the associated morbid conditions of the uterine mucous membrane and the rigidity of the uterine walls lead commonly to the death of the ovum and premature uterine contractions. Where a small fibroid in the posterior uterine walls leads to sterility by the production of retroflexion, a pessary may, after replacement, at times be used with benefit.

One abortion sometimes follows another in rapid succession in newly married women. While the first abortion may have been due to some accidental cause, the sequence is often kept up by a morbid condition of the endometrium, generated by the shortness of the interval between the pregnancies, which does not allow the restoration of the membrane to a normal condition. In such cases, a six weeks' abstention from sexual intercourse may be usefully enjoined.

In certain diseases of the placenta, in which the respiratory function of the organ had suffered any marked diminution, Sir J. Y. Simpson believed he had succeeded in averting the death of the fœtus by increasing the oxygen in the blood of the mother, through the administration of chlorate of potash.* Chlorate of potash may be given in doses of twenty grains, three times daily, for weeks at a time, without injury to the mother. Though it has not always rendered me the hoped-for service, the experience of other physicians, among whom I

* Sir J. Y. Simpson, "Obstetric Memoirs," edited by Priestley and Storer, Edinburgh, 1855, vol. i, p. 460.

may mention Dr. Fordyce Barker, appears favorable to its employment.

In the class of cases in which abortion results neither from disease of the ovum nor of the uterus, but seems dependent upon some peculiar condition of nerve-irritability, the patient should not only avoid every known means of awakening uterine contractions, but should exercise the utmost caution at the recurrence of the menstrual epochs. Especially at the terminations of the second and third months a week's quiet in bed should be insisted upon. Dr. E. J. Jenks* recommends the viburnum prunifolium in cases where the habit of aborting has been formed. He writes: "My mode of prescribing the viburnum is to have the patient take from a half-teaspoonful to a teaspoonful of the fluid extract four times a day, beginning at least two days before the menstrual date, and continuing it not only during the usual period of the menstrual flow, but two days longer than that discharge continues when the woman is not pregnant." From the fourth month onward, the danger of the occurrence of abortion rapidly diminishes.

The Arrest of a Threatened Abortion.—Arrest may be accomplished in cases in which the death of the ovum has not taken place, and where the hæmorrhage arises from a slight detachment only of the decidua or placenta.

In every case of threatened abortion occurring in the early months, a careful examination should be instituted to ascertain whether retroflexion or retroversion exists. In the genu-pectoral position, replacement is easy. If the fundus is slowly raised by two fingers introduced into the vagina, so soon as the horizontal line is reached the uterus falls forward of its own weight. Replacement alone, in certain cases, suffices to relieve the congestion which furnishes the immediate cause of the abortion.

Pain in the back during pregnancy should be regarded by women as a warning for them to temporarily abstain from their ordinary avocations. With ever so slight a hæmorrhage, they should at once be made to lie down and keep perfectly still. Simple turning in bed may start up fresh bleeding. Restlessness and mental excitement should be allayed by opiates in full doses. Ice to the vulva, cold cloths to the abdomen, and the internal administration of hæmostatics are not indicated. The fluid extract of viburnum prunifolium is recommended by Dr. Jenks, in teaspoonful-doses every two or three hours, as long as its use seems to be demanded.† The author's somewhat limited experience has appeared favorable to the claims put forth for the viburnum as a uterine sedative. Where the foregoing measures prove successful, it is a safe rule to keep the patient in bed for a week after the final disappearance of the threatening symptoms.

* Jenks, "Viburnum Prunifolium," "Trans. of the Am. Gynæcol. Soc.," vol. i, p. 130.

† Jenks, *loc. cit.*, p. 130.

In cases of ascertained death of the fœtus, and in those of inevitable abortion, all measures calculated to retard the emptying of the uterus should be at once abandoned.

In the first four months there are no unequivocal signs of the death of the fœtus. From the middle of pregnancy onward, death may be assumed if, after repeated examinations, the absence of the fetal heart-sounds and fetal movements is confirmed.

The signs of inevitable abortion are profuse hæmorrhage, clots discharged from the uterus, dilatation of the cervix from the descent of the ovum, and a patulous condition of the os externum. Other symptoms consist of persistent uterine contractions, escape of the amniotic fluid, and the presence of the embryo, or of portions of the ovum, in the discharged clots. How far the ordinary signs may, in given cases, prove delusive is shown by a remarkable one reported by Scanzoni, of a woman who was seized with profuse metrorrhagia in the third month of pregnancy. Great numbers of clots were discharged. As all hopes of saving the ovum were abandoned, ergot was used in large doses, a tampon was placed in the vagina for thirty-six hours, a sound was employed to explore the uterus, and finally, as the bleeding continued for three weeks, an intra-uterine injection of a weak solution of perchloride of iron was resorted to. Eight weeks later the patient quickened, and presented the distinctive evidences of a pregnancy advanced to the sixth month.*

The Treatment of Inevitable Abortion.

In the treatment of inevitable abortion it is proper to distinguish between cases of abortion proper and those of miscarriage. To avoid, however, needless repetitions, it is only points of distinctive difference to which at the close attention will be directed. The management of premature deliveries differs in no respect from that of confinement at term.

In the first two months little treatment besides rest in bed for a few days is ordinarily required. In the exceptional cases, the treatment does not differ from that in the hæmorrhages of the non-pregnant uterus.

In the third month we distinguish—1. Cases in which the ovum is thrown off entire; 2. Cases in which the sac ruptures, and the embryo escapes with the discharged fluid.

1. When in the third month the ovum is thrown off without rupture of the fetal membranes, the hæmorrhage rarely assumes dangerous proportions. The uterine contractions press the ovum into the cervix, which dilates and, in primiparæ, becomes somewhat elongated. As the ovum descends, the body of the partially emptied uterus retracts. The effused blood coagulates in thin layers between the

* Scanzoni, "Lehrbuch der Geburtshülfe," Wien, 1867, p. 83.

ovum and the uterine walls. The ovum forms a tampon, which fills the cervix and restrains the hæmorrhage.

No active treatment is, therefore, demanded. A vaginal douche consisting of a pint of tepid water may be used twice a day as a measure of cleanliness. All attempts to disengage the ovum with the finger should be avoided, as endangering its integrity. The vaginal tampon is unnecessary. It should only be used as a safeguard, where patients live at a distance from medical assistance and can only be visited at long intervals. As it is never certain that the rupture of the ovum may not take place during the course of its expulsion, the tampon may in such cases be employed in anticipation of a possible increase of hæmorrhage from sudden collapse of the membranes. In multiparæ the ovum seldom remains long in the cervix. In primiparæ, on the other hand, the tardy dilatation of the os externum may lead to a retention of the ovum in the cervix, lasting for days. As this condition is extremely painful, it is allowable to dilate the os externum with the index-finger, or even by incisions through the ring of circular fibers which furnish the cause of delay.

Small portions of the decidua vera sometimes remain attached to the uterine walls after abortion. They commonly do no harm, but are discharged with the lochial secretion.

2. When the sac ruptures, and the liquor amnii escapes, the removal of the pressure exerted upon the uterine wall by the intact ovum is followed by profuse hæmorrhage from the utero-placental vessels.

The diagnosis of rupture may be made either from finding the embryo in the clots, or, in the case of a dilated cervical canal, by the direct examination of the uterine cavity. Although after rupture portions of the ovum may still be felt, we miss the smooth surface of the fluctuating amniotic sac. When the embryo can not be found, and the cervix is closed, profuse hæmorrhage alone would render the occurrence of rupture extremely probable.

The principles of treatment in these cases are very simple. The indications are, to check the hæmorrhage and to empty the uterus. As to the best methods of attaining these results, opinions widely differ.

When cases are treated with rest in bed, the internal administration of ergot, and cold cloths applied to the abdomen and vulva, the loss of blood is usually considerable, but the most of them terminate favorably. In some, however, the hæmorrhage may prove so severe as even to threaten life. Now, it is in every way desirable, for the future welfare of the patient, to restrain the hæmorrhage within the narrowest limits. The most effectual means of arresting the hæmorrhage is to clean out the uterus. If, therefore, the physician at the time of his visit finds the cervix sufficiently dilated to allow him to introduce his

finger into the uterus, he should not hesitate at once to remove the retained portions of ovum. The operation does not require any considerable amount of technical skill, while the immediate results are in the highest degree satisfactory. The patient should be placed crosswise in bed, with the hips drawn well over the edge. The legs should be flexed and the thighs held, where assistants can be obtained, at right angles to the body, to secure the greatest degree of relaxation to the perinæum and abdominal walls. The right index-finger should be then passed into the vagina and through the cervical canal, while the left hand, placed upon the abdomen, gradually presses the uterus down into the pelvic cavity so as to bring it within reach of the examining finger.* This portion of the act should be performed slowly, while every effort is made to divert the attention of the patient. Hasty manipulations invariably excite in the most willing of patients the full resistance of the abdominal walls. When the point of the finger reaches the os internum, it is sometimes necessary to pause for a minute or two, to await a sufficient degree of dilatation to allow the finger to pass beyond the insertion of the nail. When the right finger is used, it should be made to pass upward with its dorsal surface along the left side of the uterus to the opening of the Fallopian tube, thence across the fundus to the right side. As the tip of the finger passes down upon the right side, it presses the detached ovum before it toward the os internum. By the time the finger has thus made the circuit of the uterus, the ovum is pressed into the cervical canal, and thence passes easily into the vagina. With the left finger, the movement is exactly the reverse. The finger passes first, with its dorsal surface directed to the right side, from the right Fallopian tube across the fundus, and downward along the left side of the uterus. The only resistance the finger meets is at the placental insertion, where a certain amount of manipulation is required to complete the detachment.†

Where the uterus can not be pressed down within reach of the index-finger by force exerted above the symphysis pubis, it is permissible to introduce the hand into the vagina; but, in such a case, the fingers are apt to become cramped, and all freedom of manipulation to be destroyed. A better means of overcoming the difficulty consists in the administration of an anæsthetic. In cases of extreme anæmia chloroform should be discarded as too dangerous. Ether, however, has often seemed to me, on the contrary, to possess a stimulating action, and its use to be followed by increase in the volume and force of the

* Professor A. R. Simpson ("Transactions of the Edinburgh Obstetrical Society," vol. iv, p. 227) recommends drawing down the uterus by means of volsellum-forceps attached to the anterior lip of the cervix. I have once seen extreme hæmorrhage follow this manœuvre (seventh month of pregnancy), and now feel some hesitation about its employment, at least in the later months.

† *Vide* Hüter, "Compendium der geburtshülflichen Operationen," p. 22.

pulse. The relaxation produced by the anæsthetic makes it easy to depress the uterus down to the pelvic floor, where it can be reached with comparative ease. After the removal of the ovum, the cavity of the uterus should be washed out with a stream of tepid carbolized water, in order to bring away any small detached portions of the ovum and decidua. In the manual extraction of the ovum, deliberation and perseverance are the main elements of success.

If, when the patient is first seen by the physician, the cervix is not sufficiently dilated to allow the finger to pass without force, the vaginal tampon should be employed. The tampon restrains the hæmorrhage, stimulates the uterus to contraction, and allows time for the employment of measures to rally a patient exhausted by profuse losses of blood. The material of which a tampon is made is a matter of indifference, provided only it fills the vagina to its utmost capacity. In cases of urgent need, a soft towel, handkerchiefs, strips of cotton cloth, dampened cotton-wool, and the like, may be seized upon to meet a temporary emergency. The time-honored sponge, on account of its porosity, is least deserving of favor. When, however, the physician proposes to leave his patient for a number of hours, the mere hasty filling of the vagina through the vulva will not suffice. On the contrary, the highest degree of safety can only be secured by the closest observance of the rules of art.

The first essential of a good tampon is that it be carefully packed around the cervix uteri, and fill out the more dilatable upper portion of the vagina. This can be accomplished only by the aid of a speculum. The method I usually employ is one, the credit of which, so far as the general features are concerned, I believe belongs to Dr. Marion Sims. It consists in soaking cotton-wool in carbolized water, and then, after pressing out any excess of fluid, in forming from the carbolized cotton a number of flattened disks of about the size of the trade-dollar. The patient is then placed in the latero-prone position, and the perinæum retracted by a Sims's speculum. The dampened cotton disks are introduced by dressing-forceps, and, under the guidance of the eye, are packed first around the vaginal portion, then over the os, and thence the vagina is filled in from above downward until the narrow portion above the vestibule is reached. No other plan of tamponing with which I am acquainted can compare in solidity and effectiveness with this. Its removal is accomplished by the detachment with two fingers of a portion at a time. This part of the procedure is moderately painful. Many methods have been suggested to overcome in the removal the necessity of introducing the finger into the vagina. A very ingenious one consists in attaching the cotton to a piece of twine so as to form a kite-tail, which can be withdrawn by simply making tractions upon the extremity of the string left hanging outside the vulva. Professor I. E. Taylor uses a roller-bandage. It is efficient,

and, like the kite-tail described, can be easily removed. Dr. F. P. Foster * advises the use of the lamp-wicking as a material for the tampon.

Before the introduction of the tampon, the vagina should be thoroughly washed out. No tampon should be allowed to remain in the vagina much over twelve hours. Immediately after withdrawing the tampon, before proceeding to the examination of the uterus, the vagina should be cleansed by an injection of tepid carbolized water (ʒ j ad Oj). Often, after removing the tampon, the ovum is found in the upper portion of the vagina or filling up the cervix. If this is not the case, and the cervix is not dilated, so that manual extraction may easily be performed, another tampon should be introduced.

It is customary from the outset to sustain the action of the tampon by the administration of ergot, either in the form of the fluid extract (thirty drops every three to four hours), or of a solution of ergotin, given hypodermically (ergotin, gr. xij, glycerinæ, ʒ j. Ten minims twice in the twenty-four hours. In women with abundant adipose tissue the injection should be made into the subcutaneous tissues of the lower abdomen. In others, the outer surface of the thigh should be selected).

If the patient is collapsed from loss of blood after tamponing, opiates, tea, and alcoholic stimulants should be administered, the latter in small but frequently repeated quantities, until the cerebral anæmia is relieved and the capillary circulation restored.

If, after the removal, the cervix is found not to be dilated, a third tampon may be introduced, and left *in situ* for another period of twelve hours. The employment of the tampon is not, however, to be recommended for a period much exceeding twenty-four hours. Its continued use is apt to irritate the vagina. In spite of carbolic acid, it acquires an offensive odor. It generates septic matters, which, in the long-run, creep upward through the cervix into the uterine cavity, and produce decomposition of the ovum. I prefer, therefore, in cases of undilated cervix, after twenty-four hours of vaginal tamponing, to resort to sponge-tents. The sponge-tent is most easily introduced when the patient is placed upon her left side, with the perinæum drawn back by Sims's speculum, and the anterior lip of the cervix drawn down and steadied by a tenaculum (Sims's method). The tent may, however, in the absence of an assistant, be introduced, with the patient on her back, by the aid of a pair of strong dressing-forceps. The tent should be long enough to pass well up through the os internum. Within six to twelve hours the tent should be removed, and, after a preliminary vaginal douche, manual extraction be proceeded with in accordance with the rules already given.

In manual delivery, it is desirable to remove the decidua as well as

* Foster, "N. Y. Med. Jour.," June, 1880.

the ovum. When the cervix is patent, this is easy, as the decidua is then detached from the uterine walls. When the cervix is unchanged, the detachment is usually incomplete. In such cases, it is advisable, therefore, to try first the tampon before the sponge-tent, as the former stimulates the uterus to contract, and promotes the separation of the decidua, even when it fails to secure the discharge of the ovum.

Inside the uterine cavity, ovum-forceps should be used with great caution. I have discarded it altogether. In the first place, it is dangerous; in the second place, it is unnecessary. When, however, the retained portions of the ovum have left for the most part the uterine cavity, and occupy the cervical canal, the delivery may at times be advantageously hastened by placing the patient upon her side, and, with the cervix well brought into view by a Sims's speculum, applying the ovum-forceps, under the guidance of the eye, within the cervix to the sides of the placenta (Skene). But great care requires to be exercised not to break away the fragile structures and leave material portions behind.

Under like circumstances, Hoening* recommended a modification of Credé's method for expression of the placenta. With the patient lying upon the back, the operator, according to Hoening, should seek to compress the body of the uterus between the left hand, laid above the symphysis pubis, and two fingers of the right hand introduced into the vagina. The measure is only practicable when the ovum has, to a great extent, passed from the uterine cavity. As it is somewhat painful, and requires for success lax abdominal parietes, it possesses a limited range of applicability.

Treatment of Neglected Abortion.—Where, following abortion, the uterus has once been completely evacuated, hæmorrhage ceases. A slight lochial discharge persists for a few days during the period in which the uterine portion of the decidua vera completes its period of repair. If, therefore, a patient comes to us two or three weeks after the supposed conclusion of an abortion, with the story of recurrent hæmorrhages taking place, as a rule, whenever she leaves her bed and assumes the upright position, it may be assumed, with an approach to certainty, that portions of the ovum still remain within the uterus. Oftentimes a fetid discharge points to the fact that decomposition has been set up. The absorption of septic materials may, furthermore, become the source of chills, of fever, and of great uterine tenderness. In most cases, with rest in bed, the contents are discharged by suppuration, and recovery ultimately takes place, but only after a slow, protracted convalescence, during which pelvic cellulitis and pelvic peritonitis occur as not uncommon complications. Hæmorrhages, peritonitis, and septicæmia may, however, bring the case to a fatal

* Hoening, Scanzoni's "Beiträge," Bd. vii, p. 213.

issue. The removal of the retained placenta and membranes is therefore indicated, not only as a measure calculated to promote recovery, but to avert possible danger to life.

With regard to the operation for removal, the rules already given are applicable. The following peculiarities should, however, be borne in mind. In case the retained portions are undecomposed, the cervix is usually found closed, and requires preliminary dilatation with the sponge-tent. When decomposition has once set in, the os internum will, as a rule, allow the finger to pass into the uterus.* When a decomposed ovum is removed by the finger, a chill and a septic fever, which rapidly disappear, however, are apt to follow in the course of a few hours. This chill and fever result from the slight traumatic injuries inflicted by the finger upon the uterine walls, whereby the capillaries and lymphatics become opened up to the action of the septic poisons. The fever ends in a short time, because the reservoir of supply is removed with the *débris* of the ovum. If the uterine cavity, after the operation, is carefully washed out with carbolized water, the septic fever is often averted. The beneficial results following the complete emptying of the uterus in these cases are so decided, that of late years I have not allowed myself to be deterred from proceeding actively, even when perimetritis and parametritis, in not too acute a form, already existed. In practice, multitudes of examples show that the products of inflammations situated in the pelvis do not become absorbed so long as putrid materials are generated in the uterine cavity.

The removal of a fibrinous polypus, owing to its smoothness and the small size of the pedicle, is often a Sisyphus's task. The separation can only be successfully accomplished when the palmar surface of the index-finger presses from above upon the point of attachment. This necessitates a choice of hands. Thus, when the polypus is situated to the left, the right index-finger should be employed, and the left index-finger, when the polypus is situated to the right. After the detachment is complete, it is necessary to press the polypoid body firmly against the uterine walls, and proceed with its withdrawal slowly. If, as is sometimes the case, the polypus slips from under the finger, the latter should be again passed to the fundus of the uterus, and the attempt repeated. Small portions, not larger than a pea, can be washed out by the uterine douche. When the polypus is situated near the os internum, the latter will be found patulous, but, when it is well up within the body of the uterus, dilatation is a frequent prerequisite to removal.

For the removal of presumably small portions of retained ovum, especially in cases where, owing to inflammatory conditions, I have hesitated to make the circuit of the uterine cavity with my finger,

* Hüter, "Compendium der gebhülflichen Operationen," Leipsic, 1874, p. 32.

I have succeeded admirably by employing a tolerably firm Thomas's wire curette.*

The Treatment of Immature Deliveries.—*Fourth to seventh month.*—Distinctive of immature deliveries are: painful periodic contractions, recognizable by the hand applied above the symphysis pubis, rupture of the membranes and discharge of the fœtus, the complete formation of the placenta and umbilical cord; while in abortion the uterine contractions are obscure, the placenta is rudimentary, and the ovum is frequently expelled entire. In the treatment of immature delivery, the tampon may usually be discarded. After rupture of the membranes and expulsion of the fœtus, the hæmorrhage should be controlled by grasping the fundus of the uterus in the hand through the abdomen, and compressing the uterine walls firmly together.

The passage of the fœtus opens the uterus so as to allow, in the fourth and fifth months, the introduction of two fingers; in the sixth and seventh months, that of the half-hand. In case compression of the uterus does not arrest the hæmorrhage and expel the placenta, the cord should be carefully followed to its insertion, to determine the side upon which the implantation exists. If the placenta is implanted upon the right side, two or four fingers of the right hand, according to the degree of cervical dilatation, should be passed up along the left side of the uterus, across the fundus to the placental site. The detachment should be effected with the tips of the fingers, and the placenta pressed downward as the fingers descend along the right side of the uterus. The left hand should be employed in the reverse direction, when the placenta is situated to the right.

CHAPTER XVII.

EXTRA-UTERINE PREGNANCY.

Definition.—Tubal pregnancy.—Pregnancy in rudimentary cornu.—Interstitial pregnancy.—Tubo-abdominal and tubo-ovarian pregnancy.—Ovarian pregnancy.—Abdominal pregnancy.—Symptoms.—Terminations.—Diagnosis.—Treatment, in cases of early gestation.—Cases of advanced gestation (fœtus living).—Cases of gestation prolonged after the death of the fœtus.

After coitus, the spermatozoa make their way through the Fallopian tubes to the pelvic cavity. It is possible, therefore, for the ovum to become fecundated in any portion of the route from the ovary to

* Skene, "Med. Record," 1875, p. 59; Mundé, "Centralbl. f. Gynaek.," 1878, No. vi, p. 1. The patient should be placed in Sims's position, the perinæum should be drawn back with Sims's speculum, the cervix hooked down and steadied with a tenaculum, while the curette is made to pass over all portions of the uterine surface. Attached bits of placenta are recognized by the resistance they offer.

the uterus. In exceptional cases, the ovum may, after fecundation, be arrested in its travels, and undergo development at some point outside of the uterus. To these fortunately rare cases the term *extra-uterine pregnancy* has been applied.

The terms *tubal*, *ovarian*, and *abdominal pregnancy* designate different forms of extra-uterine development, and serve to express the site of the attachment from which the growth of the ovum begins.

Tubal Pregnancy.—Tubal pregnancy is the most frequent of the three forms. The ovum may find lodgment in any part of the tube. The causes of this anomaly are to be sought for in catarrhal affections attended with loss of the ciliated epithelium, dilatation, and, in some cases, with the formation of hernial pouches, produced by the protrusion of the mucous membrane through separated bundles of the muscular fibers; or the ovum may be arrested by flexions and constrictions of the tube resulting from adhesions and old inflammatory bands. In a few instances a small polypus has been found filling up the caliber of the tube. Because of its connection with inflammatory processes, the occurrence of tubal pregnancy is often preceded by a long period of sterility. When the obliteration is only partial, the spermatozoa, owing to their small size, are not prevented from reaching the arrested ovum; when complete, on the contrary, they can only gain access to the ovum by first passing through the patulous tube, and then migrating across the rear of the uterus to the ovary or the open abdominal end of the tube upon the opposite side. In a considerable number of cases, the corpus luteum has been found upon the side opposite to the tube containing the fecundated ovum. With the present prevailing views,* this phenomenon is only to be accounted for by the hypothesis of the migration of the ovum across the peritoneal surface of the pelvis or through the uterus from one tube to the other.

As the ovum develops, the mucous membrane of the tube thickens after the manner of the decidua, and receives the club-shaped extremities of the villi. Until the formation of the placenta, the detachment of the ovum is easy. Usually the two poles of the decidua-like covering are closed, though sometimes the uterine end remains open, and in continuity with the mucous membrane of the tube and the decidua of the uterine cavity.† A decidua reflexa is in any event extremely

* Mayrhofer, "Ueber die gelben Körper, und die Ueberwanderung des Eies," denies the whole doctrine of a distinct corpus luteum of pregnancy, and claims that corpora lutea are found at stated intervals, perhaps monthly, throughout the entire period of pregnancy. Leopold, "Die Ueberwanderung der Eier," "Arch. f. Gynaek.," Bd. xvi, p. 24, however, found that after tying the right tube and after removing the entire left ovary in a couple of rabbits pregnancy still took place.

† L. Bandl, Billroth's "Handbuch der Frauenkrankheiten," 5te Abschn., art. "Extrauterinschwangerschaft," p. 44.

rare.* The placenta is purely a fetal organ. The villi penetrate to the muscular structures of the tube, where they are occasionally surrounded by large vessels. Nowhere, however, have they been observed to have broken through the walls of the maternal vessels, nor is there any evidence of maternal blood in the intervillous spaces, such as is believed to exist in cases of intra-uterine development.†

With the beginning of pregnancy the muscular walls of the tube hypertrophy, but they subsequently are stretched thin by the growth

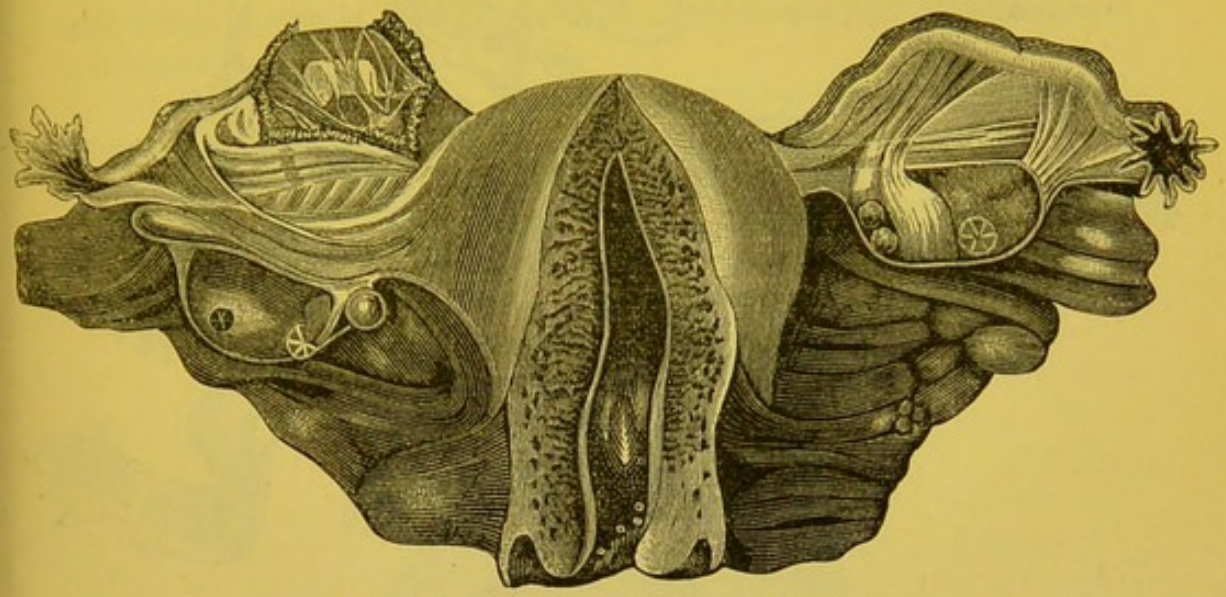


Fig. 150.—Tubal pregnancy. (N. Sommer.)

of the ovum. At an early period, usually within the first three months, rupture of the sac occurs at the point of least resistance, which corresponds in many cases to the site of the placenta. With rare exceptions death follows rupture, either immediately from acute internal hæmorrhage, or secondarily from peritonitis.

Rupture of the tube-walls may be associated with rupture of the ovum and escape of the fœtus into the abdominal cavity, or the ovum may pass intact into the peritonæum ; or, finally (and this is the more favorable termination), the ovum may remain in the tube, where it can serve as a tampon and diminish the extent of the hæmorrhage.

Recovery may occur in case of premature death of the embryo before rupture takes place ; or subsequent to rupture, by the formation of false membranes around the embryo, or the entire ovum.

Exceptionally tubal pregnancy may, owing to an extraordinary thickening of the muscular walls, advance to full term. Spiegelberg refers to three instances of the kind—one reported by Saxtorph, one

* Hennig found in one hundred and fifty reported cases a reflexa mentioned in but five ("Die Krankheiten der Eileitera und die Tubenschwangerschaft," p. 150).

† *Vide* Conrad und Langhaus, "Tubenschwangerschaft," "Arch. f. Gynaek," Bd. ix, p. 358; also Leopold, "Tubenschwangerschaft," etc., *ibid.*, Bd. x, p. 262.

by himself, and one by Fabbri.* To this list Litzmann † has added a new case, and Hofmeier ‡ reports one of probably the same character.#

Rupture of the tube may occur in the portion not covered by the peritonæum. Blood is then effused between the folds of the broad

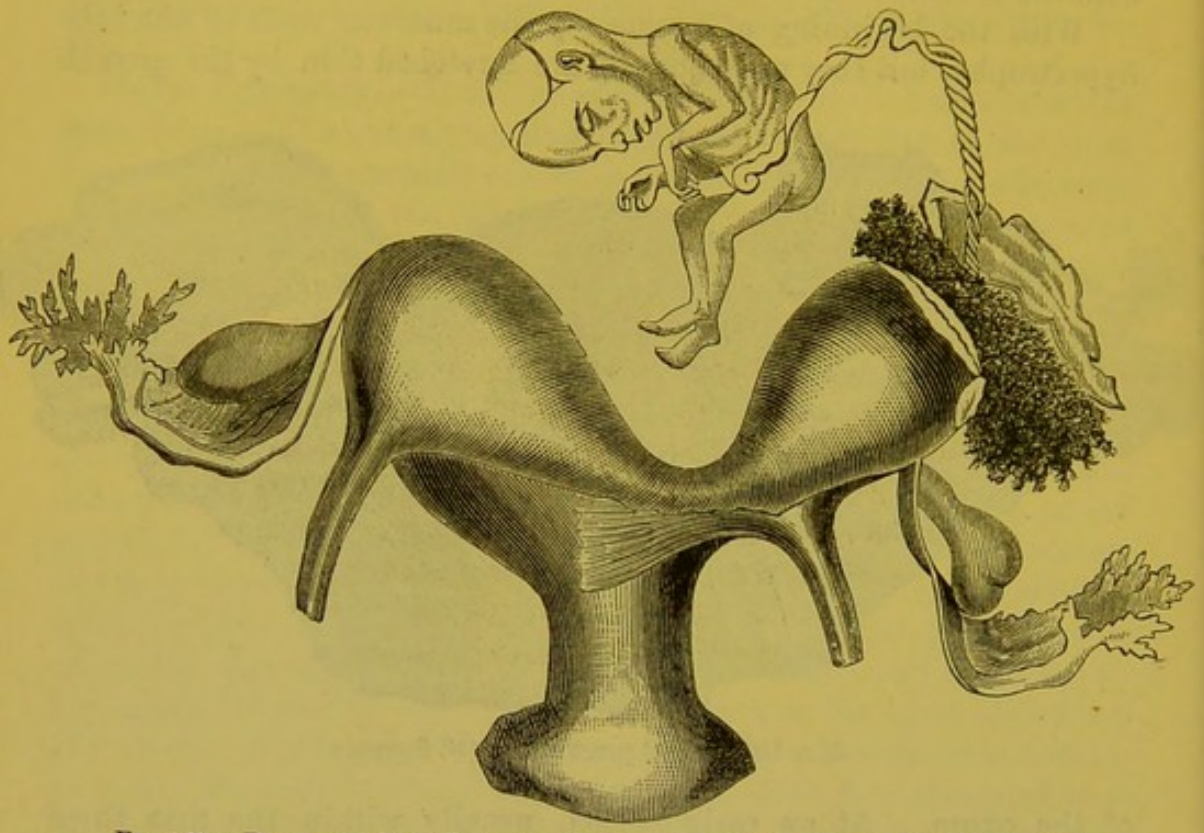


Fig. 151.—Pregnancy in rudimentary cornu. (Küssmaul, observed by Heyfelder.)

ligament, and into the cavity thus formed the ovum may escape. This form is known as extra-peritoneal pregnancy.

Pregnancy in the Rudimentary Cornu of a One-horned Uterus.—This anomaly so closely resembles the tubal form of pregnancy that the diagnostic distinction can rarely be established during life. Even after death the only certain guide is furnished by the situation of the

* Spiegelberg, "Lehrbuch der Geburtshülfe," p. 312.

† Litzmann ("Gastrotomie bei Tubenschwangerschaft, neun Monate nach dem Tode der ausgetragenen Frucht," "Arch. f. Gynaek.," vol. xviii, p. 1) expresses the opinion that the development of the ovum in the tube to maturity is by no means uncommon.

‡ Hofmeier, "Ztschr. f. Geburtsh. und Gynaek.," Bd. v, p. 115.

Ernst Fränkel ("Arch. f. Gynaek.," Bd. xiv, p. 205) collected twenty-six cases, occurring between 1875 and 1879, of pure tubal pregnancy, in which the diagnosis was confirmed by subsequent *post-mortem* examination. Of these but seventeen terminated in rupture during the first three months. Of the remaining nine, two reached full term (Simpson's and Tinker's), one completed eight months of gestation (Cullingworth's), one six months (Döllinger's), one five months (Netzel's and Blick's), and two four months (Fränkel's and Netzel's).

round ligament, which in the rudimentary horn is found external to the sac, while in tubal pregnancy it lies between the sac and the uterus. In tubal pregnancy, however, rupture takes place, as a rule, during the first three months, while the rupture of the cornu occurs somewhat later, usually between the third and sixth month. In one case, related by Turner,* pregnancy went on to full term ; the patient dying of phthisis six months after labor, the dead child was found in the left cornu. Rupture takes place at the apex of the cornu, where the tenuity of the walls is most pronounced. Kœberlé † mentions a case where the child died in the fifth month, and was converted into a lithopædion.

Interstitial Pregnancy.—The term interstitial pregnancy is applied to cases in which the ovum is developed in the uterine portion of the tube. The latter measures about seven lines in length by one line in diameter. At first the muscular walls hypertrophy and form around

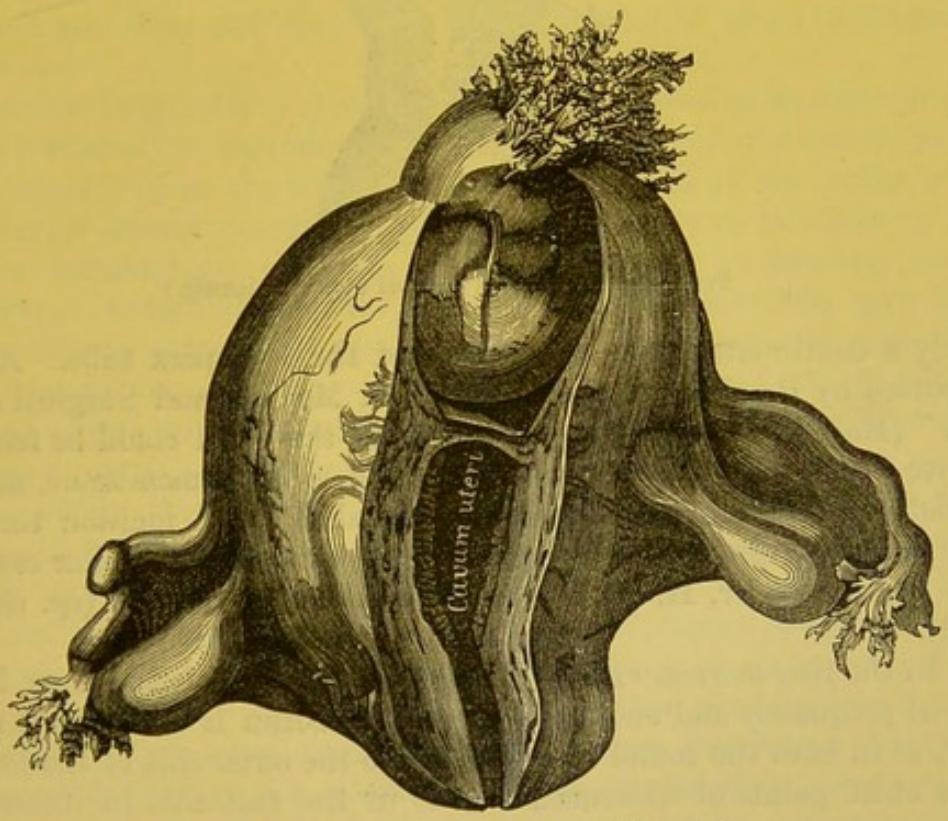


Fig. 152.—Interstitial pregnancy. (Hennig.)

the ovum a sac which projects from the upper angle of the uterus. As, ordinarily, the growth of the muscular tissue does not keep pace with that of the ovum, rupture occurs at an early period, usually before the fourth month. Rokitansky,‡ however, cites a case in which

* Turner, "Edinburgh Med. Jour.," May, 1866, p. 974.

† Kœberlé, "Gaz. Hebd.," 1866, No. 34.

‡ *Vide* Spiegelberg, "Lehrbuch der Geburtshülfe," p. 313.

the thickened muscular walls resisted the pressure of the ovum to the end of gestation, the child having been removed by laparotomy in the tenth month.

When the ovum develops in the outer end of the uterine portion, it may grow partly outward into the tube. This form is termed tubo-interstitial pregnancy. On the other hand, when near the inner extremity, the ovum may dilate the ostium and pass into the uterine cavity, and be expelled after the manner of an ordinary abortion.* Another possible form of interstitial pregnancy is furnished by the occasional existence of a canal, open at its two extremities, and appar-

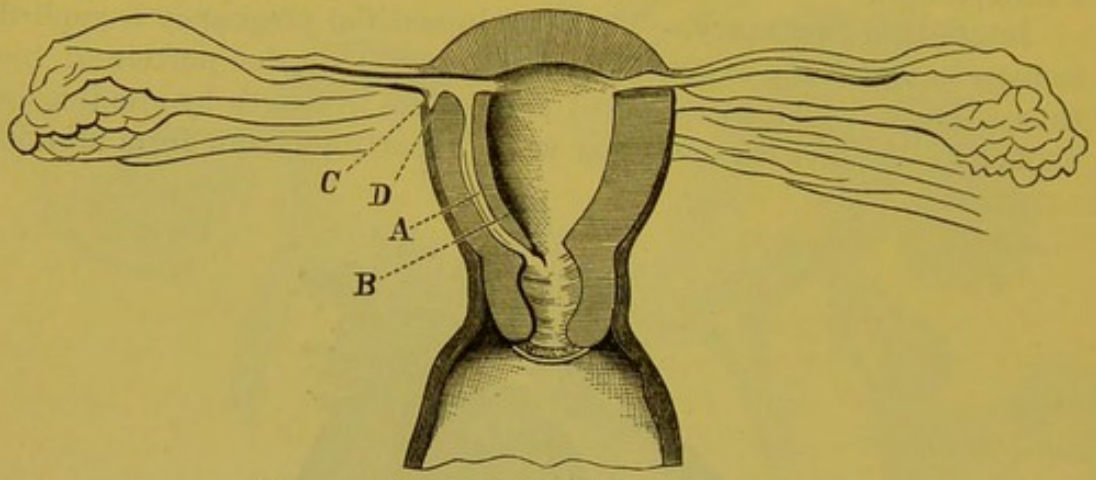


Fig. 153.—Bifurcation of tubal canal. (Hennig.)

ently a continuation or a bifurcation of the Fallopian tube. A case reported by Dr. Gilbert, in the "Boston Medical and Surgical Journal" (March 3, 1877), where the head of the child could be felt just above the os internum, covered by a thin mucous membrane, and in which delivery was successfully accomplished by an incision through the partition, probably belonged to this variety. A similar case, in the practice of Dr. H. Lenox Hodge, is reported by Parry (*op. cit.*, p. 266).

In the *post-mortem* examinations the distinction between an interstitial pregnancy and one in a rudimentary cornu is not easy to make out, as in both the round ligament lies to the outer side of the tumor. The chief points of difference consist in the fact that in interstitial pregnancy the sac is separated from the uterus by a partition, while in pregnancy in a rudimentary cornu the two halves of the uterus are united by a muscular band, which is situated, not at the upper angle, but near the os internum.†

* In this category we should certainly place the case of Dr. Charles McBurney ("New York Med. Jour.," March, 1878, p. 273) and that of Dr. Cornelius Williams, in the December number of the same journal (p. 595), both of which were followed by the recovery of the mother.

† Spiegelberg, "Lehrbuch der Geburtshülfe," p. 315.

Tubo-Abdominal and Tubo-Ovarian Pregnancy.—When the ovum becomes lodged near the trumpet-shaped extremity of the Fallopian tube it grows outward into the abdominal cavity. Local peritonitis is then set up, and plastic exudation is thrown out, forming an envelope around the ovum, which is likewise bounded by the contiguous organs. In this way the ligamenta lata, the ovaries, the mesentery, the intestines, the bladder, and the uterus, may all contribute to the investment of the fetal membranes. In case of rupture in the tubal portion, inflammatory products may form, and limit the extent of the injury. At first, owing to its weight, the distended tube drops into the *cul-de-sac* of Douglas. In advanced pregnancy, the spleen, kidneys, and liver may become involved, and form part of the sac-walls around the ovum. Usually the placenta is developed in the pelvic cavity.*

When the investment of the ovum is furnished by the tube and the ovary, the term tubo-ovarian pregnancy is employed. The course in either case does not materially differ from that of an abdominal pregnancy.

Ovarian Pregnancy.—A number of well-observed cases are now on record † where the fecundation and development of the ovum have taken place within the Graafian follicle, the walls of the latter and the ovarian stroma furnishing to the growing ovum, in whole or in part, a membranous envelope, like the wall of an ovarian cyst. Subsequent to fecundation the Graafian follicle may close, and the ovum continue extra-peritoneal, or the ovum may gradually make its way through the opening occasioned by the escape of the Graafian fluid, and thus come to lie eventually for the most part within the peritoneal cavity. In either case, rupture of the sac takes place usually within three to four months, though, when the sac-walls are reënforced by adhesions to the peritoneal coverings of adjacent viscera, the full term of gestation may be reached.

Abdominal Pregnancy.—The origin of abdominal pregnancies is unsettled. As no instances have been observed at an early period of development, it is not possible to say whether the fertilized ovum drops into the peritoneal cavity on escaping from the ovary or during its migration through the groove of the long ovarian fibria, or whether nearly all cases of abdominal pregnancy are not really secondary outgrowths from the tubal and ovarian forms.

Wherever the ovum comes in contact with the peritonæum, a connective-tissue proliferation is set up, which surrounds it with a vascular sac. The latter often attains a degree of thickness which renders

* *Vide* Bandl, Billroth's "Handbuch der Frauenkrankheiten," 5ter Abschn., p. 47.

† *Vide* Spiegelberg, "Zur Casuistik der Ovarialschwangerschaft," "Arch. f. Gynaek.," Bd. xiii, p. 73; Landau, "Zur Lehre von der Eierstocksschwangerschaft," *ibid*, Bd. xvii, p. 436; Schroeder, "Lehrbuch," 4te Aufl., p. 385.

it comparable to the gravid uterus (Klob). The walls keep pace, as a rule, with the growth of the ovum, and, as they extend into the abdominal cavity, form adhesions to the intestines, the mesentery, and omentum. It is claimed that organic muscular fibers have been found in the sac, especially near the uterine attachment. In this form the fœtus most frequently reaches maturity.

In rare cases the ovum develops free in the abdominal cavity, without the formation of pseudo-membranes, the fœtus being surrounded solely by the amnion and chorion.

Still more remarkable are the so-called secondary abdominal pregnancies, where rupture of the sac and the fetal membranes, whether primarily situated in the tubes, the ovary, or the abdominal cavity, takes place, and the fœtus passes into the abdominal cavity. Usually the child dies at or soon after the time of rupture, but cases are reported by Walter, Patuna, and Bandl,* where it continued to develop within the abdomen. The presence of the child excites an active proliferation of connective tissue, by means of which a secondary sac is formed. If the child dies, it may either become converted into a lithopædion, or, through the vascular connective tissue by which it is surrounded, the soft structures of the body may preserve their integrity for years succeeding the fatal ending.

There are, in addition to the varieties already mentioned, histories on record of the coexistence of extra-uterine and intra-uterine pregnancies, the latter occurring at the same menstrual period as the former, or subsequent to the death of the extra-uterine fœtus.†

The Symptoms of Extra-uterine Pregnancy.

The earlier symptoms of extra-uterine pregnancy do not materially differ from those of the intra-uterine form. Menstruation usually ceases, though not with the same regularity as in normal pregnancy. The recurrence of the monthly flow for one or two periods is not an uncommon incident. In some cases, too, a nearly continuous serosanguinolent discharge of moderate extent has been observed. Up to a certain point the hypertrophic changes of the uterus take place in the usual manner. The mucous membrane is converted into a decidua, and a mucous plug fills the cervix. In general terms, the length of the uterus is greater, the closer the contiguity of the ovum to the uterus. Thus, in interstitial pregnancies the length has been found to vary between four and seven inches, in tubal pregnancies the average enlargement is less than in the interstitial, and in the abdominal less than in the tubal form. In a few cases of tubal pregnancy there

* Bandl, *loc. cit.*, p. 63.

† *Vide* Browne, "Contribution to the History of Combined Intra-uterine and Extra-uterine Twin Pregnancy, with an Analysis of Twenty-four Cases," "Trans. Am. Gynæc. Soc.," vol. vi, p. 444.

has been no increase in the size of the uterus. The extra-uterine ovum may, in the course of its growth, drag the uterus upward, or push it downward, forward, or sideways, according to the site of its development.

Characteristic symptoms of extra-uterine pregnancy do not occur until the ovum has reached a certain degree of growth, and in some cases not until rupture has taken place. Often preceding rupture, or, in abdominal pregnancies, the death of the fœtus, the patient suffers from paroxysmal pains in the sac, and uterine pains of a labor-like character. The latter are associated with a sero-sanguinolent discharge, and are followed by the expulsion of portions of the decidua.

The symptoms of rupture are the usual ones of internal hæmorrhage, viz., yawning, languor, fainting, clammy perspiration, rapid pulse, intermittent vomiting, collapse, and acute anæmia. After the death of the ovum these symptoms may cease and not return again; whereas, if the ovum continues to grow, there may be repeated attacks of hæmorrhage and local peritonitis, terminating finally in death or recovery.

When the death of the ovum does not occur within the first three to four months, the pressure of the tumor usually gives rise to dysuria and constipation.

Terminations.—In tubal and interstitial pregnancies the usual terminations are, as we have seen, rupture of the sac, hæmorrhage, peritonitis, and death. It is well to bear in mind, however, that this is not the history of all, a pretty large percentage ending in recovery. Thus, a dead fœtus may be retained for years without furnishing the impulse to a fatal issue. When the fœtus dies previous to rupture, the ovum may degenerate into a mole, or the fœtus may either undergo mummification, or be converted into a lithopædion.

In abdominal pregnancies, whether primary or secondary, the ovum or fœtus usually excites a local peritonitis, attended with pain and fever, and followed by the production of pseudo-membranes, which exercise a conservative influence by shutting off the ovum from the peritoneal cavity. Indeed, in the exceptional instances where these inflammatory conditions do not develop, the movements of the fœtus within its own membranes may give rise to such intense suffering as to cause the woman to die from exhaustion (Schroeder).

In ovarian and abdominal pregnancies the child may die prematurely, or gestation may advance to full term. In the latter instances labor-pains set in, the decidua is expelled, and the child dies during the expulsive efforts. In the majority of cases the dead fœtus excites a suppurative inflammation in the sac by which it is inclosed, and the patient dies either from general peritonitis or from profuse suppuration. In favorable cases, where the peritonitis remains local and the suppuration is tolerated, fistulous communications may form with one

of the hollow viscera of the abdominal walls, through which the contents of the sac may be eliminated. Most frequently the opening takes place into the large intestine; quite often through the abdominal walls; more rarely into the vagina and bladder. In any case, the process of elimination is slow, often lasting months and even years. When the bones and soft tissues have all been discharged, complete recovery may take place. In the larger proportion of cases, however, if Nature is not assisted, the patient perishes from exhaustion and blood-poisoning before the elimination is ended (Schroeder).

Sometimes the foregoing inflammatory changes do not occur as the result of the death of the fœtus, in which case the fluid contents of the sac are reabsorbed, and the walls collapse and come in contact with the fetal cadaver. The skin of the latter, and at a later period the deep-seated soft tissues, undergo fatty degeneration, and form a greasy substance, consisting of fat, lime-salts, cholesterin-crystals, and blood-pigment. Afterward the fluid portions are absorbed, so that nothing remains but the bones, lime lamellæ, and incrustations upon the walls of the sac, or the fœtus may shrink up like a mummy, preserving its shape and organs to the minutest detail (Spiegelberg). A fœtus thus altered is termed a lithopædion. It may remain imbedded in connective tissue for years without injury to the mother. The lithopædion of Leinzell was removed in 1720 from a woman ninety-four years of age, who had carried it for forty-six years. The presence of the lithopædion does not prevent pregnancy from taking place.* In some cases it may after years excite suppuration, a result which is fostered, according to Spiegelberg, by pregnancy and labor. Recovery may follow the artificial extraction of the foreign body, or death may result from inflammation and the discharge of pus.

Note.—Küchenmeister ("Ueber Lithopädien," "Arch. f. Gynaek.," vol. xvii, p. 153) distinguishes three conditions to which the term lithopædion is applied:

1. Where, after absorption of the fluid, the membranes alone calcify, and the fœtus undergoes mummification.

2. Where, after absorption or escape of the fluid, the membranes calcify, and calcification of the fœtus occurs at points where the membranes adhere to the fetal surface.

3. Where the fœtus escapes into the abdominal cavity, and cretaceous matter is deposited in the smegma covering the fetal surface. In this way calcified strata form around the fœtus, and exert compression upon the contained tissues. Beneath the chalky layers the tissues are mummified. A lithopædion in the sense of a complete petrifaction does not exist.

Diagnosis.—The diagnosis of extra-uterine fetation is based upon the existence of the signs of pregnancy, the exclusion of an ovum within the uterine cavity, and the presence of a tumor external to the uterus.

In tubal pregnancy, the symptoms up to the time of rupture are

* Schroeder, *op. cit.*, 6te Aufl., p. 421.

often those of ordinary pregnancy. The existence of paroxysmal pains, radiating from one iliac fossa, should excite the suspicions of the physician and lead to a careful investigation. As these pains are ordinarily associated with flatulent distention of the colon, they are apt to be regarded as due to intestinal colic. Sero-sanguinolent discharges from the uterus, and afterward the expulsion of portions of the decidua, would, however, limit the diagnosis to a choice between membranous dysmenorrhœa and the condition in question, the decision depending upon the presence or absence of the menstrual, mammary, and uterine signs of pregnancy. An examination *per vaginam*, after the first five or six weeks, reveals the presence of a tumor to the side of the uterus. When situated low down, whether in the *cul-de-sac* of Douglas, or to the sides of the vagina, by conjoined palpation its ovoid shape, fluctuation in the sac, and, in the absence of peritoneal adhesions, a ballottement of the entire tumor, can be made out. Ballottement of the fœtus may be detected by the end of the fourth month. Arterial pulsations in the vaginal walls beneath the tumor are of suspicious import.

Owing to the desirability of early recognizing an extra-uterine pregnancy, when the evidence in favor of its existence is very strong it is allowable to demonstrate the empty state of the uterus by a careful introduction of the sound, or, still more clearly, by introducing the finger after preliminary dilatation of the cervix.

When the sac ruptures in the early weeks of pregnancy, the escape of blood into the peritoneal cavity may be moderate and run the course of ordinary hæmatocele. From the third to the fourth month, rupture gives rise to symptoms of extensive internal hæmorrhage, and usually proves speedily fatal.

With rare exceptions, when extra-uterine pregnancy exceeds the fourth month without the occurrence of rupture, either an ovarian or abdominal pregnancy may be predicated. After the fourth month the ovum becomes of the size of the two fists, and it is sometimes possible to make out the presence of fetal parts through the abdominal walls, provided the latter are not too thick. Of course, as pregnancy advances, the heart-sounds and the contour of the fœtus become more distinct. The difference between intra- and extra-uterine pregnancy may sometimes be established by frictions of the abdomen over the tumor with the hand, as the uterus alone contracts in response to the stimulus.

If by the foregoing means the requisite certainty is not reached, bimanual examination should be made under anæsthesia. Sometimes the diagnosis can only be decided by the introduction of the sound or a finger into the uterus, the physician assuming the risk of premature labor, should he find his supposition of extra-uterine pregnancy an error.

Treatment.—The treatment of extra-uterine fetation varies in accordance with the stage of pregnancy and the condition of the fœtus. For the sake of convenience, we distinguish—1. Cases of early gestation ; 2. Cases of advanced gestation (fœtus living) ; 3. Cases of gestation prolonged after the death of the fœtus.

1. *Cases of Early Gestation.*—The indication for treatment in the early months is plainly the adoption of measures to destroy the life of the fœtus, and thus, by arresting the growth of the ovum, avert the danger of rupture and hæmorrhage. Indeed, in this way we simply follow the plan marked out for us by Nature, spontaneous recovery commonly following the accidental death of the embryo.

The methods which have heretofore been employed to destroy the ovum are puncture of the sac, injections of morphia solutions, elytrotomy, and the faradaic current.

Puncture of the Sac.—Puncture of the sac is usually easily effected by the introduction of an exploring trocar, through either the vaginal or rectal wall. The operation is to be recommended on the score of simplicity, but has not been attended with very brilliant results. Recoveries after puncture have been recorded by Greenhalgh, Tanner, Stoltz, Jacobi, Kœberlé, and E. Martin (two cases). Fatal issues from septicæmia and peritonitis followed puncture in the hands of Routh, J. Y. Simpson, A. Simpson, Martin, Braxton Hicks, Thomas (two cases), Conrad, Netzel, Hutchinson, John Scott, Gallard, and Depaul. Fränkel * withdrew nearly three fifths of an ounce of amniotic fluid from the sac without interrupting the course of pregnancy.

Injections of Solutions into the Sac, designed to destroy the Fœtus.—This method was first suggested by Joulin.† He proposed injections of sulphate of atropia (one fifth of a grain, dissolved in a few drops of water) into the sac by means of a long hypodermic syringe. His suggestion subsequently was successfully carried into effect in two cases by Friedreich,‡ of Heidelberg. The needle of the syringe, he advised, should be introduced into the sac through the abdominal or vaginal walls, a few drops of fluid should then be withdrawn, and its place supplied by the solution containing the poison selected. Friedreich employed by preference a fifth of a grain of morphia. The operation was repeated every second day, until the diminished size of the ovum afforded evidence that the result sought for had been accomplished. The operation seemed to produce but slight inflammatory disturbance, and the maternal system did not feel the influence of the narcotic.

* Fränkel, "Zur Diagnostik und operative Behandlung der Tubenschwangerschaft," "Arch. f. Gynaek.," Bd. xiv, p. 197.

† Joulin, "Traité complet des accouchements," p. 968.

‡ Cohnstein, "Beitrag zur Schwangerschaft ausserhalb der Gebärmutter," "Arch. f. Gynaek.," Bd. xiv, p. 355. Hennig reports likewise a case operated on by Kœberlé, where profuse hæmorrhage occurred. It is not stated whether the patient recovered. ("Die Krankheiten der Eileiter und die Tubenschwangerschaft," p. 138.)

Rennert * has since succeeded in destroying the life of the fœtus in the fifth month of extra-uterine gestation by means of a single injection containing about half a grain of morphia. The patient recovered after a protracted illness. Kœberlé reported to the Gynæcological Section of the Eighth International Medical Congress at Copenhagen a case of advanced abdominal pregnancy where the child was destroyed by morphia injections. The fœtus and placenta were absorbed. The recovery was complete.

Elytrotomy.—Professor Gaillard Thomas reports a case where he cut into the sac through the vagina by means of the incandescent knife attached to the electric-cautery apparatus. The patient narrowly escaped with her life, but finally recovered. In the latest edition of his work on diseases of women, Dr. Thomas recommends Paquelin's cautery brought to a red heat. After cutting slowly through the sac, he advises removing the fœtus, but not the placenta, and then filling the sac with antiseptic cotton, which should be removed once in thirty-six hours. He offers the operation only, however, in cases where the severity of the symptoms demands immediate action.

The Faradaic and Galvanic Currents.—The transmission of the faradaic current through the ovum has proved a safe and efficient method for destroying the life of the fœtus during the first three months of its existence. The application consists in passing one pole into the rectum to the site of the ovum, and pressing the other upon a point in the abdominal wall situated two to three inches above Poupart's ligament. The full force of the current of an ordinary one-cell battery should be employed for a period varying from five to ten minutes. The treatment should be continued daily for one or two weeks, until the shrinkage of the tumor leaves no doubt as to the death of the fœtus.

The successful employment of the faradaic current in extra-uterine pregnancy we owe to Dr. J. G. Allen, who reported two cases of recovery through its instrumentality in 1872. His first case occurred in 1869, the second in 1871. Previously, in 1859, Burci had succeeded in shriveling up the ovum, in a case of tubal pregnancy, with the galvanic current transmitted through the tumor by means of two acupuncture-needles. In 1866 Dr. Braxton Hicks tried the faradaic current, but abandoned it after the second application. Dr. Allen was apparently in no haste to report his triumphs, but appears to have mentioned them incidentally in the course of a discussion before the Obstetrical Society of Philadelphia. So little pains did he take regarding his discovery, that the subject was nearly forgotten, until a new success was reported by Drs. Lovering and Landis, of the Starling Medical College, in 1877. Since then, Landis has reported a second

* Rennert, "Extrauterin-Schwangerschaft im fünften Monate," "Arch. f. Gynaek.," vol. xxiv, p. 266.

case of recovery, and one each has occurred in the practice of J. C. Reeve,* H. P. C. Wilson,† Harrison, Dr. Herrick, Dr. Cushier, Dr. Cocks, Dr. Lambert, Dr. P. F. Mundé, Dr. Garrigues, and two in that of the writer. In six cases, treated, one by Dr. McBurney,‡ one by Dr. C. E. Billington, two by Dr. Rockwell, one by Dr. Mundé, and one by Dr. Herrick, the galvanic current, with interruptions, was employed with equally favorable results.# The credit of popularizing the electrical treatment in the first four months of extra-uterine gestation in this city is certainly due to Dr. T. G. Thomas. Most of the cases referred to were seen by him in consultation, and the treatment adopted was the consequence of his confidence in its efficacy. In practice, I agree with both Drs. Thomas and Garrigues, that the faradaic current is to be preferred. It is, as compared with the galvanic current, equally efficacious, and gives rise to a much less degree of disturbance.

For the histories of many of the foregoing cases the reader is referred to Dr. Thomas's two papers in the "Transactions of the American Gynæcological Society" for the years 1882–'84, with the accompanying discussions, and to Dr. Garrigues's paper in the same "Transactions," 1882.

The treatment in my first case was begun at the end of the tenth week, dating from the last menstruation. The tumor was at that time felt quite low down upon the right side of the vagina, fluctuation was distinct, and by conjoined palpation ballottement of the entire ovum could be produced. The diagnosis was confirmed by Dr. Gaillard Thomas, who saw the case with me in consultation. At his suggestion, I tried Allen's method, though skeptical as to any benefit to be derived from it. As no perceptible effect was produced by the first three *séances*, and as I believed rupture was imminent, I became extremely anxious to make the vaginal incision at once. In a second consultation with Dr. Thomas, I was, however, persuaded to persevere, and was rewarded by finding, upon the tenth application, such distinct evidences of suspended growth that I felt justified in leaving the case to Nature. The swelling has since nearly disappeared, and convalescence has progressed without interruption.

When the tube ruptures without previous warning, treatment should be directed to the arrest of internal hæmorrhage and the re-

* Reeve, "Trans. of the Amer. Gynæc. Soc.," vol. iv, p. 313. Allen's case is referred to by Reeve.

† Wilson, "Amer. Jour. of Obstet.," vol. xiii, p. 836.

‡ McBurney, "Case of Tubo-Interstitial Pregnancy," "New York Med. Jour.," vol. xxvii, p. 273.

According to the verbal report of Dr. Rockwell at the County Society, in the discussion following the reading of a paper by the author on the "Treatment of Extra-Uterine Pregnancy," in the McBurney case two applications, in Billington's four, and in Rockwell's a single application, sufficed to destroy the embryo. The interruptions were in these cases 120 to the minute.

moval of shock. An ice-bag applied to the abdomen meets the first indication, but it is to be employed with circumspection where great depression already exists. Compression of the aorta, or a sand-bag laid upon the abdomen over the site of the ovum, may prove of service. The patient should be cautioned to maintain the most perfect quiet; opiates should be administered, and stimulants should be given in small quantities, but at short intervals. The subsequent treatment should be that for peritonitis, unless it should be decided, in view of Tait's recent successes, to open the abdomen and remove the sac.

Laparotomy.—As, under careful management, rupture of the tube most often proves fatal, Kiwisch recommended in such cases to make an incision four or five inches in length through the abdominal wall along the linea alba. In order to be sure that internal hæmorrhage had really taken place, he advised, when the peritonæum was reached, to first make a small puncture, and to introduce a pipette into the abdominal cavity. If the presence of blood was detected, the peritonæum should then be laid open the length of the abdominal wound, and, after first tying the bleeding vessels, the sac should be removed, and the peritonæum carefully cleansed. Strange to say, intelligent as these instructions seem, but two operators, in these days of abdominal surgery, have so far had the hardihood to carry them into execution. The reasons for this backwardness are probably to be found in the uncertainties of the diagnosis, the risk of finding the sac hopelessly matted to the adjacent viscera, the dislike for operating upon a dying woman, and the fact that a considerable number of spontaneous recoveries occur, either from the mummification of the fœtus, or by the limitation of the sanguineous effusion and the production of a circumscribed hæmatocele. Charles K. Briddon, of this city, operated once with a fatal result. Lawson Tait has operated five times, and has had four recoveries.*

2. *Cases of Advanced Gestation* (*Fœtus living*).—During the progress of gestation, most patients suffer from transient though often severe attacks of peritoneal inflammation, from pains caused by the fetal movements, from irregular uterine hæmorrhages, from inability to take food, and from the resulting emaciation and depression of the vital powers. The occurrence of labor is apt to excite peritonitis, and may be associated with separation of the placenta, hæmorrhage into the sac, and disruption of the sac-walls. These manifold sources of danger have been advanced as grounds for early operative interference; and assuredly laparotomy, furnishing, as it does, an opportunity to rescue the child from certain death, ought to enjoy the highest degree of favor, provided its performance does not at the same time increase the jeopardy in which the mother's life is placed. To decide this point, it is necessary to inquire as to the results thus far obtained

* Tait, "British Medical Journal," June 28, 1884.

from its employment. Parry reported twenty cases of so-called primary operations—i. e., operations performed during the life of the child—by means of which eight children and six mothers were saved. This, though not a particularly brilliant showing, was thought to furnish encouragement to continued trial, with the belief that experience would so far lead to improvements in methods of operating and in the care of patients, as eventually to raise laparotomy for the removal of an extra-uterine fœtus to the level of other forms of abdominal surgery. An examination of Parry's table does not, however, warrant his frequently quoted statement. Five of the reported maternal recoveries ought to be stricken out altogether.* For the sixth case, that of Hooper (No. 14), it is simply stated that "the cyst had burst into the bowel," and that the child was dead. Whether the death of the child long preceded the operation, it is impossible to determine. Litzmann † furnishes the results of nine additional operations, with only one recovery—viz., the now famous case of Jessup. Of seven cases collected by Werth ‡ since Litzmann's report, one—viz., that of Martin—recovered. Thus, in thirty-one cases of primary operation, only two mothers certainly survived. If we admit Hooper's case, the result will stand twenty-eight deaths and three recoveries. If we accept Parry's statement as approximately correct—that in 499 cases of extra-uterine pregnancy, including 174 cases of ruptured cyst, the mortality was 67·2 per cent.—it is evident that much remains to be done in the way of perfecting the primary operation before its admissibility, except under desperate conditions, can be recognized. In ten cases reported by Litzmann, only four children survived the third day.

The unavoidable source of danger in the primary operation lies in the impossibility of removing the placenta, owing to the absence of

* *Vide* PARRY, "On Extra-Uterine Pregnancy," p. 229. Cases 5 and 6 are the same. They were found by Parry in different journals, in one case ascribed to Schreyer, who was the principal in the operation, and in another to Zwanck, who was present as an assistant. Litzmann, on seemingly good grounds, maintains that Schreyer simply performed Cæsarean section upon a one-horned uterus.

In De Coene's case (No. 9) of twin pregnancy, one of the children passed into the abdominal cavity through an opening in the uterus formed by the gaping of the line of union at the site of a previous Cæsarean section.

In Stütter's case (No. 10), the operation was performed in the forty-fifth week, six weeks after the death of the fœtus.

In Ramsbotham and Adams's case (No. 11), the fœtus had been dead six months—operation in the fifteenth to the sixteenth month (Litzmann).

† LITZMANN, "Zur Feststellung der Indicationen für die Gastrotomie bei Schwangerschaft ausserhalb der Gebärmutter."

‡ WERTH, "Trans. of the Gynæcol. Section of the Eighth International Congress at Copenhagen." In the case of pregnancy in the undeveloped cornu of a unicorn uterus, Werth suggests that the conditions are favorable for the removal of the sac during the life of the child. The diagnosis is rendered probable by the existence of contractions in the sac, coinciding with the demonstrated vacuity of the developed cornu.

any physiological contrivance to check hæmorrhage from the maternal vessels. Even when the placenta is left *in situ*, fatal hæmorrhages may occur during the process of its elimination. Again, in the proportion of one case to six, the placenta has been found in the line of the abdominal incision.

The extraction of a living child through an incision in the vaginal wall was reported by Dr. John King, of Georgia, in 1817. The mother made an easy recovery. Campbell reports nine cases, with the saving of five mothers and five children. Parry increased the number to fifteen, with six recoveries. No recent successes have been announced. Bandl,* in 1874, operated under what he regarded as most favorable conditions, but the patient died at the beginning of the third day. The operation is only applicable to cases where the sac is low down in the pelvis, and the presenting part can be easily reached through the *cul-de-sac* of Douglas.

3. *Cases of Gestation prolonged after the Death of the Fœtus.*— It is an accepted rule not to operate in advanced extra-uterine pregnancy during the continuance of labor-pains, as the expulsive efforts at the same time diminish the chance of saving the life of the child, and increase the danger of the mother. Opiates should be administered and absolute rest enjoined, with the view of hindering the separation of the placenta, an accident necessarily followed by hæmorrhage, and possibly by rupture of the sac.

After the death of the fœtus, the most favorable result consists in absorption of the amniotic fluid, continued shrinkage of the sac, and the conversion of the fœtus into a lithopædion. More commonly, however, the fœtus undergoes maceration, and the amniotic fluid, soiled with meconium and serum, stained with dissolved coloring-matters of the blood, becomes turbid and of a dirty-red, reddish-brown, gray, or greenish-yellow color. The patient suffers from attacks of pain, due to peritoneal irritation, from loss of appetite, vomiting, and diarrhœa, from fever with irregular chills, from emaciation, and general prostration. Owing probably to the contiguity of the intestines (Litzmann), septic germs are liable at any time to pass into the sac, and excite decomposition. When an incision is then made to remove the fœtus, the latter is found in a putrid condition, and the amniotic fluid consists of a chocolate-brown, purulent menstruum of greater or less consistence. The nature of the changes that have taken place is evidenced by foul odors and the escape of stinking gases. It is obvious, therefore, that the presence of a dead fœtus seriously compromises the safety of its possessor. To be sure, many cases have been recorded where eventually suppurative processes have led to the formation of fistulous openings communicating with the abdominal walls, the rectum, the vagina, and even the bladder, through which the fluid

* Billroth, "Handbuch der Frauenkrankheiten," 5ter Abschn., p. 87.

contents first escape from the sac, and afterward the piecemeal elimination of the fœtus spontaneously takes place. As, under the circumstances, the enlargement of the openings into the cyst, the removal of the contents, and the treatment of the cavity like an ordinary abscess, are attended with but moderate risk (three deaths in twenty-nine cases of abdominal fistula, according to Parry), it has been proposed to postpone surgical aid until Nature indicates the channel by which elimination is to be effected. This proposition, however, ignores the deplorable condition to which the suppurative process inevitably reduces the patient, and the incidental dangers to life.

During the last decade, the success of secondary laparotomy, as distinguished from that performed during the life of the fœtus on the one hand, and simple incisions designed to enlarge fistulous openings on the other, has been such as to warrant its being placed in the category of justifiable operative procedures. In thirty-three cases collected by Litzmann (twenty-four between 1870 and 1880), there were nineteen recoveries.* Of the two dangers inherent to the primary operation, viz., hæmorrhage and septicæmia, the former is greatly lessened by the cessation of the fetal circulation and by the gradual thrombosis and obliteration of the maternal vessels, and the cutting off of the blood-supplies to the placenta. With the present perfection to which antiseptic measures have been carried, the risks from septicæmia are diminished though not entirely done away with.

The time for the performance of laparotomy is of some importance. All of Litzmann's patients which were operated upon during the first month subsequent to the decease of the fœtus (seven in number) died, while, in twenty-six cases operated upon at periods varying from five weeks to a year after the decease of the fœtus, there were but seven deaths. The former mortality was partially due to the desperate condition of the patients, which determined the early date of the operations, and in part to the occurrence of profuse hæmorrhages from the patent mouths of the placental vessels. There are as yet no signs known by which the time at which the obliteration of the placental vessels becomes complete can be ascertained. Schroeder removed the placenta three weeks after the cessation of fetal movements without loss of blood, while a patient of Depaul expired from placental hæmorrhage from an operation performed four months after the fœtus had perished. It is certainly evident that when the circumstances admit of delay it is best to defer operative measures, and treat the patient symptomatically, as Litzmann suggests, with pure air, nourishing food, quinine, and gentle laxatives, until the obliteration of the maternal vessels has probably taken place. In case, however, of marked septic symptoms, the opening of the sac should not be delayed, as the subsequent use of antiseptics at least is calculated to

* Dr. T. G. Thomas has at various times reported four cases, all of which recovered.

restrain the pernicious influence of the decomposing contents upon the entire organism.

The operation for laparotomy should be performed with antiseptic precautions. The incision should be made along the linea alba. In case the sac is not found adherent to the abdominal walls, it should be stitched to the cut borders of the abdominal wound previous to opening. The placenta should be left to come away spontaneously, unless it occupies the site of the incision. The wound should be closed above and left open below for the passage of the cord and the introduction of antiseptic injections. Recently Litzmann * and Billroth † have each succeeded in removing the entire sac. Both the mothers recovered. Welponer, in reporting Billroth's case, stated that the conditions were similar to those existing in a difficult ovariotomy.

No rules can profitably be laid down as to the plans to be pursued in the enlargement of fistulous openings. Each case must be treated upon its own merits, and the surgical aid rendered must be adapted to the individual peculiarities which characterize it.

OBSTETRIC SURGERY.

CHAPTER XVIII.

THE INDUCTION OF PREMATURE LABOR.

Induction of premature labor.—Indications.—Contracted pelvis.—Habitual death of fœtus.—Diseases which imperil the life of the mother.—Operation.—Catheterisatio uteri.—Intra-uterine injections.—Rupture of membranes.—Mechanical dilatation of cervix.—Vaginal douches.—Tampon.—Choice of methods.—Care of the child.—Artificial abortion.

The induction of premature labor is indicated in cases in which the continuance of pregnancy, or delivery at full term, is associated with risks to mother or child, or to both, which may be diminished by bringing pregnancy to a close at an early period after the fœtus is prepared for extra-uterine existence. The time at which the latter begins is usually placed at the twenty-ninth week. As, however, the preservation of the child at so early a date is an exceptional occurrence, and as a large proportion of those which by tender care are made to survive the first dangers of immaturity perish in infancy, commonly falling a prey to hydrocephalus or to intestinal derangements, the interests of the child call for the postponement of the operation as long as practicable. Where the choice lies with the physician, the provo-

* "Arch. f. Gynaek.," vol. xviii, p. 1. † "Arch. f. Gynaek.," vol. xix, p. 241.

cation of labor is usually deferred until the thirty-third or thirty-fourth week. The principal indications are :

1. *Moderate Degrees of Pelvic Contraction.*—In flattened pelves measuring from two and three fourths to three and one fourth inches, and in equally contracted pelves under three and one half inches, the passage of a full-term child is not impossible, though usually difficult and dangerous. By inducing premature labor, however, owing to the smaller size of the fœtus, and especially to the increased compressibility of the fetal head, we are enabled to diminish the mechanical obstacles to delivery, and thus to improve the prognosis for both mother and child. To the mother the advantage from the operation is in all cases decided, while to the child not much is gained in the extreme degrees of contraction.

The time at which gestation should be interrupted depends upon the size of the pelvis and our estimate of the size of the fetal head. The distance from the lower border of the symphysis to the promontory should be accurately measured, and the side-walls of the pelvis carefully explored. Schroeder's measurements show that the biparietal diameter of the head is, between the twenty-eighth and thirty-second week, about three and one fourth inches ; between the thirty-second and thirty-sixth week, nearly three and a half inches ; and that after the thirty-sixth week the increase is insignificant.*

One of the most important questions to be decided in reference to the induction of labor is the period to which gestation has advanced. But this, in the absence of well-defined signs, it is easy to miscalculate. Physicians have been misled by the large size of the uterus in twin pregnancies and hydramnion into provoking labor before extra-uterine existence was possible.

Ahlfeld has shown that the long axis of the fœtus, when flexed *in utero*, is almost exactly one half its entire length in an extended position. He proposes measuring the former with a Baudelocque pelvimeter, by placing one extremity *per vaginam* upon the child's head, and the other upon a point in the abdominal walls over the fundus of the uterus at which the breech of the child is felt. Very nearly the same results were obtained by measuring from the upper border of the symphysis in place of passing the lower branch through the genital canal. The following arrangement, based upon his tables, places before us in a practical way the result of his investigations, so far as they apply to the questions involved in the induction of premature labor : †

* Schroeder, "Lehrbuch der Geburtshülfe," 4te Aufl., p. 235. It is to be remembered that the bi-parietal diameter is capable of a considerable degree of compression, and that it is usually the bi-temporal rather than the bi-parietal diameter which has to pass the narrowest diameter of the pelvis.

† The arrangement is modified from one furnished by Stahl ("Geburtshülfliche Operationslehre," p. 47). Owing to individual differences in the length of the fœtus at the

Axis of fœtus.	Length of fœtus.	Bi-parietal diameter.	Duration of pregnancy.
Inches.	Inches.	Inches.	Weeks.
10	20	3½	38–40
9½	19	3⅜	35–37
9	18	3¼	31–34
8	16	3	29–30

2. *Habitual Death of the Fœtus.*—It has been proposed that, when in successive pregnancies the fœtus perishes *in utero* during the latter weeks of gestation, labor should be induced after the period of viability has been reached, but before the time at which, according to previous experience, the fatal ending was to be expected. This plan of treatment does not apply to cases where death is due to syphilis, as a better result is to be expected by subjecting both parents in advance to anti-syphilitic treatment. Little benefit, too, would be derived from premature labor where the death is due to organic diseases of the fœtus. But where death is the result of inanition, dependent upon maternal anæmia, fatty degeneration, faulty development of the placenta, or alterations of the umbilical cord, the operation is fully justifiable. With the difficulty, however, of making the diagnosis and fixing the time when labor should be induced, there have been but few cases in which the procedure has furnished favorable results.

3. *Diseases which imperil the Life of the Mother.*—In these cases the operation is primarily performed in the interests of the mother, and is indicated, therefore, even when the child is known to have perished. Sometimes, however, premature labor becomes a means of saving the life of the child, which shares the dangers that threaten the maternal existence. In this category belong especially chronic affections of the heart and of the respiratory organs ; enormous distention of the abdomen from multiple pregnancy, hydramnion, tumors, and ascites, which occasion extreme dyspnœa ; pernicious anæmia ; uncontrollable vomiting ; hæmorrhages from placenta prævia ; chorea ; convulsions ; and nephritis, associated with excessive œdema. In each case, however, it is incumbent to carefully consider whether the special condition is rendered more threatening by the existence of pregnancy, and to weigh the question as to how far, for the time being, the dangers are likely to be increased by the progress of labor.

Stehberger has proposed extending this indication to cases where the preservation of the mother's life is hopeless, but in which premature delivery affords a chance of saving the life of the child.*

same period of gestation, a considerable source of error inheres to the Ahlfeld method of computation. It is, however, much less than those to which estimates based upon the size of the uterus are subject.

* Stehberger, "Lex regia und künstliche Frühgeburt," "Arch. f. Gynæk.," Bd. i, p. 465.

Operation.

A great number of methods have been proposed with a view to provoke labor prematurely. Most of them, however, such as the administration of ergot, of quinine, or of jaborandi, the stimulation of the vagina with carbonic acid, frictions of the breasts, and the like, do not require anything more than cursory mention. The following procedures alone possess any special claims to favor :

Catheterization of the Uterus.—This method consists in the introduction of a catheter, or, better still, an elastic bougie, between the membranes and the walls of the uterus, and leaving the instrument *in situ* until active labor sets in. In performing the operation it is a good plan to place the patient in a recumbent posture upon a hard table, with the hips brought near the edge, and the thighs well flexed upon the body. Two fingers in the vagina guide the point of the bougie into the cervix. The index-finger, passed to the os internum, then follows the instrument, and as it enters the uterus directs it to one side to prevent it from rupturing the membranes. In the case of primiparæ, preliminary dilatation of the cervix may be secured, if necessary, by the use of a sponge-tent or of the vaginal douche. The bougie should be pushed slowly upward with the disengaged hand, and allowed to follow its own course, between the membranes and the uterus. To prevent the instrument from slipping down, two inches of the extremity may be left outside the cervix to find support against the vaginal wall. A retentive tampon is rarely necessary.

The method is tolerably certain. In favorable cases labor follows its employment in the course of a few hours. Sometimes, however, no action is set up during the first forty-eight hours, in which case it is well to resort to other additional measures. Outside of unwholesome hospitals, the use of the catheter or bougie to excite labor is not associated with any peculiar risks. The danger of detaching the placenta is not imminent, if the instrument be introduced slowly, as, owing to its elasticity, the bougie tends to make its way around the placental margin. In maternity hospitals, however, it may serve as a point of entry for miasmatic poisons, and thus be followed by local irritation and puerperal septic affections. Because of this danger the solid bougie is preferable to the hollow catheter. In all cases only a perfectly clean and new instrument should be used.

Injections between the Uterus and Ovum.—Cohen, of Hamburg, proposed in 1848 the separation of the membranes by injecting tar-water through a long-nozzled syringe made to penetrate about two inches within the uterine cavity. The nozzle was furnished with a rounded extremity, and with openings upon the side. He recommended that the injection should be continued until a distinct feeling of distention was experienced by the patient, which sometimes required

the employment of nearly a quart of the fluid (720 grammes).* This plan has since been modified by the substitution of an elastic catheter for the metallic tube, and by the injection of a few ounces of simple warm water (98° Fahr.) in place of the aqua picea. In case of failure with a single injection, it has been recommended to repeat the procedure. Professor Lazarewitch has demonstrated that the nearer the irritation is carried to the fundus the more certain and speedy the result. He therefore employs a syringe with a central opening, and passes it as near to the fundus as possible.†

When efficiently performed, the method possesses the advantage of rapidly exciting uterine labor-pains. Künne reports fifteen cases in which he resorted to it with complete success. He cautions against using force in injecting, and recommends, as a means of avoiding the passage of air into veins, the withdrawal of the catheter, and its reintroduction, in case a hæmorrhage should betoken that the placenta had been impinged upon. Others have employed the method many times with entire impunity. Still, cases of sudden death have occurred during its use, which have been referred to shock, to air getting into the uterine sinuses, and to rupture of the uterus. While, perhaps, the general results from uterine injections have not been less satisfactory than from the employment of other measures for inducing premature labor, the suddenness of death in the fatal cases has had a deterrent effect upon its extended employment.

Rupture of the Membranes.—This is the oldest of all the methods now in use. It is best performed by means of a simple apparatus devised by the Freiherr Braun von Fernwald, consisting of a goose-quill sharpened like a pen and nicked upon its convex surface for the passage of a uterine sound. Thus mounted, with its point guarded by the sound, it can be introduced, without risk to the maternal tissues, through the cervix to the ovum. Then, by simply pushing the quill upward, the point is made to clear the sound and effect the puncture of the membranes. The method is certain, though not always speedy in its action. It is open to the objections which hold good in all cases of premature discharge of the amniotic fluid. Hopkins recommended, as a mode to provide for the gradual escape of the liquor amnii, tapping the membranes with a sound at a distance from the os internum. Rokitansky has shown, from the statistics of Braun's clinic, that in hospital practice puncture of the membranes is the safest means of inducing premature labor, diminishing as it does the chances of infection, which is the chief source of danger in all the measures where the irritation is applied directly to the inner surface of the uterus. Though in private practice I have never from choice selected this method, I have witnessed many cases in which the membranes have ruptured

* Cohen, "Neue Ztschr. f. Geburtsk.," Bd. xxi, p. 116.

† Lazarewitch, "Trans. of the Obstet. Soc. of London," 1868.

accidentally, and yet have failed to notice, either in the case of the mother or child, the serious consequences which theory would lead us to apprehend. It is not adapted for the higher degrees of pelvic contraction or for cases where speedy delivery is desirable.

Mechanical Dilatation of the Cervix.—The dilatation of the cervix with sponge-tents or laminaria is rarely resorted to, except as preparatory to other measures. While the expansion of the tent softens the cervix and excites uterine contraction, the effect is quite frequently transient. To be sure, the action may be kept up by a succession of tents gradually increasing in size, but such a plan denudes the cervix of its epithelium, and is apt to lead to septic infection.

The Barnes dilator is a most efficient aid in cases of induced labor. I have found it convenient to seize it, well oiled and folded, with a pair of dressing forceps, by means of which it can be passed into the cervical canal. I then withdraw the forceps, and push the dilator upward with two fingers in the vagina. The dilator is, as Barnes has termed it, a water-bag. It should never be distended with air, as rupture of the bag in that case might be speedily followed by the death of the patient. As, for the introduction of the smallest-sized bag, the cervix requires to be sufficiently expanded to permit the passage of at least two fingers, it is useful chiefly as an adjuvant to other plans of treatment. At first the dilatation should only be carried to the extent necessary to render the cervix tense. When labor has fairly begun, the fluid pressure of the dilator upon the cervix serves to strengthen the uterine action. When left *in situ*, the instrument insures the development of good pains. It should, however, be removed from time to time, if not forcibly expelled into the vagina, and carbolized injections should be employed to prevent infection. So soon as the physiological softening of the cervix which results from labor has been effected, rapid dilatation can be advantageously employed. When the cervix is rigid, the rubber-bag is only useful as a reflex exciter of pains. To be sure, the rigid cervix can be forcibly dilated to almost any extent by hydrostatic pressure, but, as a rule, it closes down to its original dimensions so soon as the pressure is removed. In rare cases forcible dilatation may lead to cervical laceration.

Tarnier has devised a bag which can be passed upward through the cervix and distended in the lower uterine segment. It serves to partially detach the membranes, and excites by its presence active uterine efforts. Its liability to rupture is the most serious objection to its employment.

The Vaginal Douche.—The vaginal douche was introduced into practice by Kiwisch, in 1846. It consists in directing a stream of tepid water with considerable force directly against the cervix. The stream may either be furnished by a Davidson's syringe, or a continuous cur-

rent from a tube connecting with a vessel placed at an elevation above the patient may be used. The latter is the safer method. The large-sized fountain-syringe, made to hold a gallon of water, is a very convenient apparatus. The duration of each injection should be from ten to fifteen minutes. At the outset, three douches in the twenty-four hours suffice. Subsequently the frequency and duration should depend upon the degree of action excited and the urgency which exists for bringing labor to a close. Twelve are about the average number of injections required. In pressing cases they have been repeated as often as once in three to four hours. The temperature of the water employed should be about 106° Fahr.

In using the douche the patient should be placed across the bed, and an India-rubber sheet should be so arranged under the hips as to convey into a vessel beneath the water as it escapes from the vulva. Every care should be taken to avoid the introduction of air into the vagina, and at the beginning of each douche precautions should be adopted to aid the escape of the fluid. The forcible pressure of the stream has been known to drive air contained in the vagina into the cervix. The same accident has followed imperfection in the valves of the syringe.

The douche acts by the warmth of the water, by stimulation of the lower uterine segment, and by dilatation of the vagina. After the douche has been continued for a time, the latter is sometimes distended so as to be nearly in contact with the pelvic walls.

The vaginal douche as a means of inducing labor has of late years fallen somewhat into disrepute. Its chief recommendation was the supposed harmlessness of the procedure—a precious quality, to which in reality it appears, however, to possess little claim. Numerous cases have been reported where death has followed the accidental introduction of air, and sharp peritoneal symptoms, according to Kleinwächter,* have been known to result from the excessive distention of the vagina. The dangers referable to the latter cause increase with the repetitions of the douche. At present its employment is generally restricted to the preliminary dilatation of the os, or to the sustaining of the action of other measures.

The Vaginal Tampon.—Braun introduced an India-rubber bag, furnished with a tube and a metal stopcock, which, under the name of the *colpeurynter*, played a considerable *rôle* in obstetrical practice some dozen or more years ago. When filled with water in the vagina, it formed a painful and rather uncertain mode of inducing labor. It is now rarely employed except in hæmorrhage and where it is desired to prevent premature rupture of the membranes. Care should be taken to only moderately distend the vagina, and not to continue the pressure for any lengthened period of time.

* Kleinwächter, "Prager Vierteljahrschrift," 1872, Heft i, p. 56.

Galvanization.—Bayer * urges the constant current as an available means of exciting labor-pains. He recommends placing the negative pole of a suitably constructed electrode in the cervix, and the positive pole upon the abdomen near the fundus. Ten to sixteen elements should be used for a period varying from ten to twenty minutes. The advantages claimed for galvanism are, that it excites true pains, that it does not produce strictures, that it causes the cervix to soften and dilate naturally, and that by its use the dangers of infection are lessened. The chief drawback consists in the necessity for frequent repetitions of the procedure before labor is brought to a close. Thus, in the six cases where it was used by him, from two to thirteen applications were made, and the time from the first application to the birth of the child varied from two to eleven days. As the effect of the first application is to soften the cervix and render it dilatable, galvanism may in the future find its place as a substitute for tents, or the vaginal douche, in the preparation of the lower uterine segment for the employment of accelerative measures.

Choice of Methods.—From the foregoing it will be seen that no one of the different proceedings mentioned is entirely free from objection. Aside, however, from infection, a danger more especially dreaded in maternity hospitals, and the avoidable accident of driving air into the veins, the most serious difficulties against which we have to contend arise from the tardy dilatation of the os and the prolongation of labor. Any of the methods are good if only they act speedily. It is advisable, therefore, in practice to follow the excellent advice of Dr. Barnes, and divide the induction of premature labor into two stages, in the first of which provocative, and in the second of which accelerative, measures should be adopted. In the former category should be placed the dilatation of the cervix with sponge-tents, the vaginal douche, and the catheterization of the uterus; in the latter, dilatation of the cervix with the rubber bags, rupture of the membranes, and, in case of delay, delivery with forceps or by version.

The plan I have generally followed consists in beginning in the afternoon with the vaginal douche, and following with the introduction of a solid bougie, to be left in the uterus overnight. In many cases labor is excited in the course of a few hours. In the morning, if the process is delayed, the vaginal douche is repeated. There are few cases in which, toward the end of the twenty-four hours, the cervix is not found softened and well lubricated with mucus. The dilators should then be employed, the operator taking his time, as permanent dilatation is the object sought after. If the membranes come down well, the dilator may be removed and the progress of the case left to Nature. Often it is advisable to adopt the plan of Dr. Barnes, rupturing

* Bayer, "Ueber die Bedeutung der Electricität in der Geburtsh. und Gynaek.," vol. xi, p. 89.

the membranes when the cervix will admit three or four fingers, and then dilating with the large-sized bag until the uterus is opened fully for the passage of the child. Finally, according to the conditions present, the physician may either await the termination of the labor, or deliver by version or by lightly constructed forceps.

Care of the Child.—Premature infants possess slight powers of resisting external agencies. The customary baths should possess a temperature of 100° Fahr., or very nearly that of the amniotic fluid. The chances of raising premature infants are greatly enhanced by feeding them with mother's milk. The artificial maintenance of the body-heat is essential to the preservation of life in the early period of extra-uterine existence. In a rude way this may be accomplished by placing the child in warm cotton near the fire. Before the thirty-second week the result in such cases depends almost entirely upon the unremitting watchfulness and zeal of a devoted mother or nurse. Much better results are, however, obtainable through the agency of the contrivances of Credé and of Tarnier.

Credé's * apparatus possesses the advantage of cheapness and sim-

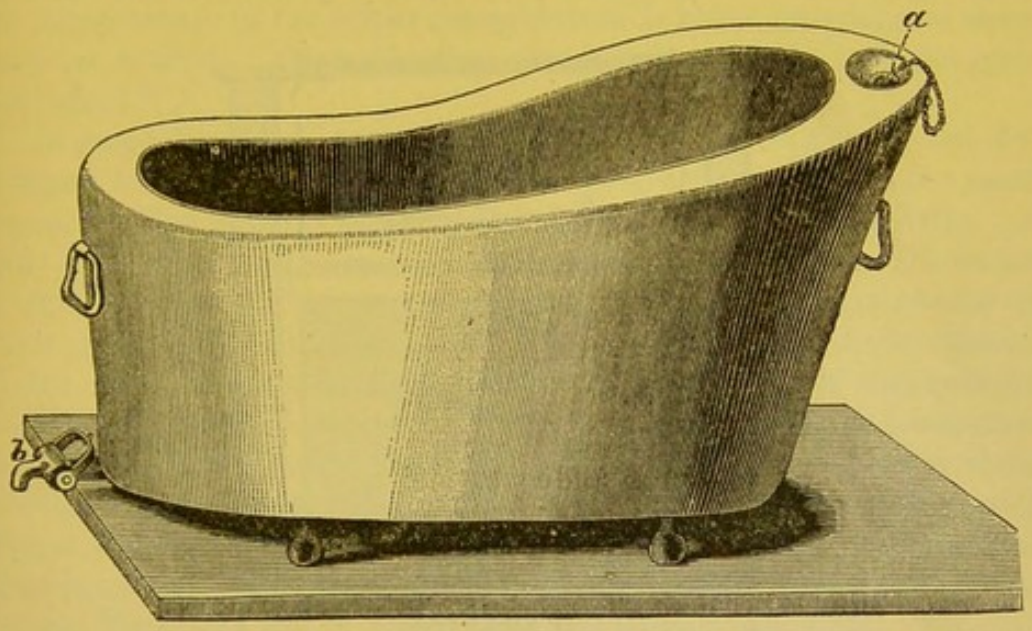


Fig. 154.—Credé's apparatus for the maintenance of the body-heat of premature and feeble infants.

plicity. It consists of a tub made of copper with double walls and floor. The compartment between the walls is capable of containing thirty-five pints of water. For convenience, in filling the compart-

* Credé, "Ueber Erwärmungsgeräthe für frühgeborene und schwächliche, kleine Kinder," "Arch. f. Gynaek.," vol. xxiv, p. 128, Berlin, 1884. The precise measurements of Credé's apparatus are as follows: Length outside, above, 39 inches, below, 25 inches; inside, above, 23½ inches, below, 21½ inches. Width outside, above, 19 inches, inside, 15 inches; inside, above, 15 inches, below, 11 inches.

ment, a funnel-shaped depression, provided with a stopper, is furnished in the upper margin. A stop-cock below, at the opposite end, permits the water to be withdrawn at will. In this vessel the child is placed, enveloped in fine cotton or soft flannel. The coverings should reach to the brim of the vessel, the face of the child alone remaining exposed. Every four hours the space between the walls is to be filled with water heated to 122° Fahr. When the water is first introduced, the temperature within the tub is about 107½°. In the last two hours it sinks to about 99½°. In extreme degrees of prematurity, a more equable temperature may be maintained by partially refilling every hour or every half-hour. The child is to be disturbed as little as possible. It should be removed only to be bathed and to be placed to the breast. The napkins should be changed, as far as possible, within the vessel.

Credé's apparatus has been employed in the Leipsic Maternity for a period of twenty years. The total number of children thus treated amounted to six hundred and seventy-eight. The weight of these children, with few exceptions, was less than five and a quarter pounds. The total mortality was eighteen per cent. Of twenty-four children, weighing between two and three pounds, twenty died; of one hundred

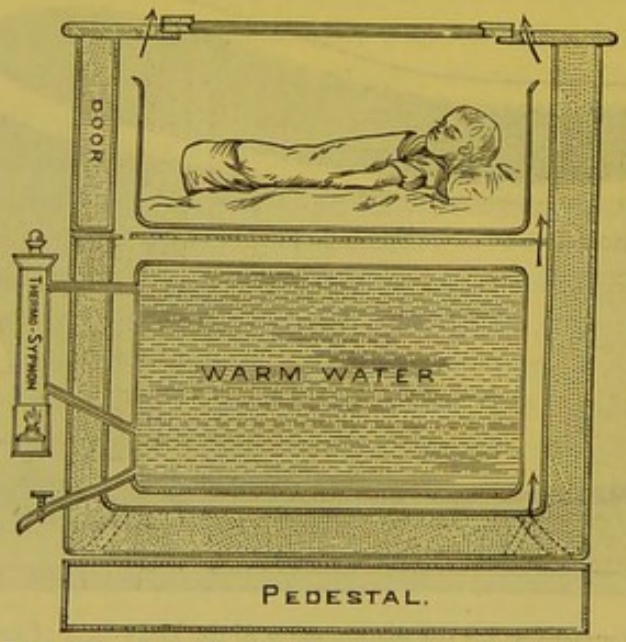


Fig. 155.—Section of hospital incubator. (Tarnier.)

and fifteen children, weighing between three to four pounds, forty-two died; of four hundred and seventy-six children, weighing between four and five pounds, fifty-four died; while of fifty-two children, weighing between five to six pounds (seventeen twins), but one died.

The incubator of Tarnier was first used at the Maternité, in 1881, for the rearing of prematurely born children. It consists of a wooden box with walls 0·10 to 0·12 centimetre thick, filled in with sawdust to prevent loss of heat. A central partition divides the box into two

compartments, the one for hot water, the other for the infant's cradle. A metal case, of a capacity of about seventy-one litres, fits into the lower compartment, leaving a space of two to three centimetres between its walls and those of the box for the free circulation of air from below upward. The capacity of the upper compartment is about eighty-six cubic centimetres; there is free circulation of air between it and the lower compartment, and it is in communication with the outer air by means of two openings—the one, on its upper surface, shut in by a double plate of glass, the other, laterally, opening like a door, and allowing exit to the cradle. In each corner of this upper compartment is a hole for the escape of the heated air from below. To the lower compartment, containing the hot water, is attached a thermo-siphon by an upper and a lower tube. When the lamp under this siphon is lighted, the heated water flows through the upper tube into the chamber, displacing an equal amount of water which flows back to the siphon. Thus a current is established, the temperature of which can be raised to the desired point. In cold weather it has been found necessary to light the lamp three times daily, allowing it to burn each time about two hours. The lamp should be extinguished when the temperature in the upper compartment is about two degrees above the heat desired. The registering thermometer may be laid alongside the infant.*

In general, a mean temperature of 86° Fahr. is sufficient, but 96° is borne without harm. The children should be clothed in the usual manner. The napkins should be changed five to six times daily. A daily bath should be given. Children sufficiently developed to suckle should be placed to the breast. Those too feeble to nurse are fed in Paris upon asses' milk. The result of two years' trial of the incubator, at the Paris Maternité, Auvard reports as follows: Of ninety-three healthy premature children, thirty-one died; of fifty-eight premature children, with complicating diseases, fifteen died. In comparing these results, however, with those reported by Credé, it is necessary to note that at the Maternité, in Tarnier's service, only children weighing four pounds and less were placed in the incubator, while the limit in the Leipsic Maternity was in general five and a quarter pounds.

Artificial Abortion.

Artificial abortion is justifiable whenever it offers the only hope of saving the life of the mother. The morality of this general proposition is unquestioned. It is not, however, by any means easy to determine in a specified case whether the requisite conditions which render the induction of abortion a duty really exist.

* Auvard, "De la couveuse pour enfants," "Arch. de Tocologie," October, 1883. p. 577. The account given above is copied from abstract furnished to the "Am. Jour. of Obstet.," April, 1884, by Robert H. Grandin.

The principal recognized causes for the operation which admit of little dispute are: 1. Incarceration of the prolapsed or retroflexed uterus when the dislocated organ can not be replaced. 2. Diseases of pregnancy which immediately imperil life, and which have been vainly combated by all the resources at our disposal. Of these diseases the most prominent is uncontrollable vomiting. Exceptionally the indication may arise in affections of the heart, lungs, and kidneys, where the symptoms are acute and peculiarly threatening.

The justifiability of abortion is, however, by no means so clear when the danger to the mother first arises after labor has actually begun. This is specially the case in extreme degrees of pelvic contraction, or where the presence of large tumors renders the parturient canal impassable, as in these cases, by means of the Cæsarean section, there is always a probability of saving the life of the child, with a fair prospect of preserving the existence of the mother. It is considered right, under such circumstances, after a dispassionate and colorless statement of the facts, to leave the decision to the mother and the friends more immediately interested. When the operation is performed for contracted pelvis, the following figures will show at how late a period it may be undertaken :

Antero-posterior diameter of pelvis.	Latest period for inducing abortion.
1½ inch.	Beginning of sixth month.
1¼ inch.	Beginning of fifth month.
1 inch.	Four months and a half.

With less than an inch the difficulties of inducing abortion increase to such a degree as to make the operation rarely advisable, or indeed even practicable.*

The induction of abortion is accomplished by puncturing the membranes with a uterine sound, or by dilatation of the cervix with a sponge-, or, still better, a tupelo-tent. In the early months dilatation by means of a tent possesses the advantage of promoting the expulsion of the ovum entire. In the sixth and seventh months the same means are available that have been described in connection with the induction of premature labor.

As to the choice of time when the operation should be performed, opinions differ. Some prefer the first two months on account of the small size of the ovum, and the slight development of the fetal tufts at the decidua serotina. Most physicians wait till the first three or four months have expired, as the diagnosis of pregnancy is then certain, the execution of the operation easy, and the detachment and expulsion of the fetal appendages more complete.

* De Soyre, " Dans quels cas este-il indiqué de provoquer l'avortement? " Paris, 1875, p. 68.

CHAPTER XIX.

FORCEPS.

History.—Varieties of forceps; short forceps, long forceps.—Action of forceps.—Indications.—Preparations.—Forceps at outlet.—Operation; introduction; locking; tractions; removal.—Forceps at brim; operation.—Axis-traction forceps.—Forceps in occipito-posterior positions; in face presentations.

History.—In 1647 Peter Chamberlen speaks, in a pamphlet written by himself, of a discovery made by his father, Paul Chamberlen, for saving the lives of infants during childbirth. The measure in the possession of the Chamberlens was, however, withheld from the profession, and utilized purely as a means of gain. In the early part of the year 1670, Hugh Chamberlen, who enjoyed a great reputation as an accoucheur, went to Paris in the hopes of finding a purchaser for the family secret. Mauriceau, to test the value of Chamberlen's pretenses, suggested that the latter should attempt the delivery of a woman with extreme contraction of the pelvis, upon whom he had previously decided to perform the Cæsarean section. Chamberlen declared that nothing could be easier, and at once, in a private room, set about the task. After three hours of vain effort he was obliged to acknowledge his defeat. The woman died; the negotiations for sale were dropped; and Chamberlen returned with his secret unrevealed to England. In 1672 Chamberlen published a translation of Mauriceau's work upon midwifery, in the preface of which he states: "My father, brothers, and myself (though none else in Europe as I know) have, by God's blessing and our own industry, attained to and long practiced a way to deliver women in this case without any prejudice to them or their infants, though all others (being obliged, for want of such an expedient, to use the common way) do or must endanger, if not destroy, one or both with hooks." In 1688 Hugh Chamberlen went to Amsterdam and sold his secret to Roenhuysen for a large sum, who in turn disposed of it to Ruysch and others, and, as late as 1746, it was the rule of the Medico-pharmaceutical College, at Amsterdam, that no one should practice midwifery without first obtaining the secret measure, which was imparted by their examining body for a heavy money consideration. In 1753 Jacob de Vischer and Hugo van de Poll, who had acquired the secret from the daughter of a former possessor, made it public property; but the instrument turned out to be the single-bladed vectis. Whatever doubts, however, this exposure may have cast upon the nature of the Chamberlen secret were set at rest, in 1815, by the discovery in a former residence of the family, in Woodham, in Essex, of a chest containing, besides letters and a variety of patterns of the vectis, a number of pairs of forceps, fenestrated, without a pelvic but with an excellent cephalic curve. Moreover, Chap-

man, in a short treatise upon midwifery, published by him in 1733, stated that "the secret mentioned by Dr. Chamberlen was the use of forceps, now well known to the principal men of the profession both in town and country." And two years later, in a second edition of his work, he published an engraving of the instrument, which became known as Chapman's forceps, though it did not differ from the one used by the Chamberlens.

Since Chapman's publication, the modifications made in the forceps by obstetric practitioners have been exceedingly numerous. Indeed, nearly every man widely engaged in midwifery practice finds it convenient to possess his own forceps. With few exceptions, however, the various patterns described by authors do not differ materially as regards essential principles, but have each some peculiarity of construction which fits them to supplement a personal defect of the contriver, or to meet some special indication. The forceps is by no means a perfect instrument. It is impossible to construct it in such a way as to cover every need. In consulting practice, it is convenient to possess a number of forceps for different emergencies. A good pair for general use is necessarily a compromise between conflicting aims, and requires, for successful use, experience and intelligence to correct its deficiencies.

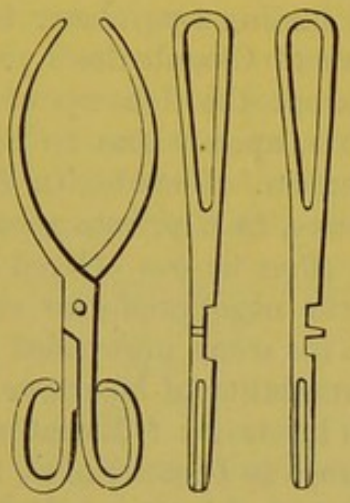


Fig. 156.—Forceps of Chamberlen.

In selecting forceps it is well to bear the following points in mind: We have first to distinguish between the long and the short forceps.

Short Forceps.—The original instrument of the Chamberlens furnishes the type of the short variety. By referring to Fig. 156, it will be seen that the Chamberlen forceps consisted of two levers, made to cross each other like a pair of scissors, with short handles, and blades diverging just beyond the point of articulation. The blades were fenestrated to lighten the instrument, and to enable them to seize the head with greater security. They were furnished with a cranial curve, as has been stated, but were straight when viewed in profile. Though somewhat rude in appearance, they were capable of rendering good service when the head

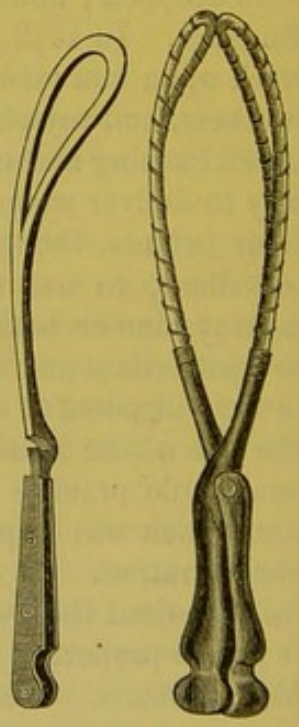


Fig. 157.—Forceps of Smellie.

had once entered the pelvic cavity. Smellie, in place of the mortise lock of the Chamberlen forceps, which required to be secured by tape or cord, invented the easily adjusted English lock, and covered the handles with wood and a durable coat of leather. The handles were five and a half inches in length, and the blades six inches. Short forceps, modified somewhat from the Smellie pattern, are used by some practitioners at the present day. It has been thought an advantage that they can be concealed in the pocket, and slipped over the child's head without the knowledge of the patient or of the assistants. Smellie laid great stress upon this point, and says: "As women are commonly frightened at the very name of an instrument, it is advisable to conceal them as much as possible until the character of the operator is fully established." In these enlightened days, however, secrecy is no longer advisable. Indeed, the forceps ought never to be used without such exposure of the vulva as will enable the operator to exercise every precaution for the preservation of the perinæum.

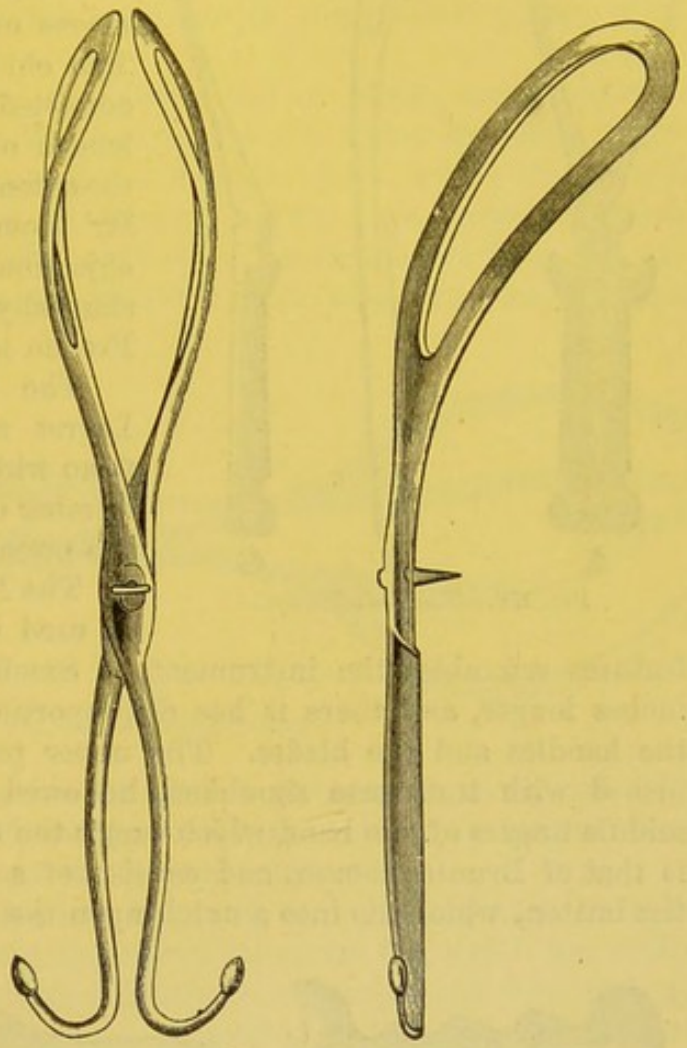


Fig. 158.—Levret's forceps.

Long Forceps.—Smellie tells us he found, in pelves with jutting-in of the sacrum, that he could not push the handles far enough backward to include between the blades the bulky part of the head, which lay above the pubes. He, therefore, to remedy this inconvenience, contrived a longer pair, curved on one side, and convex on the other. Thus, at an early period the necessity for long forceps was experienced. Smellie was deeply impressed, however, with the dangers of high forceps operations, and sought to diminish the risks incidental to them by making the handles short to free himself, as he said, from the temptation of using too great force.

Levret, on the contrary, contemporaneously with Smellie, converted the forceps of Chapman into a powerful tractor and compressor. He retained the iron handles, but roughened the surfaces, and made them slightly convex, to adapt them to the palms of the hand. The articulation was effected by means of a pivot and a mortise. The chief peculiarities, however, consisted in the weight and the length of the instrument and in the extent of the pelvic curve. So far from these features proving objectionable, they have been substantially retained in modern French instruments.

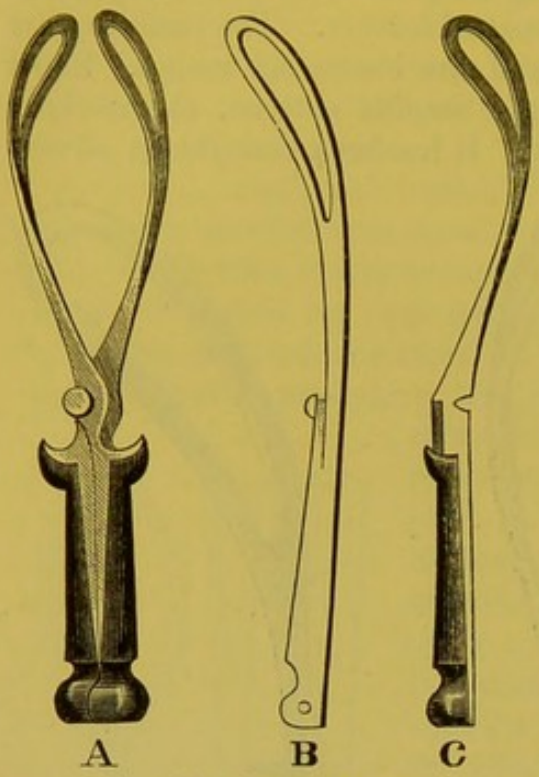


Fig. 159.—Naegele's forceps.

The forceps of Smellie and Levret are the two type-forms from which are derived the great number of the models in vogue at the present day.

The Naegele forceps, extensively used in Germany, in its main features resembles the instrument of Smellie. It is, however, two inches longer, and there is less disproportion between the length of the handles and the blades. The upper part of the handles is furnished with transverse shoulders, hollowed out for the index and middle fingers of the hand which exerts the traction force. The lock is that of Bruninghausen, and consists of a pivot, surmounted by a flat button, which fits into a notch upon the opposing blade.

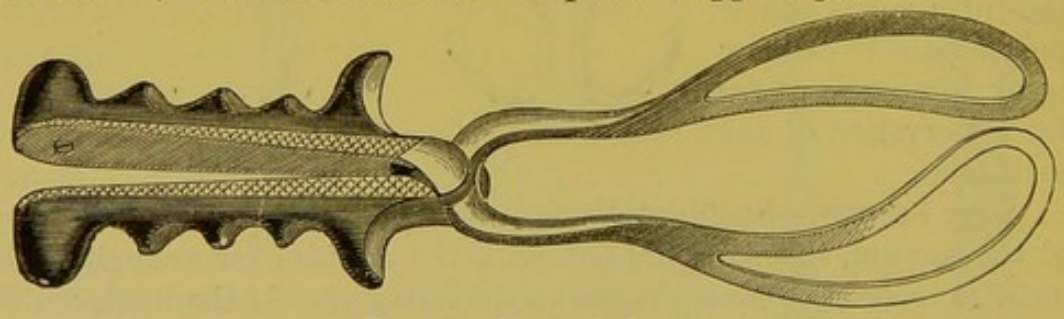


Fig. 160.—Simpson's forceps.

The Simpson forceps possesses a relatively short handle, with transverse shoulders, and indentations for the fingers of the under hand. The English lock is improved by the addition of knees or projections to diminish its mobility. The cephalic curve, in place of starting at the lock, is carried away two and three eighths inches by straight, parallel shanks, an arrangement which makes it possible to lock the

instrument outside the vulva even when applied to the head at the brim, and which enables the operator to bring the head to the floor of the pelvis without placing the vulva upon the stretch. The pelvic curve does not exceed one inch and a half. I have been in the habit of recommending this forceps to my classes of medical students on account of the ease with which it can be applied, its solidity, and the slight markings it leaves, under ordinary circumstances, upon the child's head. It is, however, defective in compressive power, when such action is necessary.*

The forceps of Hodge, of Wallace, and of White, are extensively used in this country. Like those of French make, they have metal handles, and a lock composed of a movable pivot, which slips into a notch at the moment of adjustment. They are, however, much lighter and of more graceful outline. The shanks are long and superimposed. The blades are provided with wide fenestræ, through

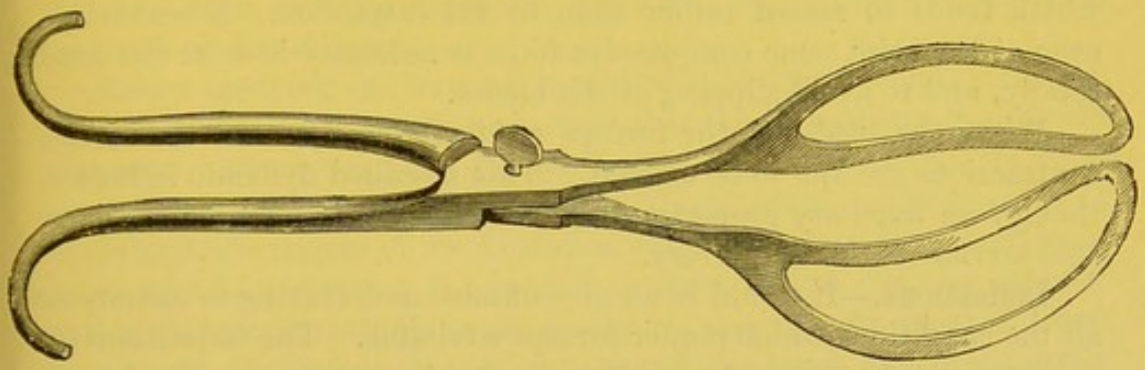


Fig. 161.—Hodge's forceps.

which the parietal bosses are intended to project. I have tried each of these instruments, and, though I cling to Simpson's forceps from habit, have found them extremely serviceable.

Finally, in choosing forceps, it is well to remember that, if there are none which are absolutely perfect, there are few which are really poor. Objectionable features are very short handles and thin, springy blades, with sharp-cutting edges. A good pair of long forceps renders the possession of short forceps a superfluous luxury.

Action of the Forceps.—The forceps is primarily and essentially a tractor. When properly adjusted, it serves as a handle by means of which the head can be withdrawn from the parturient canal. Many excellent operators are in the habit of combining with direct traction a side-to-side swaying of the forceps-handles with a view of determining the alternate descent of the lateral surfaces of the cranial vault. No doubt these so-called pendulum movements increase the extractive

* The instrument-makers of this city are accustomed to make for me an instrument exactly copied from a pair of forceps brought by me from Edinburgh in 1865. Many of the forceps bearing Simpson's name in this country have only a faint resemblance to the original model.

power of the forceps. The increase is, however, obtained at the expense of the maternal tissues. They should, therefore, be discountenanced. As to the efficiency of direct tractions, I am able to speak from experience. At first insisted upon by the Vienna school, they have found warm advocates in Matthews Duncan,* of London, and Albert Smith,† of Philadelphia.

The crossing of the forceps at the lock renders it impossible to resort to traction without, at the same time, exercising compression upon the child's head. When the forceps is applied laterally over the parietal bones, moderate pressure is harmless to the child, and undoubtedly facilitates in some degree the act of delivery. When the head is high in the pelvis before rotation is completed, the lateral application is rarely possible. If the forceps is applied obliquely with one blade over the side of the brow, and the other over the side of the occiput, bulging takes place in the opposite oblique diameter—a result which tends to retard rather than to aid extraction. Nevertheless, even at the brim some compressive force is necessary to seize the head solidly, and to avoid slipping of the blades.

When the blades of the forceps are introduced within the uterus, contractions are apt to be excited. This so-called dynamic influence, though an ancillary property of the instrument, is often of considerable service in aiding delivery.

Indications.—It would be an unprofitable undertaking to enumerate all the conditions which render forceps advisable. The indications for their use may be summed up in two general propositions. The forceps is applicable—1. In cases where the ordinary forces operative during labor are insufficient to overcome the obstacles to delivery; 2. In cases where speedy delivery is demanded in the interest of either mother or child.

Both these propositions are, however, subject to the limitation that, in the selection of the mode of delivery, choice should be made specially with reference to the maternal safety. Fortunately, in the great proportion of cases the interests of both mother and child are identical.

Preparations for Forceps Deliveries.—When it has been decided to deliver by forceps, it is a good plan always to place the patient crosswise in bed, with the head raised by a pillow, and with the hips well over the edge of the bed. To be sure, many prefer, in simple cases, to disturb the patient as little as possible, and pride themselves upon being able to slip in the forceps and deliver without the seeming of an operative procedure. This trifling advantage is, however, more than coun-

* Duncan, "Against the Pendulum Movement in working the Midwifery Forceps," "Trans. of the Obstet. Soc. of Edinburgh," vol. iv, p. 195.

† Smith, "The Pendulum Leverage of Obstetric Forceps," "Trans. of the Am. Gynæc. Soc.," vol. iii, p. 235.

terbalanced by the increased risk of injuring the vulva and perinæum, when the operator is compelled to assume a constrained or awkward position.

In this country, as in France and Germany, it is customary to place the patient upon her back; whereas in England she is made to lie upon her left side. The difference is not material. In the description to follow it will be assumed that the dorsal position is the only one likely to be selected.

At the beginning it is well, in most cases, to bring the patient well under the influence of an anæsthetic. This I am accustomed to do before changing the patient's position. In easy cases the accoucheur can administer the anæsthetic before operating, and then leave the continuance of the chloroform- or ether-giving to any intelligent bystander who acts under his supervision. In difficult cases, however, it is better to send for a skilled assistant who is capable of taking entire charge of the anæsthesia, that the operator's attention may not be diverted from the work he has in hand.

Before applying the forceps, care should be taken to ascertain the position of the head, and to make sure that the membranes have freely ruptured. Forceps applied directly to the membranes might do harm by causing a premature detachment of the placenta. The position of the os and the degree of its dilatation should likewise be determined. In excessive anteversion the head sometimes bulges out the anterior wall of the cervix, and thins the cervical tissues to such an extent that the sutures, the fontanelle, and contour of the head, can be distinctly felt, as though the head had entered uncovered into the vagina; whereas, in fact, the undilated os is situated high up, and with care may be found looking backward in the direction of the sacrum. It is only necessary to indicate the possibility of such a source of error to insure the caution necessary for the avoidance of forceps applications to the cervix.

As a preliminary to all obstetrical operations, both bladder and rectum should be emptied. The blades of the forceps should be dipped in warm water to remove the chill from the steel, and should be smeared with some oily substance to reduce to the minimum the friction produced by their passage into the utero-vaginal canal.

Practically it is important to distinguish between forceps operations at the brim and those conducted after the head has entered the cavity of the pelvis. The latter are simple, safe, and easy of accomplishment, requiring only skill in the management of the perinæum; while the former belong in the category of capital operations, and call for a large degree of patience, experience, and obstetrical tact to bring to a successful issue.

Forceps at the Pelvic Outlet.—The special indications for forceps when the head is low in the pelvis are so-called rigidity of the peri-

næum, stenosis of the vaginal orifice, and conditions demanding speedy delivery.

The condition termed rigidity of the perinæum is usually the sign of failing uterine action. So long as the labor-pains are good, the external parts progressively soften and relax in preparation for the advancing head. If after the head reaches the floor of the pelvis the pains lose their expulsive character, the perinæum may be rigid simply because the ordinary physiological forces which induce softening are absent, or, in case softening has already begun, the perinæum may become rigid from the sustained pressure to which it is subjected. In either contingency intermittent tractions made with forceps, in imitation of the natural mechanism, furnish the speediest and safest method of overcoming the resistance of the soft parts.

Stenosis of the vulva is sometimes the result of old cicatrices. Oftener it is found where there is faulty direction of the child's head, the vertex bulging the perinæum in place of serving as a dilating wedge to the vulval orifice. The danger of central perforation of the perinæum is best averted by applying forceps and bringing the occiput well forward under the arch of the pubes. The commonest conditions demanding speedy delivery are convulsions, exhaustion, and febrile disturbances in the mother, and dangers threatening the life of the child. It is, however, of great importance to keep in mind the relation that the prolongation of the second stage of labor bears to these very dangers. So long as the head advances through the parturient canal by regular progression, the vagina pours out an abundant secretion of mucus and relaxation takes place. If the advance of the head is arrested from the dying out of the pains, or from other causes, the continuous pressure exercised by the head upon the soft parts produces venous stasis, œdema, disappearance of the secretion, and finally inflammatory infiltration. The genitals become therefore hot, dry, swollen, and friable, the intensity of the symptoms depending upon the more or less close adaptation of the head to the bony walls of the pelvic cavity. It is easy to understand that with these conditions the temperature rises and the pulse becomes frequent; if the urethra is compressed, retention of urine with convulsions may follow; while, as after-results, we may have phlegmasiæ extending to the pelvic cellular tissue and thence to the peritonæum. Pressure too long continued can produce necrosis, and, as sloughing occurs, vesico- and recto-vaginal fistulæ. At the same time there is reciprocal pressure exercised by the bony walls upon the child's head, and close retraction of the uterus upon the fœtus. The first cause may lead to retarded heart-action and intra-cranial extravasations of blood; while the second is a fruitful source of asphyxia, owing to the diminution of the maternal blood-currents which circulate through the placenta.

In view of the foregoing, it will be seen that forceps is not alone

indicated in the presence of perils fully developed, but is of still greater service as a prophylactic against the dangers of an unduly lengthened second stage.

It is in vain to lay down well-defined rules as to the precise time at which the forceps should be applied. Formerly it was advised to wait for the advent of a thin, reddish-brown discharge. As the latter simply consists of serum commingled with blood from overstrained capillaries, it furnishes a sign that delivery has been delayed too long. Some counsel applying forceps two hours after the completion of the first stage of labor, and proclaim longer waiting a useless barbarity.

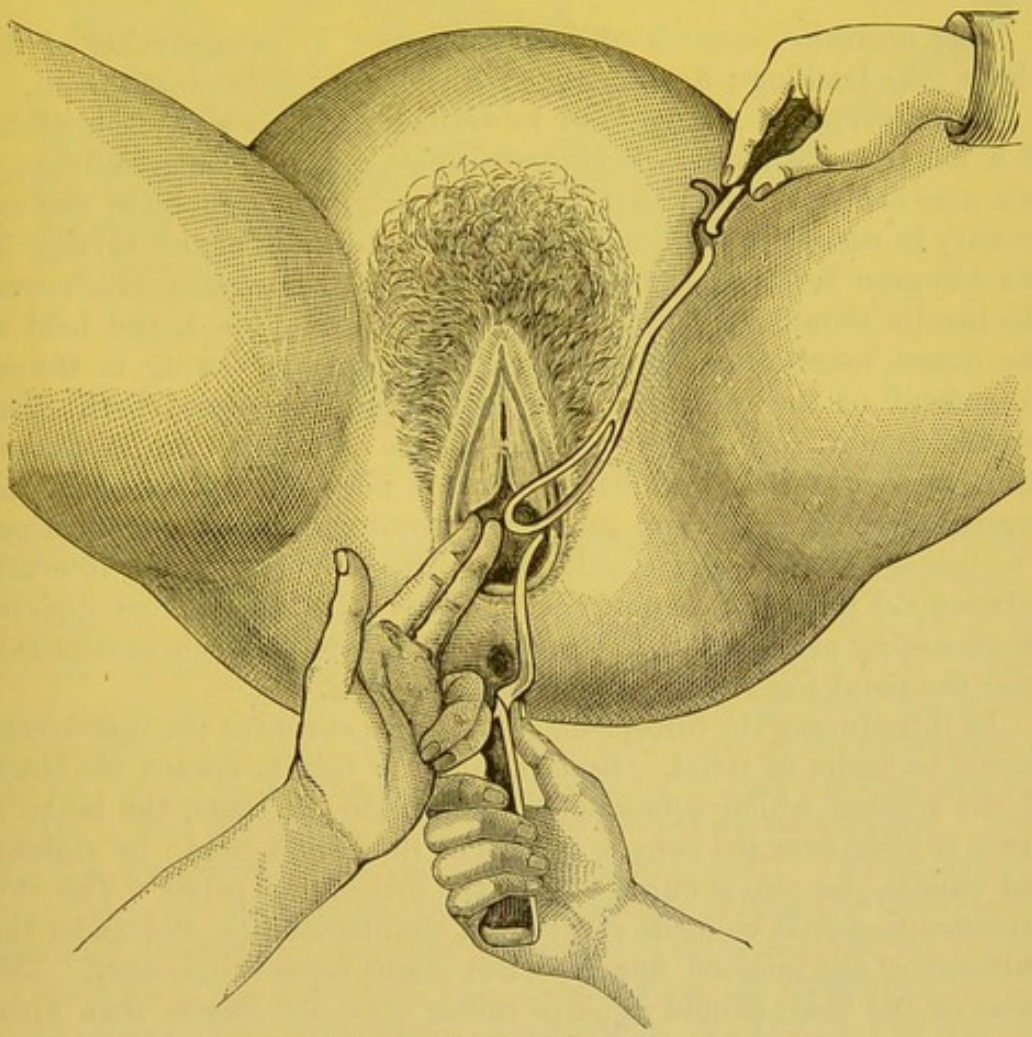


Fig. 162.—Introduction of blades.

Clearly, however, it is not so much the length of the second stage of labor which furnishes the indication for forceps as the degree of the reciprocal pressure exercised between the head and the pelvis. A valuable index to this pressure is furnished by the caput succedaneum. In the second stage, a scalp tumor of large circumference can only be produced by the circle of the bony pelvis. Such a tumor, increasing in size, without any evidence of progress in the delivery, is a signifi-

cant evidence of pressure, and furnishes, therefore, the most reliable indication for forceps.

Whether the case with which forceps can be applied at the outlet and the safety which attends its employment justify its use as a means of saving the physician's time, or the patient from an additional half-hour of suffering, are questions which are at least debatable. I can only say that, with increasing experience, my own practice has grown more and more conservative, and my own belief is that true wisdom requires us to abstain from even trivial operations so long as Nature is able to do her work without our assistance.

The operation consists of four acts, viz.: 1. Introduction of the blades; 2. Locking; 3. Tractions; 4. Removal of the instrument.

Introduction of Blades.—In introducing the forceps, each blade, if a long one with pronounced pelvic curve, should be seized like a pen near the lock, and should be held nearly vertically, with the extremity in correspondence with the slit-like opening of the vulva. In the Simpson forceps, which possesses only a moderate pelvic curve, the handle should be lightly grasped in the half hand, and held at the outset nearly parallel to Poupart's ligament. Owing to the arrangement of the lock, the left blade should be passed first. The handle should accordingly be held in the left hand, while two or three fingers of the right hand, inserted between the head and the vagina, serve to guide and guard the point during its introduction. The passage of the blade should take place only during the intervals between the pains. It is customary to pass each blade at first opposite the sacro-iliac articulation, and then to change the direction as required, after the point has reached the *linea terminalis*.

In introducing the forceps-blades, the two curves of the instrument should be borne in mind. By directing the handle toward the thigh of the mother which corresponds in name to the blade, the latter is made to glide over the convex surface of the child's head; by sinking the handle, the pelvic curve follows the axis of the pelvis. The two movements should be made slowly, but simultaneously, and under the guidance of the inserted fingers. But slight force is necessary. The point of the blade should impinge rather upon the fingers than upon the child's head. When the left blade is in place, the handle should be lowered and intrusted to an assistant. The right should be introduced on the right side, under the guidance of two to three fingers of the left hand, in accordance with the same general rules.

The cephalic curve of the forceps is intended to correspond to the lateral surfaces of the child's head. When the rotation of the occiput under the symphysis is complete, it is only necessary to sink the handles to make the blades assume the natural position over the parietal bosses. If the head is still in an oblique diameter, the forceps should

be applied in the opposite oblique diameter. When, therefore, the occiput is left anterior, the left blade should be allowed to remain opposite the sacro-iliac articulation, while the right blade, by sinking and at the same time rotating the handle, is swept forward to the right acetabulum. If the head is right anterior, the left blade is at once swept

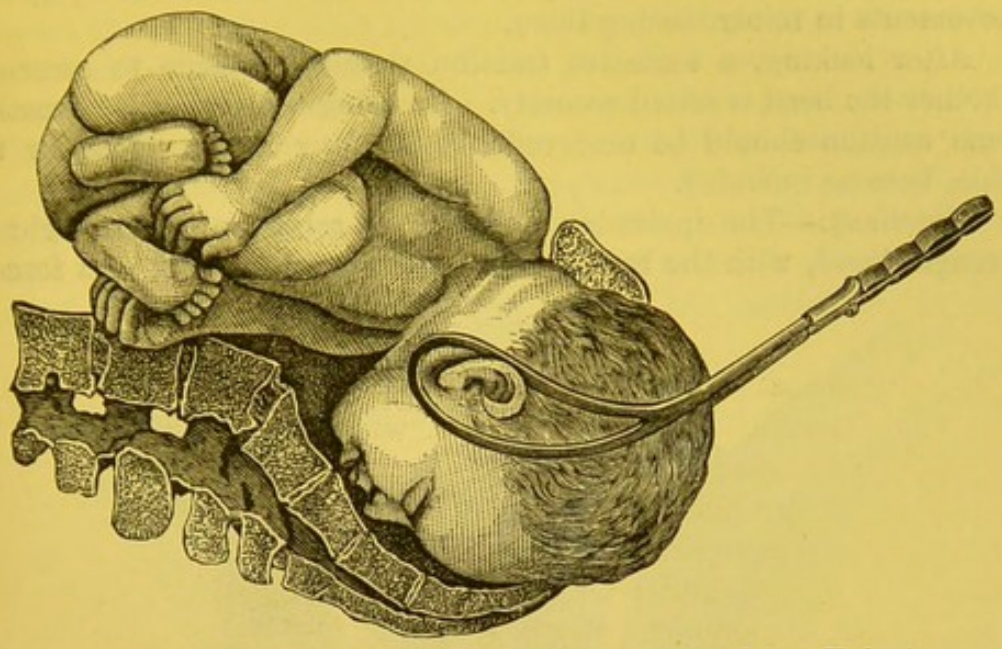


Fig. 163.—Blade adjusted to the head at outlet. (Altered from Hodge.)

forward toward the left acetabulum, while the right blade is allowed to remain opposite the sacro-iliac articulation. If the sagittal suture occupies the transverse diameter, the forceps should be applied in the oblique diameter of the same name as the side toward which the forehead is turned. This is best accomplished by first applying the forceps in the usual way; then, leaving the occipital blade in the excavation to the side of the promontory, with the guiding fingers inserted into the vagina, direct the frontal blade forward toward the acetabulum. During this manœuvre the handle should be held loosely. The forceps will seize the head very nearly between the anterior frontal and the opposite posterior parietal protuberance. The direct application of the forceps to the sides of the head, with one blade beneath the symphysis and the other opposite the promontory, is sometimes practicable, but is undeserving of commendation.*

Locking.—When the occiput is rotated to the front, and the blades are applied to the sides of the head, locking is a very simple matter. The handles should be grasped in the full hand, with the thumbs

* The application of the forceps to the sides of the pelvis, without reference to the position of the child's head, has many warm advocates. That the head can be delivered in this way is beyond all question. These so-called direct applications I practiced exclusively for some years, and it was only gradually that I became convinced of the superiority of the methods the description of which has been given.

directed upward. Coaptation is secured by slight movements of the blades as the operator sinks the handles downward.

When the head is transverse it is often, on the contrary, difficult to bring the separate parts of the lock in apposition. Under such circumstances no force should be used, but the blades should be withdrawn a little, and the attempt made to adjust the lock by gentle movements in reintroducing them.

After locking, a tentative traction should be made to ascertain whether the head is seized securely. In bringing the blades together some caution should be observed lest the hair of the pubes, or the labia, become included.

Tractions.—The instrument should be seized with the right or stronger hand, with the back of the hand turned upward. In forceps

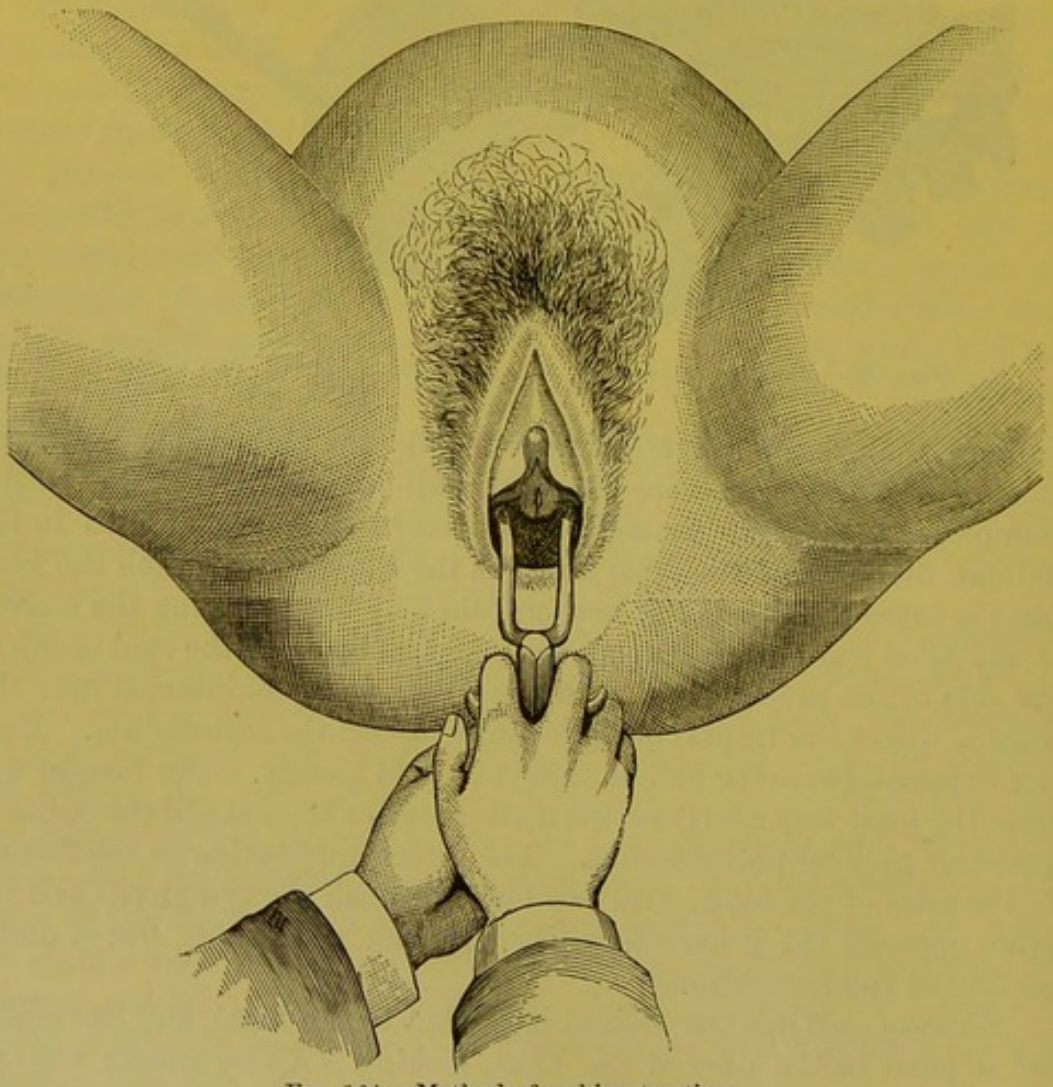


Fig. 164.—Method of making tractions.

provided with transverse shoulders, the index-finger should be placed over one shoulder, and the remaining fingers over the other. The left hand, with the palm upward, seizes the handles from below and aids in extraction. When the handles are far apart, the index-finger of the

left hand should be introduced into the vagina from time to time, to determine the position of the forceps-blades, and to estimate the amount of pressure upon the child's head during tractions.

Steady tractions are preferable to pendulum or rotary ones. Tractions are most effective when made during a pain. This is specially the case when the rotation of the head is incomplete. However, in the absence of pains, it is often necessary to use the forceps as a substitute for, instead of a reënforcement of, the propulsive action of the uterus. Pressure through the abdominal walls upon the uterus, made by a skilled assistant during tractions, is here, as in other obstetrical operations, an adjuvant of great value. Tractions should not be too prolonged. When not made in unison with the pains, they should not exceed one to two minutes in duration. The head should then be allowed to recede. Haste in delivery exposes the patient to the dan-

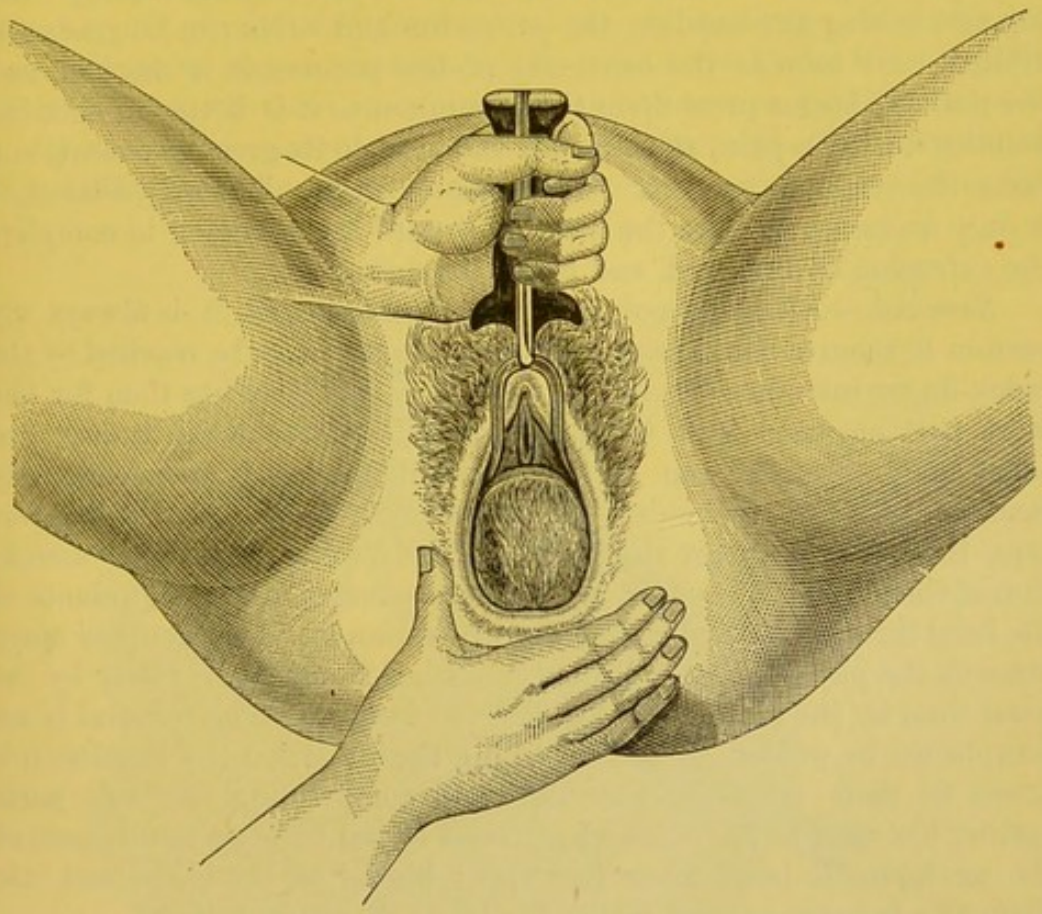


Fig. 165.—Position of operator when head is on perinæum.

gers of laceration and *post-partum* hæmorrhage. The alternate descent and recession of the head soften the external parts, and are the best means of overcoming rigidity. As the head advances, time should be given for the uterus to retract upon its contents, for, when the pains are deficient, retraction after the sudden emptying of the uterus is apt to be imperfect or of short duration.

Tractions should at first be made downward, until the head has descended below the symphysis pubis ; they should then be made in a horizontal direction until the occiput appears at the vulva. When in doubt about the direction, the handles should be held loosely during a pain, to serve as an index of the proper line of traction. If rotation has not previously taken place, it may be aided by the forceps, though rotation usually occurs spontaneously as the head descends. If the head was transverse, the forceps requires to be readjusted after rotation, either by removing the blades and then reapplying them, or by sinking the handle of the posterior blade and raising the handle of the anterior one.

When the parietal bosses are in the act of passing through the vulva, tractions should no longer be made during the pains. The operator should stand to the right of the patient, and seize the handles in the left hand. During the intervals of a pain, by alternately sinking and raising the handles, the perinæum and vulva can be gradually dilated. So soon as the convexity of the perinæum is marked, and the parietal bosses press upon the commissure, it is better to sink the handles during a pain, so as to flex the head to its greatest extent, and cause the vertex to present. When the vulva is sufficiently dilated, it is only necessary to raise the handles toward the abdomen to complete the extrusion of the head, and finish the delivery.

Removal.—Although not generally recommended, it is always my custom to remove the forceps so soon as the chin can be reached by the index-finger introduced into the rectum. The head has then for the most part emerged from the pelvis, and its extrusion, if it does not occur spontaneously, can be easily effected by any one reasonably familiar with the mechanism of parturition. The blades of the forceps, though of no great thickness, still add something to the distention of the vulva. Moreover, with expert management, the guidance of the head through the vulva and the utilization of all unoccupied space beneath the pubic arch can be accomplished much more safely by the hand than by the most skillful use of the forceps. The removal is accomplished by unlocking and reversing the direction the handles followed in their introduction. To avoid compressing the soft parts against the rami of the pubes, I am accustomed to place two fingers of the unemployed hand upon the upper border of the blade, and use them as a fulcrum around which the blade should be rotated.

Forceps at the Brim.—The safe conduct of the head through the pelvic brim by means of the forceps is an achievement which requires an accurate appreciation of the dangers to be avoided and the difficulties to be overcome. The forceps as a means of accelerating delivery is sometimes called for when the head is at the brim in cases of accidental hæmorrhage, of placenta prævia, of eclampsia, of pelvic obstruction, and in failure of uterine pains.

So long, indeed, as the head is movable at the brim, and version is practicable, the latter operation furnishes the safer mode of delivery. After the waters have drained away, and retraction of the uterus renders version impossible, a tentative application of the forceps may be made to test the adaptability of the head to the pelvic canal. Persistent attempts to drag the head into the pelvis by brute force, after moderate tractions have failed to effect an advance, should be regarded as criminal, exposing as they do the maternal tissues unavailingly to injuries which are always serious, and which may prove fatal.

When, however, the head has become fixed, which does not occur until after the engagement of its largest circumference, the difficulties of forceps operations are greatly diminished. Still, dangers to the mother arise from the fact that the blades have to be passed into the lower segment of the uterus, where, owing to the extreme vulnerability of the uterine tissues, lesions are only to be avoided by the patient carrying out of a multitude of precautionary measures; to the child, from the rarity of the occasions which permit the blades to be applied to the sides of the head, to which the cephalic curve is alone adapted.

Operation.—In introducing the forceps, the tips of the fingers of the guiding hand should be inserted between the child's head and the

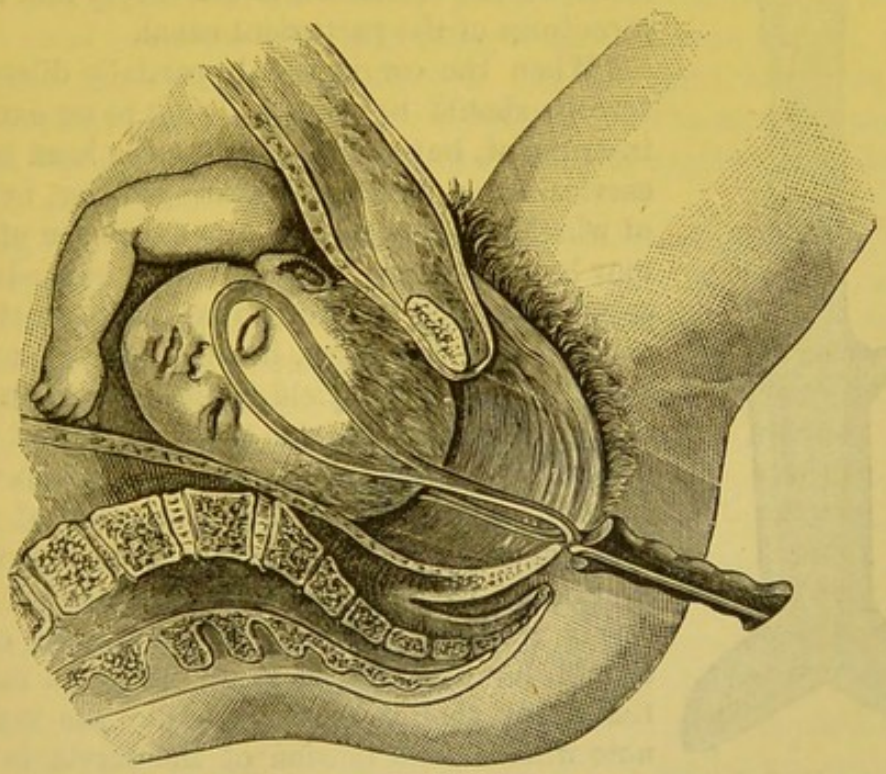


Fig. 166.—Forceps applied to head at brim.

cervix. In this way we insure the entrance of the extremities of the blades into the uterus in place of into the *cul-de-sac* of the vagina. It is generally customary to apply the forceps to the sides of the pelvis,

without reference to the position of the child's head. As a rule, under the conditions mentioned, the head will be found to have been seized obliquely—i. e., with the posterior blade over the parietal boss, and the anterior blade near the coronal suture. Thus applied, close approximation of the handles is impossible, and the tips are correspondingly separated from one another. Considerable compression of the handles is necessary, therefore, to prevent the instrument from slipping, the degree of pressure depending naturally upon the extractive force requisite to advance the head. The adjustment of the lock often requires considerable patience, and sometimes the exercise of moderate force is necessary to bring the parts into juxtaposition.

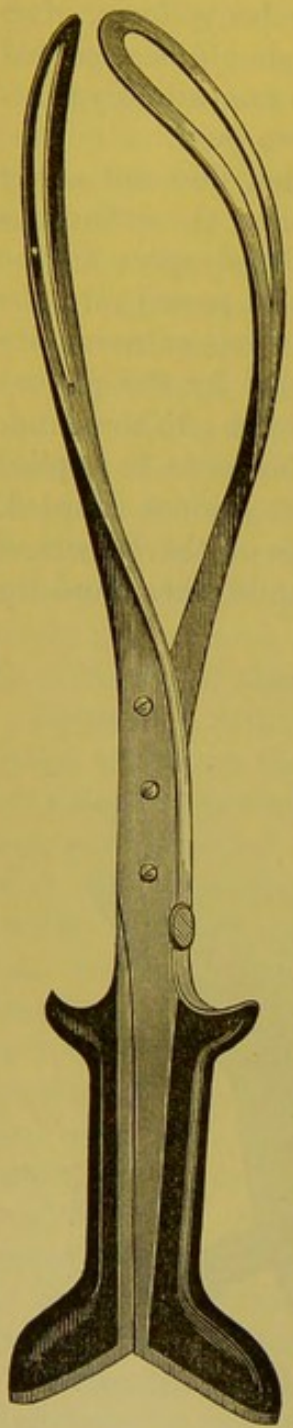


Fig. 167.—Taylor's narrow-bladed forceps.

Even when the instrument has been applied according to the strict rules of art, it will be found not infrequently that the upper border of the anterior and the lower border of the posterior blade will project beyond the tissues of the scalp, and, unless managed with care, the exposed edges are liable during extraction to cut deeply into the soft structures of the parturient canal.

When the cervix is only partially dilated, the forceps should be employed, not as an extractive instrument, but simply to bring the head into the cervical canal to act as a dilating wedge, by means of which the gradual and safe expansion of the os may be accomplished. If the head be made to descend and then allowed to recede at short intervals between the pains, in time the cervix will be found to soften and yield in the same manner as a rigid perinæum ; whereas the resistance of an undilated cervix can only be overcome, when violent tractions are made, by the production of lacerations extending to, or even above, the vaginal junction. In seeking to effect dilatation of the cervix through the forceps, the utmost caution should, however, be observed. At short intervals the finger should be slipped into the vagina to note whether the tension of the cervix is raised during tractions to dangerous proportions. Especial attention should be paid to the condition of the parts during a pain, as, when the uterus contracts, the os externum, which previously was soft and dilatable, frequently forms a sharp, resistant border.

Dr. I. E. Taylor has devised a long, narrow-bladed pair of forceps, capable of introduction through a cervix measuring one and a half inch in diameter, which he has used with advantage in the manner above described at a very early stage of labor.

In cases where it is necessary to expedite delivery, the resistance of the incompletely dilated os may be overcome by a number of incisions about one fourth of an inch in depth, made with a blunt-pointed bistoury passed between the cervix and the child's head. It is very rare, however, that this otherwise trivial operation is really called for.

In drawing the head through the superior strait, the tractions should be made, as nearly as the perinæum will permit, vertically downward. In doing this, however, care must be taken lest the pelvic curve be brought so far forward above the symphysis pubis as to subject the maternal tissues to injurious pressure. On the other hand, it is necessary not to prematurely raise the handles of the forceps, as, in that case, the head is simply crowded forcibly against the anterior pelvic wall. The best means of avoiding these two difficulties is to exercise great patience, and be content with a very gradual advance of the head, as, by omitting anything like rude force, the risks arising from misdirected tractions are kept within the limits of safety. Many, indeed, seek to prevent the anterior pressure of the forceps, by placing the left hand upon the lock, and using it as a fulcrum around which rotation of the instrument is effected. As the right hand has then to be employed at the same time to make tractions and to raise the handles, the method requires both strength and expertness to be successful.

In all high operations where the cervix is sufficiently dilated, I can not too strongly recommend the ingenious forceps of M. Tarnier, which, by its construction and action, obviates to a great extent the foregoing objections to the more familiar models.

M. Tarnier's original model possessed two distinctive features: 1. The shanks, in place of running forward continuous with the pelvic curve, were bent backward, so that the handles, when placed horizontally, occupied a level three and a half inches above the plane of the posterior curve of the blades. This Tarnier curve was intended to make it possible to adjust the blades to the sides of the pelvis at the brim, without subjecting the soft parts in front or the perinæum below to pressure. In high operations such a curve is of undoubted advantage, but at the lower strait, unless the blades are accurately applied to the sides of the child's head, the posterior borders of the blades are apt to cut deeply into the vaginal wall, so soon as the converging soft parts embrace tightly the advancing head. Probably for this reason Tarnier, in his latest model, has restored to his instrument the ordinary pelvic curve. 2. The second and permanent feature consists in the attachment of two movable traction-rods to the lower curvature of the

blades. These rods are curved, according to the model employed, to correspond to the lower border of the shanks. In Tarnier's instrument the rods, when not in use, are affixed by projecting pegs. A transverse screw, crossing the handles below the lock, approximates the blades to the surface of the child's head. When the instrument is adjusted, the outer ends of the traction-rods are detached and inserted into a socket-joint belonging to a strong steel bar with a downward curve, and furnished with a transverse handle which can be moved in any direction by means of a universal joint. Tractions are made by means of this transverse handle alone. As the head descends, the handles proper rise upward and serve as an index to show the direction in which the force should be exerted. By simply raising the traction-rods in a line with the curved shanks, the blades of the forceps swing always in the transverse diameter, and the head follows approximately* the axis of the pelvis. To one accustomed only to the familiar forceps, the facility with which delivery can be accomplished by Tarnier's instrument would seem hardly credible.

Mr. Stohlmann has modified for me the original forceps of Tarnier

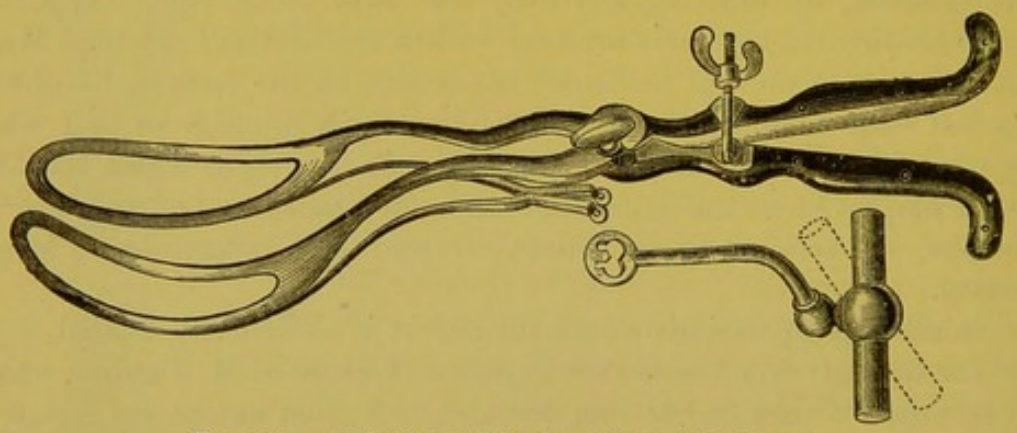


Fig. 168.—Author's modification of Tarnier's forceps.

by making the blades much lighter, modeling them somewhat after those of the well-known instrument of Wallace. This alteration makes their application, especially in contracted pelves, or through an imperfectly dilated os, a much easier matter. In place, too, of the very clumsy socket-joint into which the traction-rods are inserted, he has substituted the key arrangement shown in Fig. 168, by means of which the handle can be adjusted or removed in a few seconds of time.

In spite of the example of the illustrious author of the axis-traction principle, I still cling to the Tarnier curve. It enables the operator to

* I use the word "approximately," for my own experience does not sustain the idea that the handles of the forceps furnish an infallible guide to the direction in which tractions should be made. In this respect I am in entire agreement with Breus ("Die Becken-Eingangs-Zangen," Vienna, 1885), viz., that the advantage of the Tarnier principle consists less in the mathematical accuracy of the tractions than in the freedom of motion that the traction-rods permit to the head.

seize the head more advantageously at the brim, and, in my experience, it facilitates greatly the descent of the head in the axis of the superior straits. Mr. Stohlmann has recently made for me a pair of narrow-bladed forceps with axis-traction rods and Tarnier curve for cases in which the dilatation of the cervix is insufficient to permit the introduction of the wide blades of the ordinary instrument. In high operations the operator will find axis-traction most effective when the patient is placed upon her left side.

When the head has been brought to the floor of the pelvis, unless the occiput has previously turned to the front, it is a good plan to remove the forceps and wait for spontaneous rotation to take place. If a reapplication becomes necessary, an instrument with the ordinary curve should be selected.

Professor Alexander Simpson, of Edinburgh, has contrived an admirable instrument for general use by adapting traction-rods to the popular and widely employed forceps of Sir J. Y. Simpson. The rods as well as the handles are permanent fixtures, so that there is no possibility of the parts being mislaid when required for service. I have given this instrument an extended trial, and regard it as a most valuable addition to my obstetric equipment. With the head in the pelvic cavity it answers every indication. In high operations, however, I have sometimes found it convenient to lay it aside for a longer forceps with a backward curve.

As the solidity of the shanks in axis-traction forceps prevents the blades from springing, the amount of pressure upon the head requisite to keep the instrument from slipping has been found in practice not to prove an element of danger to the child.

Forceps in Occipito-posterior Positions.—So long as the occiput looks to the rear, it is the rule in midwifery practice to refrain from the use of forceps, which, of necessity, prevents forward rotation from taking place. An exception to this rule, however, arises in cases of a near danger to either mother or child demanding speedy delivery. As attempts to rotate the occiput around to the symphysis by instrumental means are rarely successful, it is advisable under such circumstances to apply the forceps directly to the sides of the child's head, and to imitate during delivery the mechanism of labor in occipito-posterior positions. If the sagittal suture occupies an oblique diameter, the forceps should be applied in the opposite oblique diameter. As the head descends, the occiput should be turned into the hollow of the sacrum. At first, tractions should be made directly downward until the forehead has passed under the pubic arch, and the anterior fontanelle makes its appearance at the vulva ; then, by raising the handles, the small fontanelle should be brought forward to the commissure, and, finally, as the vertex emerges from the vulva, the handles should be slowly depressed to aid the movement of extension by which the

delivery of the face and chin beneath the pubic arch is accomplished.

Forceps in Face Presentations.—When the face is deep in the pelvis and the chin has rotated to the front, forceps applications are easy and do not differ materially from those in vertex presentation, except that care should be taken to direct the blades far enough backward to securely seize the occipital extremity of the child's head. Tractions should be made in a horizontal direction until the chin has been brought well under the symphysis pubis, when the handles should be raised to lift the cranial vault over the perinæum. In oblique mento-anterior positions, Spiegelberg advises introducing first the blade corresponding to the chin (posterior blade), as, in adjusting the second blade and locking the forceps, spontaneous rotation usually takes place.

In deep transverse positions, forceps operations should be deferred as long as possible, as tardy rotation of the chin to the front is a physiological peculiarity in face presentations. The forceps should be applied in an oblique diameter, with the concavity of the blades directed to the side of the chin. Chin right, introduce the right blade posteriorly, and bring the left blade forward to the left tuberculum iliopubicum. An effort should then be made to rotate the chin to the front. If the attempt prove successful, the forceps should be unlocked, and the blades readjusted to the lateral surfaces of the head. Tractions when the face is transverse should not be attempted. The wide separation of the blades makes it necessary to compress the handles firmly to prevent slipping. When this is done, pressure upon the neck and thorax is unavoidable, so that extraction without sacrificing the life of the child is hardly possible.

In high transverse positions, forceps should not be used, as rotation is not then permissible, and the blades, applied to the neck and thorax on the one side and upon the cranium on the other, can not, for the reasons just given, be safely employed in extraction. The choice in such cases, when speedy delivery is called for, lies between version and craniotomy.

In mento-posterior positions, the rotation of the chin to the front by repeated applications of the forceps is inadmissible. In practice, such efforts do not succeed, while they are calculated to inflict injury upon both the mother and the child. Usually, if delivery becomes necessary because of danger to the mother, craniotomy should be resorted to. Smellie, Hicks,* and Braun, of Vienna, have, however, each reported a case of forceps delivery by drawing the chin down over the sacrum and perinæum, when the occiput and calvarium glided

* Hicks, "On Two Cases of Face Presentations in the Mento-posterior Position," "Trans. of the Obstet. Soc. of London," vol. vii, p. 56. Hicks likewise reports the cases of Smellie and Braun.

underneath the pubes. In two cases, I. E. Taylor* extracted the children with straight forceps after bilateral incision of the perinæum.

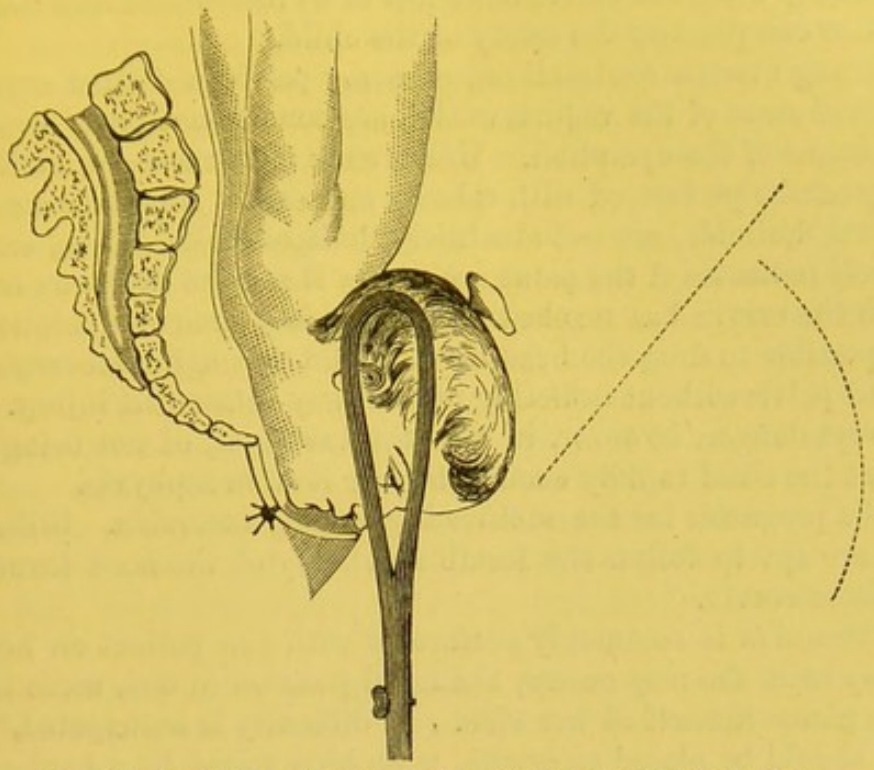


Fig. 169.—Taylor's method in mento-posterior positions of the face.

Unfortunately, both children were dead before the operation was undertaken.

CHAPTER XX.

EXTRACTION IN FOOT AND BREECH PRESENTATIONS.

Extraction in pelvic presentations.—Attitude of the physician.—Prognosis.—Position.—Extraction of trunk.—Extraction by the feet; by the breech.—Management of the cord.—Liberation of the arms.—Exceptional cases.—Extraction of the head.—Smellie's method.—Veit's method.—Head at brim.—Prague method.—Forceps to the after-coming head.

We have already seen, in studying the management of breech presentations, that the attitude of the physician during delivery, so long as no immediate danger threatens either the mother or the child, should be one of watchful observation. As a rule, the results to the child are unquestionably more favorable when Nature does her work unaided. Should, however, there be any faltering in the natural forces, the physician should be in readiness to avert by prompt interference the perils which, in pelvic presentations, are associated with

* Taylor, "On the Spontaneous and Artificial Delivery of the Child in Face Presentations," "N. Y. Med. Jour.," Nov., 1869.

delay. When an artificial breech-presentation has been produced by internal version, immediate extraction is usually advisable, as the act of version, when the entire hand has to be introduced into the uterus, is apt to compromise the safety of the child.

Strong uterine contractions, a roomy pelvis, a dilated cervix, and a relaxed state of the vaginal outlet, are conditions highly favorable to the success of the operation. Under such circumstances, artificial delivery can be performed with celerity and ease. But these conditions, however desirable, are not absolutely indispensable. Thus, extraction is rarely indicated if the pains are good; it is often necessary to deliver before the cervix has reached the desirable degree of dilatation; and it is possible to drag the head of the child through a moderately contracted pelvis without inflicting upon it any permanent injury. There is always danger, however, in the last two cases, of not being able to extract the child rapidly enough to save it from asphyxia.

The prognosis for the mother is generally favorable. Still, lacerations are apt to follow the forcible delivery of the head through the undilated cervix.

Extraction is commonly performed with the patient on her back. In easy cases she may occupy the usual position in bed, while the physician places himself at her side. If difficulty is anticipated, the patient should be placed crosswise, with hips raised by a hard cushion, and brought over the edge of the bed; or, better still, may be placed upon a table, as the operator is then enabled to draw downward in the direction of the superior strait without kneeling before her. It is desirable to have two assistants to hold the patient's knees. To one of these should likewise be assigned the duty of making firm pressure, during extraction, upon the fundus of the uterus. If anæsthesia is thought necessary, a third assistant will be required. The question of anæsthesia is not always easy to decide. Useful in unruly patients, and where the entire hand must be passed into the vagina, its occasional suspensive action upon the uterine pains and the loss of the coöperation which intelligent patients are capable of affording are alloys to its beneficent action in stilling pain. My preference is to anæsthetize lightly at first, and then be guided by events as to whether the insensibility shall be subsequently made complete or the patient be allowed to return to partial consciousness.

As in all obstetrical operations, care should be taken to insure the emptying of the bladder and rectum, and the operator should have in readiness, in case of need, forceps, a soft fillet, warm napkins, hot and cold water, and a small catheter, for use should the child be born in a state of partial asphyxia.

The operation is divisible into three acts: 1. Extraction of the trunk, as far as the shoulders; 2. Extraction of the arms; 3. Extraction of the head.

First Act: Extraction of the Trunk to the Shoulders.

The extraction of the trunk should take place slowly, with pauses between the tractions, in imitation of the uterine expellent forces. Tractions are best made during the pains only, when the latter do not recur at too long intervals. It is desirable that the uterus be closely retracted upon the child during the entire period of its expulsion. Where this does not occur, the arms are liable to be brushed upward to the sides of the child's head, the chin to become extended, and the mechanism of the head-delivery to be disturbed. Hæmorrhage, too, is more likely to follow hasty delivery than where the uterus has had time to pass slowly into a state of complete retraction. When, therefore, it is necessary to extract during the intervals between the pains, firm pressure should be made upon the uterus through the abdominal walls, so as to maintain them in close contact with the fœtus. Steady tractions are preferable to pendulum movements. Tractions should be made downward and backward, in the direction of the superior strait, until the breech meets with the resistance of the floor of the pelvis.

These general rules are applicable to every case of extraction. Special differences of procedure result from the presentation of one or both feet, and of the entire breech.

Extraction by the Feet.—If a single extremity presents, the foot should be seized between the middle and index finger, with the thumb upon the sole. It is not necessary to go in search of the second foot, unless it crosses the first, or is reflected upward over the child's back. When the leg is drawn outside of the vulva, it should be wrapped in a warm napkin, and grasped by the entire hand. Always, in seizing a limb, the thumb should be directed upward and applied to the dorsal surface. The napkin serves partly to prevent the hand from slipping, partly to protect the surface from air, which at times is capable of exciting reflex respiratory movements. Tractions should be made downward, to avoid friction at the symphysis pubis. Until the pelvis is delivered, the child should be seized as near the maternal parts as possible. The hand, therefore, should be shifted upward as the limb is drawn out of the vulva. Whichever extremity is seized rotates forward under the symphysis pubis during extraction. So soon as the breech reaches the pelvic floor, traction should be made more in an upward direction, to facilitate the passage of the buttocks over the perinæum. After the breech has cleared the vulva, the index-finger of the free hand should be carefully inserted into the fold of the posterior thigh, while the thumbs of both hands are placed upon the sacrum. During the subsequent extraction of the trunk, the lower leg falls from the vagina without special assistance.

If both extremities present, they should be seized so that the mid-

dle finger is placed between the feet, while the index- and ring-fingers encircle the external malleoli. After they have passed sufficiently far outside the vulva, the left leg should be seized with the left hand, and

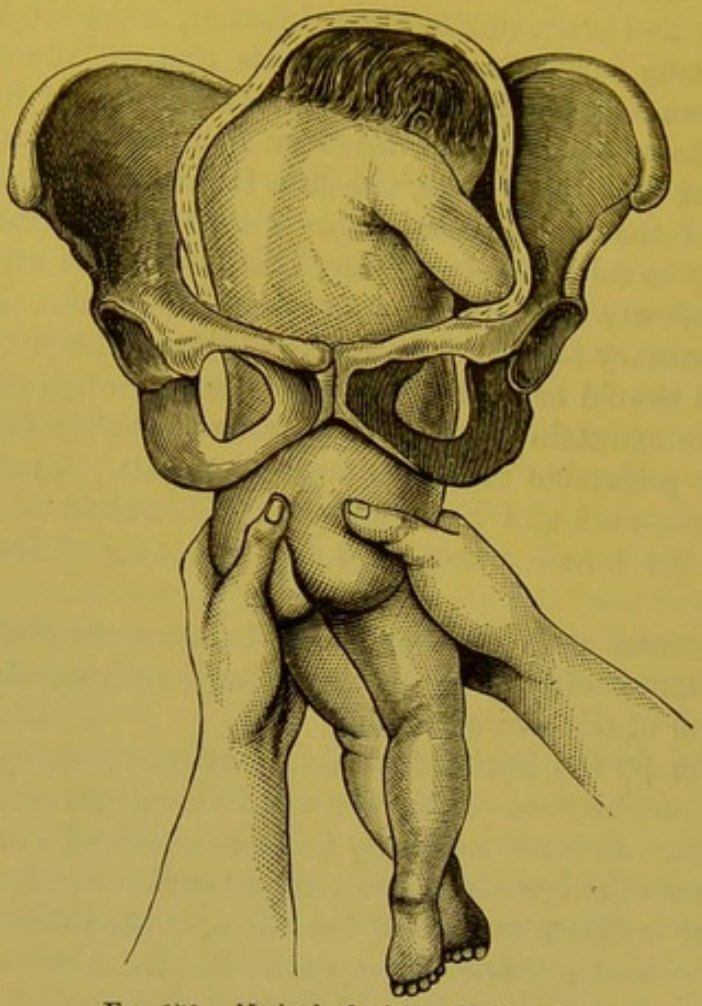


Fig. 170.—Method of seizing the breech.

the right foot with the right hand. During extraction the normal rotation of the child may be aided by dragging with somewhat greater force upon the limb, which should be turned to the front.

Extraction by the Breech.—When the breech alone presents, with both extremities reflected upward parallel to the anterior surface of the child, spontaneous delivery is sometimes, as pointed out by Tarnier, prevented by the fact that the extended limbs act as splints which interfere with the lateral flexion of the trunk, and, consequently, with its accommodation to the curve of the parturient canal. If, in pure breech cases, obstetrical aid becomes necessary, the operator is embarrassed by the absence of a natural handle by means of which extraction can be effected.

Theoretically, cephalic version by external manipulations, performed during the latter part of pregnancy, or in the early stages of labor, most completely fulfills the required indications, viz.: the saving of the

child with the least possible risk to the mother. That, in cases where the breech is not engaged in the pelvic cavity and the membranes are intact, external version may be successfully accomplished, has been shown by Mattéi, Hégar, and Pinard. Tarnier at first opposed the measure on the ground of its impracticability and the risk of rupturing the membranes before the version was completed, thus converting a breech into a shoulder presentation, but more recently has practiced the procedure in many cases without inconvenience to the mother or

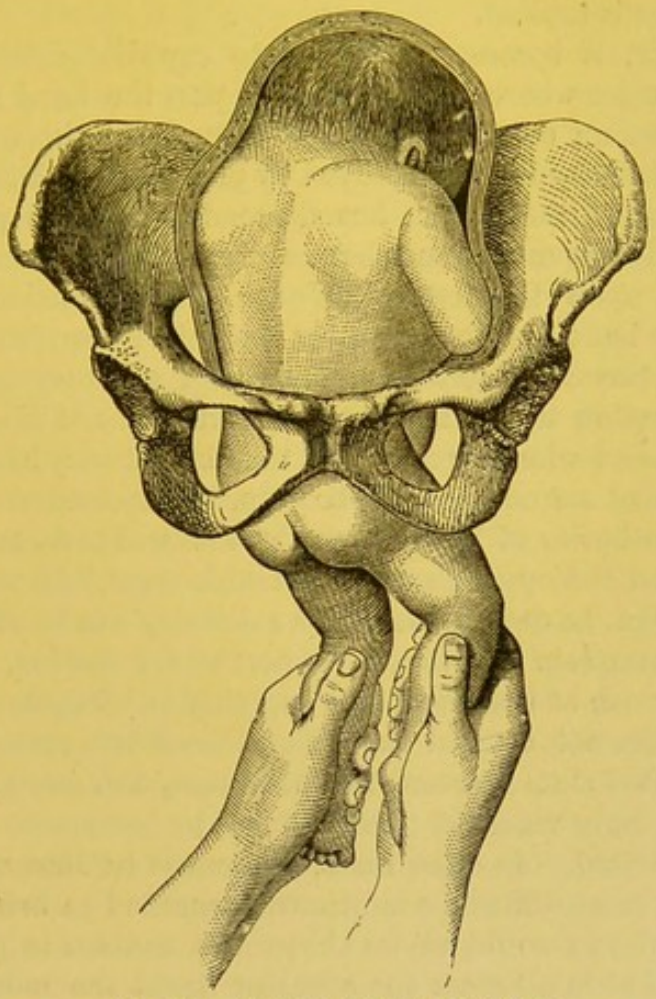


Fig. 171.—Method of seizing both feet.

child.* Its successful performance presupposes a relatively considerable quantity of amniotic fluid, the absence of reflex irritability in the patient, and experience on the part of the operator in mapping out the fœtus through the abdominal wall. Ahlfeld † advises that in primiparæ the hand be introduced immediately after the rupture of the membranes, or at least while the introduction is still practicable, and that the anterior extremity be brought down as a prophylactic measure,

* Ollivier, "De la conduite à tenir dans la présentation de l'extrémité pelvienne," "Mode des fesses," p. 103, Paris, 1883.

† Ahlfeld, "Arch. f. Gynaek.," vol. v, p. 174, Berlin, 1873.

leaving the child to be expelled subsequently by the natural forces. The hand should be passed over the anterior surface of the child to the knee; the thumb should then be placed in the popliteal space, while four fingers grasp the leg, flex it upon the thigh, and draw it down into the vagina. The operation is facilitated by placing the patient upon the side to which the child's feet are turned. But Küstner, in common with most authorities, objects that the manœuvre is apt to weaken the uterine contractions, and to favor prolapse of the cord. In other words, in order to avert a remote danger, a near one quite as serious is invited.

If, however, it becomes necessary to expedite delivery, without doubt, in all cases where it is possible to pass the hand to the fundus and bring down an extremity without imperiling the uterine structures, this method should be employed by preference. But emergencies rarely arise before the breech has descended into the pelvic cavity. Most frequently the membranes have already ruptured, and the uterus has retracted upon the fœtus. Under such conditions the introduction of the hand and forearm over the anterior surface of the child to the fundus becomes a serious undertaking, and may lead to uterine rupture. Traction upon the extremity seized is not always followed by its descent, and where force is used the descent may be accomplished at the expense of a fracture. To be sure, the manœuvre is supported by the high authority of Dr. Barnes. "The wedge formed by the extended legs and the upper part of the trunk must," he says, "in some instances at least, be decomposed before delivery can be effected." He recommends complete anæsthesia, support of the fundus, gentleness in passing the breech at the brim, and applying the fingers to the instep. But Barnes does not conceal the difficulties of the operation, nor the address requisite for its successful employment, and many accoucheurs, less fortunate, have recorded their failures to decompose the wedge in the manner advised. In a few cases, influenced by Barnes's teachings, I have, under most difficult conditions, succeeded in bringing down a foot; nevertheless, I would advise the utmost caution in practicing the method, and that in all cases the operator desist the moment address fails and force becomes necessary. If, at the time intervention becomes necessary, the breech is well engaged, the fœtus is of ordinary size, and the resistance of the pelvic floor is inconsiderable, the expulsion of the child may sometimes be effected by graduated pressure upon the fundus of the uterus. Should this measure prove ineffective, manual extraction should be attempted. To this end the index-finger should be inserted into the fold of the anterior groin and traction made directly downward. By seizing the wrist with the disengaged hand, an increase of traction-power can be exerted. If the breech is low, both index-fingers may be employed—the one in the anterior, the other in the posterior groin; or the entire hand, passed over the sacrum, may seize

the pelvis with the thumb in one groin and the index-finger in the other.

Many writers insist upon manual extraction to the exclusion of all other methods; but in primiparous women they are liable to fail at the critical moment. Instrumental aids then become necessary. The choice consists in the forceps, the fillet, the blunt hook, and, when the child is dead, the cephalotribe. So far as the relative value is concerned, I would recommend them in the order given.

The chief objection urged against the forceps is that, by its construction, it is designed to seize the fetal head. As a consequence, when applied to the breech to which its curves are not adapted, it does not grasp the presenting part securely, and is liable to slip off when tractions are employed, thus endangering the maternal soft parts. If, with the view to prevent slipping, the handles be compressed firmly, it has been argued that fracture of the thighs may result, the circulation of the cord may be accidentally arrested, or fatal injuries may be inflicted upon the fœtus by the pressure of the points of the forceps against the abdominal viscera. Miles,* to obviate these drawbacks, has devised a pair of breech forceps, apparently well designed for seizing the pelvic extremity. As, however, a forceps of special construction is likely to be but rarely at the disposition of the physician when an emergency calls for action, it is not without interest to know how far the ordinary instrument is available in practice. Omitting earlier authorities, we find in modern times Jacquemier declaring that "it is inexact to state that the forceps would crush the pelvic bones, and inevitably kill the fœtus by bruising and lacerating the abdominal viscera." Tarnier stated, in his famous article on the forceps, published in the "Dictionnaire de médecine et de chirurgie," 1872, that, under exceptional circumstances, neither Stoltz nor Dubois feared to apply the forceps to the breech, and added that he had a number of times imitated their practice with success for the mother, and sometimes for the child. When the fœtus was dead, he assured himself at the autopsy that the forceps had produced no lesion either of the pelvis or of the abdominal viscera. Hüter, in his excellent treatise on the "Obstetrical Operations" (Leipsic, 1874), declares that no better instrument exists for the extraction of the breech. Dr. Henry Fruitnight, of New York city, published, in July, 1877, in the "Virginia Medical Monthly," a successful case where the forceps were used at the suggestion of Dr. E. C. Harwood. Dr. I. E. Taylor has applied the forceps to the breech six times with success. In 1877 Haake† published five cases in which, as he says, to the astonishment of the physicians pres-

* Miles, "The Forceps in Difficult Breech Presentations," "Am. Jour. Obst.," vol. xii, p. 135, New York, 1879.

† Haake, "Ueber den Gebrauch der Kopfzange zur Extraction des Steisses," "Arch. f. Gynaek.," vol. xi, p. 558, Berlin, 1877.

ent, the extraction with the forceps was easily and quickly ended without detriment to the fœtus. In the same year Agnew reported two successful cases to the London Obstetrical Society. Last year I saw, in consultation with Dr. F. A. Castle, a case of breech presentation in a primipara past her thirtieth year, where, after ineffectual essays at manual extraction, I applied the forceps over the sacrum and the anterior surface of the thigh. Though the breech had not completed its descent through the cervical canal, and the parts were rigid, the child was easily extracted in about fifteen minutes. The child was alive, and the trifling pressure-marks disappeared in a few days. Recently I have had occasion to apply the forceps to the breech in the case of an elderly primipara, where the rigidity of the soft parts was extreme. The operation occupied nearly an hour. The patient suffered no inconvenience, and only a slight abrasion was found upon the thigh of the child, which was born living. Dr. Harvey, professor of midwifery in the Medical College of Bengal, in an essay just received (1884), reports six cases. In three out of six the success was complete, in one the forceps was without avail, while in the other two, although the instrument slipped, it did not do so until it had brought down the breech, so as to allow him in one case to get his fingers over the groin, and in the other to apply the fillet, which he had previously failed to do.

Since the invention of axis traction by Tarnier a new impetus has been given to the method. With axis traction, not only is the resist-

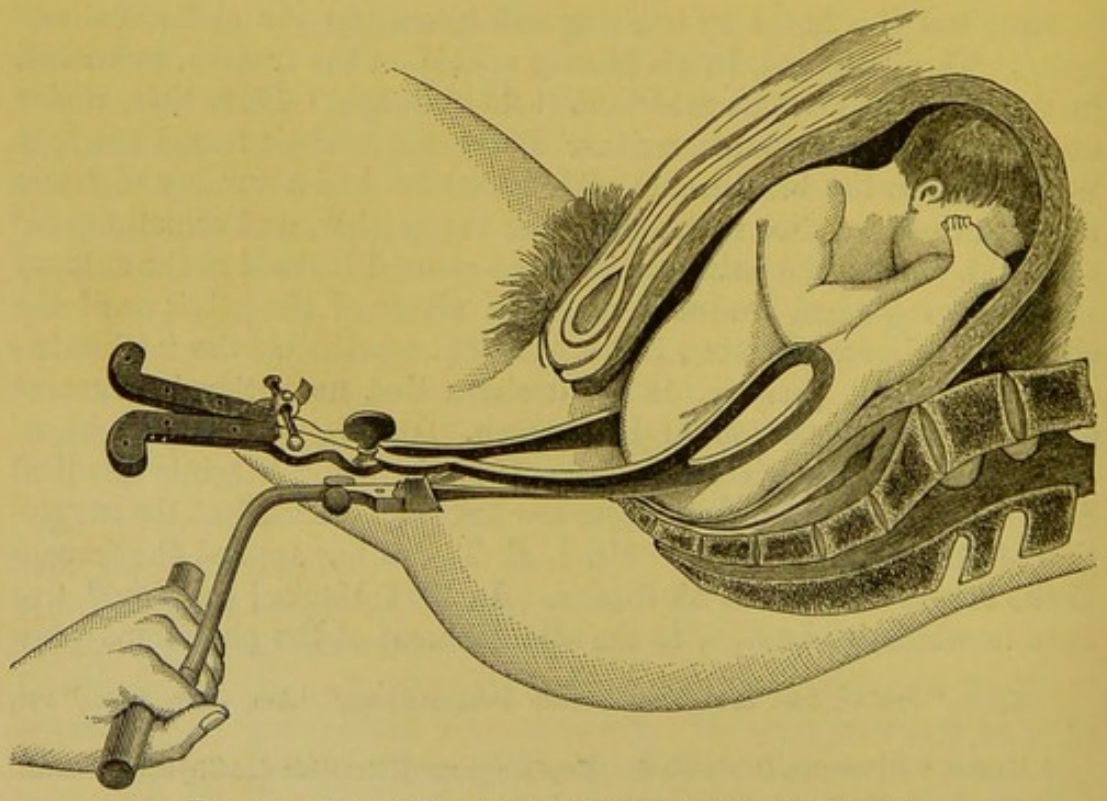


Fig. 172.—Tarnier forceps applied to the thighs. (Ollivier.)

ance offered by the parturient canal diminished, but, as Pinard states, the pressure is regulated, and is not increased by traction. The fetal part is seized solidly, and with the least risk of harm. Ollivier reports successes with Tarnier's latest model in his own practice, and in that of Budin, Thomas, Berthout, Lobat, and Cayla.

Thus it will be seen that the weight of experience is favorable to the forceps as a breech-tractor, while the objections are mainly theoretical. The instrument is inadmissible so long as the breech does not engage in the pelvic cavity. Haake limited its use to cases in which the breech was already at the pelvic outlet, and only after complete rotation had taken place. With axis-traction forceps the indication is certainly extended, as a rule, to all cases where the breech has passed the pelvic brim, and the dilatation of the os is well advanced. If rotation has taken place, the blades should be applied, respectively, over the sacrum and over the posterior surface of the thigh, as recommended by Haake. If the hips are transverse, Ollivier advises that the blades be applied to the lateral surfaces of the thighs. The application of the blades over the trochanters, with the extremities overlapping the crests of the ilia, is to be deprecated, as the ilia are compressible and allow



Fig. 173.—Fillet in dorso-anterior positions. (Ollivier.)

the forceps to slip (Ollivier). The extraction of the child should not be made an exhibition of strength. The rigidity of the maternal structures is rarely to be overcome by any justifiable degree of force. The slow descent of the breech, effected by intermittent traction, best insures the physiological softening of the tissues in advance of the pre-

senting part. As the genital canal softens and relaxes, but little force is required to effect the birth of the breech. The tractions are most effective if made during the pains. They should be aided by simultaneous pressure exerted by an assistant upon the fundus of the uterus.

If the forceps fails, or, owing to the non-engagement of the breech, is contra-indicated and an extremity can not be brought down without the employment of force, a resort to the fillet is admissible. The objections urged to its use are: 1. That the fillet is apt to become twisted, and that, when moistened with the vaginal secretions, it may form an uneven band, which, even with care, is capable of cutting deeply into the tissues; 2. That in some cases it causes partial extension of the extremity, and, as a consequence, slips forward upon the thigh, whence

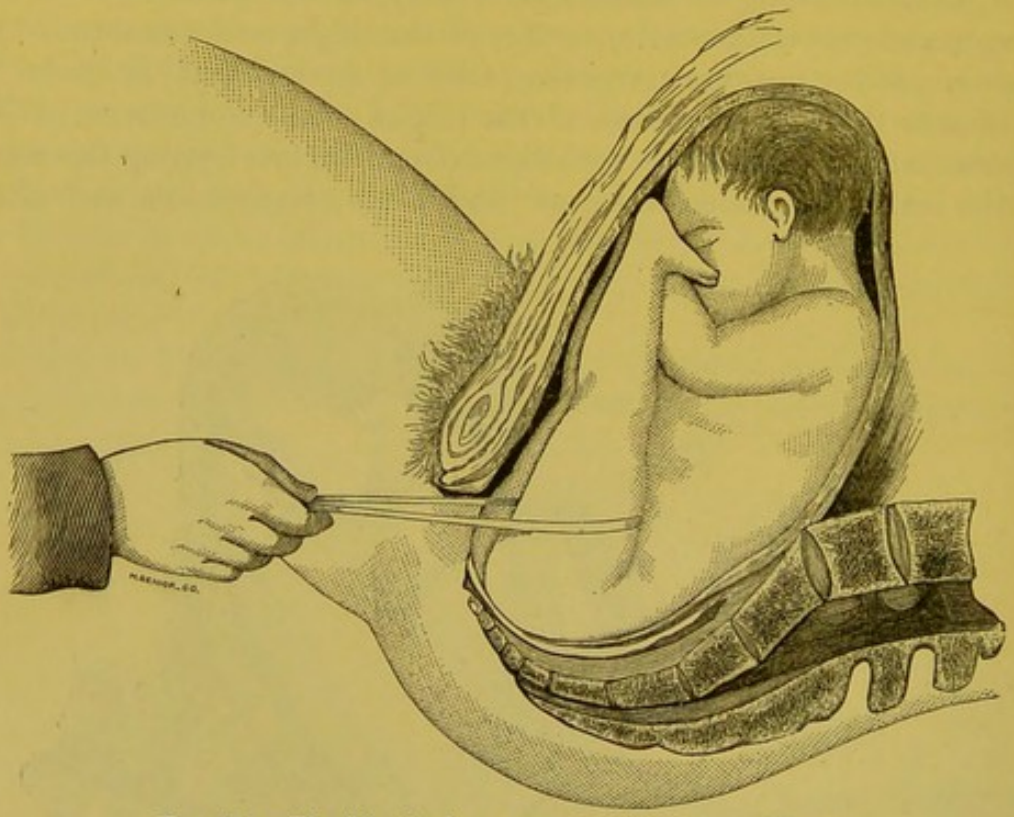


Fig. 174.—The fillet in dorso-posterior position. (Ollivier.)

fracture of the thigh-bone becomes inevitable. The reports from the Lying-in Institution of Munich, where, owing to the advocacy of Hecker, the fillet has been assiduously tested, do not confirm the idea that these accidents are of necessary occurrence. Thus, in the last report of von Weckberger Sternefeld, the records of thirty cases—twenty-one primiparæ and nine pluriparæ—are given. The mothers all did well. One of the children was in a macerated condition when the fillet was employed. Of the remaining thirty, twenty-four were born living. Of these, eight were partially asphyxiated, but seven were revived. In no one of the children born dead was the result attributable to the

method of extraction employed. Twenty-three of the children left the institution in a healthy condition. In four cases, deep pressure-marks, but without excoriation, resulted from the use of the fillet. In the others either no traces of pressure were found, or they were of an insignificant nature. In all, the marks had disappeared in a few days. In one instance only fracture of the thigh occurred. The back was turned to the right and to the rear. Ollivier has shown that it is in dorso-posterior positions that especial caution is called for when traction is made at the groin. A glance at Fig. 174 will show that it is not easy in these cases to direct the tractions in such a way as to avoid the partial extension of the thigh, and the transfer of the pressure to the shaft of the thigh-bone. This extension, Ollivier suggests, can be prevented by passing the fingers into the rectum and pressing the breech forward as tractions are made. The fillet should be passed over the anterior thigh, the tractions should be of moderate force, they should be made during the pains, and should be sustained by external pressure made by a skilled assistant.

The passage of the fillet around the groin by the finger alone is by no means always easy in the class of cases in which the fillet is principally indicated, viz.,

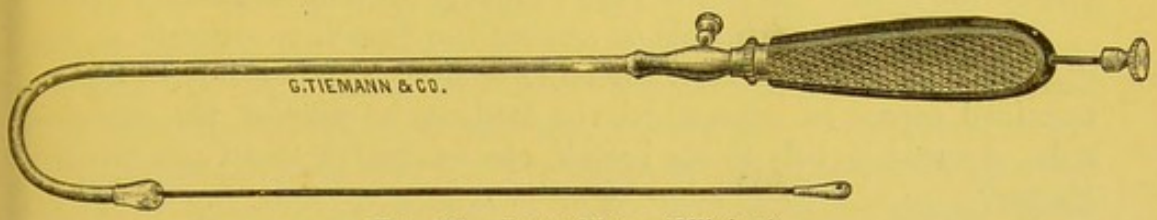


Fig. 175.—Porte-fillet. (Ollivier.)

in those where the breech is high and difficult of access. To be sure, with patience the knotted end of a handkerchief can sometimes be pushed around the groin, or, failing in this, an elastic catheter, with a loop attached to the extremity may be guided by a finger in the groin down between the thighs, to serve as a means of conducting the fillet into position.

Many ingenious instruments have been especially devised to serve as porte-fillets. Of these, Ollivier's instruments, modified by him from an invention of Tarnier, will serve as an example. It consists of a long-handled, blunt hook, with a central tunnel and a terminal olive-shaped bulb. Through the central canal a long piece of whalebone is passed. The extremity of the whalebone terminates in a metallic eye, which occupies, when the whalebone is withdrawn, a hollow space in the olive-shaped extremity of the blunt hook. Below the handle the end of the whalebone is armed with a button, to prevent it from being accidentally withdrawn into the canal. A screw above the handle serves to fix the bone at any point deemed desirable. The blunt hook is adjusted by passing it upward along the side of the child, directed to the front to a point above the pelvis, and then directing the curve so as to adjust it to the groin. The whalebone is then easily pushed forward until it is felt by the fingers of the physician between the thighs of the fœtus. The metallic eye is next directed by the fingers outside of the vulva. The attached fillet is easily withdrawn by reversing the directions given.

The fillet employed may be of any material. In emergencies the nearest object can be made to serve. It is desirable that the fillet should be adjusted without forming folds or creases. Ollivier recommends passing a lacing through a piece of rubber tubing the size of the little finger. The lacing should be fixed by stitches to the ends of the tube, a projecting portion serving to attach the tube to the eye at the end of the whalebone. In Ollivier's experiments the rubber tubing acted admirably in protecting the tissues of the child from harmful pressure.

In the absence of other appliances, or should failure attend the measures already described, it is well to remember that the blunt hook owes its sinister reputation not so much to its inherent defects as to lack of proper caution in its employment. It will not break the femur if adjusted in the groin. It will not produce serious contusions if the blunt end is carefully guarded by the finger. Injuries to the maternal tissues can only occur where leverage movements are made. So long as the pressure of the curved portion is confined to the groin, serious lesions are not likely to be produced. Steady downward tractions, made with moderate force and with a hand in the vagina to guard the point of the instrument, and to give warning of commencing extension of the thigh, will in the rule suffice to prevent serious accidents.

No instrument is capable of seizing the breech so securely as the cephalotribe. If, therefore, the child be dead, a fact rarely to be determined except in cases where the cord can be reached, the cephalotribe, screwed tightly to the breech, can be trusted to act as a reliable tractor.

Management of the Cord.—So soon as the cord has passed beyond the vulva, dragging upon the navel should be avoided by gently pulling the cord downward into one of the recesses to the sides of the promontory until some resistance is experienced. Sometimes the cord is found passing between the child's legs and up over its back to the placenta. Then traction should be exerted upon the placental extremity, and an attempt made to slip the loop over the posterior thigh. In the rare cases of failure to obtain its release, and where the cord is wound around the child's body, two ligatures should be applied, and the cord be divided between them, whereupon every effort should be put forth to complete the delivery as speedily as possible.

Second Act: Liberation of the Arms.

When the Arms are flexed upon the Thorax.—After providing for the safety of the cord, the pelvis of the child should be seized in the two hands with the thumbs upon the sacrum. Traction should be employed in a downward direction until the shoulder-blades make their appearance. Then no time should be lost in liberating the arms. If the latter are folded upon the chest, delivery is an easy matter. The palmar surface of the corresponding hand is passed over the belly of the

child to the posterior arm (back to the right, right hand, and *vice versa*), while the extremities, wrapped in a warm cloth, are drawn in the opposite direction. The forearm should be seized as near the wrist as possible, and be brought down over the abdomen to the side of the child.

When the Arms are extended.—Unless, however, great care has been exerted during extraction to keep the uterus by external pressure closely in contact with the fœtus, the friction of the parturient canal is apt to brush one or both arms upward to the sides of the child's head. In such cases the difficulties involved in liberating the arms are often very great. Here, too, owing to the increased amount of space afforded by the curvature of the sacrum, an attempt should first be made to release the posterior arm.

Release of the Posterior Arm.—This is best accomplished by drawing the lower extremities strongly upward and to the side, thereby causing the posterior shoulder to sink deeper in the pelvis and to furnish more room for the introduction of the hand ; then two fingers should be passed along the side of the child to the elbow-joint, which should be pushed across the face, and be brought down over the thorax.

In case the foregoing manœuvre can not be rapidly executed, the operating hand may be removed, and the extremities of the child may be drawn in the opposite direction, while the hand which at first had seized the feet or breech should pass upward over the abdominal surface to the posterior elbow. The latter should then be directed forward, by means of two fingers in the joint, toward the anterior pelvic wall.

Whether the hand be passed behind or in front of the child, it should be introduced slowly and without force during the intermission between the pains. Pressure should always be made at the joint, and never upon the humerus. A forgetfulness of the latter rule is apt to produce fracture.

Release of the Anterior Arm.—As there is rarely space enough between the symphysis and the shoulder to allow the fingers to reach the elbow, it is customary after release of the posterior arm to rotate the trunk so as to bring the anterior arm backward into the cavity of the sacrum. This is accomplished either by clasping the thorax in both hands and rotating while pushing the thorax inward, or better still by seizing the liberated arm, and drawing it upward under the symphysis pubis. Indeed, the latter method has so far never failed me in readily securing the desired rotation. (If the back is turned to the left, the arm should be drawn upward along the left labium majus, and *vice versa.*)

Exceptional Cases.—The shoulders, in place of rotating into the conjugate diameter, may enter transversely into the pelvis. If the back then be turned toward the symphysis, the hand should be passed

over the abdominal surface in search of the arms. The space opposite the sacrum renders this movement one of easy execution. When the back is turned to the rear, so long as the arms are flexed, the hand should search for them under the symphysis pubis. If, however, they are extended upon the sides of the child's head, it is rarely possible to push the arms forward between the face and the symphysis pubis. An effort should be made, therefore, to bring one arm to the rear by rotating the thorax with the hands. Michaelis succeeded twice in similar cases without rotating the trunk, by passing the hand behind the dorsal surface of the child and drawing the elbow backward and downward below the side-wall of the pelvis, and then pushing the forearm over the thorax.* I have repeatedly tested this movement in passing the cadaver of an infant through a bony pelvis, and find that it can be accomplished without producing fracture or dislocation. Of course, during the life of the child the result may be different.

Sometimes, in rotating the shoulders, the anterior arm becomes displaced backward, so that the forearm is thrown across the neck of the child. When this accident is of recent occurrence, the release of the arm may be accomplished by pressing the thorax of the child backward into the genital passage, and rotating the body in the reverse direction from that which produced the difficulty. If, however, tractions have been made upon the child until the head has entered the pelvis, the arm may become so compressed between the neck and the symphysis pubis as to render its liberation a very difficult if not impossible task. Then every resource should be quickly tested to turn the shoulder of the displaced arm to the rear, either by raising the released arm, or by rotating the thorax, or by drawing upon the elbow. In case of failure to obtain a speedy result, extraction may be attempted without releasing the arm. To be sure, fracture of the humerus is thereby rendered highly probable ; but, if the bystanders are forewarned that the risk is incurred in the interest of the child, they are generally ready, where the life of the latter is preserved, to condone the injury.

In setting a fractured arm, soft pads should be bandaged upon the anterior and posterior surface to hold the extremities in position. The posterior pad should run the entire length of the arm ; the anterior pad need not extend below the elbow. The arm should then be bandaged to the thorax. In two or three weeks consolidation takes place.†

In performing artificial rotation, it is well to bear the warning of Dr. Barnes in mind, viz., "That the atlas forms with the axis a rotatory joint, so constructed that, if the movement of rotation of the head be carried beyond a quarter of a circle, the articulating surfaces part

* Michaelis, "Abhandlungen," Kiel, 1833, p. 230.

† Spiegelberg, "Lehrbuch," etc., p. 809.

immediately, and the spinal cord is compressed or torn."* Pains should accordingly be taken to note, when a half-turn is given to the body, whether the head follows the movements of the trunk.

Third Act: Extraction of the Head.

In the extraction of the head we have to distinguish—1. Cases in which the head has entered the pelvis, and has only to overcome the resistance of the perinæum; 2. Cases where the head is retained at the brim by pelvic contraction, stricture of the os uteri, extension of the chin, or insufficient expulsive action exerted by the uterus and the abdominal muscles.

1. Extraction of the head after it has entered the pelvis.

Smellie's Method.—In the so-called Smellie's method the trunk of the child is wrapped in a warm napkin and placed astride the operator's arm; the hand is then passed into the vagina, and the index and middle fingers are placed upon the fossæ caninæ to the sides of the child's nose. By this means flexion of the head is induced. At the same time, upward pressure is made with the fingers of the other hand upon the occiput. Then by raising the trunk the face is rolled out over the perinæum. This method possesses the advantage of avoiding the risks of injuring the child which are incident to the other procedures. It requires for its successful performance the completion of rotation, a small head, and a lax perinæum.

Combined Traction upon the Chin and Shoulders.—In case the foregoing plan is not followed by immediate success, the two fingers upon the fossæ caninæ should be introduced into the mouth, and, by pressure upon the alveolar processes of the lower jaw, flexion should be accomplished. With the fingers of the other hand forked upon the shoulders, traction should be made, and, as the head descends, the body should be raised by the joint movement of the two arms, whereby the face sweeps over the perinæum. By the combined method there is obtained the greatest amount of traction force in combination with the least degree of violence to the child. As the power is exerted chiefly upon the shoulders, the fingers in the mouth are not likely to fracture the jaw, but, by keeping the chin flexed and drawing gently upon it, the danger of twisting the neck, in cases where the rotation of the face into the hollow of the sacrum is incomplete, is avoided.†

When the occiput is turned into the hollow of the sacrum, and the forehead is pressed against the symphysis, the process just described should be reversed. As the fingers are forked over the shoulders, the

* Barnes, "Obst. Operations," Am. ed., p. 210.

† The combined traction upon the chin and shoulders is in Germany known as the Smellie-Veit modified method, the latter having warmly advocated the measure in 1863. Chailly, however, long before spoke of its adoption in France, and attributed its introduction to Mme. La Chapelle.

back of the child should rest upon the arm. With one or two fingers of the other hand the chin should be flexed. Tractions should be made downward, so that while the neck rests upon the perinæum the forehead rotates under the symphysis pubis.

Ordinarily, when the head enters the pelvis in a transverse direction, the occiput rotates to the symphysis pubis during extraction. Should the head, however, remain with its long diameter in the transverse diameter of the pelvis, a hand introduced into the vagina, with the back to the sacrum and the fingers over the child's face, may sometimes be successfully employed to rotate the latter into the sacral concavity.

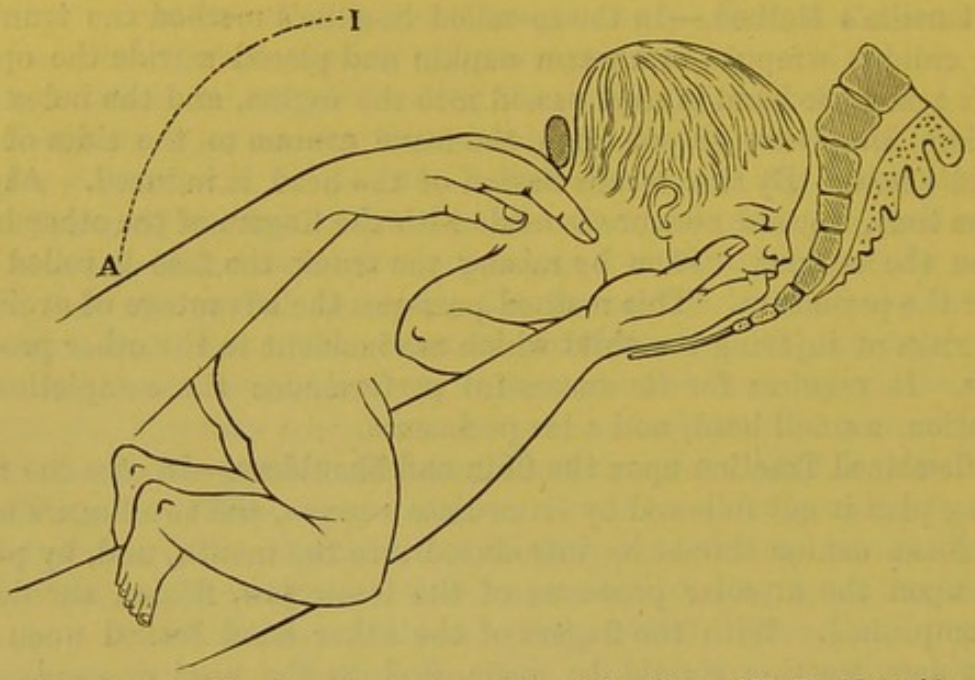


Fig. 176.—Combined traction upon mouth and shoulders. (Chailly-Honoré.)

2. Extraction with the Head at the Brim.—Schroeder, and a considerable portion of the modern German school, employ combined traction upon the shoulder and chin for all emergencies alike, whether the head be high, or after its entrance into the pelvis. As, however, the life of the child depends upon the speedy extraction of the head, it is well to become familiar with the various procedures, as, by passing rapidly from one to another, a successful result is often obtained, when failure might have followed ineffectual efforts in a single direction.

The Prague Method owes its modern name to the advocacy of Kiwisch, Scanzoni, and Lange, all representatives of the Prague school. It was, however, nearly a century earlier described by Pugh. It consists in seizing the feet with one hand, and directing the body of the child nearly vertically downward. The fingers of the other hand are hooked over the shoulders of the child, so that the tips rest upon the

supra-clavicular region. Traction is exerted by both hands simultaneously. In the absence of pains, external pressure upon the head should be made by an assistant through the abdominal walls. Care should be taken to avoid twisting the neck, and to preserve the normal relations between the head and the shoulders. After the head has passed the brim, and fairly entered the pelvis, the hand upon the neck should be employed as a fulcrum, while the extremities are raised rapidly toward the abdomen of the mother; the friction from the inner surface of the symphysis pushes the occiput upward, and forces the face to descend into the hollow of the sacrum and to sweep over the perinæum.

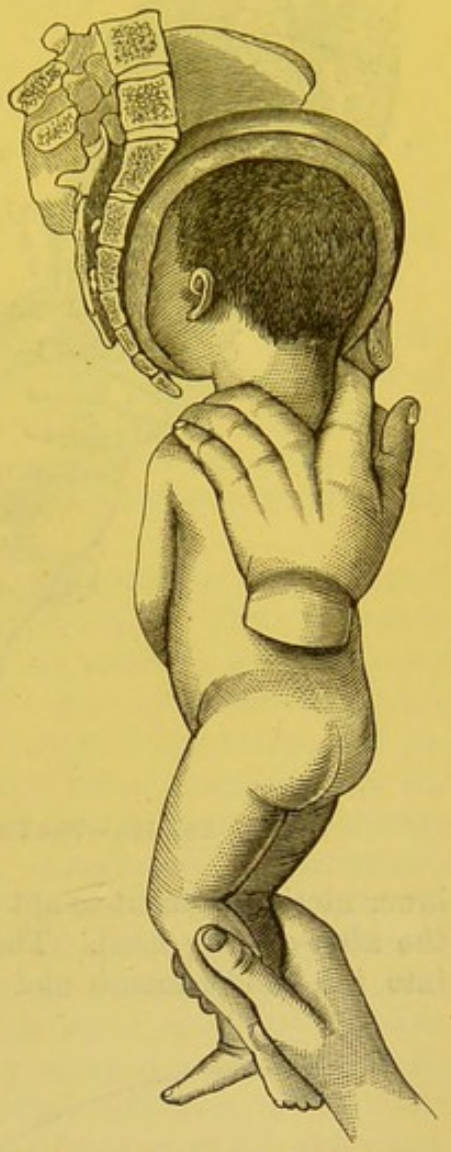


Fig. 177.—The method of extracting the trunk.

When the chin is directed to the front, and at the same time is arrested at the symphysis pubis, if the occiput occupies the hollow of the sacrum, the body of the child should, during the tractions, be directed toward the abdomen of the mother, so as to cause the occiput to rotate over the perinæum.

Forceps to the After-coming Head.—The forceps to the after-coming head has been condemned by some and warmly approved by others. As, however, with its aid I have, in a number of instances, extracted children alive in cases where the foregoing methods have failed me, it is now my custom to have the blades duly warmed and ready to hand before attempting manual extraction. The instrument is occasionally of use in overcoming the resistance of a rigid perinæum in strongly-built primiparæ, but is chiefly indicated when both occiput and chin are arrested at the superior strait. With the chin anterior, the forceps should be applied under the back of the child, and the handles raised so as to bring the occiput into the hollow of the sacrum. With the chin to the rear, the forceps should be applied under the abdomen, and be used to draw the face into the sacrum. Where the arrest of the head is due to stricture of the os externum or internum, the forceps will sometimes bring the head rapidly through the cervix, when traction upon the feet only serves to drag the uterus to the vulva. In

stricture of the cervix, however, great care must be exercised to avoid laceration, as under no circumstances are extensive ruptures of the

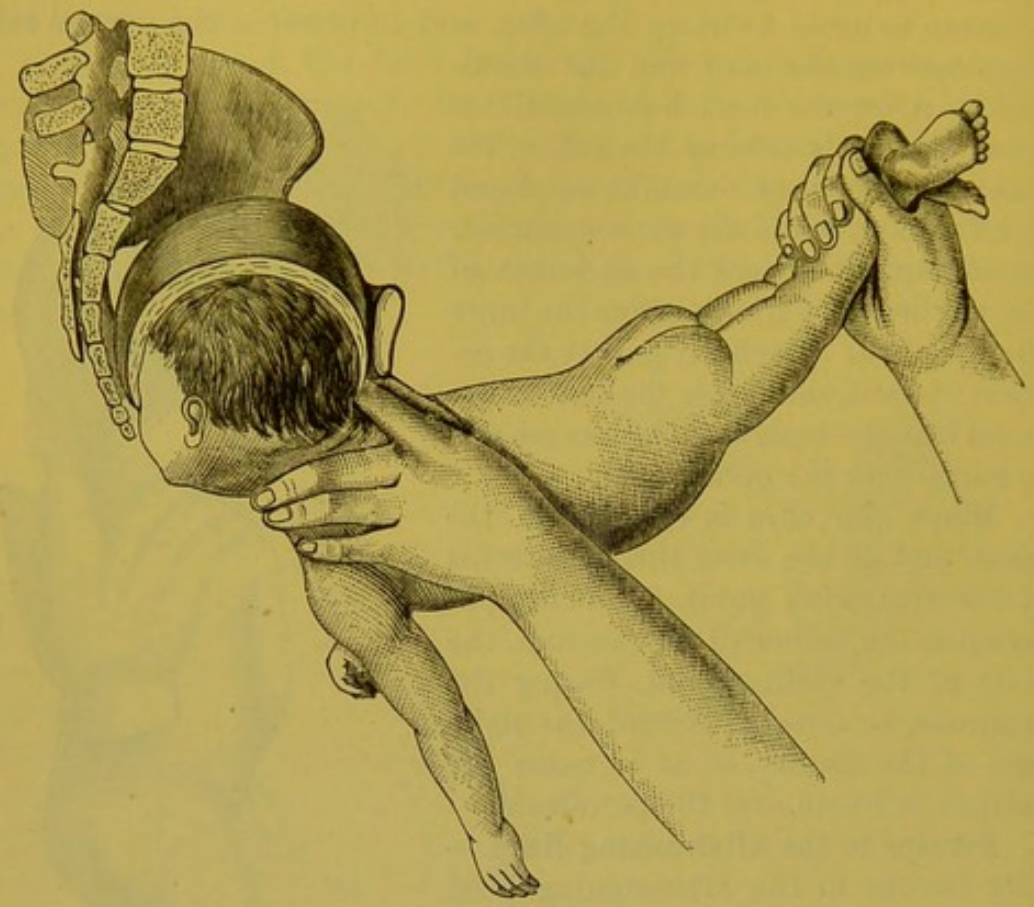


Fig. 178.—The Prague method of extracting head.

lower uterine segment so apt to follow as in the forcible extraction of the after-coming head. The introduction of a large-sized catheter into the child's mouth and drawing back the perinæum have been

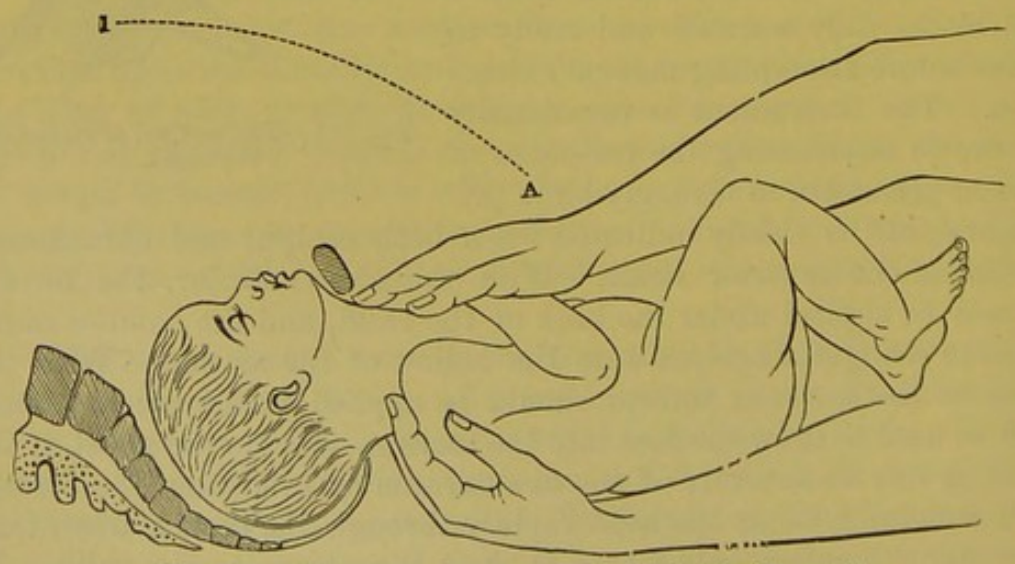


Fig. 179.—Chin arrested at symphysis. (Chailly-Honoré.)

found useful as temporary means of introducing air into the child's lungs, where delay attends efforts at delivery.

In extracting the after-coming head, the axis-traction forceps is particularly serviceable.

CHAPTER XXI.

VERSION.

Cephalic version. — External method. — Combined method. — Busch. — D'Outrepont. — Wright.—Hohl.—Braxton Hicks.—Podalic version.—Bi-polar method.—Internal version.—Neglected version.—Use of the fillet.

VERSION, or turning, is the term employed for the operations by means of which an artificial change is effected in the presentation of the child. It comprises the substitution of one pole of the fœtus for the other, and the conversion of an oblique or shoulder presentation into one in which the long axis of the fœtus corresponds to the vertical axis of the uterus.

It is customary to designate specifically the character of the version by mentioning—1. The presentation to be changed. Thus, version is made from the head, the breech, or the shoulder, as the presenting part. 2. The presentation to be effected. The term cephalic version is used where the head is brought to the brim of the pelvis, and podalic version where the feet are seized and the extremities made the presenting part. 3. The method adopted by which version is accomplished. The expression external version is applied to manipulations exclusively through the abdominal walls; internal version, to the introduction of the entire hand into the uterus; and the combined method to cases in which both hands, the one externally and the other with two to four fingers introduced through the os, coöperate together.

Cephalic Version.—When it is simply required to rectify a faulty presentation (shoulder or transverse), without reference to modifying circumstances, cephalic version unquestionably deserves the preference. In practice, however, this method requires the concurrence of so many favorable conditions that its employment is very limited. For instance, there must be no complications which call for rapid delivery. It would be unsuitable in prolapse of the cord and in cases of placenta prævia. There should be nothing to prevent the child's head from entering the brim of the pelvis. It should, therefore, not be attempted in contracted pelves. A prolapsed arm, unless previously replaced, would render the operation impossible. The child should enjoy a considerable degree of mobility. An abundance of amniotic fluid contributes much, though it is not indispensable, to success, as, even after the rupture of the membranes, provided the uterine walls are sufficiently

relaxed, the head may be brought into the pelvis. Before rupture, excessive sensitiveness to manipulations, and, after rupture, rigidity of the uterus stand in the way of success.

The operation may be performed by either the external or the combined method.

Of the external methods the best is that which is known as Wigand's (1807), which combines a suitable position of the mother, with manipulations through the abdominal walls. The mother is at first made to lie upon her back, with knees flexed, and with the abdomen exposed or covered by some light material. The physician stands by the side of the patient, looking in the direction of her face. He begins by laying his hands flat upon the surface of the abdomen, and seeks with the one the head and with the other the breech of the fœtus. During the intervals of the pains, by gentle movements of the two hands working simultaneously, he strives to press up the breech and anterior surface of the child and to bring the head into the pelvic brim. Should the uterus harden, all friction movements of the hands should cease, and the efforts of the operator be confined to holding the fœtus steady in the position previously produced. The movement may be aided by turning the woman upon the side toward which the head is directed. As the fundus of the uterus sinks to the side upon which the woman lies, it carries the breech of the child with it, while the change in the uterine axis tends to throw the cephalic end in the opposite direction.

When the head is once brought to the brim of the pelvis it may be retained *in situ,* if the patient lies upon her side, by the hand of an assistant, or by a small, hard pillow pressed firmly against it. If the patient lies upon the back, two compresses may be laid along the sides of the uterus near the head, and a bandage applied to the abdomen to keep them in position. When the pains are regular and the cervix partially dilated, fixation of the head may be accomplished by rupturing the membranes and allowing the waters to escape. Until the uterus retracts down upon the child, the head should be held at the brim either by the two hands through the abdominal walls, or by the thumb and four fingers of one hand applied directly to the head through the cervix.

The more important of the combined methods are those of Busch, D'Outrepont, Wright, Hohl, and Braxton Hicks. They have in common the simultaneous employment of the external and internal hand. They differ, however, in detail. The methods of Busch and D'Outrepont have now chiefly an historical interest. Busch introduced the hand corresponding to the child's head through the vagina and cervix, while counter-pressure was made with the other hand upon the fundus uteri. The back of the hand is at first directed to the front. When, however, its widest portion has passed above the symphysis pubis, the back of the hand is turned to the concavity of the sacrum, and the fin-

gers are pushed up with care between the membranes and the uterus to the head. The membranes are then ruptured, and during the escape of

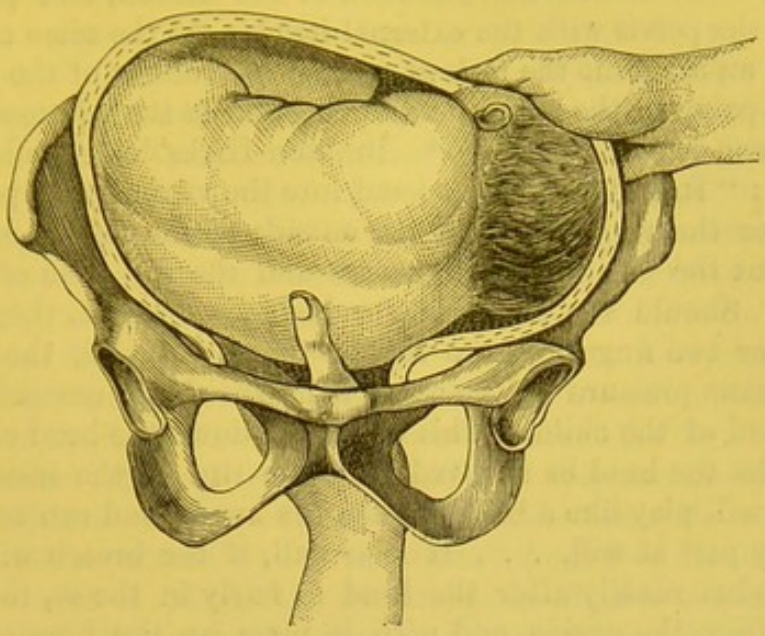


Fig. 180.—D'Outrepont's method, modified by Scanzoni.

the waters the head is seized by the fingers and thumb and drawn into the pelvis, while the disengaged hand presses the breech toward the median line. Every pains should be taken to prevent, with the fingers, the prolapse of the cord, or of an arm,* during the escape of the water. D'Outrepont seized the presenting shoulder between the thumb and fingers of the hand corresponding to the breech, and, during the intervals between the pains, pushed the shoulder upward and in the direction of the breech until the head descended into the pelvis. During this manœuvre, D'Outrepont simply used the external hand to support the uterus. Scanzoni recommended that it should be employed externally to press the head toward the pelvic brim.†

Wright's method differs from that of D'Outrepont, in that he employed, to seize the shoulder, the hand corresponding to the head, and, while he pushed the shoulder, without lifting, in the direction of the curve of the uterus, he applied the remaining hand to dislodge the breech and move it toward the center of the uterine cavity.‡

All the foregoing methods require for their successful performance a movable fœtus and a dilated cervix, conditions which render podalic version safe and of easy execution. In practice, therefore, they have never enjoyed any considerable degree of popularity. Of far greater importance are the methods of Hohl and Braxton Hicks, which, possessing the advantage of requiring the introduction of two fingers only into the uterus, can consequently be resorted to at an early stage of

* Scanzoni, "Lehrbuch der Geburtshülfe," 1867, Bd. iii, p. 63. † *Op. cit.*, p. 65.

‡ Wright, "Am. Jour. of Obstet.," vol. vi, part 1, 1873.

labor. Hohl, like Wright, employed for internal use the hand corresponding to the head. With two fingers in the cervix, he pushed the top of the shoulder in the direction of the breech, and pressed the head into the pelvis with the external hand. At the same time he intrusted to an assistant the task of seizing the fundus of the uterus between the palms of the hands, and directing it to the side toward which the head was originally turned.* Braxton Hicks describes his method as follows: "Introduce the left hand into the vagina as in podalic version; place the right hand on the outside of the abdomen, in order to make out the position of the fœtus and the direction of the head and feet. Should the shoulder, for instance, present, then push it, with one or two fingers on the top, in the direction of the feet. At the same time pressure by the outer hand should be exerted upon the cephalic end of the child. This will bring down the head close to the os; then let the head be received upon the tips of the inside fingers. The head will play like a ball between the hands, and can be placed in almost any part at will. . . . It is as well, if the breech will not rise to the fundus readily after the head is fairly in the os, to withdraw the hand from the vagina and with it press up the breech from the exterior."† Lately, Hicks has proposed to employ the external hand to alternately press the head into the os and the breech to the fundus. His plan differs from that of Hohl, in that he operates with the patient upon the side, and uses the left hand with the patient upon the left side, and the right hand when she lies upon the right. He likewise dispenses with an assistant.‡

Podalic Version.

Podalic version is indicated in the following cases:

1. The transverse presentation, where cephalic version is contraindicated, or attended with any considerable degree of difficulty.

2. In head presentations, where there is reason to suppose that the result would be favorably influenced by bringing down the feet. As illustrations of such conditions, we have faulty presentations of the head and face, prolapse of the cord and extremities, placenta prævia, and contracted pelvis. The various contingencies which call for version will be more closely considered in connection with the special morbid conditions mentioned.

The operation may be performed by combined external and internal manipulations, or by the internal hand alone.

The Bi-polar or Combined Method of Braxton Hicks.—In the bipolar method of turning, the two hands operate simultaneously upon the extremities of the fœtus. It may be carried out at will with the

* Hohl, "Lehrbuch der Geburtshülfe," 2te Auflage, 1862, p. 784.

† Hicks, "Combined External and Internal Version," "Trans. of the Obstet. Soc. of London," vol. v, p. 230. ‡ Hicks, "Am. Jour. of Obstet.," July, 1879, p. 593.

patient upon the side or upon the back. The latter position is the one which finds most favor in this country. The patient should be placed transversely in the bed and the nates drawn to the edge. Two assistants are required to hold the legs, which should be flexed and rotated outward. As the beds in America are very low, where difficulty in operating is anticipated it is sometimes advisable to remove the patient after she has been anæsthetized to a table covered with a blanket or woolen comforter. Complete anæsthesia is useful as a means of facilitating the introduction of the internal hand, and maintaining a relaxed condition of the uterus. Care should be taken that both bladder and rectum are emptied. The hand selected for internal manipulations should be of the same name as the side to which the extremities are turned—i. e., feet to the right, right hand ; feet to the left, left hand.* The fingers should be brought together in the form of a cone. The back of the hand and forearm should be well lubricated with oil or lard. In passing the hand into the vagina, the labia should be separated by the thumb and fingers of the disengaged hand. Entrance is effected by directing the fingers toward the sacrum, and pressing backward upon the distensible perinæum. In this stage of the procedure hasty action is out of place. Patience and gentleness are the prime requisites. Two or three fingers only need to be carried through the internal os. When the presenting part is reached, the external hand should be laid upon the abdomen, and pressure brought to bear upon the breech. The two hands should then move the extremities of the child in opposite directions. To quote Dr. Barnes, "The movements by which this is effected are a combination of continuous pressure and gentle impulses or taps with the finger-tips on the head (or shoulder), and a series of half-sliding, half-pushing impulses with the palm of the hand outside." When the breech is well pressed down to the iliac fossa, the membranes should be ruptured during a pain, and a knee, which at this time is generally near the os internum, should be seized and hooked into the vagina with the fingers. As the breech is brought into the pelvis by tractions upon the leg, the outer hand should be employed to press up the head until the version is completed.

The manipulations described are to be conducted during the intervals between the pains. Care should be taken not to hook down the cord with the knee. When the lower extremities are reflected upward upon the body so that a knee is not attainable, the breech may often be brought down by a finger inserted into the fold of the thigh, or by pressure upon some part of the pelvis.

* In England the patient is delivered upon the left side, and the left hand is commonly introduced into the vagina. In Germany, when the patient lies upon the right side, the left hand is employed inside ; when upon the left side, the right hand. The choice of hands, it will be seen, is not a matter of considerable importance.

The combined method of version, which we owe in all its essential features to Braxton Hicks, is one of the most important contributions to obstetrical practice of the present century. It possesses the priceless advantages of enabling the physician to perform version early in labor, and to accomplish the operation without in any way imperiling the integrity of the uterus. The only prerequisites for success are: sufficient dilatation of the cervix to permit the passage of two fingers, a certain degree of fetal mobility within the uterine cavity, and a precise knowledge of the fetal position. After rupture of the membranes and escape of the waters, the operation becomes more difficult, but is even then not always impracticable.

Internal Version.—In internal version the entire hand is introduced into the uterus. It is necessary, therefore, that the cervix should be so far dilated that the hand can be passed without violence through the cervical canal. Irregular uterine contractions require to be relieved by hypodermic injections of morphia, with or without the addition of atropia, or by the induction of complete anæsthesia. As internal version is not an indifferent operation, but may be followed by inflammations due either to injuries of the maternal tissues or to the introduction of infected air into the uterus, it should not be attempted until the impracticability of the combined method has been demonstrated. It is applicable chiefly to cases in which a certain degree of uterine retraction has followed upon the escape of the amniotic fluid.*

The patient should be placed upon the back or side; the bladder and rectum should be emptied; and anæsthesia should be pushed until the action of the abdominal muscles is suspended. The exact position of the fœtus should be carefully ascertained. The hand, well oiled upon its dorsal aspect, should be passed slowly, after the expiration of a pain, with the fingers formed into a cone, through the vagina and cervix, opposite the sacro-iliac synchondrosis, upon the side of the child's feet. At the same time counter-pressure should be maintained over the fundus uteri, to prevent rupture of the vaginal attachments. If the uterus begins to contract, the fingers should be spread out, and the operator remain passive until the pain subsides.

In head presentations, the hand employed should be always the one which corresponds to the side of the child's feet. In transverse presentations, when version is performed soon after the rupture of the membranes, before retraction of the uterus has taken place to any extent,

* If the membranes are intact, and internal version is chosen in place of the bi-polar method, one of three plans is open in practice: 1. Boer recommended passing the hand between the membranes and uterus to the feet of the child, and then rupturing the membranes; 2. Hüter seized the feet of the child through the membranes, and turned without rupturing; 3. Levret ruptured the membranes at the os uteri, and introduced the hand during the outflow of the water. The third plan is the one most deserving of favor.

the choice of hands is of little consequence. This is especially true in the dorso-anterior position. Thus, when the child lies with the head to the left, feet to the right, and belly to the rear, the right hand may be passed directly across the belly, to the extremities of the child, or the left hand may be made to pass from the breech, along the surface of the thigh, to the nearest knee or leg. By the latter method the danger of mistaking an arm for the leg is avoided. Should, in any case, doubt upon this score arise, the characteristic differences between the hand and foot should guide us to a correct diagnosis. Thus, the wrist enjoys greater mobility than the ankle, the fingers are longer than the toes, the palm is shorter than the sole, the position of the thumb is peculiar to the hand, and the pointed heel to the foot.

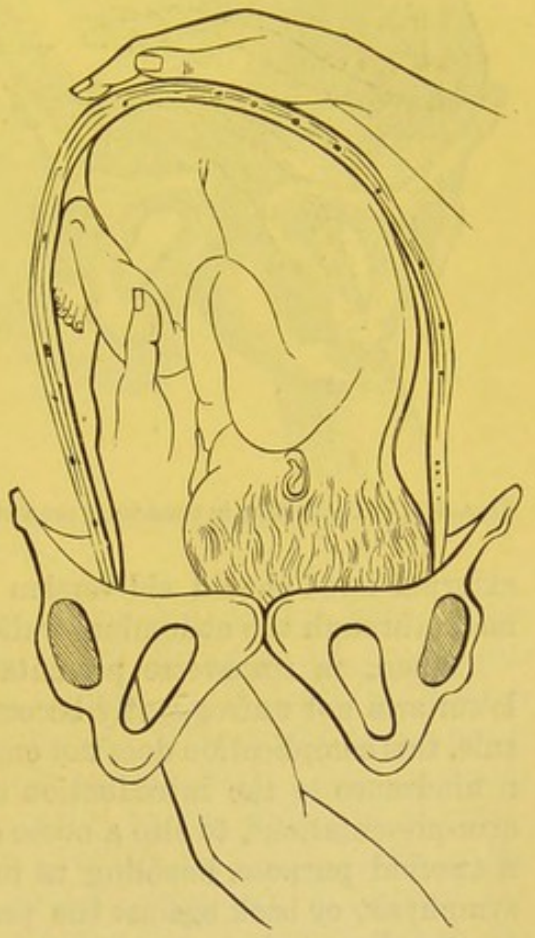


Fig. 181.—Version in head presentations. (Chailly-Honoré.)

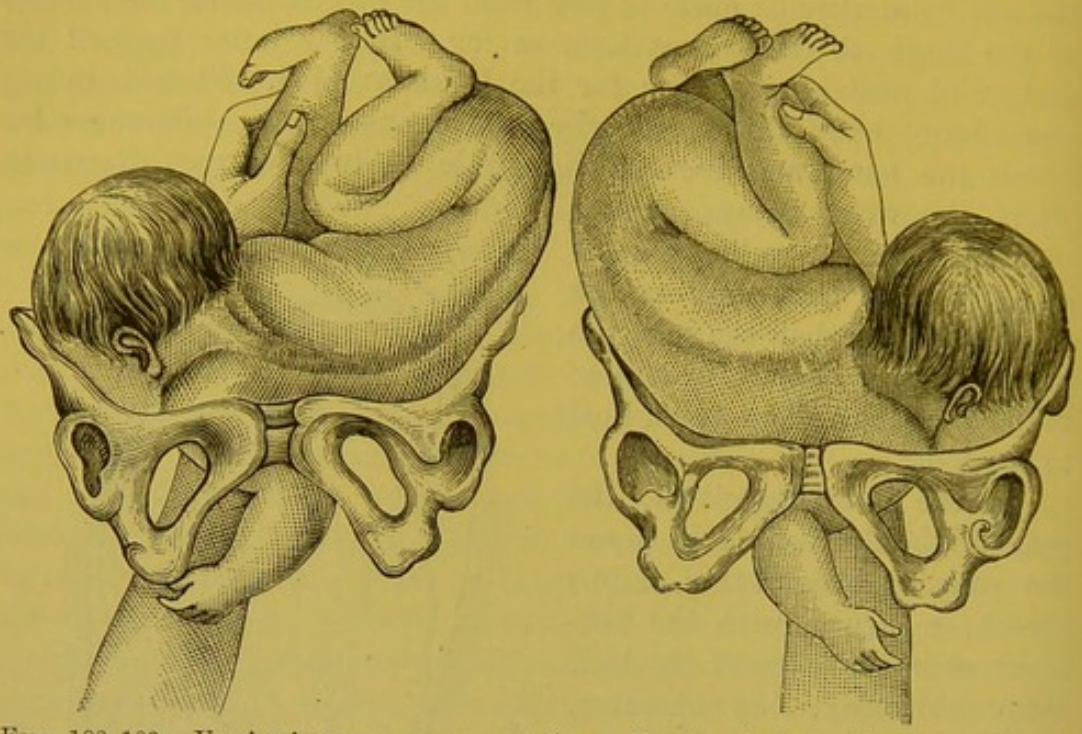
In the lateral position, the patient should be placed upon the side to which the child's breech is turned, with the buttocks near the edge of the bed. Here, obviously, the operator, standing in the rear of his patient, would use with the greatest facility the hand corresponding to the side upon which the woman lies (left side, right hand, and *vice versa*). In dorso-posterior positions especially, the advantages of such a selection are manifest.

In easy versions, it is correct practice to bring down one foot or knee only. When one extremity is left reflected upon the abdomen, the larger size of the breech more fully distends the cervix, and thus prepares the way for the subsequent passage of the child's head. In difficult cases, or when rapid delivery is to be effected, both feet should be seized. A single foot should be held at the ankle between the thumb and fingers. When practicable, the entire leg may be grasped with the closed hand. When it is sought to turn by both feet, the middle finger should be placed between them, while the ankles are held by the second and fourth fingers.

Little importance should be attached to the question as to which extremity should be selected, so long as the version is uncomplicated.

While in Germany preference is accorded to the seizure of the lower extremity, the superiority of turning by the more remote limb is generally advocated in England.

As in the bi-polar method, during the traction upon the foot, the



Figs. 182, 183.—Version in transverse presentations; direct method of seizing feet. (Braun.)

external hand should aid version by pressure upward upon the head made through the abdominal walls with the disengaged hand.

When, in transverse presentations, the membranes rupture, the lower arm not unfrequently becomes prolapsed into the vagina. As a rule, this complication does not embarrass version, though it may prove a hindrance to the introduction of the hand. It is a good plan, in arm-presentations, to slip a noose of tape about the wrist, which serves a twofold purpose, enabling us to draw the extremity up toward the symphysis, or back against the perinæum, according as the hand is to be passed posteriorly or anteriorly, and to hold the arm to the side of the child's body during the performance of version, thus avoiding the difficulties of arm delivery in the period of extraction. Dr. F. P. Foster, in a case where the mobility of the child was unimpeded, used the prolapsed arm as an aid to version in the following ingenious manner: The child lay with the back to the front, the head upon the right iliac fossa, and the left arm presenting. With the right hand in the vagina, he seized the arm, and pushed gently upward in the direction of the humerus. In this way he succeeded in elevating the cephalic pole until with the index-finger alone in the cervix uteri he managed to reach the breech of the child. With the point of his finger he gently urged this along to the mother's right side, and soon

encountered the left foot, which he readily hooked down into the vagina.*

When, after rupture of the membranes, aid is not promptly rendered, the shoulder becomes crowded into the pelvic brim. If the

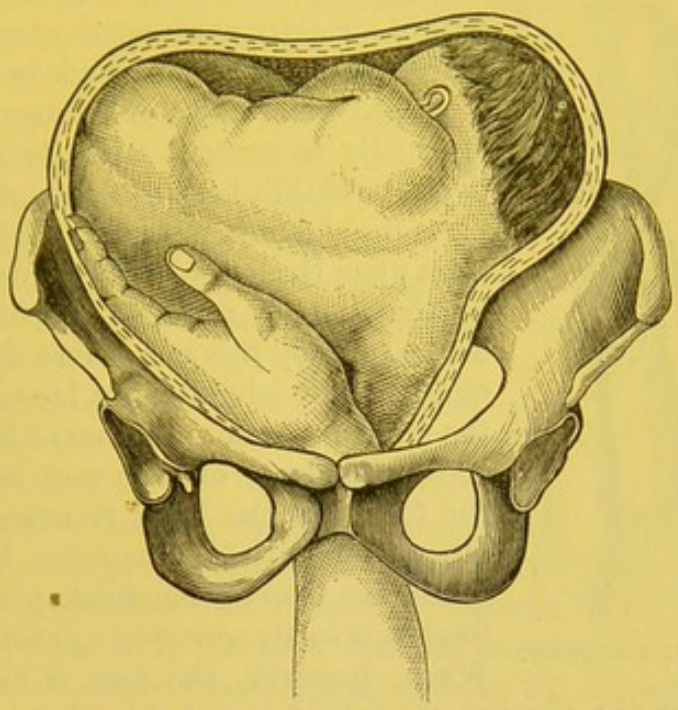


Fig. 184.—Method of reaching an extremity by first passing the hand around the breech. (Scanzoni.)

pains are feeble the uterus may remain relaxed, so that hours afterward version may be readily performed. If the pains are good, however, as the waters escape the uterus retracts, until finally it becomes rigidly applied to the surface of the fœtus. This condition is known to obstetricians as a neglected shoulder presentation. Version, under the circumstances, is embarrassed, partly by the difficulty of introducing the hand into the uterus to seize the foot, and partly by the fact that when tractions are made upon an extremity, in place of the child turning *in utero*, both child and the closely applied uterus are apt to move together.

In operating after the retraction of the uterus has become complete, the physician should seek to effect the utmost relaxation by pushing anæsthesia to complete insensibility. The hand should be introduced slowly and with the utmost gentleness. Precipitate action, or an attempt to overcome the uterine resistance by force, may cause fatal rupture. The external hand should make firm counter-pressure upon the fundus, to prevent the uterus from being torn from the vagina. The seizure of the lower foot is usually alone practicable.

* Foster, "On Prolapse of the Arm in Transverse Presentations," "Amer. Jour. of Obstet.," vol. ix, p. 203.

Simpson, it is true, regarded the secret of success in such cases as depending upon making tractions with the upper limb, as tending to rotate the body of the child upon its long axis, and thus favoring the release of the presenting shoulder from its imprisonment. However rational all this sounds in theory, rotation within a rigidly contracted uterus is easier to represent by diagram than to carry out in practice. The result of seizing the upper leg is usually to cross it with its fellow, and to twist the child's body so as to injuriously compress the abdominal viscera. By making tractions upon the lower leg, the breech is brought by the shortest route to the uterine orifice. To be sure, by this manœuvre the body of the child is bent laterally, but lateral flexion does the child no harm. In case of failure to effect version, a noose of tape may be placed upon the foot, and the hand returned to seek the other extremity. When the foot is within reach, the loop of the fillet, placed about the fingers, is easily conveyed upward to the ankle. When, however, the foot is high up in the vagina, where the movement of the fingers is impeded, some form of instrument is needed to push the loop from the fingers over the foot. Unquestionably the most serviceable contrivance to this end is the repositor of Carl Braun, which consists of a gutta-percha rod, sixteen inches in length, with an aperture two inches from the extremity, through which the loop of a double tape is threaded. When in use this loop is passed around the noose of the fillet, and is then reflected over the end of the rod. Thus secured, the fillet is conveyed to the position aimed at. Then by loosening the ends of the tape, which during the upward movement are held to the sides of the rod by the operator's hand, and by shaking the rod, the instrument is easily detached, and can be withdrawn without difficulty.

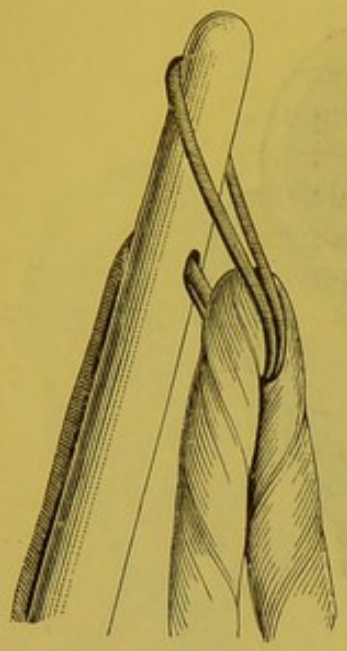


Fig. 185.—Braun's repositor.

If the operator does not care to release the foot, because of the difficulties he has encountered in getting possession of it, the fillet may be noosed around his arm, and thence be pushed upward over the hand, to the seized extremity.

A device, which in many instances has rendered me excellent service, has consisted of an ordinary catheter threaded with a doubled piece of twine, so that the loop projected from the eye of the instrument. This loop, after inserting the stylet into the catheter, I have used in precisely the manner laid down for the employment of Braun's instrument.

In case the second limb can not be reached, or where traction upon

both extremities fails to bring the breech into the cervix, an attempt should be made to dislodge and elevate the presenting shoulder. This can sometimes be accomplished, in accordance with the suggestion of Professor Goodell, by bringing down the upper arm, and turning the child upon its long axis; or, while the noosed foot is held out of the way by the attached fillet, the hand corresponding to the child's head may be introduced into the vagina, and employed to press the presenting part away from the cervix. The raising of the shoulder should be gradual, and should be performed with the utmost gentleness, as the danger of uterine rupture is peculiarly enhanced by the thinned, overstretched condition of the lower segment. Meantime a skilled assistant should exercise counter-pressure from without upon the fundus of the uterus, and upon the head of the child, and aid the descent of the breech by rightly directed pressure. Resolution to succeed, combined with patience in manipulation, usually overcomes the obstacles presented by the most difficult cases.

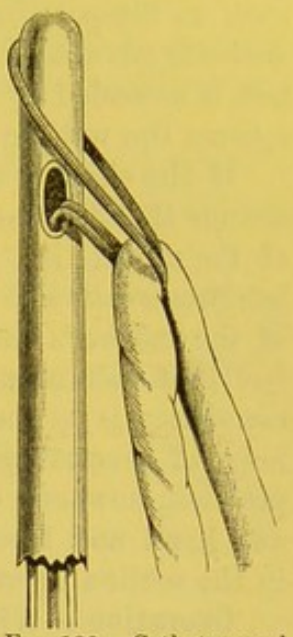


FIG. 186.—Catheter used as repositor.

In the few instances where failure follows all attempts to accomplish version, or where rupture is imminent, or where the child is known to be dead, the obstacle to delivery may be overcome by decapitation, and the removal of the head and trunk separately.

CHAPTER XXII.

CRANIOTOMY AND EMBRYOTOMY.

Craniotomy.—Indications.—Operation.—Perforators.—Method of perforating.—Extraction after perforation.—Forceps.—Cephalotribe.—Action of the cephalotribe.—Objections.—Application of the cephalotribe.—Cranioclast.—Crotchet and blunt hook.—Cephalotomy.—Embryotomy.—Exenteration.—Decapitation.

CRANIOTOMY.

CRANIOTOMY includes all the various operations employed to reduce the dimensions of the child's head. Thus the term is applied—1. To the perforation of the skull, and the evacuation of the brain-contents; and, 2. To the various procedures subsequently adopted to further minimize and extract the cranial walls.

Indications for Perforation.—Perforation is resorted to, in cases of mechanical obstacles to delivery, to overcome the disproportion existing between the child's head and the parturient canal. As the operation is performed solely in the interests of the mother, it possesses a

wider range of applicability when the child is dead than when still living.

Perforation, in the dead child, is allowable in difficult labors so soon as temporizing becomes dangerous to the mother. The mere æsthetic advantage of removing by forceps an unmutilated child ought not, if attended by any risk, to be allowed to weigh with the physician against the welfare and safety of the parent.

If the child is alive, the question of perforation is one of the most serious that falls to the lot of the conscientious physician. If the life of the mother is at stake, and the sacrifice of the child is necessary to her preservation, few would dispute at the present day the superiority of the mother's claim to existence. Still, it is not sentimentality to feel that it is an awful thing to destroy a living child before a clear conviction is reached that conservative measures, which hold out the hope of preserving both lives, are of little or no avail. The proper position, however, of craniotomy, between the Cæsarean section on the one hand and forceps and version upon the other, will be discussed in the section upon the treatment of contracted pelves.

Operation.—When perforation has once been decided upon, there should be no delay in its execution. By delay, the very object of its performance, viz., the preservation of the life of the mother, is imperiled.*

The patient should be placed in the usual obstetrical position, with the knees flexed, and the hips drawn over the edge of the bed. Chloroform is not requisite. It is useful, however, as a means of saving the mother from painful after-memories. If the head is not fixed at the brim, it should be held firmly in position by the hands of an assistant, through the abdominal walls, or the child should be turned, and perforation performed on the after-coming head.

Complete dilatation of the cervix is not essential to the execution of the operation. If the object is simply to relieve the maternal soft parts from pressure, perforation may be performed at an early stage of labor. When, however, it is intended to follow perforation by immediate extraction, it is necessary to secure sufficient preliminary dilatation. In just this class of cases I have seen excellent results from the employment of Dr. I. E. Taylor's long, narrow-bladed forceps, which can be passed through a cervix dilated to scarcely an inch and a half in diameter. They enable the operator to seize the head, and use it as a dilating wedge during and after a pain (*vide* p. 368). If the cervix hangs empty in the pelvis, and the head can not be moved from the brim, Barnes's dilators are often of great service. Unques-

* Spiegelberg states that between the years 1870 and 1877, of thirty-three cases of perforation, three terminated fatally, while in the previous five years in which the operation was performed, at a late period, of thirteen cases, seven ended in death. ("Handbuch der Geburtshülfe," p. 833.)

tionably in many cases less violence is done to the mother, if simple perforation is resorted to, the brain evacuated, and the dilatation of the cervix left to be accomplished by the pressure of the gradually collapsing head. This method, however, exposes the mother to the dangers of septic poisoning, as, unless the pains should be good and delivery rapid, decomposition of the fœtus *in utero* speedily sets in after perforation.

Instruments employed in Perforation.—Most of the perforating instruments in use in this country are patterned, with modifications,

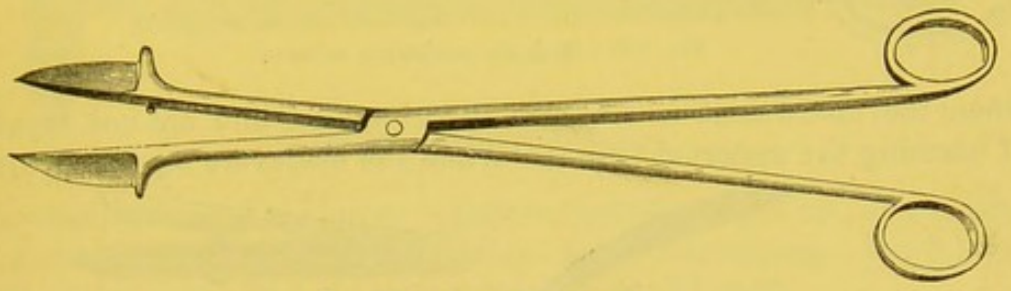


Fig. 187.—Scissors of Smellie.

after the scissors of Smellie. Simpson's perforator is the one I have been in the habit of employing. As compression of the handles causes

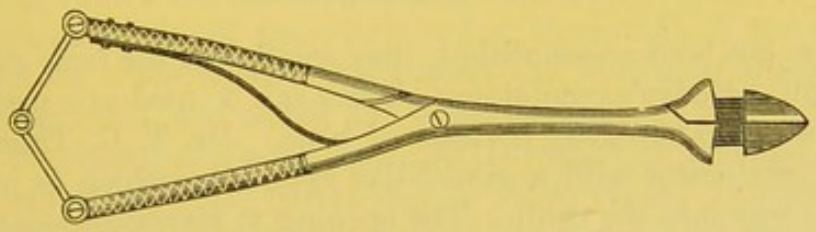


Fig. 188.—Simpson's perforator.

the separation of the perforating points, it can be easily managed with one hand. The projecting shoulders, just beneath the cutting portions, prevent the instrument from penetrating too far into the skull. The edges and points of the blades are rounded, so that they are not

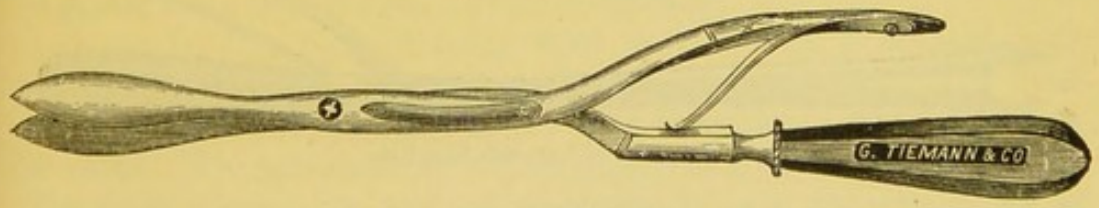


Fig. 189.—Blot's perforator.

liable to injure the soft parts of the mother during the operation. The chief objection to the instrument arises out of these special measures of safety, as, owing to its bluntness, considerable force has to be employed to penetrate the skull, which increases, of course, the risk of

slipping. A better instrument is that of Monsieur Blot. It possesses a spear-point, which makes it effective as a perforator. The blades,

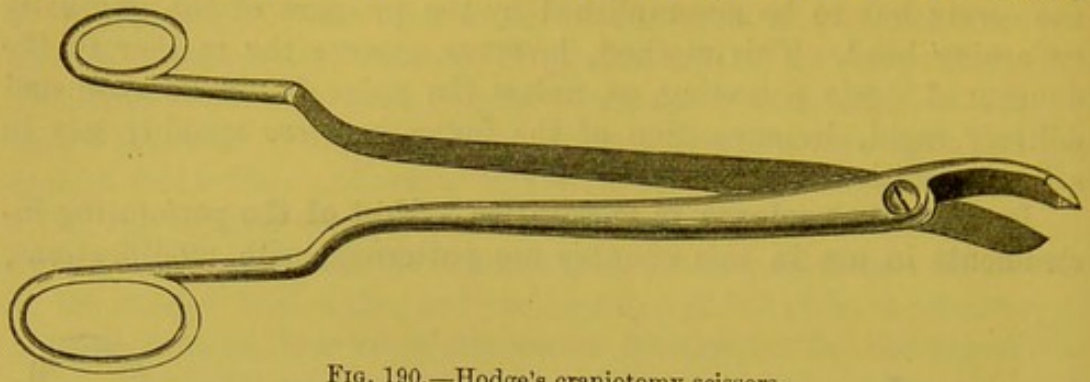


Fig. 190.—Hodge's craniotomy scissors.

when the instrument is shut, are superimposed, and are not capable of harming the maternal tissues. When the blades are separated, after

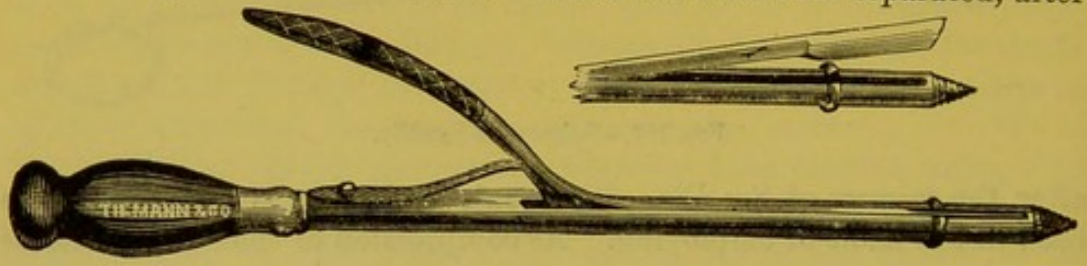


Fig. 191.—Thomas's perforator.

perforation has been accomplished, they readily cut the bony structure of the skull. Hodge's craniotomy scissors can be used as a perforator, and afterward to cut away portions of bone. Dr. T. G. Thomas has devised a perforator with a gimlet-like extremity, which is intended to bore its way into the skull. The opening is afterward enlarged by a knife which lies concealed and guarded in the body of the instrument until required for use. Mechanically considered, Thomas's perforator is beyond reproach. It is, however, somewhat more difficult to keep in order than those previously mentioned.

The basylist of Professor Alexander Simpson resembles in its gen-



Fig. 192.—Simpson's basylist.

eral features the perforator of Dr. Thomas. It is, however, much heavier and of more solid construction. In the place of the concealed knife it possesses two arms, which, when separated from one another, act as powerful levers. The instrument is designed not only to perforate the cranial vault, but, as its name implies, to break up the base of the skull. When this action is rendered necessary, the basylist should be pushed

inward to the sphenoid bone, and a point selected for perforation in front of the sella turcica. After boring well into the sphenoid, the lever is used to forcibly separate the base into two portions. Ordinarily, the expulsion of the child can then be left to the natural forces.

The Germans employ for the most part a long trephining perforator, which removes circular segments from the scalp and the skull.

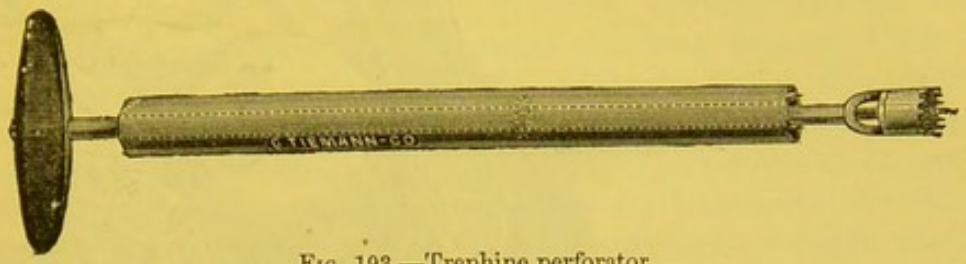


Fig. 193.—Trephine perforator.

The trephine leaves behind no splintered portions of bones, and makes an opening which is not likely to close from overlapping; but it can, on the other hand, be used only upon the cranial vault.

Previous to practicing craniotomy, the bladder and rectum should be emptied. The operator introduces his middle and index fingers into the vagina, and presses them firmly against the most accessible portion of the child's head. Great care, at this stage, should be exercised to gain an exact idea of the situation and the extent of the dilatation of the cervix. The operator then seizes the handle of the perforator in the right hand, and passes the pointed extremity, under the guidance of the fingers of the left hand, to the region of the head at which it has been decided the perforation is to be made. If convenient, a suture or a fontanelle may be selected, in place of the bony table of the skull. The perforator should be pressed against the cranium with a boring movement until the cessation of resistance warns the operator that the bony incasement has been traversed. In cases where the skull is unusually thick or hard, this part of the operation may prove a matter of some difficulty. Care should be taken to hold the instrument at right angles to the point of perforation, as otherwise it is apt to glance from the rounded surface of the head.

If the head, in place of being fixed in the pelvis, is situated high up, every precaution should be taken in the operation. The head should be pressed firmly against the brim through the abdomen by an assistant. The perforator should follow the axis of the superior strait. The point selected for perforation should be near the symphysis, as the instrument is then much less liable to slip than if carried backward toward the promontory. The fingers of the left hand should keep constant guard upon its direction. Oftentimes, by way of protection, the operator introduces the entire half-hand into the vagina. After the perforator has penetrated the skull, the opening should be

enlarged by compressing the handles and separating the cutting blades; then, allowing the latter to close, the instrument should be semi-rotated, and a second cut made at right angles to the first. Be-

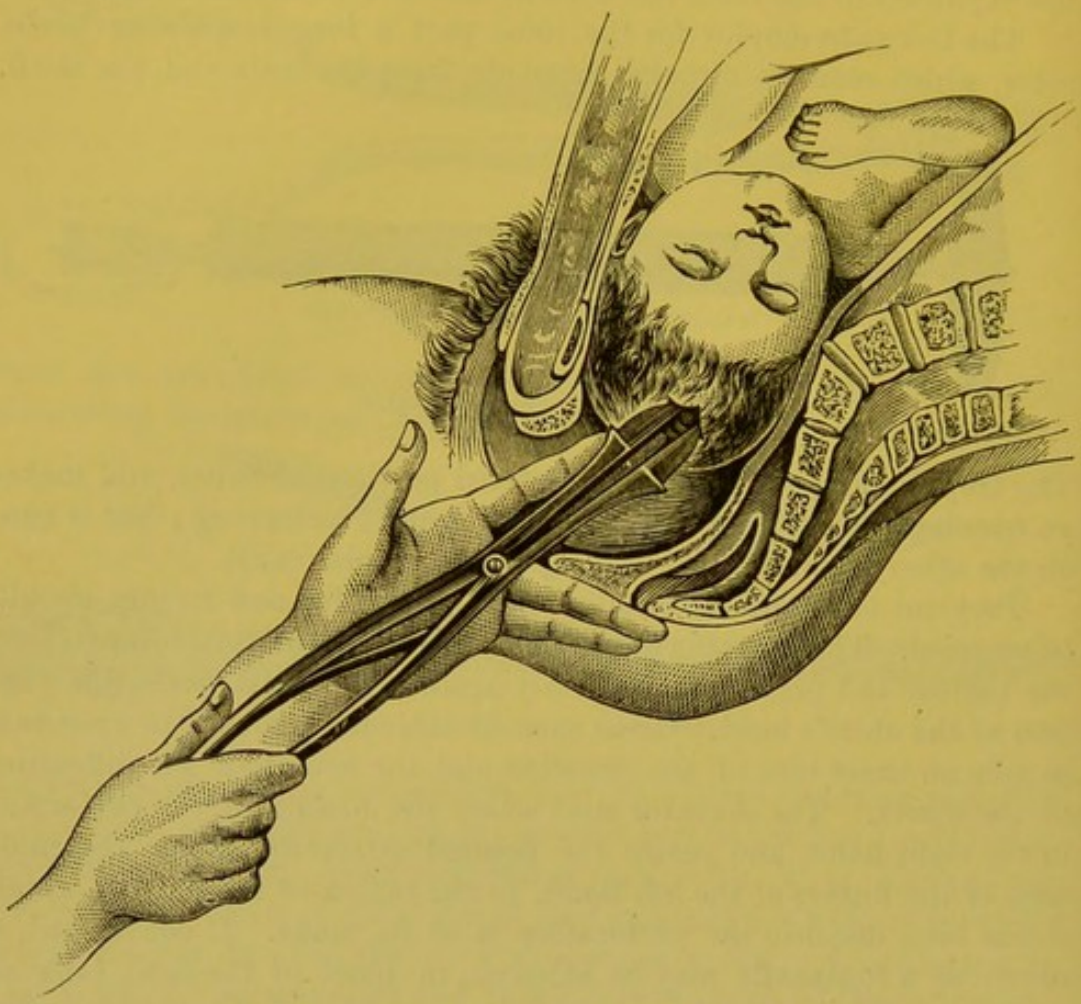


Fig. 194.—Operation for perforating the child's head.

fore withdrawing the perforator, it should be moved about freely to break up the brain-mass. The rapidity and completeness of the collapse of the cranial walls are, in a measure, dependent upon the completeness of the evacuation of the cranial contents. Care too should be taken to pass the perforator into the foramen magnum to break up the medulla oblongata, and thus to insure the death of the child before delivery. Sometimes it is advantageous to wash out the brain-pulp by injecting a stream of water into the cranial cavity.*

In face presentations care should be taken to pass the perforator through the frontal bones, or through an orbit. Where neither of

* Von Weber has shown that no cephalotribe can fully decerebrate a perforated head, in general only the small part of the brain being evacuated. He has likewise demonstrated that a greater amount of compression can be accomplished in case of a fully than a partially decerebrated head. The head, therefore, that has been fully emptied can be more easily extracted than one that has only been partially deprived of its contents.

these points is, however, accessible, it is possible to make the opening through the roof of the mouth, behind the nasal fossæ.

The perforation of the after-coming head is always a matter of considerable difficulty. The point of the perforator has to be inserted obliquely in place of at right angles to the skull, and therefore is more liable to glance. On theoretical grounds it has been recommended to insert the instrument either between the occiput and atlas, or through a lateral fontanelle. In practice, however, such niceties are rarely observed. The operator simply passes the four fingers of the left hand under the symphysis pubis, and, while the feet of the child are drawn downward and backward by an assistant, the perforation is made at any point behind the ear at which the manipulation can be most easily effected. Chailly recommends hooking down the chin of the child, and perforating, as in face presentations, through the roof of the mouth.*

The trephine-perforator requires to be pressed firmly and steadily against the parietal bone. Sometimes, when a large scalp-tumor exists, it is necessary to make a preliminary incision through the integuments. The trephine is not liable to slip, and is easily managed ; as it can not be used either upon the after-coming head or in face presentations, and as it is difficult to keep clean and in order, the less complicated lance-pointed instruments have, however, enjoyed the preference in all countries outside of Germany.

Extraction of the Child after Perforation.—Formerly, after perforation, a waiting policy was by many thought desirable. Osborne, indeed, recommended that at least thirty hours be allowed to elapse before delivery, in case craniotomy was performed upon a living child. The grounds for favoring a temporizing policy were found in the softening and relaxation of the sutures, and the ease with which flattening takes place after putrefaction has once set in. At present, however, it is customary to extract so soon as the condition of the os renders it safe to resort to the necessary operative procedures. This change in practice results from altered views regarding the dangers due to mere protraction of labor, to fear of septic poisoning, and finally to improved methods now at our disposal for the termination of labor. Extraction may be performed by the forceps, the cephalotribe, the cranioclast, the crotchet, or the blunt hook. In some cases version may be employed with success. Each instrument, each method, has its limitations, and its range of applicability. Usually, in extreme disproportion, the operator finds it to his advantage to have

* Cohnstein recommends cutting down upon the cervical and upper dorsal vertebræ, and then opening into the spinal canal by dividing the laminæ. Through the opening a silver catheter can be passed to the cranial cavity, and be used to break up the brain-mass, which should be washed out through the canal by injections of water.—(*Vide* "Ein neues Perforations Verfahren," "Arch. f. Gynaek.," Bd. vi, p. 505.)

at hand a complete equipment, and to resort at different stages of delivery to a succession of operative manœuvres. The acceptance of single measures and the wholesale condemnation of all others are calculated in difficult cases to lead to embarrassment and failure. A study, therefore, of the capacity of the various extractive instruments employed to deliver the perforated head is essential to the formation of correct judgment as regards practice.

Forceps.—The use of forceps as an extractive instrument, after perforation, is recommended by Tarnier as follows: "As the application of forceps has often succeeded in our hands, we do not hesitate to say that it is a good operation, applicable above all to cases in which the pelvic contraction is not considerable. The forceps possesses the advantage of being in the hands of every physician; it seizes the head firmly, and, by pressing the handles forcibly together, a sufficient evacuation of the cerebral contents is effected to secure a marked flattening of the cranial walls. In making prudent tractions, one often succeeds in extracting the head without any harm to the mother; the danger begins only with too violent tractions."* These remarks apply, however, to the powerful French forceps, which is capable of exerting considerable compressive force. Hodge has found his forceps useful under similar conditions.† The short handles and the great width between the blades, in the English forceps, render it useless as a tractor when craniotomy has been performed.

Cephalotribe.—On the 6th of June, 1829, Baudelocque, *le neveu*, read before the Institut Royal de France a memoir upon a new method of performing embryotomy.‡ He first pictured the dangers incident to all operations effected with pointed and sharp-edged instruments introduced within the uterus. From the statistics of the previous sixteen and a half years in the "Maternité," he showed that half the mothers thus operated upon died, and that the shortest of these operations lasted three quarters of an hour. He then described an instrument he had invented, which he termed the cephalotribe, and represented that with it he could crush in an instant the base and parietes of the fetal skull, forcing the brain from the orbits, the nostrils, and the mouth, the integuments at the same time remaining intact and forming a sort of sac, which sufficed to prevent the edges of the fractured bones from inflicting injury upon the soft parts of the mother. The author furthermore expressed his conviction that the cephalotribe was destined to abolish and replace the perforator and the crotchet, and that it could be employed successfully in pelves measuring but two inches in the contracted diameter.

This early instrument was two feet long, and weighed over seven

* Tarnier, "Dict. de Medécine et de Chirurgie," art. "Embryotomie," vol. xii, p. 657.

† Hodge, "On Compression of the Fetal Head," "Am. Jour. of Obstet.," May, 1875.

‡ A. Baudelocque, "Revue Méd.," August, 1829, p. 321.

pounds. In shape it resembled the forceps. To the handles a crank was attached, destined to approximate the enormous blades to one another. The original cephalotribe has since been subjected to various modifications, with a view chiefly to the removal of its repulsive appearance. The observation of Chailly, in his "Traité pratique des accouchements," 1842, that perforation should always precede cephalotripsy, led specially to the construction of lighter and more convenient instruments. The dream of Baudelocque, that the cephalotribe was destined to abolish the perforator, has never been fulfilled.

The models in use at the present day vary considerably in weight, the extent of the pelvic and cranial curves, and the character of the apparatus for producing compression. These different varieties are simply expressions of the defective working of the instrument itself. The shape of the blades possesses the greatest importance practically. It is to be borne in mind that the cephalotribe is designed to act both as a crusher and as a tractor. Now, it so happens that whatsoever tends to make it available in the one direction is obtainable only by the sacrifice of some corresponding advantage in the other. Thus, it is evident that the greatest amount of crushing force is exercised when the blades run nearly parallel to one another; but, without a cranial curve, the blades, in place of being applied to the convexity of the child's head, open like scissors, and thus are liable to slip, if the instrument is employed as a tractor. Again, as the blades are usually applied in the transverse or in an oblique diameter, it is necessary to rotate the cephalotribe to make the flattened head correspond to the flattened pelvic diameter. Rotation of the cephalotribe within the genital organs necessitates an instrument without pelvic curve; and yet, where there is any considerable projection of the promontory, a straight instrument is apt to seize the head upon its posterior aspect only, and thus the head is often forced from the blades, when compression is used, like a cherry-pit, to use Cazeaux's simile, from between the fingers.

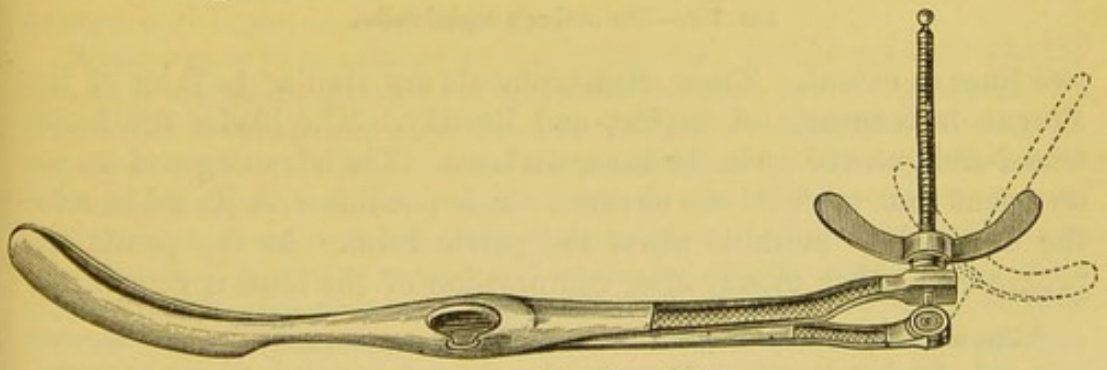


Fig. 195.—Cephalotribe of Blot.

Fig. 181 represents the French instrument of Blot, which is provided with a good pelvic curve, but the blades are in close approxima-

tion to one another. In Scanzoni's cephalotribe, Fig. 182, the line of greatest difference between the outer surfaces of the blades is nearly two inches. The inner surface of the blades is supplied with a longi-

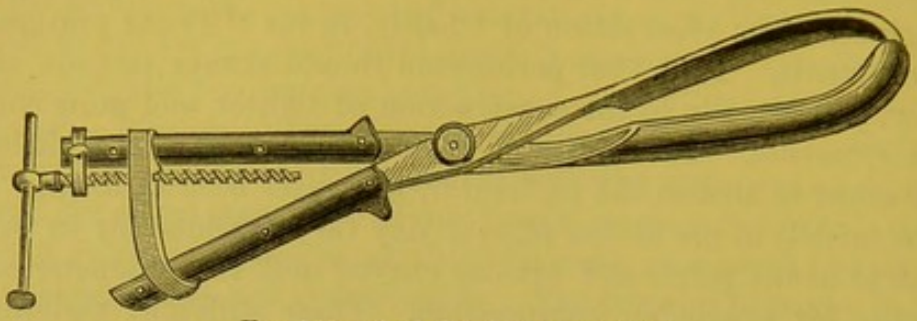


Fig. 196.—Cephalotribe of Scanzoni.

tudinal ridge occupying the center, while the square extremities curve sharply inward like pincers. The instrument possesses a pelvic curve of two and three quarters inches. When the Scanzoni cephalotribe is applied to the sides of the decerebrated head, the latter lengthens in the axis of the instrument, but Mundé reports that he has witnessed the failure of the instrument to seize the head securely in the Wurzburg clinic, in three cases out of four. Fig. 183 represents a cephalotribe made for me some years ago by Messrs. Tiemann & Co., which has met with considerable favor in New York and its vicinity. It has a cephalic curve of two inches and a quarter, measuring from the outer surfaces of the blades.* The pelvic curve is three inches and

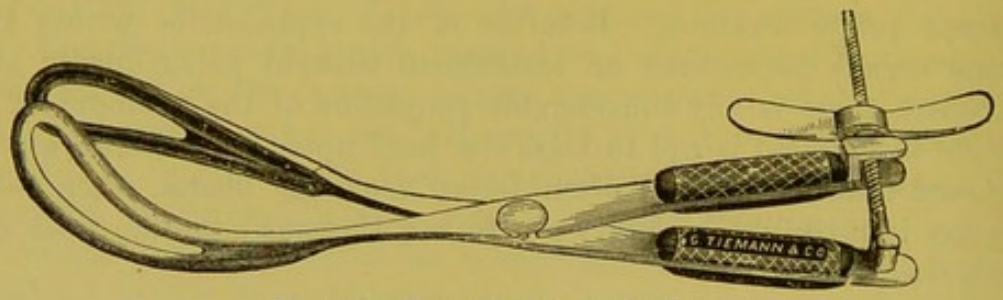


Fig. 197.—The author's cephalotribe.

two lines in extent. These measurements are similar to those of the Prague instruments of Seyfert and Breisky. The blades are fenestrated and grooved upon the inner surfaces. The advantages of an instrument thus modeled are obvious. It is possible with its aid to seize the head when movable above the pelvic brim. As the points approach each other closely after compression of the head is completed,

* The advantages of making the blades parallel to one another are rather apparent than real; for, however effectively compression with such an instrument may be applied, the head acts as a wedge, producing a separation at the extremities proportioned to the absence of the cephalic curve. Breisky and Seyfert have insisted that it is better to transfer the greatest width between the blades from the extremities to the points at which they come into immediate contact with the child's head.

the instrument becomes a perfect tractor, holding the head as securely as an ordinary forceps. Its construction is, however, virtually the abandonment of two favorite but chimerical ideas regarding the capacity and mode of action of the cephalotribe, viz., that it is capable of flattening the head so that the latter can be drawn through a pelvis measuring but two inches in the conjugate diameter, and that this can be accomplished by rotating the instrument, as we have mentioned, so as to make the flattened head correspond to the shortened diameter of the pelvis.

The actual result of compression by means of the cephalotribe was long a matter of dispute. Baudelocque, with his ponderous instrument, claimed to have been able to instantly crush the skull, including the base. Kilian* relates that in his first case of cephalotripsy he succeeded in breaking up the skull by a single application into fifty-four pieces. Von Weber, however, made a large number of experiments upon still-born children, employing for purposes of comparison instruments of various patterns, and found that in no case did he succeed in fracturing the bones of the skull. Even after the complete evacuation of the cerebral contents the bones would bend, but did not fracture. The result was different, however, in cases where the cephalotribe was employed in actual labor, where the head was subjected at the same time to pressure from the uterine and pelvic walls. Under such circumstances the bones certainly may break, if they do not invariably. Fractures he found, in fact, less common than simple incurvations. Where a fracture took place in one bone it rarely extended to contiguous ones, and, in general, contributed but little toward the actual reduction of the head. Winckel† presented three heads to the Obstetrical Society of Berlin, upon which the cephalotribe had been used to facilitate delivery. Compression, in these cases, had been employed in several diameters, and each time the cracking sound elicited could have led one to suppose that the bones were being reduced to small pieces, yet subsequent examination showed that only a single bone, and that, usually, according to the position of the head, a parietal bone, was broken to any extent, while the opposite side, generally the basis cranii, was but slightly ruptured. Now, the greatest amount of compression effected by the cephalotribe does not exceed two to two and a quarter inches. The bizygomatic diameter, indeed, which measures three inches, is not, in ordinary cephalotripsy, attacked at all.‡

It has always been objected to the cephalotribe that its application in the transverse diameter increases the length of the head in the antero-posterior diameter, or precisely where the pelvis is the narrowest, and thus adds to the difficulty of delivery. This is no doubt true when the head is fixed in the pelvis, a fact which should lead us to give the preference to other instruments for extraction after engagement has taken place. Above the brim, the cephalotribe seizes the head usually in an oblique diameter, so that the compensation takes place in the opposite oblique diameter. If the head is seized in the transverse diameter, it may easily be rotated into an oblique diameter. Sometimes the

* Kilian, "Organ f. die gesammt. Medecin," Bd. ii, p. 279.

† Winckel, "Kephalotripsie," "Monatsschr. f. Geburtsk.," Bd. xxi, p. 81.

‡ Fritsch, "Der Kephalothryptor und Braun's Cranioclast," Volkmann's "Samml. klin. Vortr.," No. 127, p. 870.

compressed head rotates spontaneously, so that the cephalotribe comes to occupy the conjugate, a thing obviously possible only in moderate degrees of contraction. Artificial rotation of the cephalotribe into the conjugate is dangerous and should under no circumstances be attempted. It must be borne in mind that the axis of the instrument is in a line between the upper border of one blade and the lower border of the other, and not in one drawn transversely between them. If spontaneous rotation occurs, the instrument should be removed, and the cranioclast employed as a tractor. Extraction with a powerful instrument like the cephalotribe can not be safely undertaken when the points of pressure from the blades are the soft tissues between the symphysis and promontory.

Thus we find the cephalotribe useful in compressing the head before it becomes fixed at the brim. It is, moreover, advantageous as a tractor in moderate degrees of pelvic contraction. With two and three quarters inches in the conjugate, the limit for its safe employment is, as a rule, reached. Of course it is understood that other factors than the pelvic diameters may influence the result. Thus, much depends upon the size of the child's head, the resiliency of the cranial bones, and the relations of the pelvic diameters to one another. It is not disputed that the cephalotribe is capable, if force is used, of accomplishing delivery through a smaller space than the one given, but the severe injuries to the maternal tissues which the instrument is apt to inflict, even when every caution is exercised, make its employment dangerous in the higher degrees of pelvic deformity.

In 1863 Pajot* published a paper in which he stated that, while in cases of distortion, in which the narrowing did not exceed two and a half inches, cephalotripsy was a favorable operation, requiring the exercise of no great amount of force, and but two or three applications of the instrument, below that point he regarded it as nearly as dangerous as the Cæsarean section. In the belief that these results were due to rude attempts to drag an imperfectly reduced head through the contracted space, he proposed that in all cases below two and a half inches no tractions should be made, but, so soon as dilatation had proceeded far enough to permit, perforation should be performed, whereupon complete dilatation would occur more speedily, and cephalotripsy might be begun at an early period of labor—a point in itself of considerable importance. While applying the cephalotribe, one or two assistants should make counter-pressure over the pubes to steady the head. The blades should be introduced as high as possible by depressing the handles. After compressing the head, rotation, if it has not occurred spontaneously, should be cautiously attempted. The slightest obstacle should, however, be the signal for suspending rotation and withdrawing the instrument, when Nature usually brings about rotation with astonishing rapidity. The instrument should then be reapplied, and the compression repeated. The same process should be gone through with a third time, after which the woman should be placed in a convenient posture, and given bouillon to drink. Then, governed by the state of the pulse and the general appearance of the patient, the quiet or excitement manifested, the weak or energetic character of the pains, the cephalotribe should be applied two or three times every two, three, or four

* Pajot, "De la céphalotripsie répétée sans tractions," Paris, 1863.

hours, leaving the expulsion of the fœtus entirely to Nature. M. Pajot has never found more than four applications of this procedure necessary, while one or two have generally sufficed. After the passage of the head, one or two applications of the instrument are required, as a rule, to reduce the thorax. To be successful, however, it is requisite that the operation should be resorted to at an early period of labor, when, as a rule, not more than six to eighteen hours are needed for Nature to expel the uterine contents. Tractions should be employed only in those cases to which one is called at a late period, after the powers of Nature are exhausted. Objections to this plan of Pajot have been made as follows: That there is risk of rupture of the uterus from the prolongation of the labor; that the uterus is exposed to injury from the spiculæ at the point of perforation; that, owing to the great rapidity with which decomposition takes place after cephalotripsy, the bones of the skull are liable to become denuded of their coverings; and, finally, that after a given period the membranes become so far destroyed as no longer to protect the uterus from its decomposing contents. Pajot replies by adducing seven cases in which he employed his method. Five of the cases were successful, and two terminated fatally. The highest degree of deformity for which he operated was a case in which the contracted diameter was something less than an inch and a half. The patient died from ruptured uterus, due, according to M. Pajot, to attempts made previous to his arrival to perform cephalotripsy with a badly constructed instrument. The method of M. Pajot has never won the approbation of the profession, but, in the absence of the necessary instruments to execute other preferable manœuvres, the success of its author recommends it for trial.

The application of the cephalotribe does not differ from that of the forceps. Where perforation has been performed, spiculæ of bone should be carefully removed with the fingers. Confirmatory evidence as to the direction of the head may be obtained by exploring the cranial cavity with the finger, as, in this way, the exact position of the base and vault may be determined. Great caution should be exercised during the introduction of the blades not to injure the vaginal or uterine tissues. It is not always easy to lock the instrument after the blades have been adjusted. The left blade is easily placed, but often the right blade is with difficulty brought forward to the corresponding transverse or oblique diameter. Compression should be made slowly, and the opening made by the perforator should be carefully guarded lest cutting portions of bone protrude. Extraction should take place under the guidance and protection of the fingers of the left hand.

Sometimes the cephalotribe is used to compress and extract the after-coming head in cases of moderate pelvic contraction. Under such circumstances perforation is usually not a prerequisite. The cephalotribe seizes the head securely, and acts with great power upon the basis cranii. The increased diameters of the head accommodate themselves more readily, too, to the long diameters of the pelvis than in cranial presentations. When the head is retained in the uterus after it has become detached from the body, it should be held by an

assistant through the abdominal walls, and steadied by a crotchet introduced into the foramen magnum, or fixed into an orbit, or in the lower jaw. The cephalotribe may then be applied to complete the extraction.

Cranioclast.—It is necessary to distinguish between two instruments, each of which bears the name of cranioclast. The original model was the device of Sir J. Y. Simpson, and was intended by him to replace the cephalotribe. It is substantially a powerful pair of craniotomy-forceps. The larger blade, which is intended to be placed upon the outer surface of the head, is fenestrated and grooved. The smaller one, for introduction into the perforated skull, is solid and supplied with ridges which fit into the grooves upon the opposite blade. The two blades articulate by means of a button-lock. By a twisting movement, the cranioclast, when applied, can be employed to wrench off the bones of the calvarium, different portions of the skull being seized successively with the view of accomplishing that result. As the fractured bones are covered by the scalp, they are prevented from inflicting injury during the subsequent course of delivery. But the cranioclast is not only of use in breaking up the cranial vault, it is likewise the most effective of all the instruments employed for extraction of the perforated head.

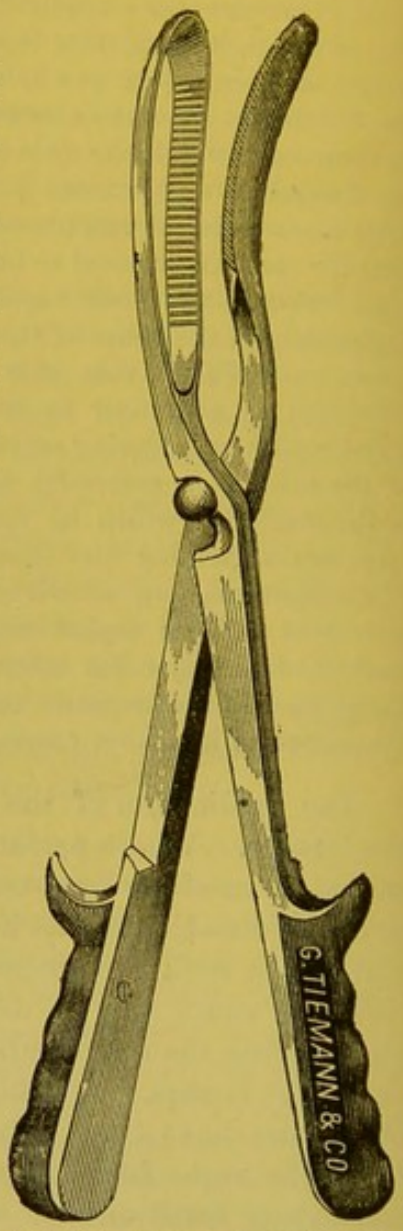


FIG. 198.—Simpson's cranioclast.

The principal defect of the Simpson cranioclast is that it attempts to combine in the same instrument the functions of crusher and tractor. Now, as in the cephalotribe, the devices which make it the most effective instrument in the one direction weaken its utility in the other. Braun's modified cranioclast is intended to serve purely as a tractor. All idea of its undertaking to break up the skull is discarded. The work of compression and disarticulation is left to the counter-pressure of the pelvic walls, and to the employment of craniotomy-forceps and the cephalotribe. The term *cranioclast* is therefore a misnomer. Mundé's proposed substitute of "craniotractor" is descriptive of its real action. Yet the modifications of Braun were as simple as they have proved appropriate. A pelvic

curve has been given to the blades ; the handles have been lengthened so that the lock, even when the instrument is introduced high up, is

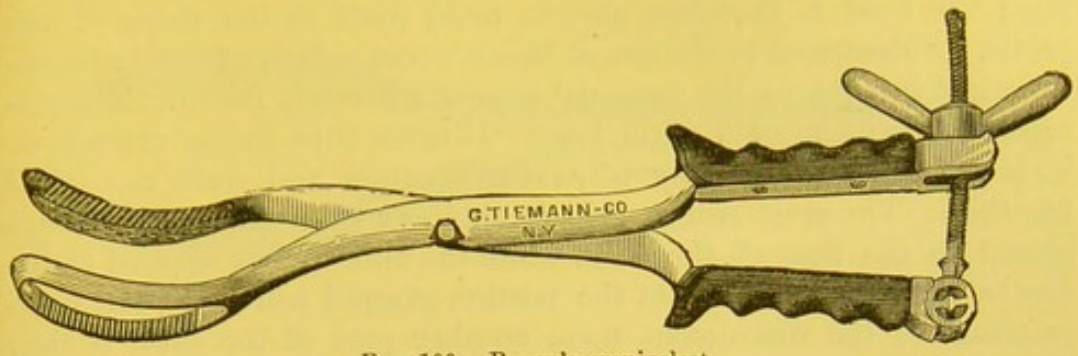


Fig. 199.—Braun's cranioclast.

outside the vulva ; and, finally, an apparatus for compression has been added. The advantages of Braun's cranioclast over its rival, the cephalotribe, are as follows : it is of comparatively small size ; again, one branch lies inside the head, in a space not otherwise occupied ; the outer branch imbeds itself in the soft coverings of the head,

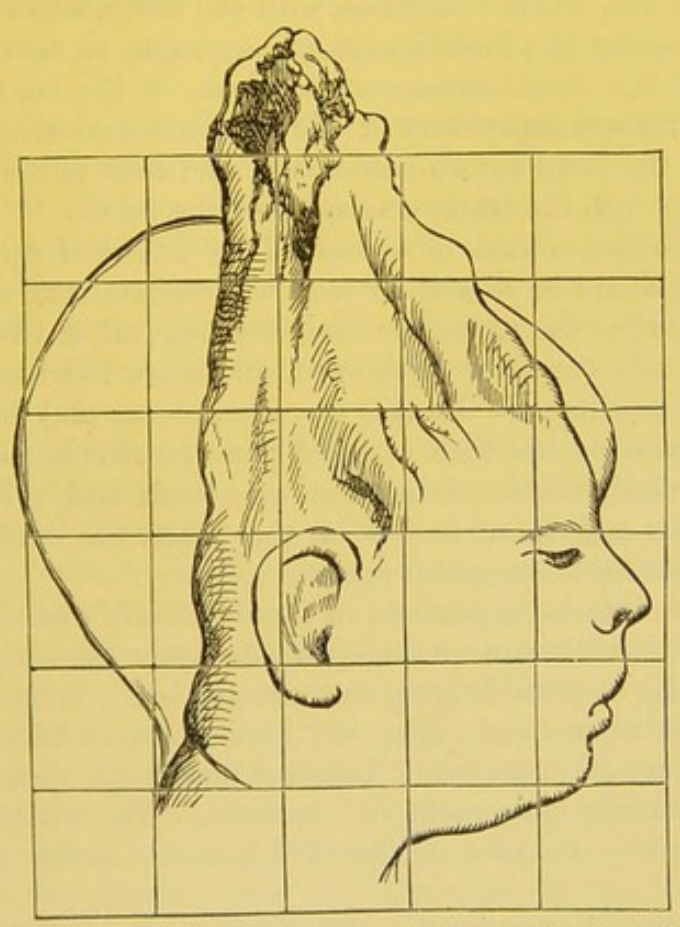


Fig. 200.—Head of child after delivery with the cranioclast. (Simpson.)

and thus is protected from doing harm. After a few tractions the cranioclast occupies the middle of the pelvis, where it can be so guarded by the hand that it need not even come into contact with the

vaginal walls; as the head is drawn into the pelvis, the pressure is not concentrated at one or two points, but is diffused over the entire pelvic rim; the head is therefore able to mold itself to the shape of the pelvis. Subsequent to the use of Braun's cranioclast, extensive lacerations and injuries to the maternal organs are rarely found. The cranioclast takes firm hold of the head. It never slips during extraction. It is not apt to tear away when the cranium and scalp are seized together. The most secure grip is obtained when the inner blade is passed to the base of the skull, while the outer one is applied to the face or over an ear. Should the portion grasped tear away, the readjustment of the instrument upon another part of the skull is easy. Thus, the inner blade can be turned, of course, in any direction without difficulty, while the outer blade is easily disengaged from the scalp-tissues and changed in its position by direct pressure from the fingers and slight leverage movements of the handle.

The cranioclast may often advantageously be used as a tractor in cases where the head has been previously crushed and flattened by the cephalotribe, but, where extraction with the latter is rendered difficult by slipping, or by the inability of the operator to make the altered diameters of the head correspond to those of the contracted pelvic space, the immense superiority of the cranioclast consists in the capacity to seize the head antero-posteriorly, and thus to bring its lengthened diameter into the transverse space of the pelvis.

The cranioclast enables us to extend the limits of safe delivery far beyond what would be admissible with the cephalotribe, as with its aid it is possible, after the partial or complete removal of the flat bones of the skull, to tilt the chin downward, and draw the base by the edge through the conjugate. In this way craniotomy may be resorted to in pelves measuring less than two and three fourths inches antero-posteriorly. Indeed, Barnes claims that one inch and three fourths in the conjugate and three inches in the transverse diameter furnish sufficient space for a successful operation.*

The proceeding to be pursued in these difficult cases is as follows: After perforation introduce a forceps-blade under the scalp, and detach the latter as far as possible from the cranial bones; break up and wash out the entire brain-mass; seize the parietal bones beneath the scalp with a good pair of craniotomy-forceps,† and break them away piecemeal by a twisting movement of the wrist. The withdrawal of the fractured bones is always a matter of delicacy. Unless the soft parts

* Barnes, "Obstetric Operations," p. 402. For discussion of this point, see "Treatment of Contracted Pelves."

† Meigs's craniotomy-forceps has been largely used in America, and may be confidently recommended. There are two forms, one straight and the other curved. Dr. Taylor's modification consisted chiefly in increasing the length of the instrument, so as to render it more available in operations at the superior strait.

are carefully guarded by the hand, the maternal tissues are apt to be cut and lacerated by the sharp edges and splintered corners of the bones.

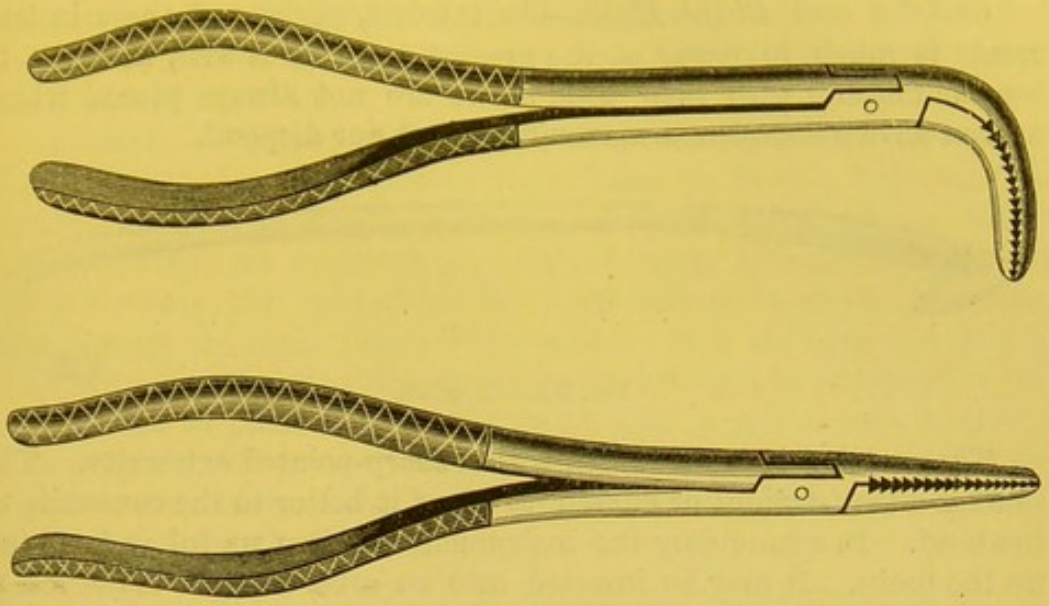


Fig. 201.—Meigs's craniotomy-forceps (modified by Professor I. E. Taylor).

Skene* has found it a great aid, in some cases, to use a large-sized Sims speculum to bring the head into view, and to go through the various steps of craniotomy with the guidance of the eye. The suggestion is an excellent one, but when the head is high up, as is the rule in difficult cases, I have not always found it practicable to expose in this way the presenting part. Horwitz† recommends, in difficult cases of the unexpanded cervix, to perforate through a large Fergusson speculum.

After the removal of the parietal bones, the fenestrated blade should be placed under the chin, or in the mouth, while the smaller one is introduced inside the perforation, and applied so that the frontal bones are included in the grasp of the instrument. The blades should then be screwed tightly together by means of the apparatus for compression, and the head turned so that its bizygomatic diameter is brought into the transverse diameter of the pelvis. As the distance between the orbital plates and the chin, including the instrument, does not exceed two inches, and the width of the base is only about three inches, it is evident that, in skillful and experienced hands, this method is capable of almost indefinite extension.

After delivery of the head, the extraction of the body may still cause difficulty. If, then, through an opening made with a perforator between the clavicle and shoulder-blade, the smaller blade be intro-

* Skene, "Trans. of the Am. Gynæc. Soc.," vol. ii.

† Horwitz, "Uber ein Perforations Verfahren," "Ztschr. f. Geburtsh. u. Gynaek.," Bd. iv, p. 1.

duced, and the outer blade be applied on the back, so that the two include the spine, the cranioclast will seize the trunk firmly, and is capable of exerting great force as a tractor.

Crotchet and Blunt Hook.—As tractors, neither of these instruments is much in vogue at the present day. It is well, however, to become familiar with their uses, as we are not always placed where we can have a complete armamentarium at our disposal.

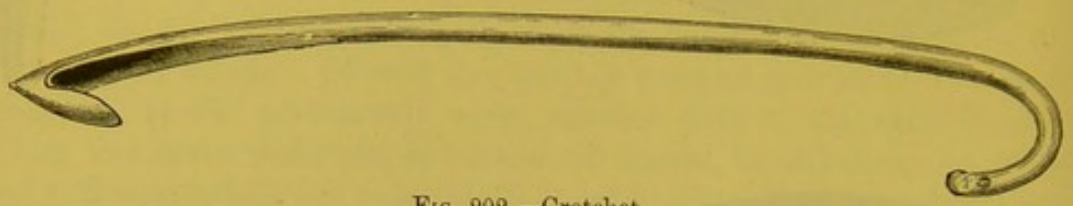


Fig. 202.—Crotchet.

The crotchet is a steel hook, with a sharp-pointed extremity. The shaft is either straight or curved to adapt it better to the convexity of the head. In craniotomy the instrument is often useful in breaking up the brain. It may be inserted into an orbit when it is desired to bring the base of the skull end on into the pelvis. In default of either cranioclast or cephalotribe, it may be employed to extract the perforated head. To this end it should be passed through the opening and its point inserted into one of the bones of the cranial vault. Two fingers of the left hand are then passed to the outer surface of the skull, to serve as a guard and to make pressure against the point fixed upon the inner surface. If much resistance is met with, the part is apt to tear away, and a new hold has to be taken. When portions of bone are broken away, they should be removed with the fingers, to prevent their doing harm. The process is often tedious, and, in unskillful hands, is not devoid of danger. When the bones of the vault yield under traction, a more effective grip may sometimes be obtained by fixing the crotchet at the foramen magnum or the sella turcica. Or, in place of introducing the instrument into the skull, it is sometimes inserted outside, behind the ear, into the mastoid process, or into the occiput, near the foramen magnum. The blunt hook, though not indispensa-



Fig. 203.—Dr. Taylor's right-angled blunt hook.

ble, is capable of rendering valuable service in delivering the head after the performance of craniotomy. Dr. I. E. Taylor gives the preference to a right-angled instrument. The blunt hook can not, of course, be attached to flat surfaces of bone. It may be used, however,

to draw down the chin, or it may be thrust into an orbit. Where perforation has been made upon the after-coming head, the blunt hook may be introduced through the opening and traction made directly upon the base of the skull. In difficult cases, delivery of the trunk is sometimes favored by tractions made by a blunt hook inserted under the posterior shoulder.

Version.—Version, with extraction by the feet, with or without cephalotripsy, has been warmly commended by Bertin, Tarnier,* and Taylor,† while it has been condemned in harsh terms by others. Where it is practicable to perforate and turn early in labor, at a time when version is easy, the method has the advantage of bringing the longest diameter of the head into correspondence with the long diameter of the pelvis, and favoring the molding of the head to the shape of the canal it has to traverse. At the same time it avoids the dangers of contusing the soft parts incident to the use of the cephalotribe. Dr. Taylor recommends combining propulsion above the pubes with tractions made upon the extremities.

Great ingenuity has been exerted to devise some good way to overcome the difficulty which grows out of the defectiveness of the preceding measures in acting directly upon the base of the skull. Cephalotomy,‡ or the removal of the head by segments, has been proposed as a substitute for perforation and cephalotripsy. Van Huevel's forceps-saw divides the head from crown to base into two halves. Tarnier's forceps-saw removes from the head a triangular segment, the apex of which is cut from the skull-base. Dr. Barnes# has suggested the application of Braxton Hicks's wire *écraseur* to successive portions of the head. Hubert's *transforateur* is designed to bore through the sphenoid, and thus to destroy the resistance of the base. The sphenotribes of Valette, Hüter, and the Lollines, are a combination of the cephalotribe and the *transforateur*. Notwithstanding the principle of cephalotomy is mechanically correct, the operation has never met with any general acceptance, partly owing to the high price and complicated structure of most of the instruments required for its performance, and perhaps in part to the fact that, in the higher degrees of pelvic deformity where their advantages over the more familiar methods would be theoretically most complete, the bulky nature of the forceps-saws and the sphenotribes interferes with their employment. The favorable reports made by their inventors, of the results they have personally obtained, render, however, a reference to the subject necessary.

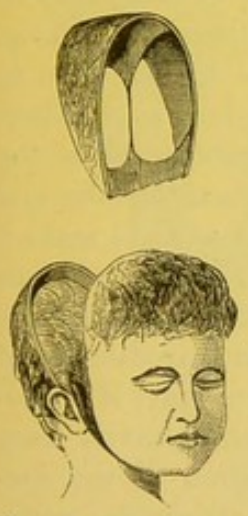


FIG. 204.—Segment removed by the Tarnier forceps-saw. (P. Thomas.)

* TARNIER, "Dict. de Médecine et de Chirurgie.," art. "Embryotomie," t. xii, p. 668.

† TAYLOR, "What is the Best Treatment in Contracted Pelves?" "Trans. of the New York Acad. of Med.," 1875.

‡ TARNIER, "Dict. de Médecine et de Chirurgie," art. "Embryotomie," p. 680.

BARNES, "Obstetric Operations," p. 411.

Embryotomy.

In a literal sense, embryotomy includes all the graver operations designed to diminish the volume and resistance of the fœtus. Custom has, however, restricted the term to those operations only which are performed upon the trunk of the child. It is used, therefore, as a rule, in contradistinction to craniotomy, and not in its generic sense.

Indications for Embryotomy.—1. In extreme degrees of pelvic contraction, where the size of the body obstructs delivery.* 2. In fetal malformations, with abdominal enlargement due to pathological conditions of the more important viscera, and in cases of extraordinarily developed children. 3. In neglected transverse presentations, in which version is impossible, or, at least, can not be performed without endangering greatly the life of the mother.

Embryotomy includes two operative measures, viz., exenteration and decapitation.

Exenteration.—By exenteration we mean the opening of one of the large cavities of the trunk, and the removal of the contained viscera. It is most commonly indicated in transverse presentations, where decapitation is not easy to perform, as in cases of extreme pelvic contraction with the head high up above the pelvis. The opening may be made by means of a pair of curved scissors or the ordinary perforator. The same precautions against injury of the maternal tissues have to be observed as in craniotomy. In shoulder presentations an assistant should press the fundus of the uterus downward. The operator at the same time thrusts the perforator, or the scissors, between the ribs, and then enlarges the opening by turning the instrument so as to make a second incision at right angles to the first. Next, splintered portions of bone should be carefully broken away with the fingers, until the opening becomes sufficiently extensive to permit the introduction of the half-hand. In tearing away the viscera, the fingers may, if necessary, be aided by the volsella-forceps. The abdominal cavity may be reached directly through the thorax by perforation of the diaphragm, or a fresh opening may be made through the abdominal walls.

After evisceration, the reduced bulk of the child renders it possible to proceed directly to seize the feet and perform version. This method is, however, generally difficult, and endangers the distended cervix and lower uterine segment. If, therefore, the shoulder is high up, the breech, which is easily reached, should be drawn down with

* It has been said that, in cases which do not demand the Cæsarean section, this indication is not likely to arise. In the extraction of the child's body, however, through a small justo-minor pelvis, which required for its completion upward of twenty-five minutes, *post-mortem* examination showed more extensive disturbances from arrested pelvic circulation, due to compression from the child's body, than from the lesions arising out of the performance of craniotomy.

the fingers or the blunt hook, in imitation of the mode of delivery in spontaneous version. When, however, an arm presents, and the shoul-

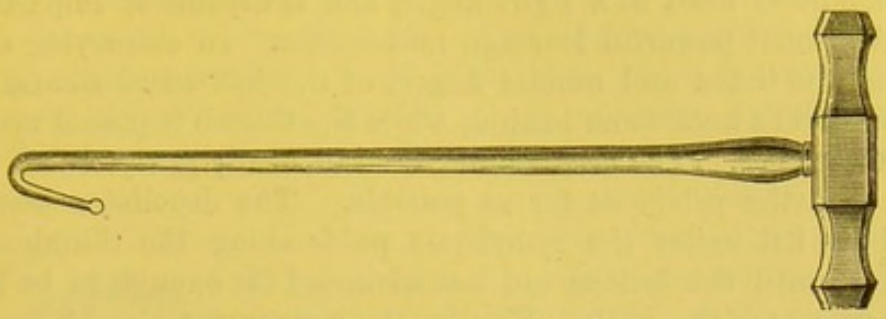


Fig. 205.—Braun's decapitating hook.

der is crowded into the pelvis, the child may be drawn through doubled upon itself, as in spontaneous evolution.

Decapitation.—Whenever, in neglected transverse presentations, the neck can be easily reached, decapitation furnishes the simplest and mildest plan for overcoming the difficulties which prevent delivery.

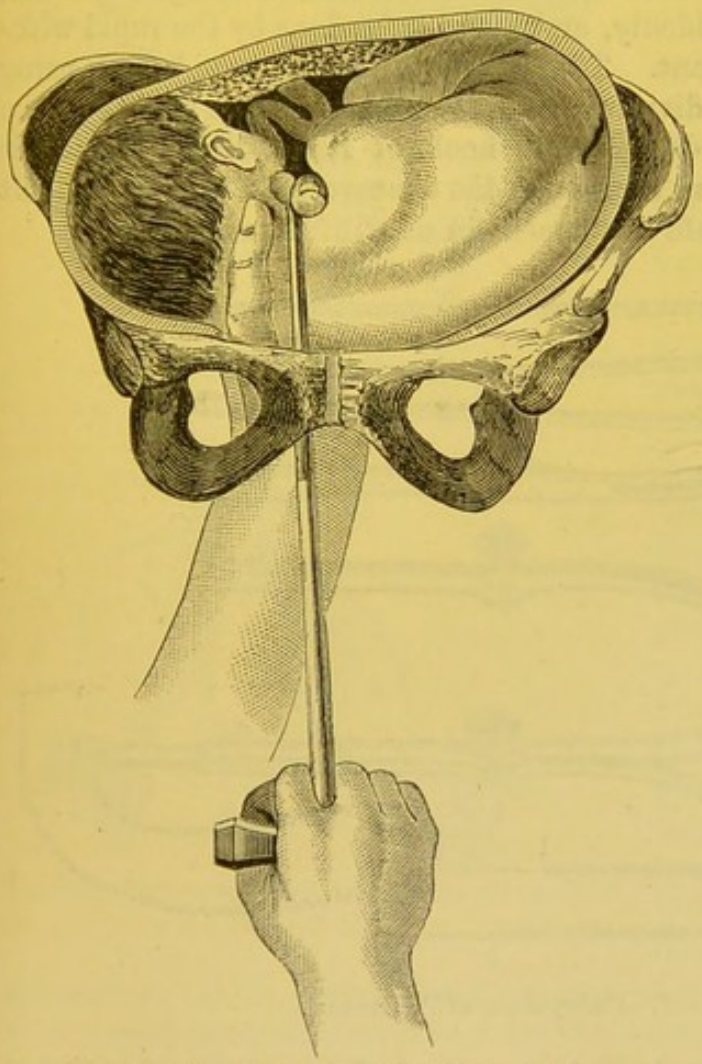


Fig. 206.—Braun's method of decapitation.

Decapitation may be effected in a number of different ways:

1. Draw upon the prolapsed arm to bring the neck well down, and within reach. Pass the finger or a blunt hook around the neck, and then, carefully guarding the points, divide with a strong pair of scissors by a series of short movements the soft structures and the vertebral column.

2. In many cases the division of the neck can be advantageously accomplished by Braun's decollator. This instrument is a modification of the blunt hook. The terminal

portion is, however, bent at nearly an acute angle. It is likewise flattened from side to side, and ends in a button-shaped extremity. The handle is fixed at a right angle, and is capable of imparting to the instrument powerful leverage movements. In employing the decollator, the index and middle fingers of the left hand should encircle the child's neck from behind, while the thumb is placed upon the anterior surface. The neck should then be firmly grasped and drawn down into the pelvis as far as possible. The decollator should be passed up flat under the symphysis pubis along the thumb of the operator, until the button-end has advanced far enough to be turned to the rear over the neck. Finally, the instrument should be seized by the handle with the right hand, and rotated to and fro, while tractions are simultaneously made in a downward direction. It is surprising how quickly, as a rule, the spinal column may be divided by this manœuvre. After the separation of the vertebræ, care must be taken not to draw down with too much force, lest the integuments and soft structures yield suddenly, and violence be done by the rapid withdrawal of the instrument. This accident may be avoided by using moderate tractions and dividing the last remnant of the tissues with a pair of scissors. The decapitating hook of Ramsbotham, which is curved, and has a cutting edge upon the concave part, is more difficult to apply, and is a less safe instrument in unskillful hands.

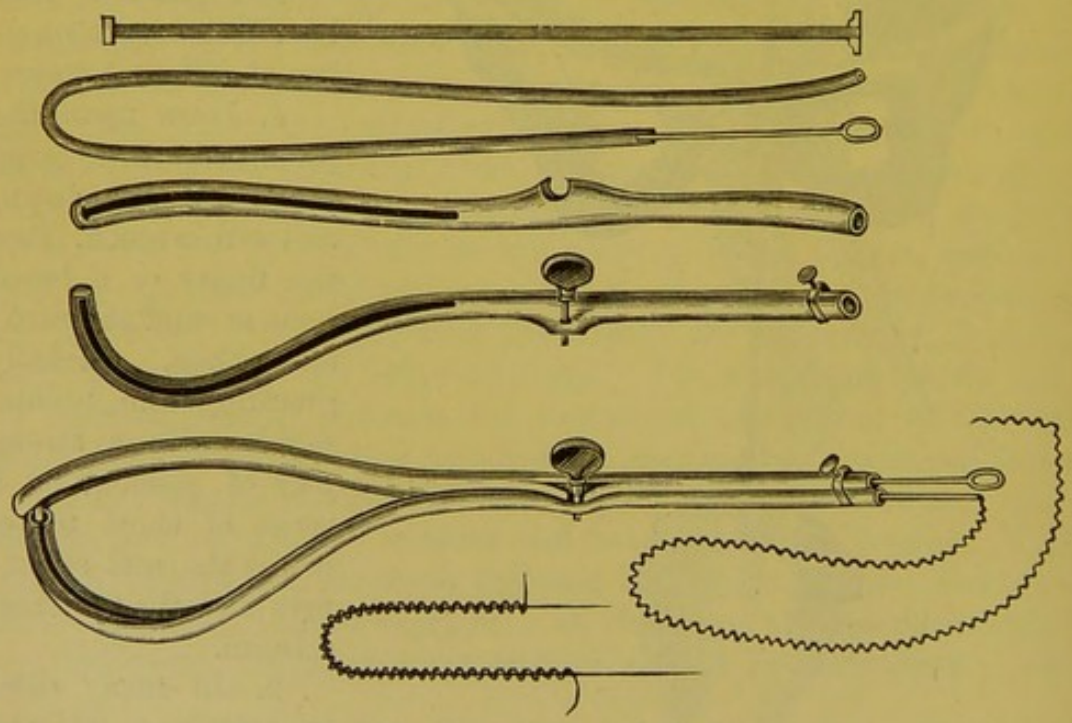


Fig. 207.—Embryotome of P. Thomas.

3. Pajot originated an ingenious method of decapitation, which, in default of special instruments, is capable of rendering valuable service. It consists in passing a strong cord around the child's neck, and, by a

sawing movement, cutting through the parts. The vagina should be protected by a speculum from the friction produced by the to-and-fro movement of the string. The chief difficulty of the operation lies in getting the string around the neck. Pajot caused a groove to be made upon the concave surface of the blunt hook which forms a constant attachment to one of the handles of the ordinary French forceps. Through this groove he passes a string, to the end of which he fastens a round lead bullet; when the blunt hook is adjusted about the child's neck, the weight of the bullet draws the cord downward so that it can be reached by the hand of the operator. Dr. Kidd recommends attaching a string to an elastic catheter armed with a strong stylet; then, after imparting to the instrument the proper curve, it should be passed around the child's neck, and, as it is withdrawn, the string should be used to drag a strong cord or the chain *écraseur* into place.

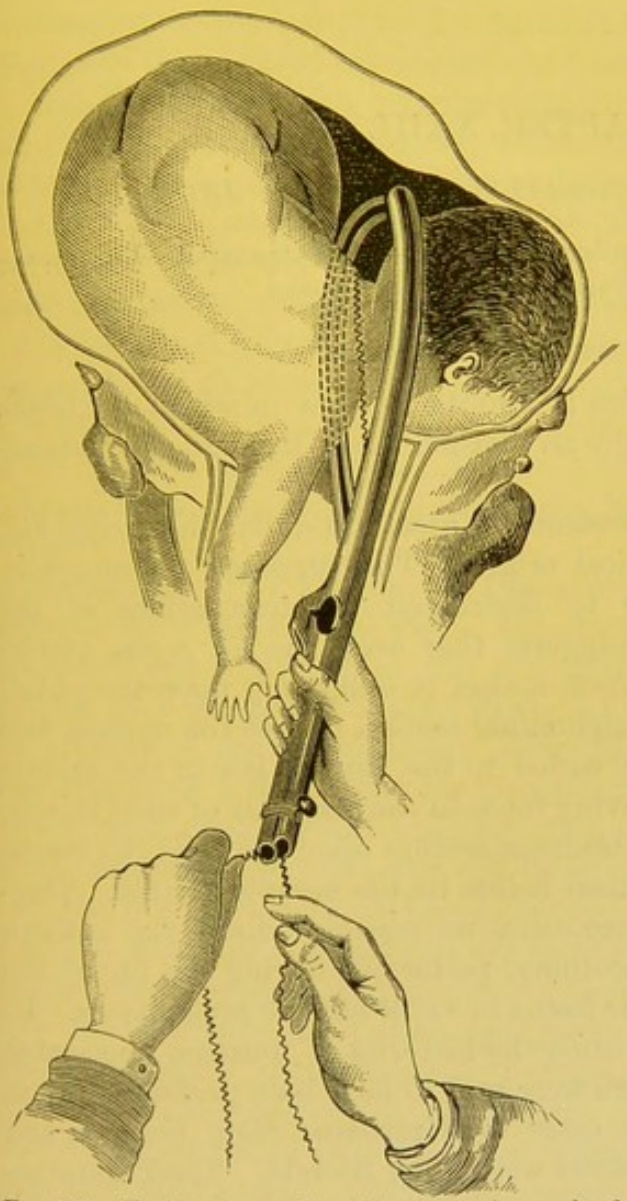


Fig. 208.—Embryotome adjusted around the neck of the child.

Still more ingenious is the embryotome of Pierre Thomas, consisting of two blades modeled after a somewhat expensive instrument devised by M. Tarnier. The curved blade should be passed posteriorly opposite the sacrum. The straight blade should be introduced in front directly beneath the pubic bones. When adjusted, the extremities of the blades are in apposition. Both blades contain a grooved canal. A piece of whalebone armed with an ivory knob is then introduced into the canal of the straight blade, while a long, flexible piece of whalebone provided with an ivory ring is passed into the canal of the posterior curved blade. The descent of the posterior whalebone furnishes the evidence

that the canals of the two blades are in apposition, and that the longer piece has entered the posterior canal. When the circuit is completed, a loop of cord is passed through an eyelet in the end of the whalebone, and serves as an attachment to a chain-saw, which, as it is drawn upward, leaves the groove and encircles the child's neck. In decapitating the child by a to-and-fro movement, the soft parts are protected by the blades of the embryotome.

CHAPTER XXIII.

CÆSAREAN SECTION.—OPERATIONS OF THOMAS AND PORRO.

Cæsarean section.—History.—Indications.—Operation.—After-treatment.—Prognosis.—Operation of Porro.—Operation of Thomas.

The Cæsarean Section.

The term *Cæsarean section* is applied to cases in which the fœtus is removed from the mother by an incision made through the abdominal and uterine walls.

Although the operation pretends to great antiquity, the earlier histories are probably of mythical origin. The supposed references in the Talmud are, according to Rodenstein, mistranslations of the text. The same authority suggests that even the *lex regis*, attributed to Numa Pompilius, which makes it obligatory upon the physician to remove the child by abdominal section in case the mother dies during pregnancy, was really added to the Roman law in the middle ages, with the intention of giving force to the decretals of the Church, which sought, through the Cæsarean section upon the dead, to rescue the child for the rite of baptism before its life became extinct. During the sixteenth century there seems no reason to doubt the authenticity of certain cases of laparotomy, performed during the life of the mother, for the removal of the fœtus in extra-uterine pregnancies. In 1581 François Rousset* published the histories of fourteen successful Cæsarean sections, six of which were said to have been performed upon the same individual. These cases were repeated from hearsay, and from accounts taken from letters written by friends. Their genuineness was challenged at the time of publication by the opponents of the operation, and they are now generally regarded as resting upon questionable authority. The first operations mentioned after the publication of Rousset's work are said to have proved fatal. The earliest well-authenticated record of Cæsarean section comes to us from Germany. It was performed in Wittenberg, by Trautmann, in 1610. The patient

* Rousset, "Traité nouveau de l'hysterotomotokie, ou enfantement Césarienne."

lived from the 21st of April to the 16th of May. Scarcely any doubt was entertained of her recovery, when she was suddenly seized with a fainting-fit and died, contrary to all expectation, in about half an hour.

Indications for the Cæsarean Section.—As the Cæsarean section belongs to the most hazardous operations of surgery, its performance is chiefly justifiable in cases in which craniotomy and the delivery of the child by the natural passages involve the life of the mother in still greater peril. It is indicated, therefore, in extreme degrees of pelvic contraction, in the case of solid tumors which encroach upon the pelvic space, and in advanced carcinomatous degeneration of the cervix.

The Cæsarean section is permissible if the mother is moribund, and the child is known to be alive, where rapid delivery by the natural passages is impossible. It may be undertaken at the mother's request if otherwise delivery can not be accomplished without the sacrifice of the child. If in any case the decision is left to the physician, he should regard the welfare of the mother as of paramount importance. It has been said that if a woman, knowing herself to be incapable of bearing living children, exposes herself to the repetition of pregnancy, it becomes the duty of the physician to perform the Cæsarean section in the interest of the child. The duty of the physician is, however, to his patient. He is not to constitute himself either judge or executioner.

Operation.—The success of Cæsarean section depends in large measure upon the control which the obstetric surgeon possesses over the conditions under which the operation is performed. The most suitable time to operate is after dilatation has begun, but previous to the rupture of the membranes : after dilatation, because it is desirable to provide a free outlet for the uterine discharges subsequent to the operation, and because the retraction of the uterus after delivery, which furnishes the most efficient means of controlling hæmorrhage from the uterine wound, is best secured if the operation is performed at a time when the contractions are strong and frequent ; previous to rupture, because there is then greater probability of finding the child alive and the maternal tissues uninjured. Unless, too, the head or breech protrudes spontaneously through the incision made in the uterine wall, the delivery is much more readily performed while the membranes are intact than after the uterus has retracted firmly down upon the child's body. Michaelis reports a successful case operated upon by Schmitt, of Eylau, after eighty hours labor, and long after the escape of the waters, where the incision had to be extended over six inches in length before extraction could be accomplished.*

The room where the operation is performed should be thoroughly aired and disinfected, and the temperature raised to from 75° to 80° Fahr. For purposes of disinfection I prefer the fumes of sulphurous

* Michaelis, "Abhandlungen aus dem Gebiete der Geburtshülfe," p. 162.

acid, disengaged by burning sulphur, placed in an iron vessel in the center of the room to be occupied. The ignition of the sulphur is facilitated by the addition of a teaspoonful or two of alcohol. A convenient operating-table can be readily improvised by covering an ironing-table with blankets or an old-fashioned comforter. The head of the patient should be moderately elevated, the lower extremities slightly flexed, and the knees rotated outward. The abdominal tension in the complete horizontal position is apt to impede the circulation and respiration, and to facilitate intestinal hernia when the abdominal incision is made. Ether should be employed as an anæsthetic in preference to chloroform. All the details of antiseptic surgery should be carried out with painstaking exactitude.

Four assistants are requisite, viz.: one to give ether; one to steady the uterus and hold back the intestines; one to take charge of the instruments; and, finally, a nurse experienced in the methods for resuscitating partially asphyxiated children, to receive the infant.

Convenient instruments to have in readiness are: a scalpel, a blunt-pointed bistoury, two pairs of scissors, one straight, and the other bent at an angle, a large grooved director, artery-forceps, a half-dozen pair of Kœberlé's compressing-forceps, suture-needles, a long-handled needle-holder, sponge-holders, and plenty of clean, new sponges, which have been carefully soaked in a two-per-cent. solution of carbolic acid. The instruments, with silver wire for sutures, should be kept immersed in a similar solution up to the time they are removed for actual use. If silk ligatures are employed, they should be first carbolized. A vessel with warm carbolized water should be conveniently placed where the operator from time to time can bathe his hands. For the dressing, subsequent to the operation, protective silk, antiseptic gauze, borated or thoroughly cleaned cotton, and a broad abdominal bandage, should be provided.

The operation consists of four stages, viz.: 1. The incision through the abdominal wall; 2. The incision into the uterus and the extraction of the fœtus; 3. The removal of the placenta, the arrest of hæmorrhage, and the cleansing of the peritoneal cavity; 4. The closure and dressing of the abdominal wound.

1. After the operator has passed the catheter, and personally ascertained that the bladder has been emptied, he places himself to the right of his patient. The assistant stands upon the opposite side. The presence of loops of intestines in front of the uterus is then carefully ascertained by percussion. If intestines are detected they should be pushed to the sides of the uterus out of harm's way. After first washing the abdomen with carbolized water, the assistant steadies the uterus in the median line, and produces a moderate degree of abdominal tension by means of the hands so placed that the ulnar edges press against the sides, and the thumbs encircle the fundus. The

principal function of this assistant is to guard the field of operation from the protrusion forward of the intestines. The incision now universally adopted is made through the linea alba, and should extend from a point just below the navel to a distance two or three fingers in breadth above the symphysis pubis. In rachitic and undersized persons, the length of this incision may require subsequently to be increased, in which case it should be extended upward to the left of the umbilicus. The section through the abdominal wall should be performed deliberately, and layer by layer. Bleeding from vessels should be arrested by compression or by ligature. When the peritonæum is reached, it should be raised by the artery-forceps, a small opening should be made, and the incision then extended under the guidance of the index and middle fingers, or of a grooved director, the entire length of the wound.

2. When the surface of the uterus is exposed to view, and an examination has been instituted to make sure that neither omentum nor intestines present, the assistant redoubles his vigilance. Above and at the sides he should compress the uterus firmly, and push it somewhat forward. He should keep the middle of the uterus carefully in the line of the abdominal incision, and be in readiness, after the opening is made in the walls, to quickly insert his index-fingers into the upper and lower angles of the wound. The incision through the uterine walls should be made with a scalpel. The division of the muscular fibers should take place layer by layer. The operator should, however, work rapidly, as the hæmorrhage, which is often enormous, can only be controlled by the removal of the fœtus. The site of the incision should be as nearly as possible in the body of the uterus. Both the fundus and the parts adjoining the os internum should, where it is possible, be avoided. The length of the incision required for the extraction of the child should be at least four and a half to five inches. To reduce the hæmorrhage to the smallest limits, it is a good plan to begin with an incision of two inches, and work down at the lower angle of the wound to the membranes, or, where the amniotic fluid has escaped, to the body of the child. Under the guidance of one or two fingers, the wound may then be lengthened upward by means of a blunt-pointed bistoury. Every care should be exercised to avoid puncturing the ovum, if at the time of operating it happens to be still intact. The moment the uterine incision is completed, the assistant should insert his index-fingers into the upper and lower angles of the wound and lift the uterus into close contact with the abdominal wall (Winckel). As the uterus retracts during the delivery of the child, the assistant has to follow its movements downward with great care, to avoid protrusion of the intestines.

The membranes should be ruptured through the wound, rather than through the vagina. It is more quickly effected, and time at this

stage is precious. The escape of the amniotic fluid into the abdomen can be avoided by a dexterous assistant.* If the head presents at the uterine opening, it should be seized and drawn out first. Sometimes the fœtus is expelled spontaneously, as in natural labor, by the uterine contractions. Usually it is necessary to introduce the hand and seize

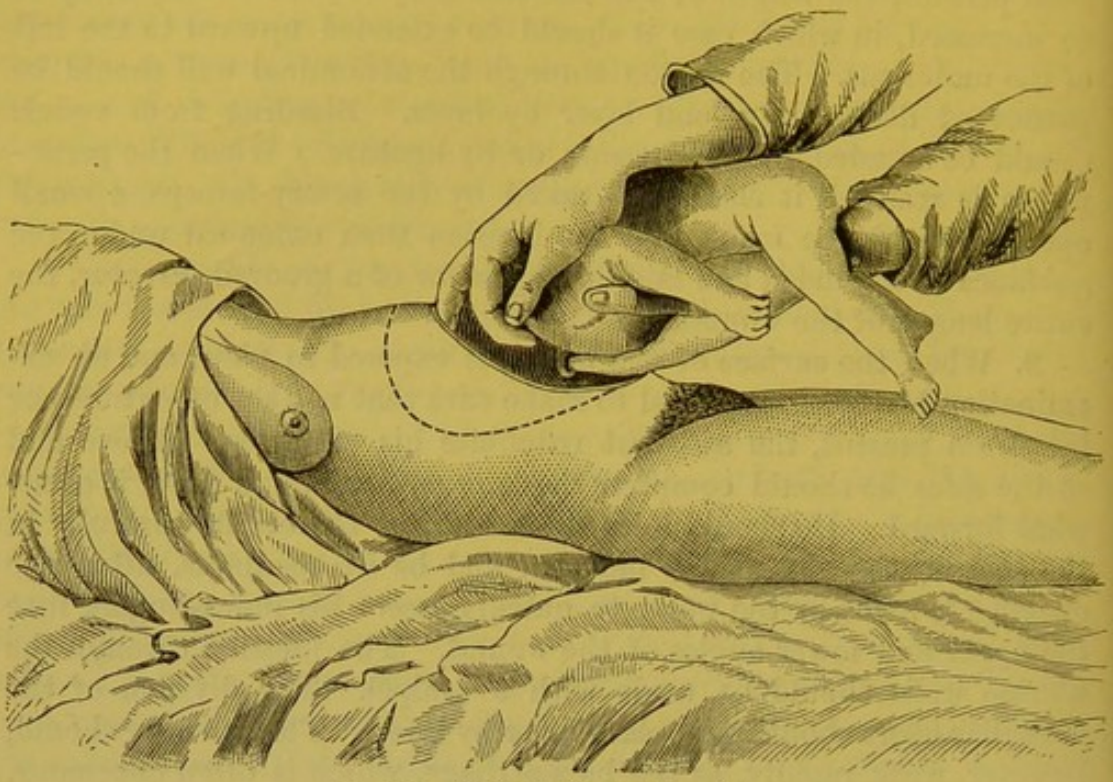


Fig. 209.—Method of extracting fœtus.

one or both lower extremities. The extraction of the child by the breech is performed in the usual way. The delivery should not be too rapid, but should be graduated so as to permit the assistant to fulfill his duties in keeping back the intestines. If, owing to the retraction of the uterus, the head becomes arrested, it is better to enlarge the incision upward with the bistoury than to tear the tissues.† After the removal of the child, the cord should be tied quickly, and the child handed to the nurse. The mother claims the entire attention of the physician.

When the placenta is implanted upon the anterior wall of the uterus, it is liable to be cut down upon in making the Cæsarean section. This accident occurs about once in three cases.‡ It occasions,

* The escape of a small quantity of amniotic fluid into the abdomen is of no great consequence, as it is for the most part bland and unirritating.

† Owing to the presence of large veins in the neighborhood of the os internum, a tearing of the lower angle of the wound is apt to be followed by persistent hæmorrhage. When such an accident occurs, it is best to bring the wound together with fine sutures, as no reliance can be placed upon the contractile action of the cervical tissues.

‡ Stoltz, "Dictionnaire de Méd. et de Chir.," t. vi, art. "Opération Césarienne," p. 700.

for the time being, enormous hæmorrhage. The bleeding begins with the division of the outermost layer of muscular fibers. It is, however, necessary to complete the incision to the placenta, and then to detach the latter upon one side until the hand can pass into the uterine cavity. The extraction of the child furnishes the only effective means of controlling the hæmorrhage.*

In addition to the directions already given for guarding against the escape of the intestines, it is sometimes useful for the assistants to press the uterus out of the abdominal opening. This method has the further advantage of preventing bleeding into the abdominal cavity during the extraction of the placenta and pending the retraction of the uterus. Of course, the assistant has at the same time to see that the cut surfaces of the abdomen are kept in close contact with the uterine walls. If from negligence, or from unavoidable causes, a protrusion of the intestines should take place, the assistant remains passive, while their replacement becomes the charge of the operator.

3. In case, after the delivery of the child, the hæmorrhage ceases, the uterus may be wrapped in a warm cloth, moistened with a weak solution of carbolic acid, and a short respite allowed before proceeding to the manual removal of the placenta, as its extrusion is often spontaneously effected by the contractions of the uterus. After five to ten minutes have elapsed, or, in case the hæmorrhage continues, immediately after the extraction of the child, the uterus should be gently kneaded while tractions are made upon the cord. If needful, it is allowable to introduce the fingers into the wound to separate the placenta and membranes. Every pains should be taken to detach the membranes entire. After the complete removal of the ovum, the fingers should be introduced into the uterus to turn out clots and stimulate contractions. A temporary rubber ligature should be placed loosely about the lower uterine segment, and tightened in case of emergency. Finally, the uterine wound should be closed with sutures. If, owing to imperfect contraction, hæmorrhage continues after the uterus has been emptied, the suture is the safest hæmostatic in our possession. Prolonged friction of the fundus and the applications of ice are apt to increase the shock of the operation and to excite peritonitis. But even where, at the conclusion of the operation, the uterus is well retracted, and the hæmorrhage arrested, it is well to still use the suture as a prophylactic against secondary hæmorrhage. In many fatal cases the uterine wound has been found gaping, so that

* It is usual to caution against cutting through the placenta. Spiegelberg ("Handbuch der Geburtshülfe," p. 858), who, in three of his cases, cut down upon the placenta, found the direction to separate the latter with the hand a very difficult thing to follow. The fingers tore through the placenta without detaching it, so that in the end he was obliged to cut through the vascular organ to the membranes. Of course, the more rapidly the operation is performed, the less the hæmorrhage ensuing.

the lochia had escaped into the peritoneal cavity. The deep sutures should be inserted a half-inch from the cut borders, and at intervals of an inch from one another. Superficial sutures, designed to approximate the peritoneal edges, should be introduced between the deep ones. Much ingenuity has been employed in devising a suture capable of being withdrawn a few days after the operation through the abdominal walls. As, however, experience in the extirpation of ovarian tumors has shown that ligatures may be safely abandoned within the peritoneal cavity, preference is now given to the ordinary interrupted suture. The material used should be carbolized silk, as it cuts less than silver wire. Catgut has been found impracticable, as the knots are apt to become loosened by the alternate contraction and relaxation which normally take place in the uterus after confinement.

After the sutures have been introduced, and the hæmorrhage checked, the uterus should be returned to the abdominal cavity. Long sponge-holders, armed with sponges which have been soaked in warm carbolized fluid, should then be employed to cleanse the visceral and parietal surfaces of the peritonæum, and to soak up any free fluid in the *cul-de-sac* of Douglas.

It is obvious that the classical Cæsarean section, even with the addition of the suture and the employment of strict antisepsis, is still far from answering the requirements of a conservative procedure. To place it upon the same plane with other forms of abdominal surgery, it is necessary to devise some means to surely prevent the separation of the uterine wound, which has been found to occur in spite of the suture and the most careful coaptation of the cut surfaces. The secondary gaping is due in a measure to the tendency of the external borders of the wound to become everted after section, the wound in consequence assuming a prismatic shape, but chiefly to the alternating periods of contraction and relaxation in the uterine muscle itself, whereby the tension of the sutures is subjected to continual change. Recently both Kehrer and Sänger have proposed modifications in the methods of operating designed to render more certain the speedy union of the tissues along the line of the incision.

Kehrer's* plan consists, in brief, of a transverse incision through the anterior convex surface of the uterus at the level of the os internum, of deep sutures for the muscular walls, and superficial sutures to secure immediate contact of the peritoneal borders, and of strict antiseptic precautions during the operation, combined with subsequent drainage of the abdominal cavity. He claims as advantages for the transverse incision through the lower uterine segment that there is lessened disposition of the wound to gape, that the placenta is avoided, that a shorter incision is required, and that the fetal head is usually in proximity to the artificial opening. In order to cover the line of incision with peritonæum, he directs that the latter be separated from the underlying muscle for nearly a half-inch from the borders of the wound. Kehrer relates the histories of two cases operated upon by his method. One patient recovered, the second died.

* Kehrer, "Ueber ein modificirtes Verfahren beim Kaiserschnitte," "Arch. f. Gynaek.," vol. xix, p. 177, Berlin, 1882.

the fatal result being due, according to the author, to a defect in the operation, whereby a small triangular spot, in the course of the wound, was accidentally left uncovered by the peritonæum.

Sänger,* after an exhaustive study of the past history of the uterine suture as employed in cases of Cæsarean section, concludes that the prevention of the escape of the lochia from the uterus into the abdominal cavity subsequent to the operation is best secured by the employment of special means for bringing the peritoneal surfaces into immediate contact with one another, as it is a fact made familiar by Sir Spencer Wells that two peritoneal surfaces in apposition unite within twenty-four hours. In order to attain this end, Sänger suggested that, after the removal of the child through the ordinary incision, and a temporary elastic ligature had been placed around the cervix, a narrow strip of muscular tissue should be removed by a section running at first parallel to the borders of the wound, but diverging outward as the section approached the peritoneal surface. The peritonæum was next to be detached and allowed to cover the expanded portion of the Y-shaped section. He then advised the introduction of deep uterine sutures running obliquely through the uterine tissues to the inner border of the wound, avoiding, however, the decidua, with a second set of superficial sutures designed to secure the contact of the peritoneal borders. The principle of subperitoneal muscular resection, as Sänger termed his method, has been tested in three instances by Leopold,† with the saving of the three mothers as well as of the three children. In practice, however, the plan was found to require some modification. Thus Leopold, after raising the peritonæum with tissue-forceps from the borders of the wound, separated it by a horizontal incision, made with a bistoury to the extent of a half-centimetre, at the upper and lower angles, and about one centimetre at the middle of the wound. In carrying out this dissection, a layer of muscular tissue, upward of a millimetre in thickness, was removed with the peritonæum. Then, after lifting the detached serous layer, he removed, cutting from within outward, from each side a segment of muscular tissue extending through the entire thickness of the uterine walls—each segment possessing a wedge-shape with the base above, and the apex directed toward the decidua. In this way he obtained two smooth muscular surfaces overlapped by a wide layer of serous membrane. The deep sutures employed were of silver, while the superficial ones were in one case composed of catgut, in the two others of fine silk.

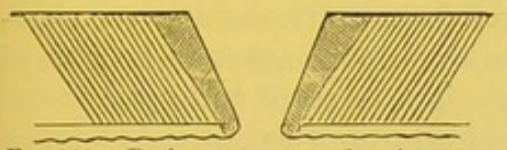


Fig. 210.—Peritonæum muscular-tissue mucous membrane; before resection. (Leopold.)

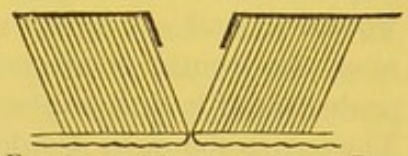


Fig. 211.—After resection. (Leopold.)

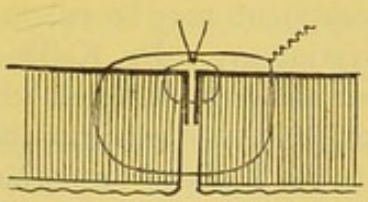


Fig. 212.—The uterine sutures. (Leopold.)

* Sänger, "Der Kaiserschnitt bei Uterus-Fibromen nebst vergleichender Methodik der Sectio-Cæsarea und der Porro-Operation," Leipsic, 1882.

† Leopold, "Ein Kaiserschnitt mit Uterusnaht nach Unterminirung der Serosa und Resection der Muscularis"; "Zwei weitere glückliche Kaiserschnitte," etc., "Arch. f. Gynæk.," vol. xix, p. 400, 1882, and vol. xxiv, p. 427, 1884.

Beumer * likewise operated in accordance with the method employed by Leopold in a case where the birth of the child was obstructed by a fibro-myoma occupying the posterior cervical wall. His patient, however, died eighteen hours after the operation. The result was partly due to pyelo-nephritis existing as a complication, and partly to Beumer's losing a sponge from a sponge-holder in the peritoneal cavity, during the search for which it became necessary to withdraw the intestines from the abdominal wound.

In his recent utterances, Leopold states that in future he proposes, in the interest of conservatism, to abstain from the muscular resection, as he believes that, even without the sacrifice of tissue, the separated serous membrane can be stretched and folded into the uterine wound.

4. The abdominal wound may be closed by either silk or wire sutures. The sutures should be introduced an inch to an inch and a half apart. They should be inserted rather more than an inch from the border of the wound, and should slope toward the inner surface, yet so as to include upon each side a narrow strip of peritonæum. Superficial sutures should be added to complete the adaptation of the wounded surfaces to one another. After carefully washing the abdomen, the wound is covered first by a layer four inches in breadth of protective silk, and afterward by six to eight layers of antiseptic gauze. The entire abdomen should then be padded over with one or two layers of cotton-wool, and supported by a firm bandage of unbleached muslin. For three or four days the dressings do not usually require to be disturbed. When, however, the antiseptic gauze shows evidence of soiling from the wound-secretion, it should be replaced under carbolized spray. In case it should be thought desirable to insert a glass drainage-tube into the lower angle of the abdominal wound, the antiseptic treatment may be carried out by adopting a device of Dr. Keith in ovariotomy. Dr. Keith makes a small incision in a piece of thin rubber sheeting, through which the drainage-tube is passed. After the latter is inserted into the abdomen, a sponge soaked in carbolic fluid (1:20) is placed over the mouth of the tube. The rubber is then reflected over the sponge, which is thus kept from getting dry, while at the same time a carbolized vapor at the mouth of the tube preserves the peritoneal cavity from the penetration of septic germs.

The writer is fully aware that it is not possible to realize in every case all the conditions and all the precautions contained in the foregoing directions. Perhaps the majority of past operations have been performed after the woman has been days in labor, after the rupture of the membranes and the retraction of the uterus, after the lower uterine segment has been subjected to prolonged pressure between the child's head and the pelvic brim, without adequate assistance, without antiseptic precautions, and with only the instruments of the physician's

* Beumer, "Sectio-Cæsarea-Sänger'sche Methode der Uterusnaht," "Arch. f. Gynaek.," vol. xx, p. 409, Berlin, 1882.

pocket-case. The uterine suture is rejected by many to-day, as indeed was the case with the abdominal suture in the early history of the operation. And yet it can hardly be hoped that the reproach which surrounds the Cæsarean section will be removed until, in its performance, the rude methods of the veterinary art are replaced by the procedures of scientific surgery. In reading the histories of many of the bygone operations, we can not but agree with Mauriceau in thinking that, "if it is true that any women have escaped, it was the work of a miracle, or the express wish of God, who, if he wills it, is able to raise the dead, as he did Lazarus, . . . rather than by any effect of human prudence."*

The After-Treatment.—The after-treatment is conducted upon the same principles as those followed in ovariotomy. The patient should be isolated, and perfect quiet maintained. A nurse should be in constant attendance. The circulation should be stimulated by the application of warmth to the surface of the body, especially to the extremities. Pain should be subdued by opiate suppositories or subcutaneous injections of morphia. In vomiting, following the operation, only ice, or a teaspoonful of ice-water at intervals, should be allowed by the mouth. Until the stomach becomes quiet, nutrition should be maintained by rectal alimentation. The diet during the first week should consist of milk, beef-tea, and other fluid forms of food. The catheter should be passed every six hours, until the patient is able to void her water voluntarily without straining. The bowels should be kept confined for at least the first five days. Only in very exceptional cases should lactation be permitted. During the first three to four days, where antiseptics have been used, it is not necessary to disturb the dressings. The superficial sutures may be removed on the fifth day, the deep sutures should be gradually removed between the seventh and tenth days. Peritonitis, septicæmia, and shock are to be treated according to the usual rules.

Prognosis.—We have already alluded to the formidable character of the Cæsarean operation. Michaelis† collected 258 authentic cases, of which 54 per cent. ended in recovery. Kayser‡ added 80 new cases to those reported by Michaelis, and reduced the recoveries to 38 per cent. Mayer# gathered 1,605 cases, with 54 per cent. recoveries. Pihan-Dufeilhay‖ collected 88 cases, published between 1845–'49, of which 57 per cent. ended in recovery. Finally, Dr. Harris has gathered with great industry the histories of 134 cases performed in the United States, 53 of which, or 40 per cent., ended in recovery. Under this showing it will be seen that fully one half of all the Cæsarean

* Baudon, "L'ovotomie abdominale," p. 12.

† Michaelis, "Abhandlungen aus dem Gebiete der Geburtshülfe," 1833.

‡ Kayser, "De Eventu Sectionis Cæsariæ."

Mayer, notice by Bromeisl, "Wien. med. Woch.," 1868, No. 67.

‖ Pihan-Dufeilhay, "Arch. Gén. de Méd.," 1861, t. ii.

operations end fatally. Large, however, as the mortality appears, the results are, I have no doubt, much more favorable than would be obtained from a similar number of craniotomies which should include, as the statistics of the Cæsarean section do, the work of many unskilled hands. But it has been objected to the statistics that they do not even approximately represent the truth. It is well known that many cases have never been included in the large collections. By some it has been assumed that the unpublished and omitted cases have all been fatal ones. Stoltz,* however, reports that he knew of five successful operations not contained in Kayser's statistics, though they had been published during the period embraced in his calculations. Harris collected 47 cases by correspondence with practitioners in various sections of the country. Of these, 14 ended in recovery and 33 in death. In Mayer's statistics, the recoveries from the operation in America were placed at 33 per cent., while, as we have seen, Harris found them to have amounted to 40 per cent. In cases where the Cæsarean section has been twice or oftener performed on the same patient, the results have been strikingly favorable. Lundgren † reports 119 operations upon 48 women with but 8 maternal deaths. Thus it is by no means certain that statistics present the Cæsarean operation in too favorable a light. The habitual indifference of the rural practitioner to the publication of his triumphs is one of his besetting sins. While admitting that the whole question is purely a matter of speculation, it is, at the same time, quite probable that a goodly number of successes as well as of failures lie buried, to use the words of Stoltz, in the note-books of modest physicians. If, however, we drop the numerical method altogether, and devote ourselves to a careful study of the cases upon which our statistics are built, we leave the mists of uncertainty, and are able to plant ourselves upon tolerably firm ground.

Now, the first pertinent fact that strikes us in examining the tabulated cases of Cæsarean section is, that a very large proportion of the entire number have been derived from the reports of lying-in hospitals. Michaelis ‡ found that of 96 cases, the details of which were given with sufficient minuteness to leave no doubt concerning this point, 36, or rather more than a third of the entire number, were hospital patients. With astonishment, too, he noticed that 25 of the 36 died, and that only 11 recovered ; whereas, of the 60 cases in private practice, only 29 patients died, while 31 recovered. This remarkable discrepancy in the result was such that Michaelis could not at first give it credence. When he found, however, that there was no possible source of error in his figures, he sought to account for the mortality in hospitals on the

* Stoltz, "Lettre sur la provocation de l'avortement," "Gaz. Méd.," 1853, p. 304.

† Lundgren, "A Case of Cæsarean Section twice successfully performed on the same Patient," "Am. Jour. Obst.," January, 1881, p. 78.

‡ Michaelis, *loc. cit.*, p. 156.

ground that the latter were the receptacles of all the most unpromising and hopeless class of cases, while the private practitioner more often had to deal with women in good health and with slight degrees of deformity. Then he insinuates that the private physician does not usually care to stake his reputation upon an operation which probably will terminate fatally, but that, between weighing the case, and summoning counsel, and putting off action, the woman often dies undelivered before a decision is reached. Kayser's results* were even worse than those of Michaelis, for in 67 hospital cases he found the mortality 79 per cent. Spaeth says that there has not been a single case in the lying-in hospital in Vienna during this century in which the mother has survived. Baudon, writing in 1873, says, "In Paris there has not been one successful case in eighty years, though in the present century the operation has been performed on perhaps as many as fifty women." This statement is often quoted as a crushing rejoinder to those who claim that the time has not yet come for sweeping the Cæsarean section from the list of legitimate obstetrical operations. But, as we glance over the list of operators, and find fourteen deaths accredited to Seutin, seventeen deaths to Paul Dubois, four deaths to Depaul, three deaths to Danyau, two deaths to Tarnier, and several to Moreau, we find in the ghastly record only fresh evidence that there is but little hope for the success of abdominal surgery, whatever the skill of the operator, when performed in the putrid atmosphere of an infected hospital.

On the other hand, the results of the Cæsarean section in healthy rural localities are in striking contrast with those obtained in hospitals or even in large, overcrowded cities. Thus, Stoltz mentions that in the department of the Creuse the operation was performed six times between the years 1843 and 1852, and in every case with success.† Hoebecke operated sixteen times in the country, and, though his patients were poor, and so scattered that he was not able to visit them as frequently as was desirable, eleven of them recovered. Maslieurat-Lagemard operated six times in the country; all of his patients recovered.‡ Découéne, of Courtrai, operated six times, and saved five women and four children (Harris). Prevost had three successes and four operations. Cottmann and Boaqui each had two successful cases. In Ohio, Harris reports six recoveries in eight operations; in Louisiana, fourteen recoveries in nineteen operations.#

Now, it does not seem logical, when such successes have been ob-

* *Vide* Baudon, "L'ovotomie abdominale," p. 101. † Stoltz, *op. cit.*, p. 689.

‡ Baudon, "L'ovotomie abdominale," p. 106.

Harris, "Cæsarean Cases in Ohio," "Obstet. Gaz.," September, 1878, p. 99; "New Orleans Med. and Surg. Jour.," vol. v, 1878–'79. In this article are related the successes quoted above of Prevost and Cottmann. Pilate in the article was accredited with two successes, but Harris subsequently assigned them to Boaqui.

tained in certain districts by certain operators, to place the Cæsarean section under the ban because other operators in other localities have failed altogether. No one reasoned, after the triumphs of Clay, Peaslee, and Spencer Wells, that ovariotomy should be proscribed, because contemporaneously in France and Germany the extirpation of ovarian cysts had been almost constantly followed by death. Certainly the intelligent course to pursue always, in the face of conflicting results, is to sift out the reasons for failure on the one hand, and the conditions of success on the other.

If we begin by asking why the Cæsarean section has so often ended fatally, we have already found the answer for many cases in the fact that the patients were operated upon, without antiseptic precautions, in the impure atmosphere of maternity hospitals. The frequency with which gangrene of the uterine wound is mentioned in the *post-mortem* records bespeaks the prevalence and activity of septic germs. Ovarian patients placed in the midst of similar unwholesome surroundings die almost certainly, in spite of the skill of the operator.

Again, the accounts of the cases which have come down to us shed a deal of light upon the causes of the untoward results. I have before me the histories of one hundred and eight cases collected by Michaelis, and published by him in 1832. They all belong to the nineteenth century, and are of undoubted authenticity. Moreover, they are included in all the statistical tables which have since been published. In the entire number, there were sixty-one deaths. In thirty-four of the fatal cases, the histories given are tolerably explicit. From these accounts, I gather the following suggestive particulars :

Cæsarean section performed upon a corpse. Case of ruptured uterus ; Cæsarean section, the day following the rupture. Ritgen's unsuccessful case of laparo-elytrotomy. As "the strength of his patient was failing fast," owing to the hæmorrhage from the vaginal wound, and as "the contractions of the uterus had entirely ceased," the Cæsarean section was performed to save the life of the child.

In five cases Cæsarean section was first tried after prolonged but vain attempts at delivery by the forceps and version. In another it was first resorted to after the failure of craniotomy.

One operator extended his incision to the os uteri.

Two cases were complicated with eclampsia, and one with placenta prævia.

In one case the operation was performed six days after the membranes had ruptured. The bladder had to be previously punctured. The fœtus was putrid.

To control hæmorrhage, Ritgen in one instance tied nine arteries in the uterine wound.

In one patient the operation was deferred until peritonitis had set in.

There were two cases of neglected shoulder presentation. In the

one the operation was performed four days after the rupture of the membranes, and in the other thirty hours. In the latter the uterine tissues were found necrosed from pressure between the promontory and the presenting part.

In one case the operation was performed by violence, in spite of the protests and struggles of the patient.

There were a number of women upon whom the operation was repeated in a succession of pregnancies. Of these, two died after the second operation, and three after the third. In one of the latter series the patient seemed to be doing well, until the twenty-seventh day, when she got out of bed, and sat by an open window for an hour to watch the passing of a troop of soldiers. The wound gaped open, and death followed the same day.

In one patient the first days of danger were past and the wound promised to heal kindly, when the brother, disappointed in the expected succession to her property, beat the woman, whereupon the wound tore open, and fatal fever followed.

In another case all went well until the seventh day, when, delighted at the prospect of recovery, the patient jumped from bed, danced around, and swallowed a pint of brandy.

In two cases death resulted from the protrusion of the intestines from the abdominal wound subsequent to the operation. In one, this occurred on the third day. The physician, who operated with a razor and used no bandage or adhesive straps to support the abdomen, did not see his patient after the operation until the accident referred to had taken place. In the other, two inches of the abdominal wound were intentionally left open, vomiting set in, and the bowels were forced through the gap.

The injurious effects of protracted labor upon otherwise perfectly natural deliveries are well known. In contracted pelves, in addition to the exhaustion and nervous depression which follow in long labors, the pain, the loss of sleep, and the inability to take food, the outlook for the patient is still further darkened by the early and complete escape of the amniotic fluid, the consequent retraction of the uterus upon the fœtus, the bruising of the maternal tissues from pressure of the child's head, and at times from perforation or even rupture of the uterus. *A priori*, therefore, one would expect that every hour's delay, after the Cæsarean section had once been decided upon as necessary, would imperil the result. This deduction is fully justified by the facts. Thus Dufeilhay's statistics showed that, when the Cæsarean operation is performed before the woman becomes exhausted, eighty-one per cent. recover. Harris has collected twenty-eight American cases of timely operation, which ended in the saving of twenty-one mothers, or seventy-five per cent. If, now, we return to the fatal cases reported by Michaelis, we find, in addition to those

from the histories of which we have quoted, two operations performed twenty-four hours after the rupture of the membranes; two, forty-eight hours; one, seventy-two hours; and one, ninety-six hours. Two operations were performed two days from the beginning of labor; two, five days; and one, eight days.

Thus we find that, in more than one half of Michaelis's reported fatal cases, the operation was performed upon the dead and the dying, or under circumstances which reduced the chances of success to a slender possibility. How far the remaining cases are open to the same criticism it is impossible to say, owing to the defectiveness of the histories.

Dr. Harris sends me the following statement of recent operations in the United States, which is at once full of instruction and warning:

"Of 33 operations, 12 of them as yet unpublished, which were performed between January 15, 1875, and the same day in 1885, there were 25 that resulted fatally to the women; and of the 33 children, 18 were lost. In 24 of the cases the uterus was sutured, and in 9 it was not. Of the 24 cases, 8 were saved, and of the 9, not one. Silver wire was used in 7, saving 4; silk in 15, saving 4; and catgut in 2, saving none. (The time in labor varied from 6 hours to 3 weeks, and one case was irregularly affected for 2 months.) One case was not in labor; one was recorded as 'early'; in 7 the labor had lasted from 3 to 9 hours; 7 were operated upon on the second day of labor; 3 on the third; 6 on the fourth; 4 on the fifth; 1 on the seventh; 1 in three weeks; 1 in two months; and in one the time was not noted = 33.

"In the last five years there were 16 operations, saving 4 women and 7 children; and in the last three years 10, saving but 1 woman and 2 children. So you see we are gradually getting worse, by reason of the bad management of the cases before the operations are performed; the fact that only 15 children were saved shows this. Six of the cases were in hospital; all fatal. Eight women were dwarfs; all lost but one. The 9 cases not sutured, and all fatal, were in labor, respectively, 3 days, 3 days, 4 days, 2½ days, 8 hours, 4 days, 30 hours, 32 hours, and 48 hours; the 8-hour case was one of fibroid tumor, and died of septicæmia.

"In several of these cases the uterine wound was found closed, and no fluid in the abdominal cavity; still they were dead, and in some instances from septicæmia.

"The danger of the operation is from the uterine wound, which becomes more and more serious to make as the labor advances beyond a few hours. If the uterus is not in the least fatigued by muscular effort, the prognosis should be favorable."

Now, Dr. Barnes says, with great truth, "Obviously, we can not

recognize fatal cases of craniotomy in extreme deformity of the conjugate diameter reduced to 2″ or 1·75″, unless the operation was begun under selected circumstances—that is, before exhaustion had set in—and conducted with due skill, and after the most approved methods."* But we have an equal right to refuse to recognize fatal cases of Cæsarean section in which the conditions and methods of the operation rendered success an improbable, if not an impossible issue.

Porro's Operation and Laparo-Elytrotomy.

While objection may be fairly taken to the disfavor with which the Cæsarean section is commonly regarded among English-speaking races, it can not be denied that it is open to one strong objection, viz., that the results in the end depend upon the efficiency of the uterine contractions subsequent to the operation. When the operation is performed early in labor, after the pains are well established, but before the patient's strength is exhausted, and when the sutures have been introduced, art has done all that it can accomplish to prevent gaping of the uterine wound. But, even when these precautions have been scrupulously observed, imperfect retraction of the uterus or a cutting out of the sutures may leave an open communication between the uterine and abdominal cavities. As the uterine section in itself is apt to excite a considerable degree of catarrhal endometritis, and as the admission of air into the uterus furnishes the condition for decomposition of the lochia, the patient is always exposed to the dangers arising from penetration of septic materials into the peritoneal sac. Porro's operation and laparo-elytrotomy have both been designed to avoid the risks incident to this cause.

Porro's Operation, or Ovaro-Hystorectomy. — The characteristic feature of the Porro operation consists in the removal, after the performance of the Cæsarean section, of both uterus and ovaries. As the result of experiments upon animals, its theoretical practicability was demonstrated as early as 1769 by Cavallini, and later, in 1823, by Blundell. G. Ph. Michaelis, in 1809, after referring to the danger from reaction following injury to any of the abdominal viscera, goes on to say: "That the danger specially depends upon this reaction, we see not only from the often greater associated disorders in other organs, but from the experience that, when the uterus has been removed so that the reaction in other organs falls away, the danger appears to be much lessened. Several cases are known where the uterus has been excised by ignorant persons without the occurrence of violent disturbances [Zufälle]. . . . It is a question, therefore, whether the Cæsarean section would not be rendered less dangerous by connecting with it the extirpation of the uterus." The ablation of the uterus after Cæsarean section was not, however, actually executed

* Barnes, "Obstetrical Operations," D. Appleton & Co., p. 418.

upon the living human female until 1868. The first operation was performed by Dr. Horatio R. Storer, of Boston, in the case of a patient whose delivery was rendered impossible by the natural passages, owing to a large-sized fibro-cystic tumor blocking up the pelvic cavity. The hæmorrhage which followed the incision into the uterine cavity proving frightful, Dr. Storer ligatured the cervix, and, having applied the chain *écraseur*, slowly removed the mass. Both the child and placenta were in a state of decomposition. The patient lived sixty-eight hours. At the time of the occurrence the hardihood of the operator was the subject of a good deal of unfavorable comment.

In 1874 Professor Edward Porro, of Pavia, having succeeded in preserving the lives of animals from which he had removed the gravid uterus, decided that, as soon as a chance offered, he would add to the Cæsarean section as a completive measure the ablation of the uterus and its appendages. The sought-for opportunity presented itself on the 21st of May, 1876. The patient had a rachitic pelvis, with an antero-posterior diameter reduced to one inch and a half. The child was extracted living, and the mother survived. After the publication of Porro's report, the two Brauns and Spaeth, of Vienna, where the Cæsarean section had been proverbially fatal (no case saved in this century), resolved to give the new operation a trial. Spaeth led off with a success in June, 1877. Since then I learn, through a private communication from Dr. R. P. Harris, who has with untiring zeal made all questions connected with the Cæsarean section his peculiar province, that the number of operations performed to the present time (March, 1885), in which the uterus and its appendages have been removed after the extraction of the child, has swollen to 164 (3 moribund at time of operation), of which 70 have ended in recovery, or a little over 42 per cent.

These results, though they still leave much to be desired, are encouraging when we remember that they have for the most part been obtained in lying-in hospitals, where the unmodified Cæsarean section has proved nearly uniformly fatal. As in all Cæsarean operations, the statistics contain a number of cases where the doom of the patient was well-nigh decided in advance of the operation itself. Thus, Harris informs me that there were 90 women in which the prognosis was "favorable," and 57 "unfavorable." Of the 90, 53 recovered, while of the 57 only 13 recovered. The worst results followed the dropping of the pedicle into the abdominal cavity. Of fourteen cases thus treated, but four recovered.* The possibilities of the operation are,

* In a remarkable case reported by Professor I. E. Taylor, the patient lived twenty-six days. On the seventeenth day phlegmasia dolens was developed, which was, however, rapidly improving, when the woman, who was somewhat unruly, after sitting up in a rocking-chair against orders, was suddenly seized with dyspnœa, and died in a few hours from pulmonary embolism. (*Vide* "Am. Jour. of the Med. Sci.," July, 1880.)

however, best determined by the records of single operators in whose practice the prognosis was not vitiated by faulty methods or by errors of judgment.

Now, Harris reports that Fehling has had five cases with one death; Porro, five cases with one death; Breisky, five cases with no deaths; and that in the Santa Caterina Hospital, at Milan, ten women were saved in thirteen operations. Fehling states that C. Braun has saved eight women out of twelve. Thus, in practiced hands there were but nine deaths in forty cases. As thirty-nine of the children were born living, it is likely that the operations were for the most part timely ones, always, as Harris has shown, an important element in the prognosis.

Operation.—The preparations and the details of the operation are the same as in Cæsarean section, with the exception of those which have reference to the ablation of the uterus and the prevention of hæmorrhage. Careful attention to the details of antiseptic surgery appears to be essential to a successful issue. In Porro's first case the abdominal incision was nearly five inches in length. After opening the uterus and removing the fœtus, the placenta, and the membranes, Porro lifted the emptied organ from the abdomen, and placed the *serre-nœud* of Cintrat around the lower segment, just above the os internum. The tissues were then constricted until all hæmorrhage from the cut uterine surface was arrested. The uterus was then cut away with a bistoury, the stump was brought outside of the abdominal wound, and held in position by strapping the handle of the *serre-nœud* to the patient's right thigh. Müller modified Porro's original method by enlarging the first incision upward sufficiently to enable an assistant to lift the uterus outside of the abdominal walls, and by applying compression above the cervix (either the wire *écraseur* or the Esmarch bandage) before opening the womb and removing the child. This plan offers the obvious advantage of rendering the operation bloodless, and of making it easy to prevent the entrance of the amniotic fluid into the abdominal cavity. Breisky, Litzmann, Müller, Tarnier, and Elliott Richardson, of Philadelphia, found no difficulty in thus drawing the uterus outside the abdominal cavity; Spaeth, Wasseige, Tibone, Chiara, and Carl Braun, on the contrary, either encountered great difficulties in performing the manœuvre, or were obliged to abandon it altogether. According to Harris, there have been 42 Porro-Müller operations, with the saving of 21 mothers and 30 children. The compressors which have so far been employed are the Cintrat *serre-nœud*, the chain *écraseur* with a Péan attachment rendering it possible, after detaching the chain from the handle, to maintain the constriction, the various forms of wire *écraseur*, and the elastic ligature. Compression should be made slowly, and should not be carried to the extent of cutting through the peritonæum.

Owing to the liability of wire to break, great care should be taken in its selection. In case of accident, a second instrument should be held in readiness.

Fehling, whose excellent record we have already noticed, gives the following directions: After careful disinfection of the abdominal surface, the incision should be made in the median line. As the abdominal coverings are for the most part thin, ligatures are rarely necessary. The peritonæum should be divided upon a grooved director. Then either a median incision is made through the uterine walls with the uterus *in situ* and with the precautions against hæmorrhage described in connection with the older operation, or, as recommended by Müller, the uterus, after enlarging the abdominal wound, should be tilted laterally, and withdrawn outside the abdomen previous to section. An elastic ligature, placed rapidly around the lower uterine segment, furnishes a safeguard against hæmorrhage. In the Porro operation proper the elastic ligature is used after removal of the child; in the Müller modification, which Fehling prefers, the ligature is applied previous to uterine section. In the latter case the child should be extracted as speedily as possible, for the sudden interruption of the placental circulation is decidedly more dangerous to the child than when it takes place gradually. The diameter of the ligature should be about one third of an inch. After the removal of the child and the tying of the cord, the field of the operation should be cleansed, and the after-birth should be removed. Fehling next recommends the application of a second ligature beneath the first. Then the uterus and ovaries are to be removed, the stump cauterized, and pins inserted above the ligatures to prevent the recession of the stump. To insure the speedy and complete union of the peritoneal surfaces, the latter should be carefully stitched to the stump beneath the ligatures. For this purpose a round needle and carbolized silk should be employed. Single sutures passing through the peritoneal borders and the uterine tissues should be introduced below and to the sides of the stump, and two sutures through the peritoneal borders and uterine tissues upon the upper surface of the stump. Above the latter two or three more sutures should be employed to bring together the peritoneal border alone. The abdominal sutures should next be introduced, and, after a final cleansing of the abdominal cavity, the wound should be closed. For a dressing Fehling employs iodoform and fills the funnel-shaped space around the remains of the uterus with chloride-of-zinc cotton. Above he places iodoform gauze and cotton fixed in place by means of a wide bandage. The dressing, except in cases of bleeding or fever, may be left undisturbed for six to eight days.

It should be here mentioned that on the second or third day the pulse becomes irregular and oscillates between one hundred and one hundred and forty pulsations without a corresponding rise in the

temperature, a nervous disturbance attributed by Lucas-Championnière * to the dragging of the pedicle. The separation of the stump occurs from the twelfth to the fifteenth day.

The sterilization of the female as the result of amputating the uterus has been discussed from its moral aspect. Few persons in this country are likely, however, to be restrained in its performance by the extremely rare cases where the older operation has been successfully carried out a number of times upon the same individual.

The chief merit of the method of Porro lies in the fact that each step in the operation is capable of human control, and is capable, therefore, of human improvement.

Thomas's Operation, or Laparo-Elytrotomy.—In Professor Thomas's operation, the dangers of opening into the peritonæum and wounding the uterus are avoided by incising the walls of the abdomen in the line of Poupart's ligament, lifting the peritonæum, and dissecting down to the vagina, dividing the vagina transversely, and then, having reached the cervix, extracting the child through the passage thus artificially created.

The credit of defending the practicability of the extra-peritoneal delivery of the child above the pelvic brim belongs chronologically to Ritgen. It was the natural outcome of the teachings of Abernethy and Cooper, to whom we owe the ligation of the external iliac artery without opening the peritonæum. The *modus operandi* was carefully thought out by Ritgen, and was put by him to the practical test October 1, 1821. The incision through the vagina, which was made with a sharp bistoury in a longitudinal direction, was, however, followed by such profuse hæmorrhage that the operation was discontinued, and the ordinary Cæsarean section performed in its place. The patient died at the end of fifty-eight hours.†

In 1823 Baudelocque the younger, unaware of the work of his predecessor, advised an incision down to the peritonæum along the external edge of the rectus muscle, extending from the umbilicus to two inches above the pubes, separating the peritonæum from the iliac fossa with the finger introduced into the lower end of the wound, incising the vagina to a length of four and a half inches, and then leaving the expulsion of the child to nature, or extracting it with the short forceps. In 1884 he published an essay reporting two cases in which he had tried his plan, modified, however, by substituting the flank incision of Ritgen for that along the rectus muscle. Like Ritgen, Baudelocque did not complete his first operation, owing to the extent of the vaginal hæmorrhage. In his second case he succeeded

* Maygrier, "Étude de l'opération de Porro," Paris, 1880, p. 33.

† For the particulars of this and the succeeding cases, the writer is indebted to Dr. Henry J. Garrigues's model essay "On Gastro-Elytrotomy," "N. Y. Med. Jour.," October and November, 1878.

in delivering the child, which was, however, dead at the time of his undertaking the operation. Having accidentally pricked the external iliac artery, Baudelocque tied the common iliac, in order to arrest the hæmorrhage thence resulting. The labor was likewise complicated by convulsions. Death took place on the fourth day. The merit of first performing laparo-elytrotomy belongs, therefore, to Baudelocque.

In 1837 Sir Charles Bell, in his "Institutes of Surgery," suggested practically the same plan of procedure as that subsequently advocated by Dr. Thomas.

In 1870 Dr. Thomas, who was at the time unaware of the labors of his predecessors, read a memorable paper before the Medical Association of Yonkers, giving an account of, first, laparo-elytrotomy performed tentatively upon the cadaver of a woman dying in the ninth month of pregnancy; and, second, upon a living woman at the end of the seventh month of pregnancy, who had been suffering from pneumonia for a week or ten days, and was at the time of his visit *in articulo mortis*. The operation was undertaken in the interest of the child, which was extracted alive, and survived about an hour. In 1874 the operation was repeated by Dr. Skene. The patient had been forty-eight hours in labor, and unsuccessful attempts at delivering her by craniotomy had been resorted to. She was suffering at the time of the operation from exhaustion and shock, which gradually became more marked, and she died seven hours after. In 1875 and in 1877 Dr. Skene had the glory of successfully performing the operation under circumstances of great difficulty, with the result in each case of saving the lives of both mother and child. In 1877 Dr. Thomas had the good fortune to obtain a like triumph. In England the operation has been performed by Drs. Himes and Edes, both times in the interest of the child, the condition of the mothers being well-nigh hopeless. Both children were saved. In 1880 Dr. Walter R. Gillette * extracted by laparo-elytrotomy a putrid child, which he was obliged to perforate and extract with the cephalotribe, the forceps and version having been previously tried without success. The mother recovered with scarcely an untoward symptom.

In 1883 Professor W. H. Taylor, of Cincinnati, operated with a fatal result. Forceps, craniotomy, the cranioclast, and version had been previously tried in vain. When laparo-elytrotomy was decided upon, the patient was much exhausted, with a very rapid, feeble pulse and elevated temperature. The patient died forty-four hours after the operation. In the same year Professor Jewett, of Brooklyn, operated upon a patient who had been a week in labor. The woman was exhausted by long labor, and previous attempts at replacing the arm, by the use of forceps, and by attempts at version. The uterus was in a

* Gillette, "A Successful Case of Laparo-Elytrotomy," "Am. Jour. of Obstet.," January, 1880, p. 98.

state of tonic contraction, and the soft parts were excessively œdematous. The child died before delivery. The mother died seventy hours later of acute septicæmia.

In the present year (1885) both Drs. Skene and Jewett have operated each successfully. The statistical results, therefore, of laparo-elytrotomy are the saving of six mothers in twelve operations. But in no one of the fatal cases were the conditions such as to render success a possibility.

The foregoing results, considering the age of the operation, are most satisfactory. They ought to inspire a confidence in its feasibility at least equal to that enjoyed by the rival procedure of Porro.

The question to be decided in the future is, as to how far laparo-elytrotomy is adapted to general usage. It is possible that the successes so far obtained have been largely due to the exceptional merits of the operators who have undertaken it. With the present experience it would seem as though it ought to receive the preference in all cases, where the dilatability of the cervix is such as to allow delivery by forceps or version, after the artificial passage has been formed, to be accomplished with ease and celerity.

The vaginal hemorrhage noted in the cases of Ritgen and Baudelocque can apparently be avoided by tearing the vagina transversely, as recommended by Thomas, in place of incising it with a bistoury. In four of the cases vesico-vaginal fistulæ were produced, but all healed spontaneously. The following description of the operation is borrowed from the excellent essay of Dr. Garrigues, which has already been quoted. It has received the sanction of Drs. Thomas, Skene, and Gillette, with the exception that, in discussion, all have agreed that it is desirable to insert a perforated drainage-tube through the abdominal wound into the vagina, and to keep the parts cleansed with antiseptic injections.

Operation.—"The bowels having been emptied by an aperient and a copious enema, and the os having been fully dilated by Barnes's water-bags, if it is not so already, the patient is placed on her back, on a long, narrow table covered with a mattress or quilts, rubber or oil-cloth, and a sheet. The pelvis is well elevated on a hard cushion, the head and shoulders slightly raised by means of pillows, the legs stretched out. If, from some cause, it has been impossible to dilate the os fully by Barnes's dilators, it is now done by the fingers, or, if that is impossible too, it is dilated later through the abdominal wound. The patient is anæsthetized. Since disinfection can not be carried out strictly, and since its administration would give some additional trouble, it is scarcely necessary to operate under disinfectant spray.

"The operator takes his place at the right side of the patient. Besides one who administers the anæsthetic, four assistants are needed; one on either side of the operator, and two in front of him. The first

assistant, standing at the left of the patient's chest, lays his flat hands under the umbilicus and draws the uterus upward and toward the left, thereby putting the skin in the right iliac region on the stretch. Counter-extension may be made by the assistant placed at the right of the operator. A slightly curved incision is made through the skin from a point one inch and three quarters (4·5 centimetres) above and outside the spine of the pubes, parallel to and an inch above Poupart's ligament, to a point an inch above the anterior superior spine of the ilium. This incision may also be made in the opposite direction, from without inward. By a few touches with the edge of the knife the external oblique muscle is laid bare, and spouting branches of the superficial epigastric artery secured by holding-forceps. The abdominal muscles are cut to the same extent, layer by layer, the external oblique, the internal oblique, and the transversalis, the first of which is aponeurotic. The transversalis fascia is very carefully hooked up with a fine tenaculum, and the knife carried horizontally, so as to make a small opening in it, avoiding the peritonæum that lies beneath it, separated from it by loose areolar tissue, and sometimes fat. A director is introduced through the opening and pushed between the fascia and the peritonæum toward the inner and the outer angle of the wound, and the fascia is cut. The best instrument for this purpose is Key's hernia director, the one which Spencer Wells uses when incising the peritonæum in ovariotomy. It is firm, a quarter of an inch (six millimetres) broad, slightly curved on the flat, well rounded at the end, and has on its concave side a groove that stops a quarter of an inch (six millimetres) from the point of the instrument. Next, the operator places the pulp of his fingers on the peritonæum, separating it from the transversalis and iliac fasciæ, until he reaches the vaginal wall. The second assistant, placed at the left of the operator, holds the peritonæum and intestines, applying a fine, warm napkin under his hands, in order to be sure not to let them slip. The first assistant draws the uterus vigorously upward and toward the left, in order to expose the deeper part of the vaginal wall on the right side. A female silver catheter is introduced into the bladder by the third assistant, placed at the left hip of the patient and held in the known direction of the boundary-line between the bladder and the vagina, below the ureter on the side on which the operation is being performed. A blunt wooden instrument, something like the obturator of a cylindrical speculum, only longer, is introduced into the vagina and applied above the linea ileo-pectinea, raising the vaginal wall as much as possible into the abdominal wound. An incision is made parallel to the ileo-pectineal line and the catheter felt in the bladder, as far below the uterus as possible, in order to avoid the ureter and Douglas's pouch, and incise where there are fewest vessels, cutting down on the obturator with Paquelin's thermo-cautery, the galvano-

caustic knife, or simply cautery-irons (table-knives) only heated to *red* heat. The surrounding parts are protected by the application of wet compresses around the place to be cauterized. The incision made by the cautery is extended forward toward the symphysis and backward toward the promontory by placing the pulp of both index-fingers perpendicularly on the edges, and applying the force in different places in the direction of the os uteri and the ileo-pectineal line, so as to *tear* the vaginal wall as far forward as is deemed safe in regard to the bladder and the urethra, the locality of which organs is ascertained by feeling the catheter held by the assistant, and as far backward as the wound in the abdomen will allow. Now the catheter is withdrawn, the membranes ruptured if the liquor amnii has not escaped before, the uterus tilted as much as possible to the opposite side, and the os drawn with the forefinger into the iliac fossa.

"The operator draws the child through the double wound either by simple extraction, or after turning, or by applying the forceps, according to the presentation and other particular circumstances. The placenta is expelled by compressing the uterus, and withdrawn through the wound.

"If bleeding occurs, the operator tries to check it by applying ligatures through the abdominal wound, holding-forceps, styptics, or cauteries, using a large wooden tubular speculum ; or a Sims speculum may, perhaps, give easier access to the bleeding vessel than anything else. If it be impossible to check the hæmorrhage, the vaginal wound must be firmly tamponed from below through the vulva and from the abdominal wound with cotton pledgets soaked in cold water and squeezed, and held *in situ* by broad straps of adhesive plaster round the abdomen, as after ovariotomy. Except in the last eventuality, the bladder is distended by injecting lukewarm milk in order to ascertain if this organ has been injured. If so, the fistula is immediately sewed with catgut, which need not be removed. The wound is cleaned by injecting a stream of lukewarm carbolized water (two per cent.), or a solution of thymol (two per thousand), from the vagina and from the abdominal wound. Next, the edges of the abdominal wound are brought together by interrupted sutures, and the lower part of the abdomen covered with borated or salicylated cotton, and surrounded by broad straps of adhesive plaster fastened to the hips, as in ovariotomy. A pledget of cotton soaked in carbolized oil (1 to 10) is applied at the entrance of the vagina."

Professor William M. Polk has demonstrated that the operation can be performed as well upon the left side as upon the right.*

* Polk, "N. Y. Med. Jour.," May, 1882.

THE PATHOLOGY OF LABOR.

CHAPTER XXIV.

ANOMALIES OF THE EXPELLENT FORCES.

Precipitate labors.—Tardy labors.—Irregular pains in the first stage of labor.—Treatment of protracted first stage.—Irregular pains in the second stage.—Treatment of protracted second stage.—On the use of ergot in labor.—Irregular pains in the third stage; treatment.—Painful labors: from hysteria; from rheumatism; from intestinal irritation; from inflammatory changes.

In physiological labor the expellent forces are adequate to overcome the resistance encountered. Labor becomes pathological—1. When the pains are defective; 2. When the resistance offered by the soft parts or the bony pelvis exceeds the limits of safety to the mother or the child; 3. When natural delivery is rendered difficult or impossible, owing to malformations or malpresentations of the fœtus; 4. In consequence of dangerous complications, such as hæmorrhage, eclampsia, and prolapsed funis.

From a clinical point of view the anomalies of the labor-pains are divisible into pains in excess, weak pains, pains attended by an extreme of physical suffering, and pains complicated by strictures. Physiologically, however, these different forms are far from composing distinct conditions, isolated from one another. Thus, rigidity of the os is always intensely painful, and is usually dependent upon feeble action of the expellent forces. There is no standard of strength by which the weakness or excess of pains can be measured. The terms are always relative, and are used with reference to the obstacles to be overcome. In primiparæ strong pains are requisite to induce softening and dilatation of the cervix. In multiparæ pains may be intrinsically weak, and yet suffice to bring labor to a prosperous conclusion. Much confusion of mind is often occasioned by the double sense in which the term "labor-pains" is employed. Thus, it is frequently stated that the pains are good, when an examination reveals only a feeble measure of expellent force, the word "pains" representing nothing more than an acute degree of physical suffering. Clinically, pains are to be judged by the effects they produce. In practice it will be found convenient to study the various forms of irregular uterine action in connection with the results of their influence upon the duration of labor. These results are—1. Precipitate labor; 2. Tardy labor.

Precipitate Labors.—It is customary to ascribe precipitate labors to an excess of the pains. The term excess is, however, only relative. There is no reason to believe that the uterus ever acts with such a

degree of energy as *per se* to constitute a pathological condition. With a large, roomy pelvis, a soft, dilatable cervix, a distensible vagina and perinæum, labor may be terminated by a few strong pains. Such rapid deliveries are not to be regarded with apprehension. As a rule, they are followed by firm retraction of the uterus, and the continuance of good contractions acts as a safeguard against hæmorrhage. The puerperal state usually pursues a favorable course. Aside from the inconvenience which sometimes results when, perchance, women are suddenly overtaken by labor-pains in the streets or in public places, an easy, rapid labor is to be regarded as one of the varieties of normal labor. Except the adoption of precautions against such untoward accidents, they call for no special treatment.

When, however, the parturient act occurs in women who possess an undue reflex irritability, which impels them to an excessive use of the abdominal muscles, it is possible for serious mischief to ensue. Thus, if the patient happens to be seized when in the standing posture, the straining efforts may throw the child suddenly upon the floor; but even here the consequences are less detrimental than would be naturally anticipated. The force of the fall is usually broken by the cord. Lacerations of the latter take place at a distance from the navel, and are not followed by hæmorrhage. *Post-partum* hæmorrhage, prolapse, and inversion of the uterus are said to be possible occurrences, though of extreme infrequency. When all the expellent forces are called into play at an early period of labor, before the rigidity of the utero-vaginal canal has been overcome, the violent straining has been known to cause subcutaneous emphysema of the head and neck, to interfere with the utero-placental circulation, and even to produce fracture of the fetal skull. Excessive straining, before the soft parts have been properly prepared for the passage of the child, may likewise lead to lacerations of the cervix, vagina, and perinæum.

The proper treatment for this condition is to lower the reflex irritability by hypodermic injections of morphia; or, better still, by the production of complete anæsthesia, so as to suspend the action of the voluntary muscles.

Tardy Labors.—For the proper understanding of labors protracted beyond the period of safety by irregular uterine contractions, it is necessary to bear in mind the principal features of normal delivery. These are, contractions of the uterus followed by relaxation and distinct periods of repose; stretching and thinning of the muscular fibers below the contraction ring, with retraction of the uterus above that point; softening and dilatation of the cervix; the fixation of the uterus in the axis of the pelvis; and the addition of the abdominal muscles to the expellent forces.

The first requisite of every normal labor is that the pains shall be good—i. e., shall possess a markedly expulsive character. We have

seen that for the uterus to perform work the contractions should not be continuous, but distinctly rhythmical. For effective work, moreover, the excursions of the uterus during a contraction should possess a certain degree of amplitude, and the interval between the contractions should be sufficient to allow the nervous system to recover from the shock of pain.

Irregular Pains in the First Stage of Labor.—In the first stage of labor, pains are most frequently defective by reason of their short duration. As a rule, short, cramp-like pains occasion acute suffering. When they recur with little or no interval between them, they are very exhausting to the patient. As the cervix in such cases is tense and rigid, it is to this condition that the delay is usually attributed. If, however, the tissues of the cervix are healthy, the presentation is normal, and the pains preserve their expulsive character, rigidity of the cervix is never an obstacle to delivery. The activity of the organic changes which lead to softening and dilatation is closely related to the activity of the uterine contractions. The exception to this rule in primiparæ is only apparent. To be sure, in them the firm, closely knitted tissues of the cervix yield more gradually to the dilating forces than in multiparæ. Indeed, in multiparæ we sometimes find the organic changes in the cervix induced by contractions which have hardly excited the notice of the woman; but in primiparæ, while good pains, under the reservations mentioned, certainly induce softening of the cervix, weak pains effect no changes in its tissues.

The uterine contractions may be abnormal from the commencement of labor; more frequently the loss of their expulsive character is a secondary condition. In many primiparous women labor progresses in an auspicious manner for a time, inspiring hopes of a speedy termination. Then the cervix, which had previously been dilating favorably, becomes rigid, the sufferings of the patient during each contraction are enhanced, and further advance is arrested. This transformation is not to be accounted for by a spasm of the circular fibers of the os, but is the result of secondary changes in the action of the uterus itself. The right understanding of the phenomenon in question renders it necessary to recall the physiological fact that the uterus is endowed not only with contractility, but with retractile properties likewise. These are shown in a marked way by the manner in which the uterus closes upon its contents after the escape of the amniotic fluid; so, too, by the manner in which the uterus follows down the fœtus during the period of expulsion. Normally, the gradual closure of the uterus upon the ovum leads with a dilated os to the permanent formation of the bag of waters. Thus it will be seen that in normal labor retractility is a wholly beneficent possession of the uterus. When, however, from any cause the cervix dilates slowly, and the pains are strong and close together, as the uterus retracts

upon the stationary ovum, the excursions made by the labor-pains shorten, which thus tend to assume the clonic form. The continuance of the same process leads finally to the close investment of the ovum by the uterus, when the only indication of contractility which remains is the increased hardening of the uterus at short intervals. These changes in the character of the contractions are marked by corresponding changes in the cervix, the condition of the latter affording an index of that of the entire uterus in much the same way that a furred tongue bespeaks a catarrhal condition of the stomach.

These secondary changes in the pains are dependent upon a variety of conditions. The tardy dilatation of the cervix, which stands in a causal relation to them, may result from over-distention of the membranes with amniotic fluid, or from their firm adhesion to the walls of the uterus around the os internum—conditions which, in either case, interfere with the stretching of the lower segment, and thus lead to waste of uterine force by distributing it uniformly over the entire ovum. Again, where there is lack of parallelism between the axis of the uterus and that of the pelvic brim, the presenting part may, by bearing especially upon the anterior portion of the lower uterine segment and of the cervix, exercise so little pressure upon the os that its sphincter long maintains its integrity. Finally, irregular contractions may be consequent upon faulty presentations, and upon any form of pelvic obstruction.

A special and dangerous form of irregularity results when the membranes rupture prematurely, and the entire amount of amniotic fluid leaks away. This, to be sure, is a rare event, as the presenting part, as a rule, acts as a valve which closes the lower segment of the uterus, and prevents the amniotic fluid from escaping. When, however, owing to the small size, the uneven shape, or the hindered descent of the presenting part, the accident in question takes place, as a combined result of muscular retractility and the pressure of the intestines during the pains, the uterus gradually conforms to the surface of the fœtus. In this way the much-dreaded "dry labors" are produced. The consequences are far-reaching. The retraction of the muscular fibers about the child's neck in head presentations forms an impediment to natural delivery; the disturbance of the utero-placental circulation endangers the life of the child; the uterine walls applied to the convex surfaces of the child become anæmic, while the reëntrant portions, subjected to negative pressure, become hyperæmic and œdematous, extravasations take place into the tissues, the walls are rendered friable, the contractions are associated with intense pain, and peritoneal irritability develops.*

The prolonged retraction of the uterus may be followed in the end by the entire cessation of pains, and paralysis may ensue. Uterine

* Lahs, "Die Theorie der Geburt," pp. 285 *et seq.*

retractility is not precisely the same force as that which causes the expulsion of a fluid from an over-distended elastic sac, for retractility and contractility are in the uterus barely disassociated from one another. When the uterus ceases to contract, it forfeits, as a rule, its retractile properties likewise.* It sometimes follows, therefore, that, following prolonged tonic contraction, after the evacuation of the uterus, the walls of the latter collapse like those of a pricked bladder.

The Treatment of a Protracted First Stage.—The treatment of a protracted first stage has for its object the mitigation of pain and the restoration of their expulsive quality to the uterine contractions. No plan of action should be decided upon without first carefully investigating the cause of delay. The suspensive influence of a full bladder or rectum is always to be borne in mind. In face, breech, and shoulder presentations, and in contracted pelves, the slow dilatation of the cervix is the rule, and, with such exceptions as will be noted in their appropriate connections, do not call for interference. A faulty position of the uterus should, if possible, be rectified by suitable abdominal support. Adhesions of the membranes to the lower uterine segment should be dissected up by the index-finger. In hydramnion, rupture of the membranes, so as to allow the partial escape of the amniotic fluid, is sometimes serviceable.

If the length of the labor is simply due to the insufficient uterine action, the conduct of the accoucheur will, in a measure, depend upon the frequency and severity of the pains and the endurance of the patient. If the pains occur at such intervals, and with such mildness that the patient is able to eat, to sleep, and to attend to ordinary household duties, the dilatory progress of labor should cause no apprehension. In pathological conditions it is the element of pain which is most to be dreaded. Pain long continued is a powerful nerve-depressant. When combined with starvation and deprivation of sleep, it greatly impairs a woman's capacity to resist the perils of the puerperal period. While, therefore, the indication for treatment is clear enough, it is not so easy in a given case to decide whether the remedy should be applied first to the relief of pain, or whether efforts should be directed at once to the acceleration of labor, so as most speedily to place the patient beyond the hazards of parturition. As a rule, however, it may be stated that anodynes are appropriate in cases where the cervix is but slightly dilated, while accelerative measures naturally receive the preference in those where the first stage of labor is already far advanced.

The pain-stilling agents from which the selection should be made are the warm bath, chloroform, chloral by rectal injection, and mor-

* Breisky, "Ueber die Behandlung der puerperalen Blutungen," Volkmann's "Samml. klin. Vortr.," No. 14, p. 92.

phia, either alone or combined with minute does of atropia. In practice it will usually be found convenient to begin with chloroform, and then to sustain its action by the hypodermic injection of morphia, or the rectal administration of chloral, suspending the chloroform so soon as the tranquilizing effect of the latter is developed. Anodynes often accomplish wonders in one of two ways: when, owing to the prolongation of the labor and its attendant pain, the patient's nervous energies have become exhausted, the arrest of pain enables the woman to sleep, and, with the recuperation of power that comes upon awakening, good pains follow, which bring the labor to a happy termination. In other cases, after the employment of the anodyne the parts apparently relax, and an acceleration of labor follows. In these cases the oxytocic effect is probably due to the quieting action exerted upon the spinal nerves. It has been surmised that the nerves of the uterus derived from the cerebro-spinal system possess inhibitory properties—a theory which, if true, readily explains how severe pain suspends uterine action, and how the quieting of pain would restore to the motor nerves their full energy.

In a certain proportion of cases the effects of the anodyne or anæsthetic are of but short duration. In from ten to thirty minutes the acute suffering returns, and the short truce is unattended with benefit. There is an erroneous opinion that, so long as the membranes are unruptured, this condition may be allowed to go on indefinitely. It is, however, of the greatest importance that the length of the period of non-interference should be governed by the strength of the patient. There is nothing that requires more judgment in midwifery practice than to decide when the time has arrived at which delay is fraught with more danger than active interference. For my own part, I believe that many fair lives are needlessly squandered because of excessive timidity begotten of imperfect obstetric teachings.

If pain-stilling agents do no good, or if the first stage is already far advanced, the physician should seek, by restoring to the pains their expulsive character, to hasten delivery.

Of reputed service in cases of uterine insufficiency are the warm vaginal douche, the dilating bags of Barnes, the introduction of a bougie into the uterus, forceps, and the internal administration of quinine, ergot, viscum album, borax, cannabis Indica, cinnamon, or digitalis.

The bougie is applicable only to cases where the membranes are intact, and where the pains are weak without being cramp-like in character. In hospital practice it possesses the disadvantage that it can become the conveyer of infection to the uterine cavity.

The vaginal douche possesses a wider range of utility. It is safe and tolerably effective, under favorable conditions. It promotes the organic changes in the cervix, stimulates the uterus to contract, and

mechanically distends the vagina. Its action is, however, apt to be slow and somewhat uncertain. In a case of over-distention of the amnion, I once saw its employment followed immediately by complete tonic rigidity of the uterine muscular fibers.

Of all the resources at our disposal, however, the water-bags of Dr. Barnes stand easily at the head. Passed within the cervix, and distended so as to place the canal moderately upon the stretch, they not only serve to mechanically dilate the os, but are most efficient as reflex excitors of the labor-pains. If left *in situ* until expelled into the vagina by the bearing-down efforts they awaken, the cervix will be found to have lost its rigidity. If necessary, a larger dilating-bag should then be employed in the same way. An attempt to dilate the cervix rapidly and with violence is neither safe nor profitable. To obtain permanent results it is essential to effect the organic changes in the tissues which render them physiologically dilatable. In cases of tonic rigidity of the uterus, the production of normal pains will sometimes be assisted by rupturing the membranes and raising the head, so as to allow a small portion of the amniotic fluid to escape, previous to resorting to the Barnes water-bags.

When, after rupture of the membranes, a segment of the head presents at the os externum, the rubber bags are of less service. In such cases often we are able to accomplish speedy dilatation by simply asking the woman to hold her breath, and to reënforce the uterine pains by the action of the auxiliary muscles. If this plan fails, forceps should be applied, and the head be made to serve as the dilating body. To avoid lacerating the cervix, the tractions should be intermittent, and should be suspended during the acme of the pains. The rule given for the preservation of the perinæum will be found most serviceable in attempts to maintain the integrity of the cervix, viz., that the extraction is most safely accomplished during the period of greatest relaxation, and not at the moment of extreme tension.*

Of the various internal remedies to stimulate uterine action, ergot should, in the first stage of labor, be unqualifiedly prohibited. In spite of numerous favorable experiences from its use, its tendency to intensify tonic contraction of the involuntary muscular fibers makes it always a perilous drug. The enthusiastic praises of quinine by Drs. Fordyce Barker, and Albert H. Smith, of Philadelphia, warrant further trials of its efficacy. Dr. Smith says: "I do not hesitate to give it in every case, because, even where there is no decided inertia at the onset of labor, there may be failure of the powers of the mother from early exhaustion and fatigue, and we get the benefit of the quinia in diminishing this tendency and also in promoting the condensa-

* I have purposely avoided making mention of incisions through the vaginal portion of the cervix, as, in a large experience in difficult labors, I have never so far seen the occasion for their employment.

tion of the uterine fiber after the delivery of the placenta, thus lessening the dangers of *post-partum* hæmorrhage and the annoyances of the after-pains so commonly resulting from a slow condensation of the uterine muscle." * He recommends the bisulphate in a fifteen-grain dose, which he declares acts altogether beneficially as a stimulant to the normal uterus. The other agents mentioned as possessing direct or incidental ecbolic properties are now chiefly of historic interest.

Irregular Pains in the Second Stage of Labor.—In many cases the pains maintain their normal quality until the completion of the first stage of labor, and the descent of the head to the floor of the pelvis. When in the second stage of labor the pains become inefficient and lose their expulsive character, the non-advance of the head is usually attributed to a rigid perinæum. But it is a matter of every-day experience that with really good pains and normal head mechanism the perinæum speedily loses its rigidity. Of course, it is not denied that, in primiparæ, the organic changes which effect the softening of the perinæum need for their accomplishment relatively stronger pains than in multiparæ. The faulty action of the expellent forces in the second stage is due either to exhausted nerve-power or to excessive uterine retraction. In the former case, labor becomes powerless from the feeble character of the pains; in the latter, it results from the withdrawal upward of the uterine muscle, and the consequent lessening of the intra-uterine pressure. These cases of retraction are worthy of special consideration. Thus, Hofmeier † found in a number of instances, where the head rested on the pelvic floor, that the contraction ring, which was made out by palpation through the abdominal walls, was situated at from five to seven inches above the symphysis pubis, so that the contractile portion of the uterus covered not more than one third of the fœtus. Under such circumstances, while the patient suffers from intense pain, the contractions of the partially emptied uterus do not possess the force to overcome the resistance of a rigid perinæum.

Treatment.—In all cases of protracted second stage, before deciding upon the existence of uterine irregularity, both the bladder and the bowels should be emptied, and care should be taken to exclude the existence of obstruction from the bony pelvis. If the only resistance to be overcome is that furnished by the soft parts, weak pains should be reënforced by the action of the abdominal muscles. After rotation of the head is completed, a new *vis a tergo* may be supplied by pressure applied to the breech through the abdominal walls after the method of Kristeller, or by the modified form of expres-

* Albert H. Smith, "Retarded Dilatation of the Os Uteri in Labor," p. 27.

† Hofmeier, "Ueber Contractionsverhältnisse des kreissenden Uterus," "Ztschr. f. Geburtsh. u. Gynaek.," Bd. vi, p. 164.

sion recommended by Bidder.* According to the latter, the physician should stand to the left of his patient, and grasp the breech of the fœtus with the right hand; he should then raise the breech and fix it in such a position that the pressure applied will be best transmitted through the spinal column to the cephalic end—a point to be determined by the fingers of the left hand, which should likewise control the movements of the head during the period of expulsion. The force, the frequency, and the length of the acts of expression should of course be decided by the judgment and experience of the operator.

Where the movements of flexion and rotation have been imperfectly performed, little is to be expected from any of the forms of expression. The available remedies are then ergot and the forceps. Of these the advantages of safety and celerity are all on the side of the forceps. Many practitioners, however, who have observed that in practice ergot often acts likewise with speed and safety, accord to it a large measure of confidence. But along with these more fortunate experiences there is a shady aspect to be remembered. When the tardy labor is due to tonic retraction, the use of ergot is calculated to aggravate the sources of delay. In other cases tonic retraction is the direct result of ergotic action, and, as a consequence of restricted utero-placental circulation, the life of the fœtus is jeopardized. When, therefore, the drug is used, the heart-sounds of the fœtus should be carefully watched, and, with the first signs of failing force, the forceps should be applied to rescue the child from the impending danger of asphyxia.

Note on the Use of Ergot in Parturition.—*Secale cornutum*, or ergot, the active principle of which is ergotin, according to Buchheim,† and ergotic acid, according to Zweifel,‡ is universally acknowledged to increase the frequency, length, and power of the uterine contractions during parturition, and to finally induce a tetanic condition of the uterine muscular fibers. Its action upon the unimpregnated uterus is the same in kind, but less marked in degree, and of less constant occurrence. The views of high authorities in regard to the manner in which these effects are produced present irreconcilable differences. Wernich# attributes the ecbolic properties of ergot to irritation of the uterine nervous centers, induced by arterial anæmia of the spinal cord and of the uterine tissues. This anæmia is referred by him to loss of tone in and dilatation of the veins, whereby venous congestion, leading to secondary arterial anæmia, is produced.‖ Other observers assume a primary contraction of the capillaries, with a consequent increased arterial pressure, as the source of the anæmic irritation of the

* E. Bidder, "Zur Beurtheilung der Kristeller'schen Expressionsmethode bei Kopflagen," "Ztschr. f. Geburtsh. u. Gynaek.," Bd. iii, p. 241.

† Buchheim, Schmidt's "Jahrb.," vol. clxiv, p. 12.

‡ Zweifel, "Ueb. d. Secale corn.," "Arch. f. exp. Pathol.," vol. iv, 1875, p. 407.

Wernich, "Einige Versuch. üb. d. Mutterk.," "Beiträg. z. Geburtsh.," vol. iii, 1874, p. 102.

‖ Wernich, *op. cit.*, p. 97.

nerve-centers; while still others believe direct stimulation of the uterine muscular fibers, by the ergot, to be the cause of their exaggerated contractility.*

Köhler refers the uterine contractions produced by ergot to increased irritability of the peripheral nerves, in conjunction with anæmia of the spinal cord.† These conflicting views pertain chiefly to points of purely theoretical interest, and need not prevent the obstetrician from obtaining a clear conception of his duty in the practical administration of ergot. The above-mentioned incontrovertible facts concerning its operation suffice to guide the physician in the employment of this useful drug, even if he be unable at present to definitively decide regarding the exact mechanism of its physiological action.

Ergot should never be exhibited during the first stage of labor, because the tetanic uterine contractions, which it substitutes for the normal rhythmical ones, tend to prevent the further dilatation of the os uteri and to deprive the fœtus of its blood-supply through the constriction of the uterine vessels. Should the membranes have ruptured before the termination of the first stage, the administration of ergot would endanger the life of the fœtus by causing undue pressure to be exerted upon the umbilical cord. We should also abstain from the use of ergot during the second stage, unless it seem necessary as a prophylactic against *post-partum* hæmorrhage. Even under these circumstances it should never be administered if there be the slightest mechanical obstacle to delivery, or if the fetal head be high up in the pelvic canal. Spiegelberg‡ insists upon the necessity of carefully observing the fetal heart after the use of ergot, in order that instrumental delivery may, in case of threatened asphyxia, be promptly resorted to. Benicke records twenty-seven cases in which ergot was administered during the second stage on account of inertia uteri. Spontaneous delivery occurred in only seven of these cases.* Ergot is not specially adapted to the arrest of hæmorrhage accompanying abortion. In these cases, and in hæmorrhage caused by retained shreds of the fetal envelopes, the appropriate treatment consists in the tampon and in subsequent complete evacuation of the uterine cavity. The only imperative exhibition of ergot is presented by the occurrence of *post-partum* hæmorrhage resulting from uterine atony.‖ The unyielding, tetanic uterine contractions which it produces act most beneficently by occluding the orifices of the bleeding vessels. Even under these circumstances it should, however, be withheld until after the expulsion of the placenta, lest the uniform uterine contractions lead to its prolonged retention or interfere with manual efforts for its extraction.

Irregular Pains in the Third Stage of Labor.—The tardy expulsion of the placenta, due to atony of the uterus, is of rare occurrence when the Credé method of expression is uniformly practiced. As, in relaxed conditions of the uterus, blood pours from the patulous mouths of the torn utero-placental vessels into the fundus, a free external discharge of blood follows of necessity whenever contractions are excited—a fact to be borne in mind by an unpracticed obstetrician, lest he mistake the simple conversion of an internal into an external

* Benicke, "Ueb. Anwend. d. Mutterk. in d. Geburtsh.," "Ztschr. f. Geburtsh. u. Gynaek.," vol. iii, 1878, p. 174.

† Köhler, Schmidt's "Jahrb.," vol. clxiv, p. 14. ‡ Spiegelberg, "Lehrb.," p. 414.

* Benicke, *op. cit.*, p. 178. ‖ Schroeder, "Lehrb.," fifth edition, p. 471.

hæmorrhage for one produced by the manipulations which have been recommended. The whole subject of atony in the third stage is, however, so closely associated with the occurrence of *post-partum* hæmorrhage that its specific consideration will be reserved for separate study in connection with the hæmorrhages which take place during and subsequent to labor.

After the birth of the child, retraction of the uterus is Nature's safeguard against hæmorrhage. As a result of the abuse of ergot, or, in other cases, from an abnormal adherence of the placenta, such an extreme degree of retraction may be reached before the completion of the third stage as to lead to the imprisonment of the placenta within the uterine cavity. In these cases, complete retraction in the body of the uterus is prevented by the presence of the placental mass. Below the latter, where no obstacle is opposed to the shortening of the muscular fibers, a constriction results. The stricture is most pronounced at the contraction ring. The lower uterine segment and the cervix proper are usually in a sub-paralytic condition, and widen from above downward to the vaginal insertion. From the shape thus imparted to the uterus, this condition is generally known as an "hour-glass contraction." When met with for the first time, it is apt to prove extremely puzzling. In following the cord upward, its continuation through the stricture is sometimes overlooked. In several cases I have known the pulpy mucous membrane of the lower segment to be mistaken for an adherent placenta, and have been, in consequence, summoned to assist in its removal.

Treatment.—By patient waiting, relaxation of the stricture usually takes place spontaneously. The result may be promoted by the hypodermic injection of morphia, combined with atropia. It is not, however, altogether safe to leave the patient before the expulsion of the placenta has taken place; for, exceptionally, the muscular fibers of the body of the uterus may relax prior to those of the lower segment, and thus hæmorrhage may result. Injections of ice-cold water were recommended in such cases by Seyfert, as tending not only to restrain hæmorrhage, but to promote regular expulsive uterine action. Forcible dilatation is rarely necessary, and should be reserved for hæmorrhages of an alarming character. In nearly all cases, however, it is practicable, even in extreme examples, to extract the placenta in a short time without force or violence. The plan I have followed of late years, with uniform success, consists in introducing the index and middle fingers, with the whole hand in the vagina, to the point of constriction. Then, by pressing the uterus downward, the fingers are brought in contact with the placental border. Now, it is only necessary to draw a single cotyledon into the canal to render the further extraction a matter of certainty. Under the pressure of the soft placental mass the stricture relaxes slowly. By combining ex-

pression with slight traction, the delivery is surely accomplished. The principal difficulty of the operation lies in the manipulations needful to bring the placenta at the outset to the point of stricture, but this difficulty can be pretty certainly overcome by patience and the determination to succeed. During the period of withdrawal, the operator should be content with a very slow progression, proportioned to the yielding of the stricture; otherwise the presenting portion of the placenta tears away, when the labor expended is lost.

Painful Labors.—In nearly all forms of abnormal uterine contractions the pain of labor reaches a pathological degree of intensity. Especially we have had occasion to call attention to the intolerable suffering in cases of long-continued reciprocal pressure between the uterus and its contents.

But acute suffering sometimes attends upon the preliminary stages of labor. During the latter days of pregnancy in primiparæ, often for a few hours only preceding the advent of true labor-pains in multiparæ, contractions occur which normally scarcely attract the attention of the patient. In rare instances, however, the suffering they occasion is extreme. In hysterical women these preliminary pains are often of an agonizing character, rendering it necessary to resort for their relief to such palliatives as the warm bath, opium, and chloroform.

But, even where hysteria does not exist as a cause, the pains may be so severe, while the cervix has still its normal length, that the woman believes herself in labor, and, indeed, the contractions are as painful as in actual labor. There are no febrile symptoms indicative of inflammation either of the uterus or of its appendages. The pain is like that in muscular rheumatism. Though the term rheumatism of the uterus is often applied to this condition, its pathology is uncertain. It is very probable that practitioners confound together, under the foregoing title, a number of distinct affections, such as hysterical hyperæsthesia, intestinal irritability, and the early stages of inflammation. Excluding these morbid conditions, there remains a class of cases practically important from the disappearance of the pain upon the induction of intense diaphoresis. Patients, who for days have been treated with hypodermic injections of morphia, with only moderate results, are often relieved as if by magic by placing them in a warm bath, and then covering them with blankets, giving in addition hot drinks and Dover's powder, until they become bathed in abundant perspiration.

It is often difficult, toward the close of pregnancy, to distinguish between colic-pains due to fecal accumulation, or the presence of gases in the stomach and intestines, troubles to which pregnant women are especially disposed, and uterine contractions of a painful character.

Indeed, in the former case the uterus becomes involved to some extent, so that the cervix is felt during a cramp to simultaneously harden. Moreover, after labor has actually begun, it may become complicated by colic-pains, which exercise in turn a suspensive influence upon parturition. But the colic-pains are themselves intermittent, and are, therefore, liable to be mistaken for those of labor. Thus it is possible to become involved in perplexities which time alone can solve. Even when we have made out the diagnosis of "false labor," and give an opiate for the relief of the patient, it may happen that the first result of quieting the pain may be the acceleration of labor. When this does not occur, we should guard against the return of the trouble by clearing out the bowels by purgatives or enemata.

In normal labors, the pulse becomes more rapid at the beginning of each pain, and continues to increase in frequency until the pain has reached its acme, after which a gradual declination follows. But sometimes labor is attended by marked febrile symptoms. There exist rapidity of the pulse between the pains and a continuous elevation of temperature. Now, if, at the same time, the uterine contractions are the source of extraordinary suffering, there is strong reason for suspecting that labor is complicated by inflammatory conditions of the organs concerned in parturition. Thus, a latent pelvi-peritonitis may be converted into the acute form by the several acts which comprise normal labor, or the prolonged tonic contraction of the uterus upon the fœtus after the rupture of the membranes, especially in neglected shoulder presentations and in contracted pelves, may give rise to inflammatory affections in the uterus itself. In either case the coexistence of intense pain with febrile symptoms should awaken serious apprehensions. Especially ought we to be upon our guard against the treacherous lull in the symptoms that, as a rule, takes place when labor is at an end. After a day or two we may expect a chill and the return of the fever. In the early stages of metritic and perimetritic trouble, a ten-grain dose of calomel often exercises a beneficent action in arresting the disease. Where labor has so far advanced that the induction of artificial diarrhœa is rendered impracticable, opiates, though of inferior value, soothe the pain, and are our next most valuable resource.

CHAPTER XXV.

CONTRACTED PELVES.

Varieties.—Frequency.—Diagnosis.—Pelvic measurements.—Forms of the contracted pelvis.—Justo-minor pelves.—Flattened non-rachitic pelves.—Rachitic flattened pelves.—Generally contracted, flattened pelves.—Irregular forms.—Pseudo-osteomalacia.—Scoliosis.—Kyphosis.—Influence of contracted pelves during pregnancy and labor.—Influence upon the uterus.—Influence upon the presentation.—Influence upon the pains.—Influence upon the first stage of labor.—Influence upon the mechanism of labor.—Effects of pressure upon the maternal tissues.—Influence upon the fetal head.—Effects of pressure upon the integuments; upon the cranium.—Prognosis.

In contracted pelves sometimes a single diameter, sometimes all the principal diameters are reduced below the normal average. The relative proportion of the parts may be to a considerable extent preserved, or the pelvis may have been distorted by special morbid conditions, giving rise to unequal development and changes of outline. These peculiarities embarrass all attempts at classification. Still, the study of the subject is greatly simplified by the fact that the diminished space is, in the great proportion of cases, located chiefly at the brim. Aside from these, there remain a variety of irregular forms of rare occurrence, each requiring a separate description and plan of treatment.

It is to those cases in which the narrowing is chiefly at the brim that the term "contracted pelves" is generally applied. The other forms are all specially designated by some qualifying adjective defining their character.

Contracted pelves proper are divided into—

1. The pelvis æquabiliter justo-minor, in which all the diameters, from the brim to the outlet, are diminished in very nearly equal measure.

2. The flattened pelvis, contracted specially in the conjugate diameter. In this form, the transverse diameter may be normal, or may be diminished. Thus, we distinguish—

a. Simple flattened pelves (transverse diameter normal).

b. Flattened, generally contracted pelves (narrowing in the transverse as well as the conjugate diameter).

As it is rare to find two pelves possessing the same measurements, the question arises as to the degree of antero-posterior shortening which suffices to distinguish the contracted from the normal pelvis.

It is often customary to consider the contracted pelvis simply as furnishing a mechanical obstacle to the passage of the child's head; but this is to overlook a great variety of very important modifications to which it gives rise during pregnancy and labor. These remoter

influences are often observable in cases where labor, if considered from the standpoint of length alone, would be regarded as normal.

Michaelis * and Litzmann,† whose investigations furnish the basis of modern opinion regarding the contracted pelvis, place the limit at three and a half inches for the simple flattened pelvis, and at four inches for those likewise diminished in the transverse diameter. Yet even above these limits the action of the narrow pelvis is not rarely manifested in disturbance of the normal mechanism of labor.

In Germany, Litzmann, Michaelis, Spiegelberg, and Schroeder‡ place the average frequency of contracted pelves at fourteen per cent., and in my own field of experience, in the Emergency and Maternity Hospitals of New York City, the inmates of which are, however, almost entirely of foreign birth, every variety and degree of pelvic deformity finds abundant illustration. In our native American women abnormal pelves are rare. I frequently hear from country physicians, who attend lectures at the Bellevue Hospital Medical College, that, in long years of practice, they have never met with a single instance. Yet it is impossible to study the cases of vesico-vaginal fistulæ reported by Dr. T. A. Emmet # without arriving at the conclusion that the existence of contracted pelves is frequently overlooked. Certainly the immunity of American women is by no means so absolute as to justify the neglect into which the study of pelvic deformity has so generally fallen.

The Diagnosis of Contracted Pelvis.—The diagnosis of pelvic deformity is based upon direct examination. Certain facts in the previous history of the patient are often of substantial value in the way of confirmatory evidence, or by directing attention to the probable existence of deformity.

Previous History.—Inquiry should be instituted regarding the occurrence of rickets in early childhood, and especially in this connection as to the period of the appearance of the teeth. Late dentition is an ordinary sign of imperfect bone formation. A cross baby, bottle-fed, or improperly nursed, suffering from repeated attacks of indigestion, from restlessness at night, and profuse perspirations, who cuts the first incisor teeth in the second year, has presumptively had rickets. A history of this nature, even in the absence of the grosser evidences of rickets, such as the square head, the pigeon-breast, the tumefied abdomen, small stature, spinal curvature, enlarged joints, and incurvation of the long bones of the extremities, is to be regarded with suspicion. Data of the kind mentioned are, however, often difficult to

* Michaelis, "Das enge Becken," Leipsic, 1865.

† Litzmann, "Die Formen des Beckens," Berlin, 1861.

‡ Spiegelberg, "Lehrbuch," 1878, Bd. ii, p. 426.

Emmet, "Vesico-Vaginal Fistula," William Wood, 1868.

obtain, and it should be borne in mind that not every case of mild rachitis is followed by pelvic narrowing.

Instruction may likewise be obtained from the history of previous labors. Though a protracted and difficult labor is by no means uncommon in well-formed primiparæ, it should stimulate us, both during parturition and subsequent to delivery, to make a careful investigation as to the capacity of the pelvis. A pendulous abdomen and faulty presentations and positions of the fœtus occur with much greater frequency in contracted than in normal pelves.

Certain of the rarer deformities proceed from inflammations between the sacro-iliac bones and at the hip-joint, from inequalities in the length of the limbs, and from spinal distortion when these difficulties occur in early childhood.

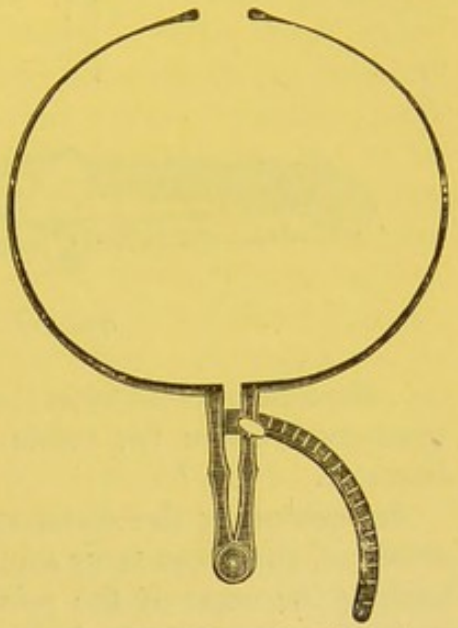


Fig. 213.—Baudelocque's pelvimeter.

Pelvic Measurements.—The examination should be made with the patient upon her back, placed preferably upon a hard table covered by a folded blanket, or a woolen comforter. The head and shoulders should be moderately elevated, the knees should be flexed, and the pelvis brought as near to the edge of the table as possible.

Facility in the recognition of abnormal conditions can only be acquired by making it a habit to note the general features of the pelvis in every case of labor which is committed to our charge. By experience we acquire a tolerably distinct idea of the relative thickness of the bones, the inclination of the ilia to the horizon, the height and angle formed by the symphysis pubis, the size and character of the pubic arch, the length, breadth, and curvature of the sacrum, the position of the promontory, and the distance between the ischia.

More exact information is derivable from direct measurements between different prominent points in the pelvis. Various pelvimeters have been devised to facilitate the required measurements. Those for determining the distance between certain external points are alone of practical value. For this purpose the circle of Baudelocque is the one I have most constantly employed. It requires to be used with caution on account of the spring of the metallic arms. Schultze's instrument possesses the advantages of greater firmness and portability. The points selected for measurement should be bony prominences, easy of recognition, and not covered by soft parts. They should be such as

to allow us to form at least approximative conclusions relative to the diameters of the small pelvis. Experience shows us that, judged by these rules, three measurements only are possessed of real importance,

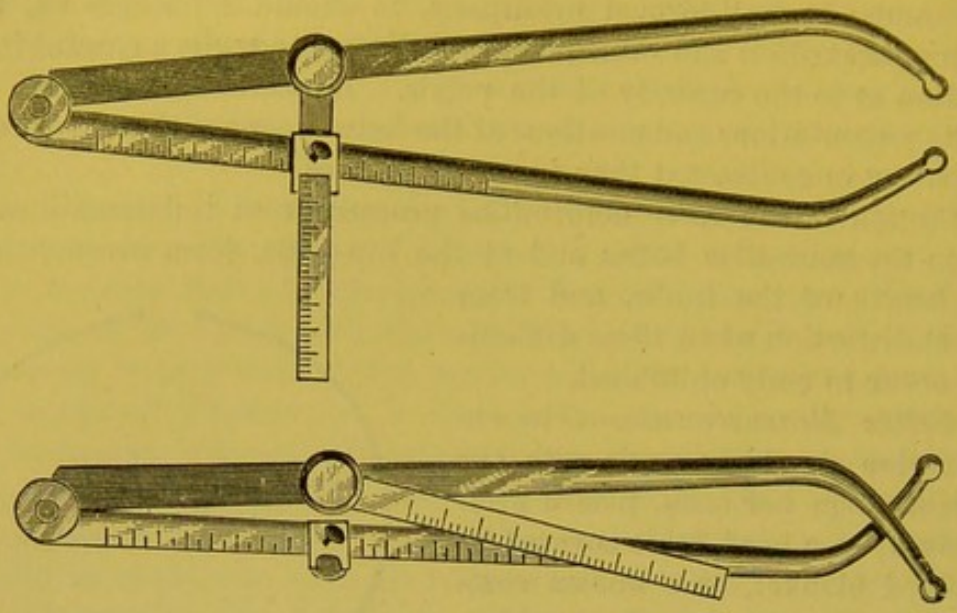


Fig. 214.—Schultze's pelvimeter.

viz., the distances between the anterior superior spinous processes, the distances between the crests of the ilia, and the external conjugate diameter.

In measuring the distances between the anterior superior spinous processes, the accoucheur should stand by the side of his patient, and, holding the arms of the pelvimeter between the thumb and fingers, apply the points of the instrument to the spines external to the insertion of the sartorius muscles. The points should then be pushed backward a number of times along the outer edge of the crests of the ilia, until, after a few trials, the greatest distance between the crests has been determined. The average distances thus obtained are nearly ten and a quarter inches between the spinous processes, and eleven and a half inches between the crests of the ilia. A pelvis in which these measurements are equal, or in which the relations are inverted (i. e., where the distance between the spinous processes is greater than that between the crests of the ilia), is rachitic in character. In rachitic pelves of the second variety mentioned it is customary to select, in measuring the distance between the crests, points situated two and a half inches posterior to the spinous processes.

Any considerable falling below the normal average in these two diameters would warrant the diagnosis of transverse shortening in the inner dimensions of the small pelvis. Deductions as to the degree of shortening should, however, be made with caution, as the relations between the diameters of the large and small pelves depend upon such

variable factors as the thickness of the bones and integuments, and the height and inclination of the ilia to the horizon.

In measuring the external conjugate diameter the patient is turned upon her side; one extremity of the pelvimeter is then placed upon the fossa just beneath the spinous process of the last lumbar vertebra, while the anterior point is made to rest upon the middle of the upper border of the symphysis pubis. The length of the external conjugate, or, as it is sometimes termed from its author, the diameter of Baudelocque, is normally about eight inches. Baudelocque thought that by deducting three inches from the external conjugate in spare women, and three and a quarter inches in women of a fleshy habit, the conjugata vera could be determined. Litzmann has, however, strikingly shown the fallacy of Baudelocque's deduction. In thirty cases, where he had an opportunity to compare the measurements of the external conjugate with the length of the internal conjugate as determined subsequently by *post-mortem* examination, he found the mean amount to be deducted was about three and a half inches. However, the amount in individual cases widely varied, owing to differences in the thickness of the bones and integuments, the maximum amounting to nearly five inches, while the minimum did not exceed two and three fourths inches. But, while the external conjugate does not enable us to estimate to a fraction the length of the antero-posterior diameter of the pelvic brim, it furnishes useful information as to the existence in general of flattening. Thus, if the diameter of Baudelocque measures less than six and one fourth inches, it may be assumed that the pelvis is flattened. If the pelvis measures less than seven and a half inches, flattening may be assumed in half the cases. Above seven and a half inches, antero-posterior shortening is very exceptional.*

For internal measurements, the only practical pelvimeter is the hand of the accoucheur. To be sure, it can only determine with exactitude the diagonal conjugate, i. e., the distance from the lower border of the symphysis pubis to the promontory; but from the diagonal conjugate it is possible to calculate the conjugata vera with a closer degree of accuracy than is obtainable by means of any of the ingenious instruments designed to measure directly the diameters of the brim.

To ascertain the diagonal conjugate, the index and middle fingers of the left hand should be introduced, well oiled, into the vagina. By pushing the posterior vaginal wall backward, the points of the fingers are made to reach the sacral vertebræ. Then, following the sacrum upward, the promontory is reached. To do this it is necessary to sink the elbow, and give to the fingers a nearly vertical direction. The resistance of a rigid perinæum and the vaginal wall is best overcome

* Litzmann, "Ueber die Erkenntniss des engen Beckens," Volkmann's "Samml. klin. Vortr.," No. 20, p. 148.

by continued, steady, upward pressure. It is often possible by this method to reach the promontory in even normal pelves. During the examination the patient should be requested to raise up her hips. The promontory is recognized partly by its convex surface, and partly by

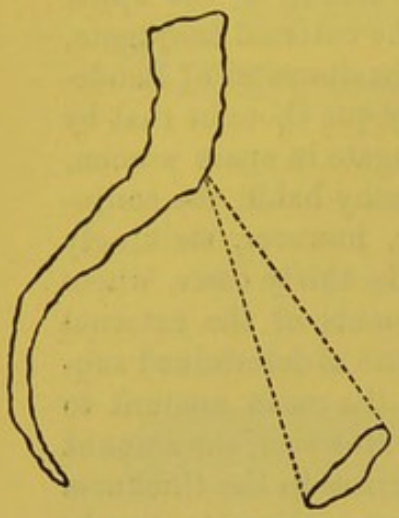


Fig. 215.—Normal inclination of the symphysis pubis. (Spiegelberg.)

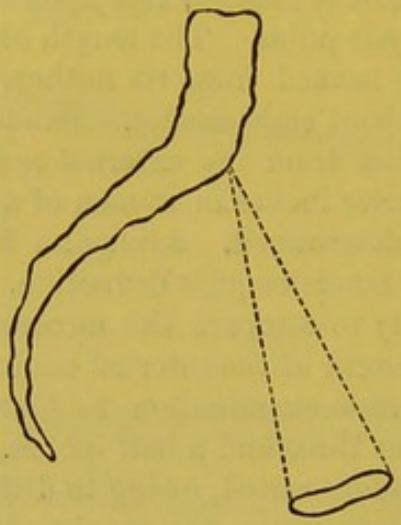


Fig. 216.—Diminution of angle between symphysis and pelvic brim.

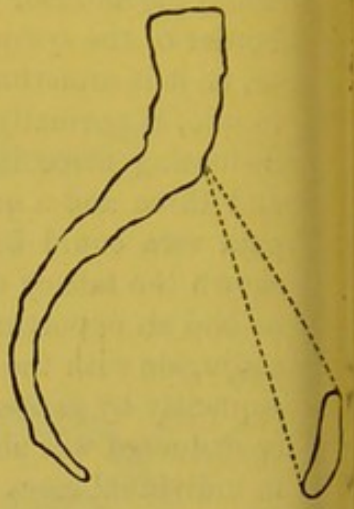


Fig. 217.—Increase of angle between symphysis and pelvic brim.

the width of the cartilage which intervenes between it and the adjoining lumbar vertebra. In practice there are two possible sources of error, viz.: an angle may form between the first and second sacral vertebræ where the union has been incomplete, producing a "false promontory" beneath the true one; or the upper surface of the first lumbar vertebra may project in such a way as to be mistaken for the promontory in cases where the latter, as sometimes happens, forms with the spinal column a very obtuse angle.* Such deviations are not without practical interest, as the prognosis is rendered less promising when the head, in place of a single point of contact, has to overcome the resistance offered by the surface of an entire vertebra.

The measure of the diagonal conjugate is taken by pressing the middle finger firmly against the most salient portion of the promontory, while the radial edge of the hand or index-finger is raised to the *ligamentum arcuatum*. The point of contact with the latter is then carefully marked with the nail of the index-finger of the right hand. It is desirable in withdrawing the fingers that they maintain, as nearly as may be, the position assumed at the time of measurement. Finally, with a small rule, the length from the mark of the nail to the tip of the finger is readily ascertained.

In calculating the length of the conjugata vera from the measure

* Litzmann, "Ueber die Erkenntniss des engen Beckens," Volkmann's "Samml. klin. Vortr.," No. 20, pp. 152, 153.

thus gained, it is necessary to reconstruct the triangle formed by the two conjugates and the symphysis pubis. The diagonal conjugate is the longest of the three sides. The length of the conjugata vera depends on the height and inclination of the symphysis pubis, and the degree of elevation of the promontory above the symphysis, as may be readily seen by reference to the diagrams.

The height of the symphysis pubis may be determined by the finger through the anterior vaginal wall. When the symphysis does not measure above one inch and a half, the subtraction of two thirds of an inch from the diagonal diameter will, under ordinary circumstances, furnish very nearly the conjugate. When the symphysis exceeds one inch and a half, three fourths of an inch should be deducted.*

The inclination of the symphysis pubis to the plane of the brim and the height of the promontory above the upper border of the pubes can only be estimated. When any unusual deviations in either of these regards are found to exist, some special allowance would need to be made by way of compensation. It is just here that judgment and experience furnish the best safeguards against vital inaccuracies.

In thin persons during the non-pregnant state, the promontory can sometimes be easily reached through the abdominal walls, and an estimate made of the conjugate by deducting, from the distance thus obtained between the promontory and the symphysis, the supposed thickness of the intervening tissues.

The transverse diameters of the pelvic brim and cavity can be neither directly measured nor calculated with any degree of certainty from other measurements.

There are certain other dimensions which we find useful to determine in the rarer forms of distortion, and which will be mentioned in their proper connections. For the three forms of contracted pelvis which at present engage our attention, four measurements alone are of practical value—viz., the distance between the anterior superior spinous processes; the distance between the crests of the ilia; the external conjugate; and the conjugata diagonalis.

The Three Principal Forms of Contracted Pelvis.

The Pelvis Æquabiliter Justo-Minor, or Symmetrically Contracted Pelvis.—This, the rarest of the three forms, presents to the casual view the appearance of a normal pelvis, except that the diameters from the brim to the outlet are reduced in nearly equal measure. We distinguish two varieties of this pelvis: 1. In the commoner variety the woman may be of small, medium, or large stature, and her figure thick-set, or, on the contrary, graceful and slender. Nothing in either

* Spiegelberg, *op. cit.*, p. 433.

her size or carriage is indicative of any abnormal condition. The pelvic bones themselves, both in their structure and in their connections with one another, are free from all traces of morbid action. They are simply below the standard size. The pelvis as a whole is of the feminine type. Litzmann has shown, however, that in the *justo-minor* pelvis the relations of the different parts to one another are not, as a rule, absolutely the same as in the normal pelvis. Thus, there is diminished width of the sacrum, due in special degree to the small size of the alæ ; the rotation forward of the promontory and the curving of the lower extremity of the sacrum are less pronounced ; the concavity of the sacrum in the transverse direction is increased ; the posterior sacral surface is nearly on a level with the posterior superior spinous processes in place of sinking forward between the ilia ; the height of the anterior and lateral walls is proportionately lessened ; and, finally, there is often an increase in the angle which the symphysis pubis forms with the conjugate.*

These peculiarities point to a premature arrest in the development of the bones, whereby the pelvis retains something of the infantile type. The causes of arrest are in most cases traceable to general disturbances of nutrition during early childhood, such as scrofula and chlorosis, to rickets, which in place of leading to deformity exceptionally exerts its influence in the suspension of bone-growth, and in rare cases to the influence of hard labor and the carrying heavy weights before the completed development of the body. A few cases in which no morbid conditions can be elicited from the history of the patient may perhaps be referred to some original defect in the primitive material from which the bones were built up. Cases have been reported in which this anomaly appeared to be hereditary.†

2. In veritable dwarfs the diminutive size of the pelvis may simply correspond to the Lilliputian proportions of the entire skeleton. These so-called dwarf pelves—*pelves nanæ*—are of the regular feminine type, but the bones are slight, and united, as in the child, by cartilage. They are extremely rare. In pelves of this variety the highest degree of contraction is observed.‡

Diagnosis.—In the *justo-minor* pelvis all the external diameters are diminished. At the same time, rickets is excluded by the normal relations existing between the spines and the crests of the ilia (*vide* p. 464). The diagonal conjugate is lessened. In estimating the conju-

* Litzmann, "Die Formen des Beckens," Berlin, p. 40.

† Michaelis, "Das enge Becken," herausgegeben von Litzmann, p. 190; *vide* likewise, Löhlein, "Zur Lehre vom Durchweg zu engen Becken," "Ztschr. f. Geburtsh. u. Frauenkr.," Bd. i, p. 53.

‡ There is a third form of justo-minor pelvis, which is the concomitant of undeveloped organs of generation. As it occurs only in sterile women, it possesses no obstetrical interest.

gata vera it is necessary carefully to notice the height of the promontory, and the inclination of the anterior pelvic wall, as these are sometimes exaggerated and call for an increase in the amount to be de-

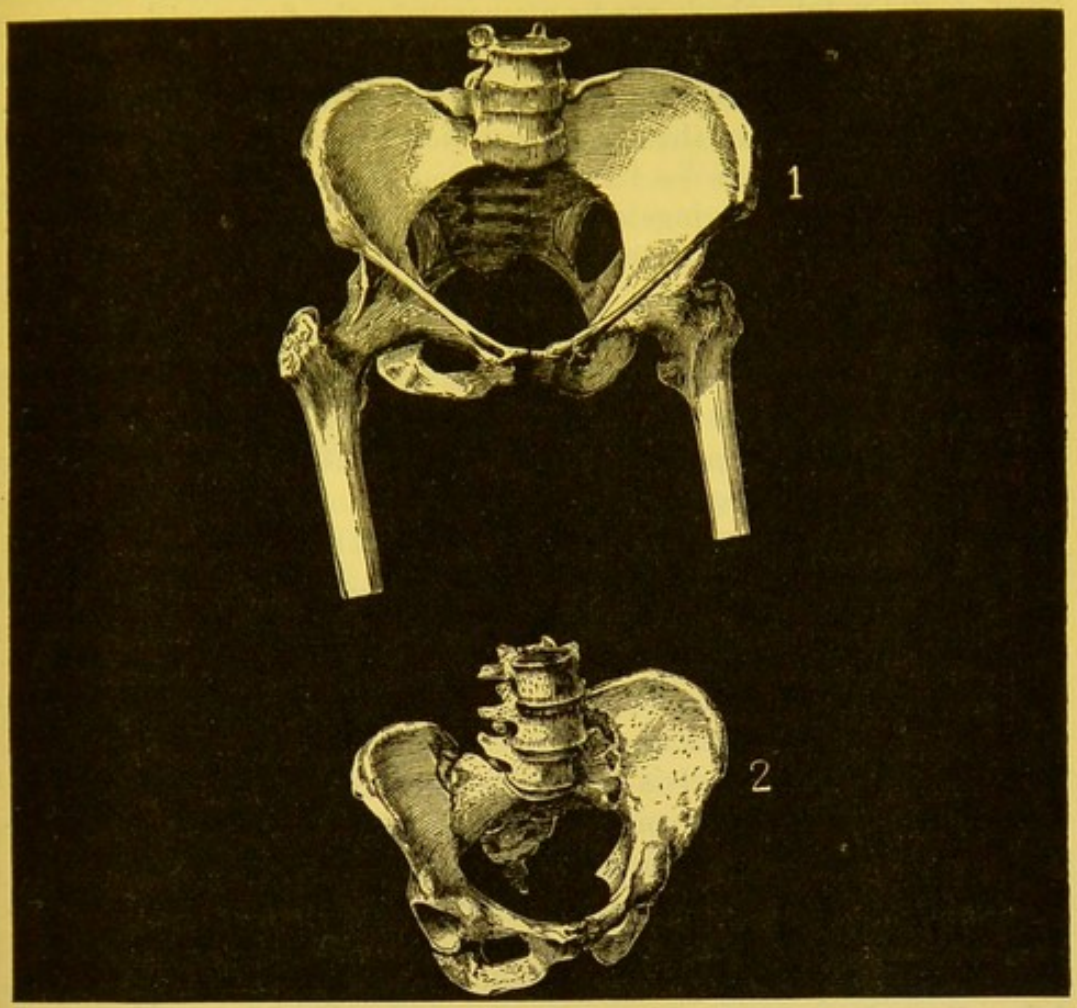


Fig. 218.—Specimens from the Wood Museum (Bellevue Hospital). Drawn on same scale. No. 1. Normal pelvis. No. 2. Justo-minor pelvis.*

ducted.† By careful palpation of the two sides of the pelvis with the half-hand introduced into the vagina, the fact but not the degree of transverse shortening may be recognized. Still, in this way the ex-

* Primipara, aged twenty-three. In labor three days previous to my seeing her. Waters all escaped. Large scalp-tumor reaching nearly to vulva. Cervix rigid. Os one third dilated and pushed down by scalp-tumor. Forceps tried. Afterward perforation and craniotomy. Chin tilted and head brought through the pelvis by the fronto-mental diameter. Patient died on third day. Extensive marks of pressure in the bladder opposite pelvic rami. Small circular perforation of uterus opposite promontory. Conjugate diameter three inches. Transverse diameter of brim four and a half inches. Slight Naegele obliquity on left side. Patient was fifty-nine inches in height, and presented no signs of rickets.

† On the contrary, owing to the shortness of the symphysis pubis, as a rule, the average amount to be deducted is rather less than in normal pelves. Löhlein ("Kunsthülfe bei der allg. Beckenenge") found the average in eighteen cases was three fifths of an inch.

istence of extreme contraction would be noticed.* Löhlein maintains that the addition of four fifths of an inch to the distance from the lower border of the ligamentum arcuatum and the upper border of the great sciatic notch, which can be measured by the finger without great difficulty, furnishes a close approximation to the length of the transverse diameter. In ordinary cases, it is fortunately safe to base practice upon the length of the antero-posterior diameter.

Flattened Pelvis.—We have seen that the characteristic of this form is a shortened conjugate diameter. The transverse diameter remains at the same time normal, or may sink below the standard. A special distinction is likewise to be made between the flattened pelves of non-rachitic and rachitic origin :

1. The flattened non-rachitic form is the most frequent variety of contracted pelvis. At a first glance, or previous to measurement, it often produces the impression of a normal, well-formed pelvis. It is occasioned by a sinking of the sacrum downward and inward between the two ilia. As this movement takes place without any forward rotation of the promontory, the antero-posterior shortening is not confined to the brim, but extends throughout the entire pelvic cavity. Extreme contraction is uncommon, the length of the conjugate rarely falling below three inches. The flattening is of necessity associated with a compensating increase in the transverse diameter. As, however, the flattened non-rachitic pelvis is usually from the outset of small size, the compensation hardly suffices to give to the transverse diameter more than the normal dimensions. Indeed, it is not infrequent to find a slight lessening in the transverse diameter associated with antero-posterior contraction.

There is nothing definitely settled regarding the etiology of this deformity. It has been attributed to lifting and carrying heavy burdens before the age of puberty, to incompletely developed rickets, and to retarded development.

During life it is not easy to distinguish between this form and that of the symmetrically contracted pelvis. In both the external signs of rickets are absent, the relations between the spines and crests of the ilia normal, and in both all the external diameters may be somewhat diminished. The stature of the individual furnishes no clew; for, though both forms occur rather more frequently in diminutive persons, there are numerous exceptions to the rule. The sinking of the sacrum between the ilia is not easy to recognize. In a well-marked example, however, the relatively greater shortening of the conjugata externa and the diagonal conjugate,† with the difficulty of palpating the inner

* Löhlein, "Zur Becken-Messung," "Ztschr. f. Geburtsh. und Gynaek.," vol. xi, part i, p. 33.

† In reckoning the true conjugate from the diagonal diameter, the same reduction needs to be made as in the normal pelvis, for, though the outward slant of the symphysis

surface of the pelvic lateral walls, furnish the prominent points for guidance. Sometimes, when no bony union has formed between the first and second sacral vertebræ, a double promontory may be felt.

2. The rachitic form of flattened pelvis presents the following characteristics :

The bones are of small size, but usually of normal texture. Sometimes, however, they are thin, and even translucent, while in other instances they may be unusually compact and thickened. The ilia are flattened, and run in a nearly horizontal direction. The anterior superior spinous processes flare outward, so that the distance between them differs little from that between the widest points of the crests. The promontory projects inward toward the symphysis pubis. The upper portion of the sacrum sinks inward between the ilia, and lies farther in front of the posterior superior spinous processes than in the normal pelvis. The upper portion, too, is directed nearly horizontally backward, while the extremity, usually at the fourth or fifth sacral vertebra, is bent sharply forward. The anterior sacral surface loses its transverse concavity, and becomes either flat from side to side, or convex from the bulging forward of the sacral vertebræ. The antero-posterior shortening of the brim is accompanied by a compensating increase in the transverse diameter. As, however, the rachitic pelvis is originally undersized, the transverse diameter rarely exceeds normal dimensions. The horizontal rami of the pubes are flattened, and the acetabula are directed to the front. The cartilage of the symphysis pubis generally projects inward, the pectineal line is often unusually sharp, and at times terminates at the insertion of the psoas muscle in a projecting spine. Below, the ischia diverge from one another, and the arch of the pubes is widened.

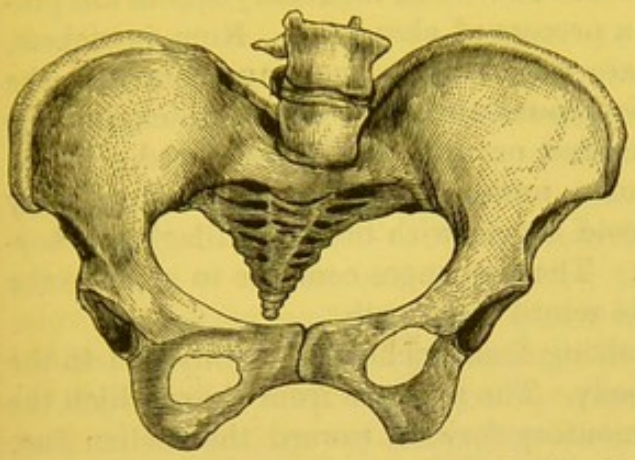


Fig. 219.—Flattened rachitic pelvis. (Wood's Museum.)

The result of these changes is to produce a shallow pelvis, with contraction at the brim, and widening at the outlet. The shape of the brim varies between a long ellipse and that of a heart or kidney, the different degrees of variation depending upon the extent of the displacement forward of the promontory. Externally, owing to the horizontal position of the sacrum, a depression exists in the lumbar re-

is increased, this is compensated for by the diminished height of the symphysis and low position of the promontory. (Litzmann, Volkmann's "Samml. klin. Vortr.," No. 20, p. 160.

gion, the sulcus between the nates is broad and superficial, and the anal orifice is exposed to view.

To appreciate the rachitic pelvis, it is necessary to bear in mind the changes wrought by rickets in the bony structures. In the physiological growth of the pelvic bones, new cell-elements develop beneath the periosteum and adjacent to the cartilaginous borders upon the articular surfaces. These cell-elements promptly ossify, and thus provision is made for the increase of the bones in extent and thickness. Simultaneously with the formation of the new bone, medullary spaces are produced in the bony tissues by a process of absorption. Now, in rickets, while the new cell-elements are deposited in such numbers that the preparatory layer is often five to ten times the normal thickness, the process of ossification is suspended or imperfectly performed. Thus, the rachitic pelvis consists of a number of more or less firm, bony masses, covered with soft osteoid layers, with broad cartilaginous borders at the articular surfaces. These changes combine to increase the pliability of the pelvis, and to retard its growth.

The pelvic deformity resulting from rickets is mainly due to the weight of the superimposed body. The pressure from above which the trunk exerts pushes the promontory forward toward the median line. At the same time the upper portion of the sacrum rotates upon its transverse axis, so that its posterior aspect is nearly on a line with the horizon. The bodies of the vertebræ sink downward between the flexile wings, whereby the concavity of the sacrum from side to side is effaced. The pliant border of the iliac articulation yields somewhat, and, as it is drawn inward by the sinking of the sacrum, the traction of the strong sacro-iliac ligaments approximates the posterior superior spinous processes to one another. The traction of the sacro-tuberous and sacro-spinous ligaments aids in hooking forward the lower extremity of the sacrum, though to this deformity the pressure exercised upon the end of the spinal column by the half-sitting, half-recumbent posture, affected by rachitic children, unquestionably contributes its part.

If we regard the sacrum as a fulcrum, and each os innominatum as a lever, it is evident that the traction of the sacro-iliac ligaments, under the pressure upon the sacrum from the trunk, would produce a separation of the innominate bones in front were it not for their firm union at the symphysis pubis. The result of these two counteracting forces is an increased incurvation of the bones at the point of weakest resistance, which is situated near the auricular surfaces. In advanced rickets, where the bones are plastic and willowy, the linea arcuata is often bent at an angle, so that the greatest transverse diameter divides the pelvic brim into a posterior and anterior half. To the latter belong the acetabula, to the former the two ilia.

The outward direction of the anterior superior spinous processes is

probably due in a measure to an arrest of development, as the S-shaped curve of the crests of the ilia does not normally develop until after the age at which rickets usually makes its appearance (Kehrer). The flattening of the ilia is partly due to the drag of the sacro-iliac ligaments, and partly to the action of the sartorii and gluteal muscles. The divergence of the ischia and the wide arch of the pubes are the product of the increased transverse diameter, and the attachments of the rotator and adductor muscles of the thigh.*

The diagnosis of the rachitic form of flattened pelvis is easy, if the characteristic changes are kept in mind. The prominent features to which the attention needs to be directed are : the relations of the distances between the cristæ ilii and the anterior superior spinous processes (diminished difference, or distance, between the anterior superior spinous processes may equal, or even exceed, that between the crests) ; diminished distance between the posterior superior spinous processes ; diminution of the external conjugate ; the form and direction of the sacrum ; the shape of the arcus pubis, and the marked projection of the promontory. A false promontory at the second sacral vertebra is not uncommon. The deduction to be made from the conjugata diagonalis in estimating the conjugata vera averages the same as in the normal pelvis. However, it is in rachitic pelves that the widest variations in this respect occur, making it specially necessary in each case to observe the height of the promontory and the length and direction of the symphysis pubis.

Flattened Generally Contracted Pelves.—In this variety we distinguish likewise a rachitic and non-rachitic form, the latter occurring rarely, the former with comparative frequency.

The non-rachitic form is apparently the joint product of a small justo-minor pelvis and the forces which lead to a sinking of the sacrum between the ilia. In these pelves a short symphysis and a low promontory contribute often to reduce greatly the difference between the diagonal and the true conjugate. During life it is difficult to distinguish it from the justo-minor pelvis.

The rachitic form is found usually in persons of small stature. It presents in a striking degree the marked peculiarities of the rachitic pelvis. The existence of transverse narrowing is recognized by the

* While Litzmann (" Die Formen des Beckens ") and Schroeder (" Lehrbuch der Geburtshülfe ") lay special stress upon the weight of the body as the main factor in producing the deformities of rickets, Kehrer (" Zur Entwickelungs-Geschichte des rachit. Beckens," " Arch. f. Gynaek.," Bd. v, 1872, p. 55) has shown that many of the changes characteristic of rickets occur in congenital cases—i. e., before the action of the weight of the trunk is brought into play. Kehrer refers the changes, therefore, in the main, to muscular action. Fehling (" Die Entstehung des rachit. Beckens," " Arch. f. Gynaek.," Bd. xi, p. 173) ascribes the deformities in rickets to disturbances of growth and persistence of the fetal type. Engel (" Wiener med. Wochenschrift," 1872, No. 40) sought to prove the deformities to be the result of partially arrested growth. J. Veit (" Die Entstehung der Form des Beckens," " Ztschr. für Geburtsh. und Gynaek.," vol. ix, p. 347) furnishes strong evidence in favor of Litzmann's theory.

narrowness of the hips, by the ease with which, in internal examination, the side-walls can be felt with the palmar surface of the half-hand, and by the modifications it produces in the mechanism of labor.

Irregular Rachitic Pelves.—For convenience' sake it seems desirable to attach to the description of the flattened form the influence of two additional forces, which, upon occasion, operate to still further modify the shape of the rachitic pelvis. These are lateral pressure of the heads of the thigh-bones at the acetabula and the various forms of spinal curvature which so commonly result from rickets.

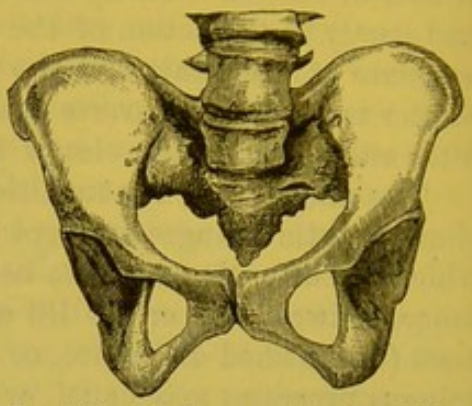


FIG. 220.—Small symmetrical rachitic pelvis. (Wood's Museum.)

Pressure at the acetabula is rarely an operative force, because rickets usually is developed at the time of the first dentition—i. e., before the child has learned to walk—and it is not until after the disease has declined that the child attempts to use its lower extremities. In the exceptional cases in which the disease occurs later, after the child has begun to walk, the lateral pressure may act in either one of two ways :

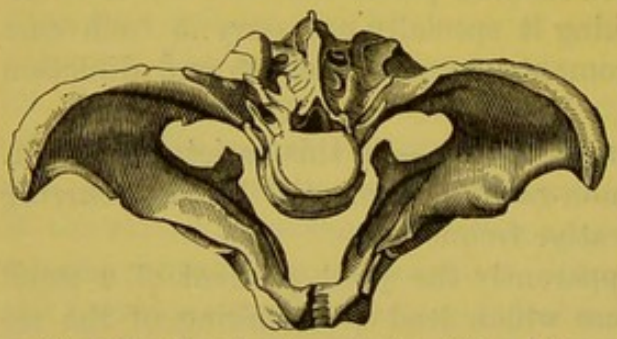


FIG. 221.—Pseudo-osteomalacia. (Naegele.)

1. As a counteracting force to that exercised by the weight of the trunk, in which case the pelvis, provided the pathological processes have only advanced to a limited extent, retains a symmetrical appearance, and resembles closely the justo-minor pelvis. The rachitic origin is betrayed by the shape of the ilia and the signs of rickets in other parts of the body. At the outlet the antero-posterior diameter is increased, and the transverse diameter somewhat diminished.*

2. In cases of excessive softening of the bones, either from the severity or the long duration of the disease, the acetabula are sometimes pushed inward, upward, and backward, and the symphysis pushed forward, so that the rami of the pubes meet at an acute angle, or run nearly parallel to one another. This lateral compression, in conjunction with the rachitic projection of the promontory, gives to the pelvic brim a triangular or clover-leaf shape, closely resembling the distortion produced in osteomalacia. The term pseudo-osteomalacia given

* SCHROEDER, "Schwangerschaft, Geburt. und Wochenbett," p. 77.

by Michaelis* to this form is warranted by the existence of certain features peculiar to rickets, such as the small size of the ilia, the distance between the anterior superior spinous processes, and the nature of the changes in other parts of the bony skeleton.†

In curvatures of the spine the shape of the pelvis is affected, when a compensatory scoliosis or kyphosis includes the sacral extremity :

1. In scoliosis (lateral curvature), all the rachitic features are usually strongly pronounced. The promontory is tilted to the side of the incurvation, and is pressed by the weight of the body toward the corresponding acetabulum. The ilium, owing to the increased pressure at the acetabulum from the femur of the affected side, is pushed upward, backward, and inward. In extreme cases the approximation of the promontory to the acetabulum may be such as to prevent the entrance of the child's head. The contracted portion becomes, therefore, unavailable for obstetrical purposes‡ (*vide* p. 488).

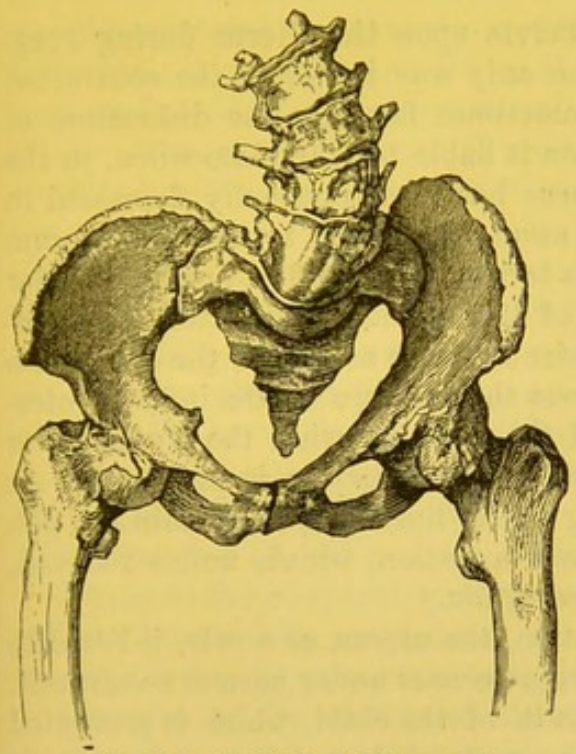


Fig. 222.—Scoliosis. (Litzmann.)

2. In kyphosis (posterior curvature) many of the characteristic features of the rachitic pelvis are reversed. As the upper portion of the sacrum is tilted backward, either the conjugata vera is increased, or the previous rachitic antero-posterior narrowing is greatly diminished. In the movement of the sacrum upon its transverse axis the lower extremity is thrown forward, and the conjugate of the outlet is thereby reduced. Kyphosis, occurring at the beginning of rickets, diminishes the distance between the tuberosities of the ischia, but has little effect upon the inferior transverse diameter after the rachitic changes have once been accomplished.

Influence of the Contracted Pelvis upon Pregnancy and Labor.

The influence of the contracted pelvis is not confined simply to the embarrassment which the form and size of the pelvis afford to the

* Michaelis, "Das enge Becken," p. 139.

† The supervention of true osteomalacia upon rickets has been observed. (*Vide* Spiegelberg, "Lehrbuch der Geburtshülfe," p. 490.)

‡ Litzmann, "Die Formen des Beckens," p. 70.

passage of the child in parturition; it extends to the production of a multitude of remoter effects, which are often regarded by the uninformed as isolated phenomena. These effects, which include faulty positions and presentations of the fœtus, unfavorable shape or position of the uterus, abnormal character of the pains, and the like, enter in turn, except where the mechanical difficulties are absolutely insurmountable, as important elements in the determination of the prognosis. For our knowledge of this subject we are indebted almost wholly to the enlightened labors of the Kiel professors, Michaelis* and Litzmann.†

Influence of the Contracted Pelvis upon the Uterus during Pregnancy.—In the early months the only way in which the contracted pelvis exerts an influence is in sometimes favoring the dislocation of the uterus backward. This action is liable to take place when, in the second or third month, the uterus has been unusually depressed in the pelvis, and the fundus has swung backward toward the sacrum as the uterine axis approximates to that of the pelvic outlet. Under such circumstances the jutting of the rachitic promontory is calculated to mechanically interfere later with the ascent of the organ into the abdominal cavity, in which case the pressure of the inflated intestines upon the anterior aspect of the uterus pushes the fundus over the inclined surface of the sacrum, and *retroversion* is produced. As the gravid uterus enlarges, owing to the limited space within the pelvis the version gradual passes into a flexion, which, unless relieved, is followed by symptoms of incarceration.

In the latter months of gestation, the uterus, as a rule, is lifted to a greater extent above the pelvis than occurs under normal conditions. This elevation is due to the growth of the child, which is prevented from sinking into the pelvis by the contracted conjugate. Sometimes the upward tendency of the uterus is overcome apparently by the resistance of the round ligaments, so that, while the head is retained at the brim, the lower segment hangs empty in the pelvis. At the same time the uterus possesses an unusual degree of mobility, in part due to the lack of fixation afforded by the descent of the fœtus into the pelvis, and in part to the laxity of the abdominal walls and the round ligaments. These latter conditions belong, of course, rather to multiparæ than to women for the first time pregnant.

In close connection with these two events, viz., the elevation of the uterus and its mobility, it is not uncommon to observe the higher degrees of the so-called pendulous abdomen, caused by the anteflexion of the gravid uterus. To this deformity, furthermore, the small stature of rachitic patients, the increased inclination of the pelvis, the anterior projection of the lumbar portion of the spine, and the stretched

* Michaelis, "Das enge Becken," Leipsic.

† Litzmann, Volkmann's "Samml. klin. Vortr.," No. 23.

state of the abdominal walls, associated often with separation of the recti muscles at the linea alba, all contribute their part.

Influence of the Contracted Pelvis upon the Presentation of the Fœtus.—Faulty presentations occur in contracted pelves more than three times as frequently as in those of normal dimensions.* Thus, when, during the latter part of pregnancy, the narrow conjugate mechanically prevents the head from sinking into the pelvic cavity, the head frequently glides sidewise or forward, to rest upon an iliac fossa, or upon the upper border of the symphysis pubis. In pendulous abdomen the uterus, in place of being inclined, when the patient is in an upright position, at an angle of thirty-five degrees, becomes nearly horizontal, or may fall forward so that the fundus occupies a deeper position than the inferior segment of the uterus. The great mobility of the uterus admits likewise of extensive lateral movements. These combined causes account for the lack of stability in the fœtus and the comparative frequency with which shoulder and breech presentations occur. When the head is fixed at the brim, the conversion of the vertex into a brow or face presentation is often simply an exaggeration of the normal mechanism of labor in a flattened pelvis. If the head, in place of filling the lower segment of the uterus, is retained at the brim, the space left between the head and the uterine walls favors prolapse of the cord and extremities. In like manner, in breech presentations, when the breech is detained by the narrow conjugate, the feet are apt to descend first into the vagina.

Owing to the progressive relaxation of the abdominal and uterine walls with successive pregnancies, the frequency of these irregularities increases nearly in proportion to the number of previous births.

Influence of the Contracted Pelvis upon the Labor-Pains.—When the degree of pelvic contraction permits the delivery of the fœtus by the normal passages without resort to embryotomy, the favorable or unfavorable ending of the labor is in large measure dependent upon the character of the pains. Good pains are of vastly more consequence in narrow than in wide pelves.

Violent pains, where the mechanical obstacles are insurmountable, either from the smallness of the pelvis, the faulty presentation of the fœtus, the position of the child's head, or its size and hardness, endanger the integrity of the uterus. Indeed, unless the mechanical difficulties are diminished by rectification of faulty positions and presentations, or by embryotomy, or unless relief is afforded by the removal of the child by Cæsarean section, there is reason to dread in such cases the occurrence of ruptured uterus, or, after retraction of the cervix, that the uterus may be torn from the vagina.

* Spiegelberg found that, of 544 labors in narrow pelves, the head presentation occurred in eighty-three per cent., whereas the proportion is ninety-five per cent. in normal pelves. ("Lehrbuch der Geburtshülfe," p. 448.)

Still more frequently weak pains are the cause of unfavorable terminations. Weak pains lead to lingering labors. Even in moderate degrees of contraction they fail to rectify unfavorable positions of the head, or to force the head by the brim into the pelvis. Under such circumstances neither the forceps nor version can be employed without serious risk, while, if a waiting policy is pursued, the amniotic fluid gradually escapes, and, as the uterus retracts down closely upon its contents, the fœtus perishes from the gradually increasing hindrances to the uterine and placental circulation.

In prolonged labors good pains alternate at intervals with those of less force. There is no standard by which the quality of pains *per se* can be determined. The quality of the pains is to be estimated rather by the results which they accomplish. It may be stated as a general rule, to which, however, there are numerous exceptions, that the strength of the pains is proportioned to the strength of the resistance to be overcome. Strong pains are on the whole rather more common in flattened pelves, and weak ones in pelves contracted in all their diameters, without, however, the rule possessing any such constancy as to lead one to regard the form of the pelvis as alone possessing any decisive importance in the production of the result.*

In the first instance, the character of labor-pains depends upon the innervation of the uterus and upon the thickness and integrity of its muscular structures. The resistance which the narrow pelvis offers to the expulsion of the child increases necessarily during the pains the tension and irritation of the uterine walls; and these, corresponding to the degree of irritability and contractility of the organ, may provoke pains of unusual violence, which, in turn, terminate, when the resistance is not seasonably overcome, in exhaustion; or the uterine activity may cease without any previous stage of increment; or, finally, the tension and injurious pressure of the uterus may lead to local circulatory disturbances, and to textural changes which in themselves weaken the strength of the contractions.

Michaelis observed that the dangers to the mother and child grow, as a general rule—to which, however, there are numerous exceptions—in proportion to the number of confinements. The increased mortality, especially of the children, he attributed to a peculiar relaxation of the uterus and its pelvic attachments, due to over-exertion in previous confinements.† But it must be borne in mind that there are other results of contracted pelves which directly contribute to the fatality of

* Michaelis thought that the partial pressure of the promontory and symphysis excited increased reflex action of the uterus in flattened pelves, whereas the complete pressure of the head upon the brim in generally contracted pelves exercised a paralyzing influence (*loc. cit.*, p. 185). This theory has been called in question by both Spiegelberg (*loc. cit.*, p. 452) and Litzmann. (Volkmann's "Samml. klin. Vortr.," No. 23, p. 177.)

† Michaelis, *loc. cit.*, p. 152.

multiparous labors. Thus, we have seen that pendulous abdomen and mobility of the uterus favor abnormal positions and presentations of the fœtus, complications of the utmost prognostic importance; and again, that the displacements of the gravid uterus occur with special frequency when the abdominal parietes have lost their supporting power from the over-distention of previous pregnancies. Moreover, when the uterus is not fixed during labor, the expulsive action of the abdominal walls can not be called into play, and thus one of the most important auxiliary forces is lost. Further sources of danger lie in the increased size and hardness of the fetal head observed in later pregnancies, and in the residue of inflammatory troubles which so often proceed from the first difficult delivery.*

Influence of the Contracted Pelvis upon the First Stage of Labor.—At the beginning of labor the head in contracted pelves is usually retained above the os internum, while the lower segment of the uterus hangs empty in the pelvic cavity. As, under these circumstances, space is left between the head and the uterine walls, the entire column of amniotic fluid acts directly during the pains upon the cervix uteri. The dilatation of the cervix takes place gradually, from above downward, as expansion follows upon the descent of the amniotic sac. The shape of the bag of waters depends upon the greater or less degree of resistance offered by the cervical walls. If the latter are soft and distensible, the usual semi-globular contour is maintained. If the cervix offers any material resistance, the membranes, if sufficiently elastic, protrude through the external os in cylindrical form. If, finally, the chief opposing force to dilatation is situated at the os internum, a constriction may take place at that point, while below the membranes assume a spheroid shape. As the result of these conditions an unimpeded, wave-like movement of the amniotic fluid breaks against the protruding membranes during the pains, the shock of which is apt to produce premature rupture, an event which is all the more inopportune, because in early rupture the circumstances all favor the complete discharge of the amniotic fluid.

After the rupture of the membranes, as the head does not descend at once into the cervical portion, the os and cervix reclose, though they continue dilatable in proportion to the degree of distention previously accomplished. Then, as under the influence of the pains the head passes into the pelvis, it gradually once more unfolds the cervical canal, and completes its dilatation. Should, however, the head meet with any considerable resistance, so that the pressure of the pelvic brim gives rise to the formation of a scalp-tumor, the latter serves to dilate the cervical canal and the os externum. If the obstacle is such as to prevent the complete descent of the head, two results are possible:

* Spiegelberg, "Lehrbuch der Geburtshülfe," p. 453.

1. If the pains continue strong, and no measures are adopted to remove the disproportion, the uterus is either retracted up over the head of the child as it remains above the brim, until the over-distended vagina gives way, in which case the laceration occurs in a transverse or oblique direction, and usually upon the posterior wall; or the lower segment of the uterus becomes compressed between the child's head and the walls of the pelvis, and a thinning and bruising of the imprisoned portion take place. As the uterus contracts, its muscular fibers drag upon the compressed and weakened tissues at the fixed points, which yield finally to the tractile force, and rupture ensues.

2. If the pains are weak or fail outright, the lower segment of the uterus remains undilated until either strong pains are excited, or the mechanical hindrance is so far removed by perforation of the head that the weakened pains suffice to overcome the obstacle.

Influence of the Contracted Pelvis upon the Mechanism of Labor.—When the pelvic contraction is not such as to render the entrance of the head impossible, the mechanism of labor depends not only upon the size and shape of the pelvic space, but upon the size, form, compressibility and position of the child's head. If a small, soft head has to pass through a pelvis contracted to only a moderate degree, the mechanism may not differ from that of a normal labor. In cases of relatively great disproportion, delivery is only practicable where the position of the head is favorable—i. e., corresponds in each case to the peculiar shape of the pelvis. If the conditions are favorable, and the pains are of normal strength, a segment of the head, after the period of dilatation has been completed, is pressed into the pelvis. The size of the segment depends upon the extent of the resistance offered, and thus, at an early stage, it furnishes us a notion as to the degree of disproportion existing. As labor progresses, the cranial bones change in shape and overlap one another, so that the head gradually becomes molded to the contour of the pelvic ring. When the largest circumference of the child's head has become fixed at the pelvic strait, as the contraction exists for the most part at the brim, the difficulties are usually overcome; and, where the pains continue good, the remainder of the labor is accomplished in accordance with the ordinary mechanism. If the pains fail, or the contraction continues throughout the entire pelvic canal, artificial aid may be needed even after the brim has been passed.

In the simple flattened pelvis the occipito-frontal diameter of the head engages in the transverse diameter of the brim. Even when the position is originally oblique, the intermittent contractions of the uterus communicate movements to the smooth surface of the head, which gradually bring its long diameter into correspondence with the long diameter of the flattened pelvis. The head enters the brim with

its posterior surface tilted toward the shoulder, the anterior parietal bone presenting, and the sagittal suture running parallel with, and in more or less close proximity to, the promontory. This lateral obliquity, or obliquity of Naegele as it is termed, is due simply to the fact that the narrowing of the antero-posterior diameter prevents both parietal bones from entering the pelvis upon the same plane. When the broad region between the parietal bosses meets with the resistance of the conjugate, the occipital portion of the head glides to one side, and the narrow bitemporal diameter engages in the contracted space. In this position, the occiput usually rests upon the *linea terminalis*. Owing to the resistance offered to the occiput, the forehead sinks into the pelvis, so that the large fontanelle occupies a deeper position than the posterior one.

Before the head adapts itself, therefore, to the pelvic entrance, the anterior parietal surface rests upon the symphysis, while the posterior surface is impinged upon by the promontory near the large fontanelle. The latter is felt low down, near the median line. The small fontanelle, owing to the dip of the forehead, is occasionally out of reach. Upon the side of the pelvis to which the forehead is turned, the space is incompletely filled out.

The adaptation of the head to the pelvic brim is the result of two combined movements, which occur nearly simultaneously :

1. The symphysis pubis furnishes a pivot around which the head rotates in the direction of the fronto-occipital diameter. As the head is pressed into the pelvis from above, the posterior parietal bone is flattened by the projecting promontory. During the descent the distance between the sagittal suture and the promontory gradually widens, and the former approaches the median line.

2. We have seen that the head entered the pelvis at first with a deep position of the anterior fontanelle. By the time, however, the bitemporal diameter becomes fairly fixed in the conjugate, the anterior fontanelle moves upward and forward toward the side-wall of the pelvis, while the small fontanelle sinks downward, and occupies a position near the center of the cavity. This movement is not simply a crowding of the entire head in the direction of the brow, but is due to a rotation of the head upon an axis furnished by the conjugate diameter,* the symphysis and the promontory furnishing the pivotal points.

By the time, in the rotation of the head upon its fronto-occipital diameter, the posterior boss reaches the level of the promontory, the largest circumference of the child's head has already engaged in the straitened brim, and the influence of the pelvic flattening upon the mechanism of labor ceases. Then, if the pains continue good, the flexed head reaches the floor of the pelvis, the occiput rotates to the front, and delivery is accomplished as under normal conditions.

* Litzmann, Volkmann's "Samml. klin. Vortr.," No. 74, p. 557.

In the justo-minor pelvis, the mechanism of labor is nearly the reverse of that described in the flattened form. Thus, as a rule, both parietal bones engage in the pelvic brim at the same time—i. e., the obliquity of Naegele is either slightly marked, or absent altogether. Again, the head may enter the pelvis in any of its diameters. To be sure, the oblique diameter is the one it usually occupies. Still, Litzmann reports two cases in which the sagittal suture corresponded to the conjugate diameter from the outset of the labor.* In the early stages, it is not uncommon for the head to oscillate at the brim for a time before fixation takes place.

Characteristic of transverse narrowing is the flexed condition of the head from the moment it begins its descent into the pelvis. Indeed, the flexion at the brim equals in degree that which usually obtains only at the pelvic outlet. The small fontanelle occupies the middle point of the pelvic space, the neck rests upon the linea terminalis, the anterior portion of the head and brow are pressed against the opposite pelvic walls, the long diameter of the head (from chin to vertex) lies in the axis of the pelvis, and the face looks upward toward the fundus uteri. If the transverse narrowing continues toward the outlet, the extreme flexion is maintained after the brow has passed below the level of the promontory. In such cases it may even happen that the small fontanelle may make its appearance at the frenulum in place of turning under the arch of the pubes. Sometimes the head gets fairly impacted in the pelvis, and further advance is rendered impossible. When the pelvis widens below the brim, the small fontanelle noticeably leaves little by little its central position.

In the generally contracted, flattened pelvis, the mechanism of labor is influenced by both the antero-posterior and transverse shortening. As in flattened pelves, the head usually occupies the transverse diameter, and the sagittal suture looks backward toward the promontory. Before the head becomes fixed, it often balances at the conjugate, rocking to and fro, as the uterus falls from the one side to the other. For a time, therefore, the position of the fontanelles varies with that of the woman. If, however, the disproportion is not absolute, and the pains suffice finally to fix the head, the latter usually becomes strongly flexed, and the occiput descends first into the pelvis.

When the head does not enter the contracted pelvis in an advantageous position, and the fault is not rectified either by the hand or the action of the labor-pains, delivery of the child without perforation often becomes impossible. The most dangerous of these faulty positions are :

1. Cases in which the lateral obliquity of Naegele is exaggerated, so that the presenting part is formed by the anterior parietal bone. The more striking forms usually occur in pelves with an extremely

* Litzmann, Volkmann's "Samml. klin. Vortr.," No. 74, p. 545.

narrow conjugate and a high promontory. The former maintains the head high above the brim, while the latter imparts to the uterus a posterior concavity. As the uterine curve is followed by the axis of the fœtus, the head is strongly bent toward the posterior shoulder. Sometimes in presentations of the anterior parietal bone the sagittal suture lies above the promontory, and an ear can be felt just behind the symphysis.

2. Cases in which the pelvic brim is covered by the posterior parietal bone. The sagittal suture is then directed to the front, sometimes lying even above the superior border of the anterior pelvic wall. Near the promontory the squamous suture, and at times the ear, can be felt. This peculiarity is rare in other forms of contracted pelves, but occurs as often as once in five times (Litzmann) in flattened pelves with coincident shortening of the transverse diameter.

3. In cases of well-marked kidney-shaped pelves, the head may engage in one side of the pelvis only. The occiput then enters usually the side of the brim to which the back of the child is turned.

4. Brow and face presentations are simply exaggerations of the anterior dip of the head, which we have seen is the normal mode of descent during the early stage of labor in flattened pelves. Although not peculiar to contracted pelves, they should always, when present, lead to careful measurements of the pelvic diameters. They increase the difficulties of delivery, not only because of the unfavorable relations of the diameters of the head to those of the pelvis, but because the pelvic deformity interferes with the proper rotation of the chin and forehead forward under the arch of the pubes.

In breech presentations, the delivery of the trunk takes place in accordance with the ordinary mechanism in the normal pelvis. The arms, however, are more liable to be reflected to the sides of the head.

In flattened pelves the after-coming head enters the brim in the transverse diameter. The position of the chin, where the transverse space is ample, varies with the degree of conjugate shortening. Where the latter is only of moderate extent, the ordinary flexion of the head may not be interfered with. If, however, the disproportion between the head and pelvic diameters is considerable, partial extension takes place. In cases of extreme contraction the entire head may be retained at the brim. The chin is then usually turned forward so as to rest upon one of the pubic rami, while chin and occiput occupy nearly the same level.

In breech deliveries, the mechanism of the head's passage through simple flattened pelves varies as the head engages in a state of flexion or extension. In the former case, while the anterior parietal bone moves downward over the symphysis, the transit-line marked by the promontory upon the posterior parietal bone runs from its anterior inferior angle, just in front of the ear, in an oblique direction upward

toward the parietal boss. When, however, the head enters the pelvis in a state of partial extension, a furrow is formed by the promontory, which runs nearly parallel to the coronal suture. If, finally, the extension is complete, and the occiput descends first into the pelvis, the marking of the promontory is found between the boss and the lambdoidal suture.

In pelves contracted in the transverse diameter, extension of the chin, unless the contraction be slight, proves an insuperable obstacle to delivery. Flexion, however, is the rule, as the resistance which the occiput meets with from the walls of the pelvis tends to direct the chin toward the chest.

The Effects produced in Contracted Pelvis by the Pressure of the Child upon the Soft Maternal Tissues.—The body of the child rarely, and only in cases of extreme prolongation of the expulsive period, leaves any traces upon the maternal soft parts. Injurious pressure proceeds almost exclusively from the child's head. As the intra-pelvic organs sustain excessive pressure when of short continuance more easily than that which is moderate but prolonged, the most striking lesions are produced in head presentations. The after-coming head usually passes through the pelvis too rapidly to produce any pronounced effects. The pressure is, as a rule, most marked at the brim, where, as we have seen, the contraction is in the generality of cases greatest, and where the pelvic canal is most encroached upon by sharp projections. The pressure may be either diffused over the entire periphery of the brim, or it may be more localized at certain definite points.

Diffused pressure occurs in justo-minor pelves, or where complete accommodation of the child's head to the form of the pelvis takes place. It gives rise to disturbed circulation in the hypogastric veins, and as a further consequence to transudation of serum, and capillary hæmorrhages in the tissues of the cervix, the vaginal walls, and external organs of generation.

Circumscribed pressure leads to crushing, thinning, and at times to the complete destruction of the tissues acted upon, the extent of the lesion depending upon the intensity and duration of the force exerted. Usually the destructive action proceeds, following the direction of the pressure from within outward—i. e., the injuries are more considerable, both in degree and extent, in the tissues next to the child's head than in the deeper ones contiguous to the pelvic border. Complete perforation of the tissues during labor is rare. Perforation is commonly the result of necrosis, the sloughing of the compressed tissues taking place during the puerperal period.

The pressure from the promontory is brought to bear, with rare exceptions, upon the cervix uteri.* The supra-vaginal portion is more

* Litzmann, Volkmann's "Samml. klin. Vortr.," No. 23, p. 186. An exceptional instance of pressure ending in perforation of the posterior vaginal wall has been reported by Hofmeier ("Zur Casuistik des Stachelbeckens," "Ztschr. für Geburtsh. und Gynaek.," vol. x, pp. 5, 6).

commonly affected than the vaginal portion. The consequent loss of substance is of a funnel shape, starting from the inner surface, and rarely penetrating through the peritonæum. The coverings of the promontory are not affected by pressure.

Pressure from the upper border of the symphysis pubis usually affects the vaginal wall and the adjacent tissues of the bladder. Fistulæ resulting are, therefore, much more commonly vesico-vaginal than utero-vesical. Here, too, the lesions are more extensive upon the inner surface of the utero-vaginal canal, and diminish as they extend outward. Thus, the destruction of tissue is greatest upon the cervical and vaginal walls, is less marked upon the posterior bladder-wall, while the anterior wall exhibits only faint traces of injury.

Pressure from the lateral walls, and from the horizonal rami of the pubes, occurs most frequently in faulty positions of the child's head. Thus, in brow presentations, the intervening tissues are apt to become clamped between the occiput and the margin of the side-wall. Again, when the sagittal suture is directed to the front, and the posterior parietal bone presents, a similar compression may take place between the anterior wall and the child's head. Sharp bony projections from the crests of the pubes are commonly covered by the tendinous attachments of the psoas minor muscles. In case of long-continued labor, however, the spinous outgrowths and sharp edges of the crests are liable to rub through their protective coverings, and secondarily the utero-vaginal tissues.

Influence of the Pressure of the Pelvis upon the Integuments of the Child's Head.—One of the commonest results of the peripheral pressure of the brim upon the child's head is the production of the scalp-tumor. Its formation is usually associated with compression of the cranial bones. As the bones overlap, the integuments of the engaged portion of the head are thrown into folds. As, however, in consequence of the obstruction in the venous circulation, transudation of serum takes place into the subcutaneous cellular tissue, the folds subsequently disappear, and a swelling ensues. It will be seen that conditions favorable to the production of the scalp-tumor are a soft, easily molded head, and such degree of transverse pelvic contraction as serves to render the circular pressure of the scalp complete. Owing to the latter condition, the scalp-tumor is found more frequently and more developed in justo-minor and generally contracted flattened pelves than in simple flattened pelves with normal transverse dimensions. Usually the tumor does not form until after rupture of the membranes. At times, however, in justo-minor pelves the head may become so fixed at the brim during the first stage of labor that a diffused swelling of the scalp may follow while the membranes are still intact. A scalp-tumor at the brim is of favorable import. It shows that the pains are good. So long as the tumor continues to increase, if the presentation

is favorable, the accommodation of the head remains a possibility. The increase of the tumor serves, too, to fix the head at the brim, and favors the overlapping of the cranial bones. It likewise gives to the head the form of an elongated ellipse, a form most favorable to its passage through the contracted pelvic canal.

Localized pressure-marks upon the child's head are derived, in the great majority of cases, from contact with the promontory. With less frequency they have their origin in pressure produced by the anterior and lateral pelvic walls and the inward projection, in rachitic pelves, of the cartilage at the symphysis pubis. They consist of round and oval spots and reddened lines, which disappear in the lighter cases usually in from twelve to twenty-four hours. If the pressure has been long continued, it may give rise to ulceration, or even to complete destruction of the skin down to the periosteum. While not usually dangerous to the child, in exceptional cases they may become the starting-point of suppuration in the surrounding subcutaneous cellular tissue, and thus lead to fatal pyæmia. They are found with greatest frequency upon the parietal bones, especially upon the posterior one. More rarely they are situated upon the frontal, and in very rare instances, finally, upon the occipital and temporal bones. The situation and direction of the red lines depend chiefly upon the manner in which the head enters the pelvis. Thus, in simple flattened pelves, where moderate extension occurs in the normal mechanism of labor, the mark of the promontory runs along the posterior parietal bone, between the boss and the large fontanelle, either parallel to the coronal suture, or at first in the direction of the boss, and then later as flexion occurs forward toward the frontal bone (Dohrn). In cases where transverse shortening causes flexion of the head at the brim, the principal point of pressure lies near the parietal boss, and the line runs obliquely forward toward the outer angle of the eye, or toward the cheek, according to the extent of the flexion. Sometimes a red line, running across the forehead nearly parallel to the coronal suture, is produced by the pressure of the side-wall.

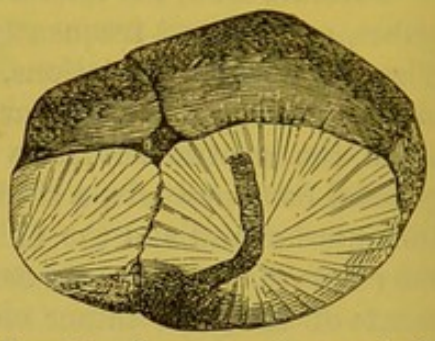


Fig. 223.—Pressure-mark upon skull. (Dohrn.)

Pressure upon the ophthalmic vein, when it occurs, leads to œdematous swelling and hyperæmia of the lid, and to increased secretion from the conjunctiva.

Influence of the Pressure of the Pelvis upon the Cranial Bones.—The so-called molding of the child's head, by which it is made to conform to the size and shape of the pelvis, is chiefly effected by the displacements and alterations in the form of the cranial bones. Of the

displacements, the most important consists in the overriding of the bones at the principal sutures. The most common site is along the sagittal suture. Usually the posterior parietal bone is flattened and depressed beneath its fellow. At the same time the curvature of the anterior or presenting parietal bone is increased. In transverse narrowing, the occipital bone is depressed along the lambdoidal suture. The position of the frontal bones at the coronal suture is subject to a variety of influences. As a rule, however, they are depressed beneath the parietal bones. Overlapping often does not extend the entire length of a suture, but may exist in one part, while in another the bones may occupy the same level. Sometimes a displacement takes place between the two lateral halves of the head in the direction of the occipito-frontal diameter. This movement is supposed to be due to the influence of the promontory, which pushes the posterior half forward when the head is flexed, and backward in cases of partial extension.

The compression to which the child's head is subjected, when prolonged and excessive, is apt to produce disturbed cranial circulation. Rupture of the capillaries which pass from the surface of the brain to the arachnoid sac, and to the sinuses of the dura mater, may give rise to intra-cranial extravasations. The overriding at the sagittal suture, in extreme cases, may cause laceration of the sinus longitudinalis. Separation of the bones at the sagittal and coronal sutures sometimes takes place while the coverings of the skull remain intact.*

In a small percentage of cases (7·3 per cent., Litzmann) furrow-like depressions occur. The usual site is along the line of the coronal suture, where they are formed by the promontory. In front a grooved line is sometimes found near the squamous suture, produced by the pressure of the anterior pelvic wall. Triangular depressions (the spoon-shaped depressions of Michaelis) situated upon the posterior parietal bone, between the boss and the large fontanelle, are of still rarer occurrence. They are found chiefly upon the heads of premature children, where they are of sinister import. Actual fracture of the skull in head presentations is extremely infrequent, and is generally due to the employment of the forceps.

In breech presentations, lesions of the scalp, owing to the shortness of the time to which the after-coming head is subject to the pressure of the contracted pelvis, are, in two thirds of the cases, absent altogether. When they are present they are comparatively trivial, consisting of slight swelling of the integuments, and now and then of a red mark left by the promontory. The cranial bones, on the contrary, when rapidly dragged by the projecting promontory, are peculiarly liable to serious injury. Thus, in breech cases, depressions, fractures, and fissures of the parietal bones, are much more common than

* Litzmann, Volkmann's "Samml. klin. Vortr.," No. 23, p. 191.

in head presentations. Forcible tractions upon the trunk sometimes lead too to a rupture of the squamous sutures, or even to separation of the condyles from the occipital bones.*

Prognosis in Contracted Pelves.—The mortality to the mother is at least twice as great as in normal pelves. The causes of this increased death-rate are to be found in the concurrent action of a great variety of influences. Among the chief of these is the prolonged labor, an event which under all circumstances, especially after the rupture of the membranes, tends to diminish the chances of recovery. This result is due to the strain upon the nervous system from the protracted duration of the associated pain, to the depression of the vital powers growing out of the fasting and loss of sleep which labor entails, to the irritation and crushing of the soft parts, and, finally, to decomposition of the fluids retained within the uterine cavity in cases where access of air has taken place. In contracted pelves we have superadded to these general sources of disturbance the special injurious effects produced by the pressure of the lower segment of the uterus, the vagina and the soft parts which cover the cavity of the small pelvis between the hard head of the child and the bony walls. As the results of pressure, we have seen that obstruction to the venous circulation, œdema, capillary hæmorrhages, superficial lacerations of the mucous membrane, and at localized points necrosis and even complete separation of the interposed tissue may take place. These further lead to metritis, endometritis, parametritis, and perimetritis, which are announced at times during labor, but more commonly subsequent to confinement, by sharp elevations of temperature. When the destruction of tissue reaches the peritonæum, general peritonitis follows, as a rule. When the necrosed tissues become gangrenous from access of air, the septic poisons generated spread through the cellular tissue, and lead speedily to a fatal termination. Sometimes shock destroys the patient during the first day or two following labor, before local inflammations have had time to develop. Further dangers to be apprehended are rupture of the uterus and the pelvic articulations, fistulous communications with the bladder and the rectum, injuries to nerves of the ischiatic plexus, *post-partum* hæmorrhage as a consequence of uterine exhaustion, and thrombus formation in the veins of the uterine parenchyma. Even the operative measures resorted to for the relief of the patients are often new sources of peril, and their employment is to be regared simply as a lesser evil.

For the child the action of the contracted pelvis is even more deleterious.† The infant mortality, in cases not requiring sacrificial

* C. Ruge, "Verletzung des Kindes durch Extraction bei Beckenlage," "Ztschr. f. Geburtsh.," Bd. i, p. 74.

† Spiegelberg puts the mortality of the children at thirty-five per cent. (*vide* "Lehrbuch der Geburtshülfe," p. 464).

operations, is explained by the long duration of the labor, and the prevalence of faulty presentations and positions. In the majority of instances death takes place from asphyxia promoted by the early rupture of the membranes, the complete escape of the amniotic fluid, the prolapse of the cord, the disturbances in the utero-placental circulation resulting from the retraction of the uterus upon the surface of the child's body, and sometimes by the premature separation of the placenta. The prognosis for the child is especially unfavorable in premature labors. This arises not alone from the increased frequency of malpresentations, but from the diminished power of premature children to resist external pressure. Thus, death may take place from direct pressure upon the medulla oblongata through the thin bony coverings of the head, or extensive cerebro-spinal effusions of blood may result from the laceration of the delicate walls of the intra-cranial and intra-spinal vessels.

CHAPTER XXVI.

TREATMENT OF CONTRACTED PELVES.

Cases of extreme pelvic contraction, rendering delivery *per vias naturales* impossible.—Cases indicating craniotomy or premature labor.—Cases where extraction of a living child at term is possible.—Premature labor.—Version.—Forceps.—Expectant treatment.

The resources at the disposition of the accoucheur, in cases of contracted pelvis requiring obstetrical aid, are the Cæsarean section, the induction of premature labor, craniotomy, forceps, and version. But, before it is possible to form an opinion regarding the treatment best suited to an individual case, it is necessary to first obtain a clear and definite idea regarding the degree and character of the pelvic deformity. We have, then, to settle the following questions: Has pregnancy advanced to term? If not, does the case call for the induction of abortion or premature labor? If the end of utero-gestation has been reached, is it possible to deliver the child through the natural passages? Is the child living or dead? If the former, do the interests of the mother require the sacrifice of the child's life? If the conditions are such as not to render it impossible for a living child to be born, in what way can we best subserve the interests of both mother and child? The right choice of measures requires not only an accurate appreciation of the advantages, limitations, and drawbacks which inhere to the measures themselves, but the extent to which the mechanical obstacles to delivery are heightened or modified by those remoter influences which we have seen are exerted upon the organic processes of labor by the pelvic contraction.

The greater the degree of pelvic narrowing, however, the more decided the influence of the pelvis becomes, and the more definite, therefore, the treatment.

For the sake of convenience it is customary to consider apart the following classes :*

1. *Cases of such extreme pelvic contraction that the attempt to deliver the child through the natural passages is inadvisable.* In these extreme degrees of pelvic deformity premature labor holds out no hope of saving the life of the child, and affords but a trifling advantage to the mother. If abortion is not produced in the early months, the only resource is the Cæsarean section or laparo-elytrotomy. The precise limit at which the dangers from delivery through the pelvis rise to the level of or exceed those from the Cæsarean section is not easy to determine. It depends partly upon the size and ossification of the child's head, and largely upon the experience and dexterity of the operator.

Michaelis, in the case of a dwarf scarcely three and a half feet high, extracted a small child through a pelvis measuring but one inch and a half in the conjugate diameter.† The operation lasted two and a half hours. At the end of two weeks the patient was able to resume her household duties. Dr. Osborn, in the celebrated case of Elizabeth Sherwood, extracted a child through a pelvis measuring, as he believed, but three quarters of an inch in its narrowest portion! Barnes‡ extracted with perfect success a child through a conjugate which, he says, certainly did not exceed one inch and a half. It would be easy to go on and extend this list, to show that there is no degree of conjugate shortening that renders it utterly impossible to extract a mutilated child. But the question which we should ask for our guidance is, not what can possibly be accomplished by the skill and ingenuity of the exceptionally experienced operator, who is capable of making whatever rules he likes to govern his own actions, but what is the point at which men in every-day practice need expect to find the dangers from craniotomy and the Cæsarean section rise to nearly the same level. Dr. Parry collected seventy cases of craniotomy in pelves measuring two and a half inches and under. Seven had to be terminated, finally, by Cæsarean section. Of the seventy women forty-three survived, and twenty-seven died. The work was not done by tyros, but by celebrated obstetric surgeons. Thus, the best results of the ablest accoucheurs show a mortality from craniotomy, in the higher degrees of pelvic deformity, of nearly forty per cent. In the hands of an operator of limited experience, I believe the Cæsarean section, when timely made, offers ordinarily to the mother a better chance of recov-

* The limits are those of LITZMANN. *Vide* "Ueber die Behandlung der engen Becken," Volkmann's "Samml. klin. Vortr.," No. 90.

† MICHAELIS, "Abhandlungen aus dem Gebiete der Geburtshülfe," p. 151. The operation lasted two and a half hours. ‡ BARNES, "Obstetric Operations," p. 406.

ery. There are, of course, exceptions to the rule. Most pelves measuring less than two and a half inches in the conjugate belong to the category of generally contracted flattened pelves. Where, exceptionally, the transverse diameter is not materially diminished, the difficulties of craniotomy are greatly lessened, and, if at the same time the child's head be soft and compressible, a comparatively easy extraction may give rise to false ideas concerning the real dangers of delivery by the natural passages. These are due chiefly to the fact that the operation has to be carried on within the uterine cavity, when, owing to the contracted brim, no descent of the head is possible. A long operation conducted within the uterine cavity is always fraught with evil.

The dangers are not altogether mechanical. Even if serious lesions, such as perforations, rupture of the uterus, and lacerated wounds, are avoided, some contusion of the lower uterine segment is inevitable, air enters freely the uterine cavity, the patient exhibits very commonly the symptoms of profound shock, and the delivery is often followed by *post-partum* hæmorrhage, due to uterine inertia. The means employed to check hæmorrhage tend still further to depress the vital powers. In many cases the uterus remains large, and the labor is followed by catarrhal endometritis. This ordinarily mild puerperal affection is apt, owing to the introduction of air and the presence of bits of necrosed tissue, to assume a septic form, and pave the way to a fatal termination.

The contiguity of the peritonæum likewise adds to the formidable character of all supra-pelvic operations. When the outlet of the pelvis alone is contracted, and craniotomy can be performed upon the head after it has entered the vaginal canal, the dangers of extraction are much diminished.

Cases of extreme degrees of the justo-minor pelvis are believed to be excessively rare. Certainly the whole number reported since Naegele's day may be easily counted on the fingers of the two hands. At full term the labor takes place, provided the general contraction is such as to retain the head at the brim, in one of two ways:

1. The uterus retracts up over the head of the child. If the head does not descend, the vagina is drawn upward and is exposed to injurious tension. Should nothing be done to relieve this condition, the thin vagina is liable to be rubbed through by the pressure it encounters at the brim, and especially at the symphysis pubis. Version would here be impossible, and the forceps would only enhance the risks. Perforation and decerebration would at once diminish the pressure. With little over three inches in the conjugate and four in the transverse diameter, the vault of the skull may be broken up with the cranioclast, the chin tilted downward, and the head brought edgewise through the pelvis. In this way, with moderate skill, it would be possible to extract a dead child. The operation of laparo-elytrotomy, however, seems so peculiarly fitted to these conditions, that it deserves a trial in the interest of both mother and child.

2. The membranes rupture early, the waters gradually escape, and, as the head does not descend, the uterus retracts down firmly upon the child. A scalp-

tumor forms, which fixes the head at the brim and pushes the cervix and lower segment of the uterus before it. Here it would be proper to await for a time the results of uterine action. As the transverse diameter can only be roughly estimated, the head may lengthen out and adapt itself to the pelvic canal. But the delay should not be too prolonged. If, in spite of the formation of the scalp-tumor, the bony head remains unmoved at the brim, it is a question whether it would not be the wiser plan to proceed at once to the Cæsarean section.

Naegele * reports the history of a dwarf whose pelvis measured but three inches and seven lines in the transverse and three inches in the conjugate. He delivered her with forceps of a five-and-a-half-pound child, but she died on the tenth day. Heim reports the history of a dwarf with three and a quarter inches conjugate, and four and three quarters inches transverse diameter. Delivery by perforation and forceps. Rupture of the three articulations.†

Spiegelberg reports a case with nearly the same dimensions. Child presented by the breech. Extraction difficult. Perforation of after-coming head. Cephalotripsy. The patient died shortly after delivery.‡ I have reported a case where the conjugate was three and one sixth inches, and the transverse four and a half inches. Delivery by perforation, the cranioclast, and the crotchet. The patient died on the third day ("Trans. of the Am. Gynæc. Soc.," vol. iv). Kormann relates a case nearly identical with my own, both as regards its diameters and the existence of a slight lateral obliquity. After over three days' labor the head adapted itself to the pelvis, and the child was extracted alive by forceps. The mother died of peritonitis.#

Thus, of five women with generally contracted pelves, in which the conjugate ranged from three to three and a quarter inches, all died as a consequence of delivery through the natural passages.

In cases where the uterus is rigidly applied to the child, and the cervix is undilated, the propriety of laparo-elytrotomy is questionable. The operation is not always a very easy one, and it certainly can not afford to be handicapped by anything which would cause delay in the delivery after the vaginal rent has been made.

There are, of course, in so rare a condition, scant statistics in favor of any special plan of treatment. Michaelis reports a case of Mantz's, that of a woman who had a pelvis measuring two inches antero-posteriorly, and three inches in the transverse diameter. Here the Cæsarean section became a matter of necessity rather than one of election. Twice the operation was performed with success. A third time the result promised to be equally favorable, but the willful and insubordinate conduct of the patient, as late as the twenty-seventh day, led to her destruction.

In spite of the fact that in generally contracted pelves craniotomy is nearly always practicable, and notwithstanding the bad repute of Cæsarean section, a careful study of the ground convinces me that where there is a diminution of nearly an inch in all the diameters, Cæsarean section, or, probably, in cases of complete dilatation of the cervix, laparo-elytrotomy, holds out the best chances of success.

* Naegele, "Das schräg verengte Becken," p. 102.

† Löhlein, *op. cit.*, p. 42.

‡ Spiegelberg, "Lehrbuch der Geburtshülfe," p. 444, *vide* note.

Kormann, "Ueber ein allgemein verengtes, schräg verschobenes Becken," "Arch f. Gynaek.," p. 472.

2. *Cases in which the pelvic contraction is such as to prevent the birth of a full-term living child through the natural passages, but in which extraction through the pelvis furnishes the best chance of saving the life of the mother.* The choice of measures in this class of cases lies between craniotomy and, where the condition of things is recognized early enough, the induction of premature labor. In general terms we are authorized to assume such a degree of disproportion in flattened pelves with the conjugate ranging between two and a half and three inches, while in justo-minor pelves craniotomy will be usually requisite at full term, even with a conjugate measuring three and a third inches. In, however, these less extreme degrees of deformity, other elements than those of the size of the pelvic canal enter into the formation of an opinion regarding the proper procedure to be selected. I have myself, in one case, extracted a child weighing six and a half pounds by forceps, without much difficulty, through a generally contracted flattened pelvis with a conjugate measuring barely two and three fourths inches. Labor had lasted three days previous to my seeing the patient, which was in consultation. The child's head presented a singular appearance, from the molding it had undergone, having been greatly flattened in its biparietal diameter and enormously elongated in the occipito-mental direction. The child died, however, shortly after birth. The mother recovered, though considerable sloughing of the vaginal walls followed the long continuance of the pressure which had preceded delivery. Grenser, in the Dresden Hospital Reports (1861–1863), gives three cases of children born alive where the pelvis measured two and three quarters inches. In one of these, where the labor lasted twenty-two hours, a living child was born weighing six and a half pounds.

If, therefore, labor comes on at full term before craniotomy is proceeded to, an attempt should be made to gauge the degree of disproportion between the head and the pelvic brim, for not only is it among the bare possibilities that a living child may be expelled through a pelvis measuring less than three inches, but it is to be borne in mind that in pelvic mensuration even the most expert may make errors of a quarter of an inch. In any case it is well to preserve the membranes as long as possible. Even craniotomy is more easily performed after complete dilatation of the os. After the waters escape, the lower uterine segment is subjected to injurious pressure between the hard skull and the pelvic rim, the damage done increasing of course with the duration of labor. By early perforation and evacuation of the brain-mass this danger is avoided. But craniotomy should not be performed so long as the hope exists of saving the life of the child. The attempt should be made, at least, before perforating, to form an estimate of the size of the child's head and its relations to the pelvic brim. An approximative result may be obtained by palpating the

head through the abdominal walls above the pubes, and, so soon as the cervix is dilated and the head becomes pressed by the labor-pains firmly against the brim, by introducing the half-hand into the vagina to determine the extent of that portion of the cranial vault which has entered the pelvis. When we have ascertained the size of the segment beneath the pelvic border, and the special points of the head which occupy the several pelvic diameters, we are in a position to estimate the size of the portion above the brim, and the mechanical difficulties which remain before the engagement of the head can be accomplished.

In shoulder presentations, where, of course, version is necessary, extraction alone should be first tried, and only when it is found impossible to effect the delivery of the after-coming head by other means should perforation be resorted to. Schroeder claims to have extracted living children through pelves measuring but seven and a half centimetres (three inches) in the conjugate.*

The induction of premature labor in pelves having from two and three quarters to three inches conjugate diameter possesses the merit of diminished risk to the mother, and affords a chance of saving the life of the child. Below two and three quarters inches the advantages of premature labor may be fairly called in question. To be sure, Kiwisch placed the biparietal diameter of the child's head in the thirtieth week at two and a half inches. Seyfert, however, fixed it at three inches, and later Schroeder obtained nearly three and a quarter inches (8·16 centimetres) as the average between the twenty-eighth and thirty-second week. In point of fact there is too little uniformity in the diameters of fetal heads belonging presumably to the same week of development to make average measurements of any practical utility. It will be seen, however, that, in the higher degrees of pelvic contraction we are now contemplating, the biparietal diameter of the child's head rarely falls within the limits of the narrowed conjugate. Still, it is possible to deliver a living child through a pelvis estimated at two and three quarters inches as late as the thirty-fourth week,† as the head, owing to the pliability of the cranial bones in premature children, is capable of sustaining a considerable degree of lateral compression. Naturally the infant mortality in these cases is very large. In addition to the ordinary increased risks attendant upon premature labor, intra-cranial extravasations of blood from rupture of the delicate cerebral vessels are extremely common. Litzmann found in nearly one fourth of his cases (8 : 34) spoon-shaped depressions of the skull. Though this lesion is met with upon the heads of living children at full term, in the series of Litzmann four of the children were dead at birth, three showed feeble signs of vitality, and in one only, which lived but fourteen hours, was it possible to excite the

* Schroeder, Lehrbuch der Geburtshülfe," p. 539.

† Wiener, "Zur Frage der künstlichen Frühgeburt," "Arch. f. Gynaek., Bd. xiii, p. 99.

respiratory process. Thus the outlook for the child is by no means hopeful; but, inasmuch as, under three inches, the only operations which come into competition with premature labor are the Cæsarean section and craniotomy, a small saving of fetal life is a powerful plea in its justification. But a stronger argument in its favor is the fact that the induction of premature labor offers a milder procedure, which, within certain limits, inures to the benefit of the mother.

Below two and three fourths inches the chances of saving the child by premature labor are too slight to be weighed in the balance.* Moreover, unless the child's head happens to be exceptionally small and yielding, approximating the conditions to those which obtain in immature deliveries, craniotomy in the end has usually to be resorted to. Now, as premature labor offers no peculiar advantages in the performance of craniotomy, and, as it is attended with certain risks of its own, it is advisable, in very narrow pelves after the twenty-eighth week, to await the normal end of gestation.

As the dangers to both mother and child are increased by delay, Barnes has proposed combining version with premature labor, in pelves of less than three inches conjugate, as a means of accelerating delivery. Milne (*vide* note), by this method, extracted a living child through a two and a half inch pelvis. Budin has found by experimentation with artificial pelves that a much less amount of traction force is requisite to drag the head of a premature child through a flattened conjugate by the feet than by forceps in cephalic presentations.

3. *Cases in which the pelvic contraction does not exceed the limits within which the delivery of a living child at term is at least possible.* In this category belong the overwhelming majority of all instances of contracted pelvis. It embraces not only cases in which the conjunction of every favorable condition is essential to delivery, but those moderate degrees of narrowing which are chiefly recognizable through the influence they exert upon the mechanism of labor. It includes flattened pelves with a conjugate of three inches and upward, and justo-minor pelves with a conjugate of over three and a third inches. Below these figures the delivery of living children at full term is too exceptional an event to be taken into account in any attempt at classification.

The obstetrical resources for overcoming the mechanical obstacles afforded by moderate degrees of pelvic contraction are, the induction of premature labor, craniotomy, forceps, and version. Each one of

* In support of this opinion, which is thoroughly confirmed by my own experience, we have especially the authority of Spiegelberg, Litzmann, and Dohrn. Milne ("Premature Labor and Version," "Edinburgh Med. Jour.," vol. xix, p. 707) relates a case where he was successful in a pelvis measuring but two and a half inches. He states, however, that the space in the other diameters of the brim was ample, which was certainly an exceptional advantage, as nearly all pelves with the higher grades of deformity belong to the category of generally contracted rachitic pelves.

these measures has its strenuous partisans, who have expended much unprofitable zeal in comparative estimates of their respective values. It is a mistake to regard them as rival pretenders to favor. Indeed, the very conditions which indicate one form of procedure often exclude the others from consideration. Good midwifery requires a just appreciation of all the auxiliaries at our disposition and a careful study of the circumstances which render them severally appropriate.

Premature Labor.—The indiscriminate induction of premature labor in every case of contracted pelvis is particularly to be deprecated. In the first volume of the "Archiv für Gynaekologie" Spiegelberg presented the statistics of 1,224 cases of full-term labor in contracted pelvis, in which the maternal mortality was 6·6 per cent. and the infant mortality 28 per cent.; while in 271 cases of induced premature labor the maternal mortality was 18·8 per cent. and the infant mortality 66 per cent. This startling discrepancy is due to the fact that a very large proportion of labors in contracted pelves either terminate spontaneously, or require forceps only after uterine action has overcome the obstruction at the brim. If all these minor cases be omitted, a very different result is obtained. Thus, Litzmann found that in flattened pelves measuring from two and three fourths to three and one fourth inches in the conjugate, and in justo-minor pelves between three and one third and three and a half inches, the maternal mortality after premature labor amounted to 7·4 per cent., while the loss of life in labors at full term was 18·7 per cent.* But, in cases of recovery, the advantages of premature delivery are by no means inconsiderable, as, owing to the diminished head-pressure, lesions of the genital canal are of rare occurrence, in striking contrast to the fistulæ, lacerations, and cicatrices which so often follow delivery at full term.

The prognosis for the child, as shown by the statistics of premature labor in contracted pelves, is decidedly unfavorable. In the restricted class of cases we are at present considering Litzmann found that, though twice as many children were born alive as at full term, the actual number discharged alive from the hospital was about the same. He concluded, therefore, that, while the operation was decidedly indicated in the interests of the mother, it offered a dubious advantage to the child. It is, however, always injudicious to draw deductions from hospital statistics alone. Especially is this true of feeble children, born prematurely, whose ultimate chances depend in a peculiar degree upon the care with which they are tended.

Dohrn, who objected to the statistics of Spiegelberg and Litzmann, on the ground that the units of which they were composed represented, not parallel cases, but an endless variety of dissimilar conditions, proposed, as a fairer way of testing the value of induced prema-

* Litzmann, "Ueber den Werth der künstlich eingleiteten Frühgeburt bei Beckenenge," "Arch. f. Gynaek.," Bd. ii, p. 194.

ture labor, to compare the results of the latter operation with those of full-term labors in the same patients. Viewed in this way, premature labor in contracted pelves has been found to furnish unexpectedly favorable results. Thus, Dohrn reports nineteen cases, with forty-one children, at term, of which thirty-seven died. In twenty-five pregnancies premature labor was induced, with fifteen living children.* Künne and Berthold report eight cases, with twenty-four children at term, of which eighteen died. In eighteen pregnancies premature labor was induced, with thirteen living children.† Still more extraordinary is the report of Milne. Six women gave birth at term to twelve children, of which eleven were dead. In the succeeding thirty-eight pregnancies premature labor was induced, and thirty-five children were born living.‡

The ordinary time for bringing on labor is from the thirty-second to the thirty-fourth week. Most writers now agree that the operation should be restricted to pelves measuring less than three and a half inches in the conjugate, whereas above that limit it is best to await the results of spontaneous uterine action.

Labor at End of Gestation.—But the physician may first be summoned to a case of contracted pelvis after the end of gestation has been reached, or he may at an earlier period have decided against the induction of premature labor.

At full term, supposing the head to present, the latter, at the beginning of labor, is prevented by the pelvic narrowing from entering the brim of the pelvis, and is usually freely movable. The conduct of the first stage of labor should be directed to preparing the way for the subsequent delivery of the child. To this end every pains should be taken to prevent rupture of the membranes until the cervical dilatation has become complete. The patient should be cautioned against restless movements in bed, and from bearing down during the pains. Examinations *per vaginam* should be made with great care, and should be avoided except where absolutely necessary. The largest-sized Barnes dilator, moderately distended with fluid, placed in the vagina to exert counter-pressure upon the cervix, is at times of use where the membranes have a tendency to protrude in the form of a narrow cylinder.

Attention should likewise be directed to faulty positions and presentations of the child's head. Should these be dependent upon a pendulous abdomen, the fundus of the uterus should be elevated, and the normal relations of the uterine axis maintained by a suitably adjusted bandage. Excessive lateral obliquity should be corrected by

* Dohrn, "Ueber künstliche Frühgeburt bei engen Becken," "Arch. f. Gynaek.," Bd. xii, p. 70.

† Künne, "Fünfzehn Fälle der künstlichen Frühgeburt"; Berthold, "Zur Statistik der künstlichen Frühgeburt," "Arch. f. Gynaek.," Bd. vi, Heft 2.

‡ Milne, "Premature Labor and Version," "Edinburgh Med. Jour.," vol. xix.

placing the patient upon the opposite side. Should transverse narrowing require a deep descent of the occiput, this can be furthered by placing the woman upon the side to which the occiput is directed. Where, on the other hand, it is desirable to promote the dip of the forehead, the patient should be made to lie upon the side to which the child's face is turned. The reason of this is obvious, as, when the breech falls to a given side, the cephalic pole has a tendency to move in the opposite direction. The right use of position as a corrective force depends upon the degree of accuracy with which the character of the pelvic deformity is estimated, and upon a proper appreciation of the mechanism appropriate to the ascertained deformity.

Where the sagittal suture looks forward toward the symphysis pubis, so that the posterior parietal bone becomes the presenting part, a firm compress above the pubes may be advantageously employed to press the head backward and approximate the sagittal suture to the median line.

The pains, when weak and inefficient, should be strengthened by the warm vaginal douche; when the source of exaggerated suffering, they should be mitigated by morphia, by rectal injections of chloral, or by the administration of an anæsthetic.

Should, by good fortune, the rupture of the membranes be postponed until after the completion of cervical dilatation, one of two contingencies may follow: 1. The disproportion between the head and the pelvis may prove to be slight, so that a considerable segment of the cranial vault may be felt below the brim; then, provided the head enters the pelvis in conformity with the mechanical laws dictated by the character of the pelvic deformity, the expulsion of the child may be left to the natural uterine forces. 2. No engagement may take place, the head continuing freely movable at the brim. Under such circumstances the disproportion may be assumed to be considerable. The physician has, therefore, to ask himself whether he shall await the action of the pains, in the expectation that the head will gradually adapt itself to the pelvis, or whether he shall at once proceed to perform version, and drag the child rapidly through the straitened diameters. The forceps, as a means of delivery before fixation of the head, should be discarded, not because it can not be employed with success, but because its use, even in the most skillful hands, is extra-hazardous.

The question of waiting, or proceeding at once to version, is one that will always be decided largely by the individual experiences of the accoucheur. It is, however, vain to deduce rules of practice from the conduct of those who have enjoyed exceptional opportunities, and who usually have developed exceptional skill in some one special direction. It is to be remembered that in contracted pelves, in case the pains prove inadequate to overcome the obstacles to delivery, the alter-

natives in head presentations are forceps and perforation. But there are very few experienced operators who have not a more or less personal predilection for either forceps or version, and this unconscious bias exercises, necessarily, to some extent, a determining influence upon their choice. It is well known that there is hardly any subject which has been the source of so much heated controversy as the one at present under discussion. For the profession at large, however, there is little to be gained from the spirit of partisanship. The general practitioner requires instruction not only in the special advantages possessed by each measure, but needs to have presented to his attention parallel statements of the dangers and difficulties from which neither procedure is free.

Version.—In considering the application of version to the treatment of contracted pelves, it is well to state in advance certain points which are rarely alluded to, probably because they are matters of tacit agreement between the contending parties to whose disputes we mainly owe our present knowledge in relation to the subject.

The first of these points is, that the intent of the operation is to save the life of the child. In the case, therefore, of a dead child, or of one in which the heart-sounds have notably begun to fail, version affords no advantage over perforation. For the same reason the conditions must be such as to hold out a reasonable hope of rapid delivery of the child's head, without the infliction of necessarily fatal lesions. Now, there does not appear to be any well-authenticated case of the extraction of a full-term living child after version through a flattened pelvis measuring less than two and three quarters inches in the conjugate diameter. But even with three, or three and a quarter inches, the result will still depend upon the length of the transverse diameter. Thus, in extreme degrees of the justo-minor pelvis, with the reduction of nearly an inch in all the diameters, the difficulties of delivering the after-coming head, even with the aid of the perforator and the cephalotribe, are wellnigh insurmountable. Again, the contraction should be limited to the pelvic brim, for, where it is continuous, or progressively increases toward the outlet, the fate of the child is not even doubtful.

The other point of importance is, that with three and a half inches and upward in the conjugate, no interference is, as a rule, called for. Since it has become the custom to measure pelves with accuracy, the profession has learned that these moderate degrees of deformity exercise their influence not so much in a mechanical way as in the modifying effects they produce upon labor. A large proportion of the cases terminate spontaneously. If the pains fail prematurely, the conditions are generally such as to make it an easy matter to deliver with forceps. Difficulties only arise where the head is unusually large and incompressible, or in faulty positions, such as the anterior dip of the head in

justo-minor pelves, and the presentation of the posterior parietal bone in the flattened varieties.

Thus, version is indicated in contracted pelves only where the child's heart beats with nearly unimpaired vigor, and in pelves measuring between two and three quarters and three and a half inches antero-posteriorly, with the contraction limited to the brim, and with sufficient amplitude in the transverse diameter.

The advantages of version in contracted pelves grow out of the unquestioned fact that the after-coming head passes more readily the contracted brim than the normal head-first presentation. This superior facility is attributable to the entry of the head by its smaller bimastoid diameter. At the same time, the fronto-occipital descends in the transverse diameter of the pelvis. The pressure of the conjugate is encountered by the bitemporal diameter of the child's head, which measures a half-inch less than the biparietal. Tractions upon the trunk of the child bring to bear simultaneously pressure upon the head from many points in the pelvic walls. As a result, bilateral flattening is effected, and a deep groove, usually near the coronal suture, is produced in many cases upon the posterior cranial surface by the pressure of the projecting promontory. The bulk of the head is still further diminished by an overriding of the bones at the sagittal suture, and, where the transverse diameter is insufficient, by the crowding of the occipital beneath the parietal bones. A reduction of the cranial contents is brought about by the retreat of a considerable portion of the cerebro-spinal fluid into the spinal canal. All these changes are induced rapidly, and are not dependent upon the activity and strength of the uterine pains.

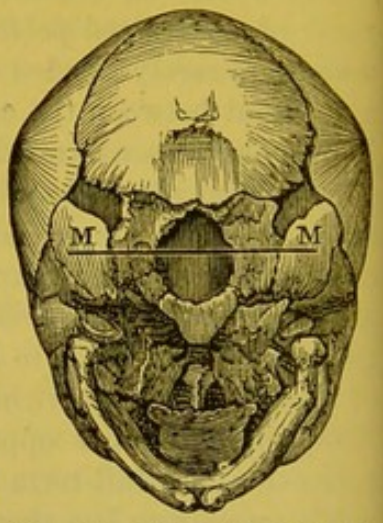


Fig. 224.—Base of skull: M M, bimastoid diameter.

The method of performing version and extraction in contracted pelves is, with few modifications, the same as in pelves of normal size. In contracted pelves great care requires to be taken lest the arms become reflected upward to the sides of the child's head, or crossed upon the neck. To avoid this difficulty it is desirable to introduce the hand over the abdomen of the child, and bring down the arms before the engagement of the shoulders. In extracting the head, tractions may be made upon the lower extremities and shoulders according to the method of Kiwisch, or they may be made with one hand upon the shoulders, while two fingers of the other are inserted into the child's mouth. Provided by either of these methods the relation of the head to the shoulders is such that no twisting of the neck takes

place, the amount of force that can be employed without producing fatal lesions is often something astounding. Thus, Rokitansky,* experimenting with the bodies of still-born infants, found the utmost strength put forth by two men upon the trunk was insufficient to cause rupture of the vertebral ligaments and separation of the articulations. It is usual, however, to combine pressure from above, exercised by a skilled assistant upon the head through the abdominal walls, with tractions from below. Schroeder states† that this practice is coeval with podalic version. It was known to Celsus and

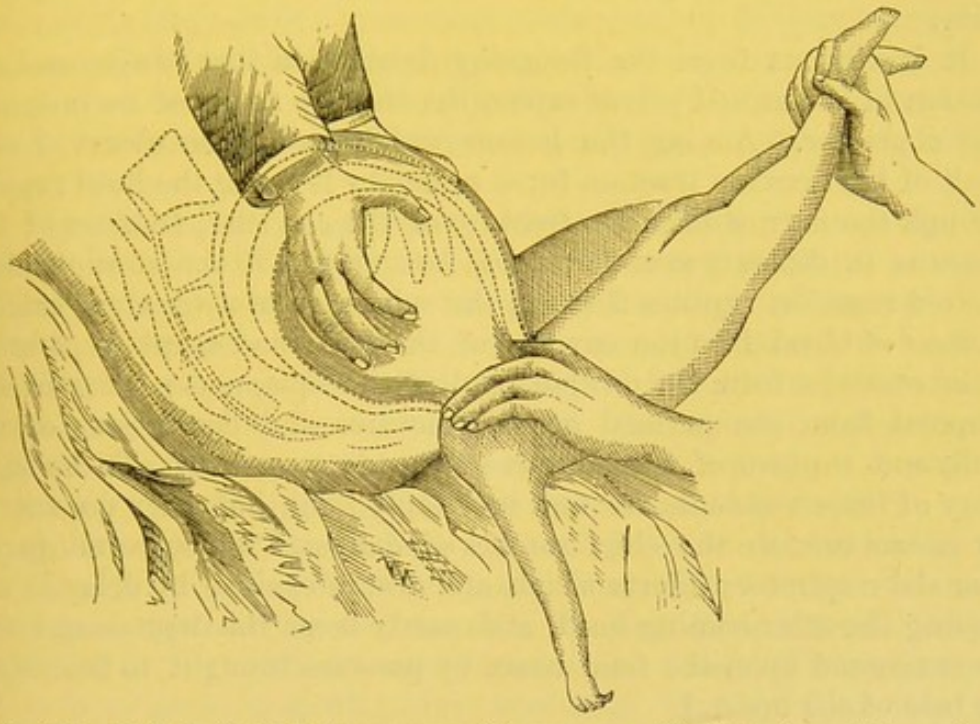


Fig. 225.—Method of employing supra-pubic pressure. Head in the pelvic cavity. (Mundé.)

recommended by Ambroise Paré. It has found warm advocates in Pugh, Wigand, Martin, Kristeller, and in this country in Taylor and Goodell. Both the latter gentlemen have made valuable suggestions regarding the technical management of difficult cases, which are well worthy of special mention. Dr. Taylor‡ at first draws the body directly backward, while the head is forced by supra-pubic pressure downward and backward into the pelvis. So soon, however, as the head begins to advance, he raises the body of the child and directs pressure upon the head to be made downward and forward in the axis of the outlet. In case of failure or delay, he has sometimes succeeded by intentionally directing the back of the child to the sacrum, and then causing the occiput to be pressed downward and backward into

* Rokitansky, "Wien. med. Presse," 1874, No. 45.

† Schroeder, "Handbuch," 6te Aufl., p. 307.

‡ Taylor, "What is the Best Treatment in Contracted Pelves?" p. 28.

the nearest sacro-iliac space, with the face looking upward, while traction is made in the axis of the outlet. Dr. Goodell,* after first drawing in the direction of the outlet, with the assistant pushing downward and backward, reverses the direction, and sweeps the child's body backward upon the coccyx, the neck likewise being forced downward and backward into the hollow of the sacrum with all one's power. Where the projection of the promontory is not very marked, he likewise recommends as sometimes of assistance a pump-handle movement, the range of oscillation extending from the axis of the outlet anteriorly to very firm pressure on the coccyx posteriorly.

It is obvious from the foregoing description that version and extraction in contracted pelves expose the child to perils of no insignificant character. Among the lesions which have been observed as a result of the extreme traction force necessary to bring the head rapidly through the narrow brim are fracture of the clavicles, fracture of the humerus in difficult arm-deliveries, lacerations of the sterno-cleido-mastoid muscles, rupture through the substance of a vertebra, extravasations of blood into the cavities of the head and trunk, separation of the condyles from the occiput, and of the squamous portion of the temporal from the parietal bones, fractures and depressions of the skull, and rupture of the sinuses of the dura mater.† To be sure, many of these accidents are not inevitably fatal, but they do not by any means furnish the chief sources of danger. These result partly from the respiratory efforts which are always excited by delay in extracting the after-coming head, and partly from the depressing influence exercised upon the fetal heart by pressure brought to bear upon the base of the brain.‡

Having thus made out, with great care, a full bill of particulars, embracing all the acknowledged drawbacks to the performance of version in narrow pelves, we have next to consider how far these associated evils tend to invalidate the claim of version to be regarded as *facile princeps* among conservative measures of treatment. The following records of the individual experience of competent operators will help us to solve this question. Kormann turned in nine cases of contracted pelves. Seven children were born living, and two dead. All the mothers recovered.# Löwenhardt turned in twenty cases of contracted pelves. Seventeen children were born alive, and three dead. Only children that outlived the first week were counted in the

* Goodell, "Clinical Memoirs on Turning in Contracted Pelves," "Am. Jour. of Obstet.," vol. viii, p. 211.

† C. Ruge, "Verletzungen des Kindes durch Extraction bei Beckenlage," "Ztschr. f. Geburtsh.," Bd. i, p. 68.

‡ Dohrn, "Ueber Pulslosigkeit des Kindes während Extraction an den Füssen," "Arch. f. Gynaek.," Bd. vi, p. 365.

Kormann, "Arch. f. Gynaek.," Bd. vii, p. 13.

successful cases. The mothers recovered.* Goodell reports eleven cases. Seven children were alive at birth, and four were still; but, of the latter, one was extracted through a pelvis measuring only two and a half inches conjugate diameter, and in one the case was complicated by eclampsia. The mothers recovered. Now, not to go beyond these forty cases, we obtain, as the result of version, thirty-one living infants, without the sacrifice of a single mother. A number of the women in whose previous labors craniotomy had been found necessary were delivered by version of living children. Löwenhardt placed in contrast his own experience with the forceps in narrowed pelves presenting degrees of contraction corresponding to those in which he had resorted to version. In forty-five deliveries, sixteen children were born dead and five died shortly after birth. Of the mothers, three died, while twenty-one suffered from puerperal affections of greater or less severity.

Now, if the foregoing testimony represented the entire truth, there would be no good reason for discussing other plans of treatment. They, in fact, show only how far special training and experience will enable an operator to overcome difficulties by dexterity and address. In the first case reported by Dr. Goodell the child was still-born. In commenting upon the cause of death Dr. Goodell states frankly: "Much force was needed to extract the head, but it was not made as promptly and efficiently as I have since learned to make it."†

Another side of the question has been presented by Borinski,‡ who, at the instigation of Professor Spiegelberg, collected the statistics of version in contracted pelves from the Breslau Clinic between the years 1865–1872. In all there were ninety-three cases. Thirty-four children were saved, and fifty-nine were born dead, or died soon after birth. Fifteen mothers lost their lives. This seemingly disastrous showing is capable, however, to a certain degree, of explanation. Thus, twenty of the fifty-nine children born still died before version was attempted. In nine of the cases the transverse as well as the conjugate was materially diminished. Of the children delivered through these flattened generally contracted pelves, only one, and that a very small one, was extracted alive. Still, there were fifty-eight cases of version in ordinary flattened pelves, with the result that just one half the children were born dead. In only three of the fifteen mothers who died was the fatal result apparently connected with the operation. In the others, death was due to spontaneous rupture of the uterus, placenta prævia, and nephritis, version having been resorted

* Löwenhardt, "Wendung und Extraction das dominirende Verfahren bei Beckenenge," "Arch. f. Gynaek," Bd. vii, p. 421.

† Goodell, "Trans. of the Internat. Med. Congr.," Philadelphia, 1876, p. 777.

‡ Borinski, "Zur Lehre von der Wendung auf die Füsse bei engen Becken," "Arch. f. Gynaek.," Bd. iv, p. 226.

to because of these complications. A considerable allowance should be made, too, in the cases from the Breslau Clinic, for the fact that the greater part of them took place in the out-department of the hospital, when they were under the charge of midwives, who rarely send for timely aid except in the presence of dangerous complications. In eighteen instances the operation was performed on account of prolapse of the cord, and in eighteen instances because of some maternal affection.

Forceps.—In presenting this less favorable side of version in contracted pelves, it is well incidentally to place in juxtaposition the results of the high forceps operation as given by Dr. Harold Williams, in a recent number of the "American Journal of Obstetrics" (January, 1879). Williams collected one hundred and nineteen cases, reported since 1858, where the forceps was applied to the head above the brim. Of the mothers nearly forty per cent., and of the children over sixty per cent., perished. The mechanical objections to the use of forceps at the brim are obvious. When the head is molded to the contracted pelvis by the natural forces, the head passes the conjugate with its long diameter in the transverse diameter of the pelvis, with the two fontanelles on nearly the same level, and with the sagittal suture looking toward the sacrum. The posterior parietal bone rotates around the promontory, the latter producing a furrow which runs either along the coronal suture, or at first in front of the parietal boss, and later, as flexion occurs, forward toward the frontal bone. The bilateral compression of the head is compensated for in part by a lengthening in the fronto-occipital and partly in a vertical direction.

The forceps applied in the transverse or oblique diameter of the pelvis prevents the former compensation from taking place. It increases the width of the head, and thus adds to the difficulty of passing the conjugate. Often it disturbs further the normal head mechanism by causing premature flexion and rotation to take place. In each of these ways it augments the difficulties of delivery, and renders necessary the employment of an increased amount of traction force. With forceps applied directly to the sides of the child's head I have had no experience, but Dr. Goodell,* who has clearly pointed out the objections to this method in contracted pelves, has shown that they inevitably produce flexion, and cause the large biparietal diameter to pass through the narrow conjugate. So long as the head does not engage at the brim, there is no rivalry between version and forceps. The latter should be placed under the ban as hardly less dangerous than the Cæsarean section.

Expectant Treatment.—Now, let us suppose that after rupture of

* Goodell, "Labor in Narrow Pelves," "Trans. of the Internat. Med. Congr.," Philadelphia, 1876, p. 788.

the membranes it is decided to resort to neither forceps nor version, but to adopt an expectant course, until circumstances arise which shall render active interference necessary. It is certain that a very considerable portion of labors in contracted pelves terminate spontaneously. Winckel* reports twenty-three cases in the Dresden Maternity in 1873, and twelve cases in 1874–'75. Of the thirty-five cases, two mothers and three children died. Osterloh† reported one hundred and thirty-nine cases from the Leipsic Maternity, between the years 1863–1872 inclusive. There were one hundred and five cases where the pelves measured from three to three and a half inches. Of one hundred and six children, seven died. Of the mothers four died. In thirty-four cases where the pelves measured over three and a half inches, two children died. All the mothers recovered. There were, however, forty-two cases in all of puerperal disease terminating in recovery. Borinski reports from the Breslau Clinic two hundred and thirty-three spontaneous deliveries in contracted pelves, with one hundred and ninety-two living children. There were ten maternal deaths, but four were from non-puerperal intercurrent affections. Thus, in three large maternity hospitals there were in cases of contracted pelves four hundred and seven spontaneous deliveries, with the loss of fifty-three children, and, from puerperal diseases, of twelve mothers, the latter representing very nearly the usual mortality in lying-in hospitals. Even in pelves measuring less than three inches, now and then, the spontaneous birth of a small living child takes place.

If we examine these results, we find that under favorable circumstances, in all but the extreme forms of pelvic contraction, Nature will do her own work with the least expense of infant life, and with a relatively small maternal mortality. On the other hand, the long-continued pressure upon the parturient canal, incident to the molding and adaptation of the head to the narrow pelvis, yields a large contingent of inflammatory affections, which complicate the puerperal period and protract the convalescence. By favorable circumstances we mean a presentation and position of the child's head suited to the form of the pelvis, and a sufficient degree of uterine activity. Rectification of a faulty position of the head after the rupture of the membranes is always a matter difficult of accomplishment. In case, therefore, the brow presents, or the head engages with an excessive degree of lateral obliquity (sagittal suture looking forward toward the pubes, or backward toward the promontory), in place of wasting time in futile efforts at correcting the malposition, version should be promptly performed. In prolapse of the cord, which occurs in about six per cent. of the cases, the indication would clearly be version rather than replacement.

* Winckel, "Berichte und Studien," 1874–'76.

† Osterloh, "Einige Beiträge zu den spontan verlaufenden Geburten bei engem Becken," "Arch. f. Gynaek.," Bd. iv, p. 520.

In eclampsia and face presentations most operators would preferably resort to version.

Thus, we have finally the field of controversy between version and other plans of treatment narrowed down to cases in which, after rupture of the membranes, the head remains above the brim, but the conditions are such that Nature is capable of overcoming the mechanical difficulties of delivery providing that the labor-pains are sufficiently energetic. There is always an element of chance in this last condition, which, however, is an essential one. If the pains are weak and powerless, it may be possible, even hours after rupture of the membranes, when the head has not become fixed, to still accomplish version. More frequently, however, as the head but incompletely fills the lower segment of the uterus, the waters escape, the uterus retracts upon the fœtus, the cervix becomes œdematous and tender, and after a time the temperature and pulse rise, betokening the presence of danger. Sometimes the retraction of the uterus ends in the withdrawal of the cervix over the child's head, and, in the failure of the latter to descend into the pelvis, the vagina is drawn upward, and subjected to a perilous degree of tension. It is easy to see that under such circumstances the time for version is past, and craniotomy is called for. Because, therefore, where labor is left in contracted pelves to the spontaneous efforts of Nature, in a certain proportion of cases the insufficiency of the labor-pains leads to the necessity of sacrificing the child, there will always be operators who, confident in their own skill, will prefer to turn soon after rupture of the membranes, that they may keep in their hands the control of the delivery. The bulk of professional men will, on the contrary, so long as spontaneous delivery is probable, prefer to wait, even though by so doing they may eventually find themselves obliged to fall back upon the perforator and the crotchet.

When the birth of the child is left to the contractions of the uterus, reënforced by the expiratory muscles, the physician should assume the *rôle* of a watchful spectator. Safety to the mother and the child requires that the time of the passage of the head through the bony canal should not be too prolonged. So long as the head descends steadily, however slow the progress may be, in case no complications demand speedy extraction, the physician should await the results of uterine activity. Should the pains grow weak and inefficient, they may be stimulated by the uterine douche, the introduction of the catheter into the uterus, and by small doses of ergot or the viscum album, provided the inertia is not the result of pathological changes in the uterine tissues.

When the advance of the head ceases, either from failure of the pains or, as in justo-minor pelves, from the growing resistance of the pelvic outlet, the rule should be to relieve the soft parts of the mother

as speedily as possible from the pressure of the child's head. Pressure too long continued ends in œdematous swelling, softening of the tissues, arrest of circulation, and eventually in necrosis and gangrene. When the integrity of the lower segment of the uterus has been impaired to any extent, perforation should be resorted to, and the child sacrificed to the interests of the mother. If, on the contrary, the changes are insignificant, and the mechanical difficulties not insuperable, by the use of forceps it may be possible to save the life of both mother and child. But to avoid the first-named cruel alternative, the forceps should be applied so soon as the requisite conditions for its employment are reached. Of course, as the forceps is used solely to save fetal life, in case the feeble heart-action of the child gives warning of impending asphyxia the interests of the mother are to be alone consulted.

In estimating the mechanical difficulties to be overcome by the forceps, it is necessary to determine how far engagement has taken place. Litzmann * recommends that the physician ascertain by internal examination, combined with external palpation, both the size of the segment of the cranium below the brim and how much of the head remains to undergo compression before it can enter the pelvis.

In ordinary flattened pelves, Litzmann found that in three fourths of all the cases the pains alone sufficed to overcome the resistance of the brim. When the head had so far descended that the sagittal suture had passed from three to four fifths of an inch below the promontory, and the boss of the anterior parietal bone could be felt with ease behind the symphysis pubis, extraction with the forceps was a task of no great difficulty, even if before its application flexion had not begun to take place.

In generally contracted flattened pelves, it is desirable that the head should be transverse and well flexed, with the posterior parietal bone at least three fifths of an inch below the promontory. With the forehead and occiput resting upon the side-walls of the pelvis, the sagittal suture near the promontory, and an ear felt behind the symphysis pubis, the prospects of forceps operations are extremely dubious.

In justo-minor pelves of moderate extent (conjugate three and a half inches), the failure of the pains, which forms the necessity for forceps, is rather the result of the paralyzing effect of the pressure of the bony canal upon the entire circumference of the cervix than of the absolute degree of pelvic contraction. The heads descends in a state of complete flexion, with the large fontanelle at the pelvic brim. If, as the head advances, the small fontanelle moves from the median line, and the large fontanelle becomes accessible to the finger, it is

* Litzmann, "Ueber die Behandlung der Geburt bei engem Becken," Volkmann's "Samml. klin. Vörtr.," pp. 715 *et seq.*

likely that the pelvis widens toward the outlet. If the forceps serves only to bring the fontanelle down still deeper, and to increase the declivity of the sagittal suture, the opposite condition obtains, which may frustrate the delivery.*

In flattened pelves the forceps should be applied as nearly as possible to the fronto-occipital diameter of the head, as the latter needs to descend into the transverse diameter of the pelvis. When applied obliquely it tends to cause premature rotation, which increases the difficulties of extraction. In justo-minor pelves the direction of the blades is of less importance, as the head often descends spontaneously in an oblique diameter. Success in high forceps operations depends upon the degree of accuracy with which the tractions are made in the axis of the pelvis. With the long-curved forceps, it is especially difficult to fulfill this requirement at the superior strait. Even when the directions to draw vertically downward are faithfully carried out, a considerable portion of the force is expended in the pressure of the forceps upon the soft tissues lying between them and the anterior pelvic wall. In careless hands this pressure is capable of inflicting a great deal of injury, particularly where the blades of the forceps are passed within an imperfectly dilated cervix, and where they project somewhat beyond the child's head. Various devices have been invented to correct this defective working of the instrument. Pajot recommends placing the left hand upon the lock to make pressure backward, while with the right hand tractions are made downward and somewhat forward. I have generally succeeded by exerting a small amount only of force at each traction, watching at the same time with great care the direction of the blades in the pelvis. This method is pretty safe, and in the end generally successful, but often requires a very considerable outlay of time and patience. A pair of straight forceps, as recommended Dr. I. E. Taylor, will often enable one to draw more directly in the axis of the brim, and will succeed when the curved forceps have had to be abandoned. Of late I have been in the habit of using Tarnier forceps in high operations, and am able to give it my cordial approval. The blades always swing in the tranverse diameter of the pelvis, while the traction force is exerted as nearly as possible upon the center of the child's head. A few trials will convince the most prejudiced opponent of the Tarnier forceps that it will at the superior strait bring the head to the floor of the pelvis in much less time, and with a less expenditure of force, than can be accomplished by other methods.

The dangers from the forceps in contracted pelves are due not so much to the pressure it makes directly upon the child's head and the pelvic walls as to the compensatory bulging of the head in its transverse diameter. When the head is fixed at the brim and the for-

* Litzmann, "Ueber die Behandlung der Geburt bei engem Becken."

ceps is applied to the forehead and occiput, it is evident that the only change of form that can take place is in a vertical direction. Safety in delivery requires that there should be no sudden augmentation of the bilateral pressure, which would necessarily deepen the furrow made by the promontory upon the posterior-lying parietal bone, and imperil the integrity of the maternal tissues confined at the conjugate between the promontory and the pubes. Until, therefore, the head has passed the narrow strait, tractions should be made with moderate force, and with short periods of intermittence. After the head has once descended to the floor of the pelvis the forceps should be removed, and the head be allowed to rotate into the conjugate, then a forceps of any pattern may be adjusted to the sides of the head should further aid be required to complete delivery.

So far we have considered cases in which the cervix was sufficiently if not completely dilated before rupture of the membranes. If, as is very common, the membranes rupture prematurely, the difficulties and risks to both mother and child are greatly increased. With rupture come, as we have already seen, escape of the amniotic fluid, retraction of the uterus, and interference in the utero-placental circulation. With an undilated os externum the cervix is stretched by the head, and its thinned tissues are subjected to pressure from the symphysis and promontory. Delay leads to arrest of circulation and necrosis at the points of pressure, but here version and forceps are alike impracticable. This leaves as the only alternatives perforation and the Cæsarean section. Timely aid, therefore, in such cases should be extended before a dangerous condition is reached. My first preference just after rupture is the Barnes dilator, which not only serves to expand the cervix, but, when employed promptly, helps to prevent the escape of the amniotic fluid. Next to the Barnes dilator, and of special utility when the waters have already escaped, I would place the long, narrow-bladed forceps of Dr. Taylor for introduction through the undilated os. With it the head can be grasped, and, when made to descend and then allowed to recede in alternation, oftentimes the rounded cranial surface will efficiently act as a dilating body, and secure such a degree of expansion as will pave the way for the safe adoption of other methods of delivery.

CHAPTER XXVII.

RARE FORMS OF PELVIC DISTORTION.

The Naegele oblique pelvis: morbid anatomy, etiology, diagnosis, mechanism of labor in, prognosis, treatment.—The kyphotic pelvis: morbid anatomy, etiology, diagnosis, prognosis.—Scolio-rachitic pelvis: anatomical characters.—Robert's pelvis: anatomy, etiology, diagnosis, prognosis.—Spondylolisthetic pelvis: anatomical characters, diagnosis, prognosis.—Funnel-shaped pelvis.—Osteomalacia.—Pelvis narrowed by exostoses.—Divided symphysis.

I. The Naegele Oblique Pelvis.

This variety of deformed pelvis derives its name from the author who first systematically studied it and called attention to its importance as a cause of obstructed labor.

Morbid Anatomy.—The pathological characters peculiar to this variety of deformed pelvis are, according to the classical description of Naegele,* the following: 1. Complete anchylosis of one sacro-iliac

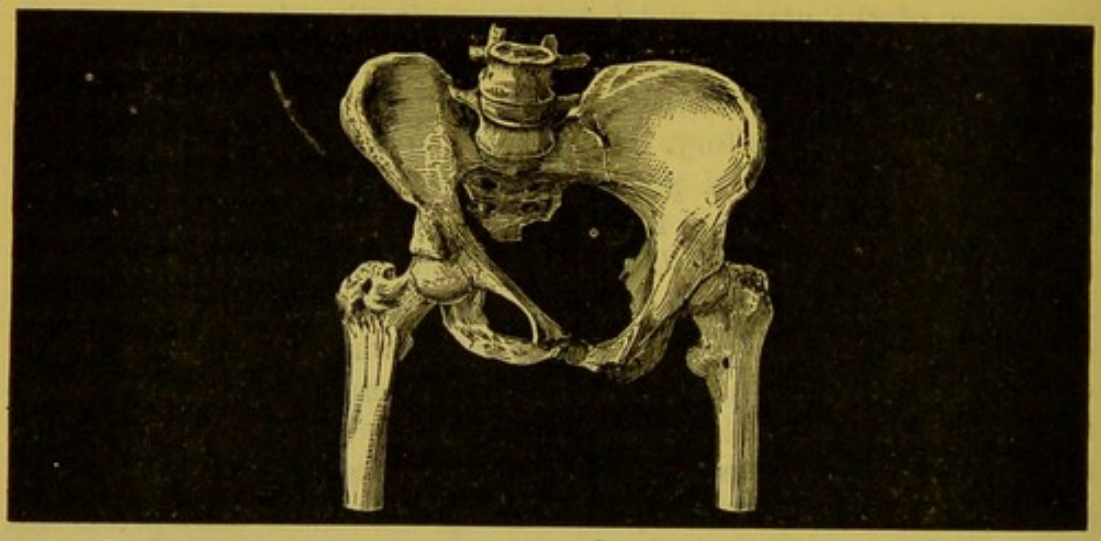


Fig. 226.—Naegele oblique pelvis. (From specimen in the Wood Museum.)

synchondrosis, or osseous union between the sacrum and one os innominatum. 2. Destruction or defective development of the lateral half of the sacrum and smaller caliber of the anterior sacral foramina on the anchylosed side. 3. Diminished breadth of the os innominatum and of the sacro-sciatic notches on the same side. The articular facet of the ilium, which corresponds to the sacral auricular surface, is less elongated than on the non-anchylosed side. 4. The sacrum is displaced toward the anchylosed side, and its anterior surface is turned in that direction. The pubic symphysis is pushed to the healthy side, and is, therefore, not directly opposite the promontory. 5. The internal surface of the os innominatum on the deformed side is flatter than the correspond-

* Naegele, "Das schrägverengtes Becken," Mainz, 1850, p. 7.

ing sound bone, and the *linea ilio-pectinea* is but slightly curved. 6. The sound side of the pelvis is not of an entirely natural shape, as is shown by the fact that its ilio-pectineal line is straighter posteriorly, and more curved anteriorly, than in a normal pelvis. 7. The results of the deformities mentioned are :

(*a*) That the pelvis is contracted in that oblique diameter measured by a line passing from the acetabulum of the anchylosed side to the opposite sacro-iliac joint, while the other oblique diameter is not shortened, but even elongated in extreme cases. (*b*) That the distances between the promontory and either acetabulum, and those between the apex of the sacrum and the spine of either ischium, measured from the affected side, are less than the corresponding distances on the other. (*c*) That the distances between the tuber ischii of the anchylosed side and the posterior superior spinous process of the opposite ilium, and those between the spine of the last lumbar vertebra and the anterior superior spinous process of the diseased side, are shorter than the corresponding distances on the opposite side. (*d*) That the distance of the superior posterior iliac spine of the anchylosed side from the lower border of the symphysis pubis is greater than that between the symphysis and the opposite posterior superior spinous process. (*e*) That the walls of the pelvic cavity converge below, and that the pubic arch is narrowed and approximated to the type of the male arch. (*f*) That the acetabulum of the flattened side is directed farther forward than is normal, while the opposite acetabulum looks almost directly outward. We may add that the anterior surfaces of the bodies of the lumbar vertebræ are directed toward the anchylosed side. The ilium is higher, steeper, flatter, and reaches farther backward on that side. The pubic arch looks toward the flattened side. The *conjugata vera* is somewhat elongated. The transverse diameter is shortened at the inlet, and its shortening progressively increases as the outlet is approached.* The os innominatum of the healthy side is somewhat displaced outward, and is more markedly curved, hence the venter of the corresponding ilium is directed more anteriorly than that of the anchylosed side.† The deformity is most apparent at the inlet, which is compared by Naegele to an oblique oval figure. The tuber ischii on the anchylosed side is higher, and directed more posteriorly and internally than normal. This description will also apply to the ordinary oblique-ovate pelvis, except so far as the anchylosis, which is the distinguishing feature of the Naegele oblique, is concerned.

Etiology.—The essential cause of oblique-ovate pelvis in general is continuous pressure directed against one of its lateral halves, the weight of the trunk falling predominantly or exclusively upon the lower extremity of the deformed side, and leading to displacement and

* Schroeder, "Lehrb.," p. 596.

† Litzmann, "Die Formen d. Beckens," Berlin, 1861, p. 69.

distortion of the pelvic bones. The conditions producing this predominant unilateral pressure are tabulated by Litzmann * as follows: 1. Lateral spinal curvature, usually of rachitic origin. 2. Impeded or entirely abrogated function of one lower extremity. In this case the deformity will affect that side the lower extremity of which is intact.† The impairment or loss of function may result—(*a*) from unilateral hip-disease; (*b*) from amputation of one lower extremity; (*c*) from an old dislocation of the femur upward and backward. 3. Unsymmetrical sacrum, produced by defective development, or by atrophy of one sacral lateral mass—(*a*) as the result of a defect in the original formation; (*b*) as the result of abnormal coalescence of the sacrum and ilium in early life, whereby the growth of both was hindered; (*c*) as the result of a loss of substance from caries. Spiegelberg ‡ calls attention to Lambl's statement that primary asymmetry of the sacrum may be due to coalescence of the sacral lateral masses and the transverse processes of the last lumbar vertebra, whereby the outward growth of the former is impeded. He also emphasizes # the fact that simple chronic arthritis of the sacro-iliac synchondrosis produces sacral asymmetry, without anchylosis, by inducing contraction and atrophic sclerosis of the contiguous osseous tissue. The continued use of one shortened lower extremity is another cause of excessive pressure upon the corresponding side of the pelvis. When this condition obtains, the deformity will be on the side of the shortening. The sacro-iliac synostosis, which has been alluded to as the distinguishing characteristic of the Naegele oblique, as contrasted with the other forms of the oblique-ovate pelvis, is sometimes the primary deformity, as will be seen from the foregoing etiological table. The coalescence of the joint-surfaces is never, however, congenital, because the articulation is fully formed before the appearance of the centers of ossification for the sacral lateral masses. Nor can the synostosis be referred to involvement of the joint-surfaces in the process of ossification, since this does not occur in any true joint. The disappearance of the joint-cavity must, therefore, be referable to an inflammatory process, resulting in adhesion of the opposed articular surfaces. The inflammation may be either of traumatic or of strumous origin. The results of unilateral pressure upon the pelvis will depend upon the amount of pressure exerted, the resistance of the bones, and the firmness of their connections.

Diagnosis.—The attention of the obstetrician will be directed to the possibility of the existence of the oblique-ovate pelvis when the subject limps and presents an inequality in the height of the hips or evidences of antecedent gluteal abscesses. The diagnosis is assured by a physical examination, which shows, in the first place, the distance

* Litzmann, *op. cit.*, p. 68. † Gusserow, "Arch. f. Gynaek.," Bd. xi, 1877, p. 264.
‡ Spiegelberg, "Lehrb.," p. 475.
# Spiegelberg, "Arch. f. Gynaek.," ii, 1871, pp. 159 *et seq.*

between the spinous process of the last lumbar vertebra and the posterior superior spinous process to be considerably less on the deformed than on the healthy side. The absence of this sign is, however, no proof of the non-existence of the deformity. The distorted ilium is higher than the other, and projects farther posteriorly than is normal. A vaginal examination reveals the straight course of the ilio-pectineal line on the side of the anchylosis, the deviation of the sub-pubic arch toward that side, a disparity in the distances between the ischiatic spines and the apex of the sacrum, and the deviation of the promontory. Naegele* suggested, for the completion of the diagnosis, the application of the following measurements, which are equal on both sides in the normal, but different in the oblique-ovate pelvis: 1. The distance of the tuber ischii of one side from the posterior superior iliac spine of the other; on the deformed side it is shorter. 2. That from the anterior superior to the posterior superior spine of the other side; shorter from the anterior spine of the deformed side. 3. That from the spine of the last lumbar vertebra to the anterior superior spinous process of the same side; less on the contracted side. 4. That from the trochanter major to the opposite posterior superior spinous process; shorter when measured from the affected side. 5. That from the under surface of the symphysis pubis to the posterior superior iliac spine; longer on the narrowed side. These measurements are only of avail in well-marked cases, and may lead to erroneous conclusions if other diseases of the bones be simultaneously present. The vaginal examination affords, on the whole, the most accurate results.

Mechanism of Labor.—The mechanism of the birth, in an oblique-ovate pelvis, is the following: If the promontory be retreating, the sagittal suture of the fetal cranium enters the inlet parallel to the longer oblique diameter. If, however, the promontory project considerably, and is closely approximated to the ilium of the affected side, no portion of the head can be admitted between them.† The cranium will then enter the pelvis most easily with the sagittal suture in the short oblique diameter, and will pass through the pelvic canal without rotation. If the pelvis be originally small and the deformity marked, the obstruction to labor may be complete. Should the pelvis, however, be roomy and the promontory retreating, no considerable impediment will be offered to parturition.

Prognosis.—It is obvious that the prognosis, for both mother and child, is best when the pelvis was originally large, and far less favorable under the reversed condition. In the latter case the mother very frequently succumbs and the child is only rescued by the Cæsarean section. Litzmann's‡ statistics report the death of twenty-two out of

* Naegele, *op. cit.*, p. 174.

† Litzmann, "Monatsschr. f. Geburtsk.," xxiii, 1864, p. 238. ‡ *Ibid.*, p. 284.

twenty-eight mothers, five of whom perished undelivered, and that of thirty-one children out of forty-one cases. These figures by no means, however, fairly represent the average result, since many cases of slight and moderate deformity escape detection.

Treatment.—In a case of extreme obliquity at the Bellevue Hospital, where the distance between the ischia barely exceeded two inches, I induced premature labor at presumably the twenty-ninth week. The child was turned and lived long enough after extraction to receive the rite of baptism. The mother made a speedy recovery. This case affords a striking contrast to those reported by Litzmann. Undoubtedly, if the obliquity were always recognized at a sufficiently early period of pregnancy, the induction of premature labor would favorably change the prognosis. Very commonly, however, the condition passes unperceived until delay in labor leads to a more careful investigation. In such cases, if the head has entered the pelvic cavity, and the diminution of the space between the ischia is not excessive, a careful attempt should be made with the forceps to test the adaptability of the presenting part to the contracted diameter. Violent tractions should, however, be avoided. Studley * has recently reported a case of coxalgic oblique pelvis in which fracture of the pubic rami upon the right side resulted from forceps delivery. If the disproportion is such that moderate tractions are unavailing to advance the head, or if the child is already dead, perforation should be performed. Craniotomy at the inferior strait is much less dangerous than at the brim.

If the head fail to enter the pelvis, we have to inquire whether the result be due to absolute deficiency of the pelvic space, or to the fact that the sagittal suture of the head corresponds to the shortened oblique diameter. In the first event the case becomes a good one for laparo-elytrotomy, while in the second version should be performed with a view to bringing the long cephalic diameter into correspondence with the opposite longer diameter of the pelvis. If extraction is then found to be impossible, perforation can still be performed upon the after-coming head.

II. The Kyphotic Pelvis.

Morbid Anatomy.—The characteristic deviations of a kyphotic pelvis from the normal type are due to the unnatural direction in which the weight of the superimposed trunk is communicated to the base of the sacrum, as the result of an existing antero-posterior spinal curvature. If a dorsal kyphosis be entirely compensated by a lumbar lordosis, the former may entail no pelvic distortion. As a rule, the deformity is most marked with lumbar and sacral kyphoses, which admit of no compensatory lordosis, and least apparent with remote dorsal kyphoses. The effect of the altered direction, in which the weight of

* "Am. Jour. of Obstet.," 1879, p. 269.

the trunk is transmitted to the sacrum, is to force the latter more deeply between the ossa innominata and to rotate its upper portion in a posterior direction. The displacement backward of the inferior extremity of the trunk causes the center of gravity to be thrown far behind the acetabula, and produces a consequent diminution in the obliquity of the pelvis by elevating the anterior pelvic parietes.* The change in the pelvic obliquity is antagonized by the ilio-femoral ligaments, and the result of these opposing forces † is as follows: The sacrum is narrowed and elongated by the traction from behind and above, and its upper part is displaced backward. Its transverse concavity is increased and its longitudinal concavity diminished.‡ The bodies of the sacral vertebræ are on a plane posterior to their transverse processes. The promontory is high and is directed far backward. The upper anterior surface is sometimes convex while the concavity of the lower part is preserved, and an S-like shape is thus imparted to the sacral curve. The higher anterior sacral foramina look upward. Owing to the tension of the ilio-femoral ligaments, the anterior inferior spinous processes of the ilium are well developed. The *lineæ ilio-pectineæ* are only slightly curved. The sub-pubic arch is narrowed. The spines and tuberosities of the ischia are abnormally approximated. Owing to the narrowness of the sacrum, the posterior superior iliac spines are in close proximity to each other, while the spines and crest of the ilium are more remote than in a normal pelvis. The venters of the ilia are expanded and directed to the front. The transverse diameter of the false pelvis is, therefore, increased, while that of the true pelvis is diminished. The symphysis is prominent, the horizontal pubic rami meeting at an acute angle. At the inlet the oblique and the conjugate diameters are elongated and the transverse diameter curtailed. In the true pelvis the transverse diameters are considerably, and the antero-posterior diameter slightly shortened. These diameters become still more

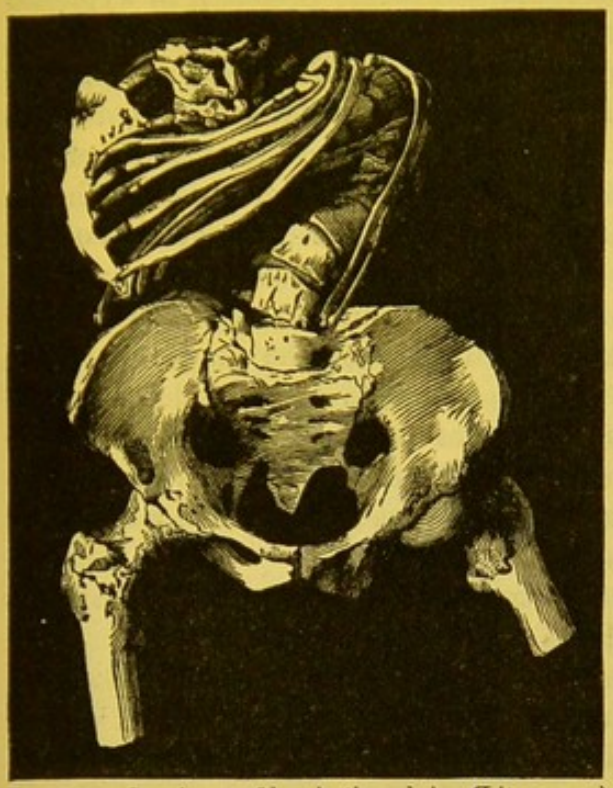


Fig. 227.—Specimen of kyphotic pelvis. (Litzmann.)

* Lange, "Arch. f. Gynaek.," Bd. i, 1870, p. 231.

† Spiegelberg, "Lehrbuch," p. 483.

‡ Breslau, "Monatsschr. f. Geburtsk.," Bd. xxvii, 1866, p. 319.

contracted as the outlet is approached.* If a lumbo-sacral kyphosis be present, the sacrum is shortened and very narrow. If this kyphosis be situated very low down, it may be compensated for by a low lumbar lordosis, which overhangs and materially contracts the pelvic inlet.†

Etiology.—The cause of the spinal curvature resulting in kyphotic pelvis is usually caries of the vertebræ.‡

Diagnosis.—The antecedent history and the discovery of kyphosis will render the existence of this form of pelvis probable. On more careful physical examination, the shape and position of the sacrum, the short interval between the spines and the tuberosities of the ischium and the posterior superior iliac spines, the wide separation of the anterior superior iliac spines, the narrow pubic arch and prominent symphysis, the flatness of the iliac venters, and the difficulty experienced in reaching the promontory, will establish the diagnosis. The differential diagnosis between a kyphotic pelvis and one deformed by osteomalacia, with which it is sometimes confounded, will be readily made by reference to these distinctive features and to the fact that the transverse diameters of the false pelvis are elongated in a kyphotic pelvis, the reverse obtaining in osteomalacia.

Prognosis.—The amount of obstruction offered to parturition will naturally depend upon the grade of the pelvic contraction. The prognosis for the mother is not exceedingly grave unless the outlet be extremely contracted. The prospects for the preservation of the child's life are unfavorable. In some instances, as in a case recently reported by Korsch,# there exists a considerable amount of mobility in the pelvic joints, which permits an enlargement of the outlet and facilitates the parturient process.

Treatment.—Dr. I. E. Taylor has recently reported a case of extreme pelvic kyphosis, where the distance between the ischia, measured by me with great care, did not exceed one inch and three fourths. In the patient's first pregnancy he delivered her by craniotomy. She was out of bed on the tenth day. At her second confinement, Dr. Taylor resorted to Porro's operation, with a view to saving the life of the child. The latter object was accomplished, and the woman lived twenty-one days, but died eventually of pulmonary embolism following phlegmasia. It is obvious that in this, as in all other forms of pelvic contraction, the treatment will be determined by the extent of the deformity. In the extreme grades, however, the comparatively favorable results of craniotomy, when performed after the head has entered the pelvic cavity, would, except for the interests of the child, give to that operation the preference over the Cæsarean section.

* Hüter, "Ztschr. f. Geburtsh. u. Gynaek.," Bd. v, 1880, p. 22.

† Fehling, "Arch. f. Gynaek.," Bd. iv, 1872, p. 2.

‡ Neugebauer, "Monatsschr. f. Geburtsk.," Bd. xxii, 1863, p. 297.

Korsch, "Ein während der Geburt constatirter Fall von Beweglichkeit der Gelenkverbindungen des kyphotischen Beckens," "Arch. f. Gynaek.," vol. xix, p. 475.

III. Scolio-rachitic Pelvis.

A brief allusion must be made to the anatomical characteristics of a purely rachitic pelvis, in order to render the differences between it and a scolio-rachitic pelvis intelligible. The leading pathological features of the infantile rachitic pelvis consist in expansion of the subpubic arch, prominence and lowering of the promontory, widening and elongation of the sacrum, flatness of the venters of the ilia, between which there is an abnormally wide interval, and in an irregularly rounded, triangular, or kidney-shaped pelvic inlet.* These anatomical features are not altered by the supervention of a scoliosis, but the latter adds to the deformity already existing its own pathological characters. The latter combine to produce a marked unilateral asymmetry of the pelvis.† The most ordinary form of scoliosis consists in a deviation of the dorsal vertebræ to the right and a compensating lumbar curve to the left.

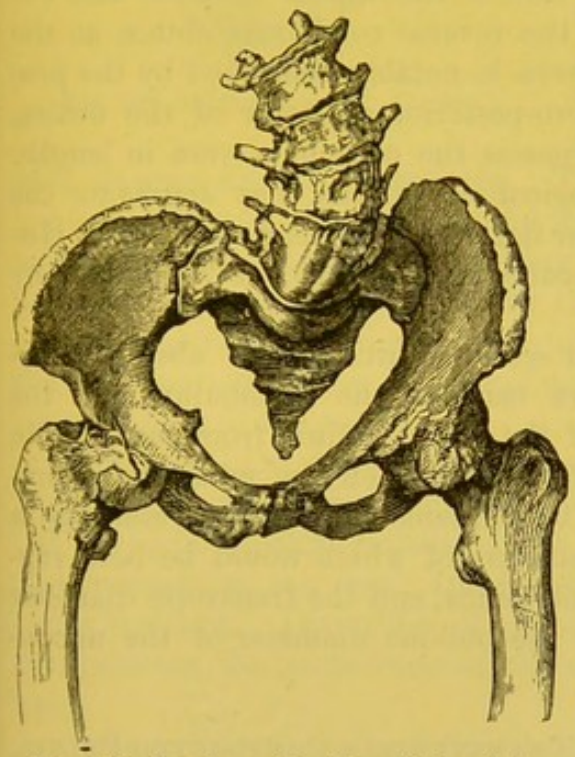


Fig. 228.—Specimen of scolic-rachitic pelvis. (Litzmann.)

The adult scolio-rachitic pelvis presents many points of resemblance to the infantile, its leading peculiarities being the following:‡ The entire pelvis is inclined toward the side of the lumbar curve, and rests chiefly upon the corresponding thigh. The cause of the pelvic asymmetry is to be sought in the increased weight thus thrown upon the contracted half of the pelvis and in the counter-pressure exerted upon its articular surface. The contracted half of the pelvis is higher and more inclined than its fellow. The sacrum has sunk deep between the ilia, and is narrower upon the side of the lumbar scoliosis. The sacral vertebral bodies are sometimes displaced forward, projecting beyond the lateral masses. The promontory is displaced toward the contracted side, and the corresponding lateral mass is often narrowed. There is rarely anchylosis of the hip-joint. The ilium

* Fehling, "Arch. f. Gynaek.," Bd. x, 1876, p. 1; *Ibid.*, Bd. xi, 1877, p. 173.

† Kehrer, "Arch. f. Gynaek.," Bd. v, 1873, p. 60.

‡ Leopold, "Das skoliotisches und kyphotisch-rachitisches Becken," Leipsic, 1879, p. 7.

is erect, looks inward, and is narrowed antero-posteriorly. Its crest is higher than that of the opposite side. The symphysis is displaced toward the uncontracted half of the pelvis. The ilio-pectineal line makes a sharp curve inward near the sacro-iliac synchondrosis, and then pursues an undulatory course to the symphysis, being notably bent inward opposite the acetabulum. On the uncontracted side the corresponding line forms a large and rounded arch. The tuber ischii on the side of the lumbar scoliosis is turned outward. The oblique diameter of this side is greater, but the distance between the sacrum and the acetabulum (*distantia sacro-cotyloidea*) is much shorter than on the uncontracted side. The plane of the inlet is obliquely cordiform, being contracted upon the side of the lumbar scoliosis and expanded on the other. Exactly the reverse conditions obtain at the pelvic outlet.* The conjugata vera is notably shortened by the protruding promontory. The antero-posterior diameter of the outlet, although contracted, still far surpasses the conjugata vera in length. Other and independent pathological conditions may aggravate the obstruction caused by the peculiar deformity in question. Thus, Hugenberger describes a case of scolio-rachitic pelvis complicated by an extensive sacral hydrorachis.†

The peculiar deformity of a scolio-rachitic pelvis obstructs delivery by so narrowing the space between the acetabulum and the sacrum as to prevent any part of the fœtal cranium from engaging in it. Rotation is thus prevented, and the delivery must be accomplished, if indeed it be possible, by the same mechanism obtaining in a justo-minor pelvis, the conjugata vera of which would be here represented by the distantia sacro-cotyloidea, and the transverse diameter of which would correspond with the oblique diameter of the uncontracted side.

IV. Robert's Anchylosed and Transversely Contracted Pelvis.

This very rare form of contracted pelvis was first described by Robert, in 1842. Its leading characteristics are bilateral sacro-iliac anchylosis, and absence or rudimentary development of the sacral lateral masses. The sacrum is consequently very narrow, and only slightly wider at its upper than at its lower extremity. The longitudinal and transverse concavities of the bone are nearly or quite obliterated. In some cases the normal transverse concavity is transformed into a convexity. The sacrum is deeply pressed between the ossa innominata. The posterior superior iliac spines are, consequently, closely approximated, and the ilia project far above the base of the sacrum. The promontory encroaches considerably upon the superior strait. The iliac venters are flattened and directed anteriorly.

* Leopold, *op. cit.*, p. 10.

† Hugenberger, "Arch. f. Gynæk.," Bd. xiv, p. 1.

The lineæ ilio-pectineæ are slightly or not at all curved, and abnormally approximated. The descending rami of the pubes unite at an acute angle. The ischiatic spines and tuberosities are in close proximity to each other and to the lateral margins of the sacrum. The dimensions of the pelvis are materially altered.

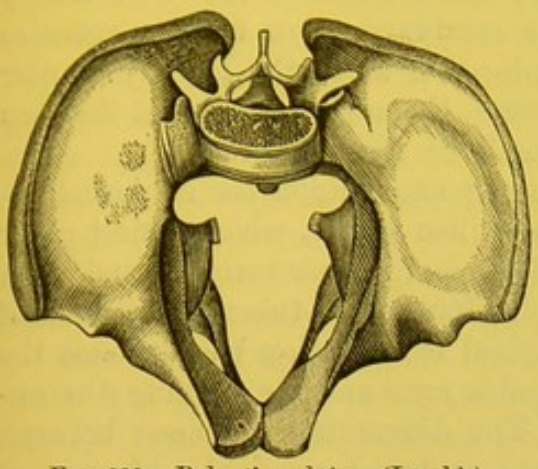


Fig. 229.—Robert's pelvis. (Lambl.)

The transverse diameter is notably diminished and grows shorter from above downward, so that at the outlet, in marked cases, it is represented by a mere crevice between the ischia and the pubic bones. The form of the inlet is that of a long and narrow wedge with its apex directed anteriorly. The average diameter of the outlet is less than two inches.* The antero-posterior diameter is either of normal length or but slightened shortened, since the projection of the promontory is compensated for by the absence of the normal outward curve of the lateral borders of the inlet. The pelvic canal is deeper than in a normal pelvis. In some cases there is asymmetry of the two lateral halves of the pelvis.

Etiology.—The decisive agency in the production of the deformity under consideration is the narrowness of the sacrum, which is chiefly due to the diminished breadth of its lateral masses, but also in a certain measure to the small transverse diameter of the bodies of the sacral vertebræ. Diversities of opinion prevail regarding the connection between the narrowness of the sacrum and the sacro-iliac synostosis.

Some authors consider deficient development of the centers of ossification of the lateral masses as the primary event and the anchylosis as dependent upon this. Others regard the synostosis as the primary change which determines the atrophy of the lateral masses,† and variously refer it to inflammatory processes or to arrested development.‡ In some cases it would seem that the sacrum was originally of normal breadth, but was narrowed and united with the ilium by osteitis and arthritis.# The transverse convexity of the anterior sacral surface is explained by the fact that the bodies of the vertebræ are pressed forward by the weight of the superimposed trunk after the union of the sacral lateral masses with the ilia, and at a time when the connections

* Spiegelberg, "Lehrbuch," p. 482.

† Litzmann, "Die Formen des Beckens," Berlin, 1861, p. 62.

‡ Kehrer, "Monatsschr. f. Geburtsk.," Bd. xxxiv, 1869, p. 20.

Kleinwächter, "Arch. f. Gynaek.," Bd. i, p. 156.

between the bodies and the lateral masses are still pliable and yielding. The close approximation of the ilia and their parallel course are referable to the narrowness of the sacrum and to increased lateral pressure upon the acetabula.* The combined action of these agencies produces the narrowness of the sub-pubic arch, the acutely angular junction of the descending pubic rami, the approximation of the iliac crests, and the straight course of the lineæ ilio-pectineæ.

Diagnosis.—The diagnosis is partly based upon the abnormal approximation of the posterior superior iliac spines, which almost cover the deeply seated spinous process of the last lumbar vertebra, and upon a similar approximation of the trochanters, of the tubera ischii, and of the iliac spines and crests. A vaginal examination then reveals the parallel course of the descending pubic rami and the striking diminution of the transverse diameter. The differential diagnosis between the Robert and the kyphotic pelves is based upon the absence of a kyphosis in the former and upon the striking difference between the respective transverse diameters.

Prognosis.—This is very bad for the mother, inasmuch as labor is completely obstructed by the deformity, and operative interference is always indicated.

The Cæsarean section offers the only hope of preserving the child's life.

V. Spondylolisthetic Pelvis.

This rare form of contracted pelvis was first described by Rokitansky in 1839. Its principal pathological feature consists in the separation of the last lumbar from the first sacral vertebra and in the descent of the body into the pelvis, where the inferior, or in an extreme case the posterior, surface of the body of the last lumbar rests upon the anterior surface of the first sacral vertebra. The anterior surface of the last lumbar vertebra is directed downward. The anterior surfaces of the fourth, third, and second lumbar vertebræ form an arch, the most prominent part of which, being nearest the symphysis, replaces the normal promontory. The result of this displacement is a considerable diminution in the antero-posterior diameter of the pelvic inlet. The descent of the lumbar portion of the spine, which is gradually accomplished, is attended by atrophy of the intervertebral cartilages, and frequently by osse-

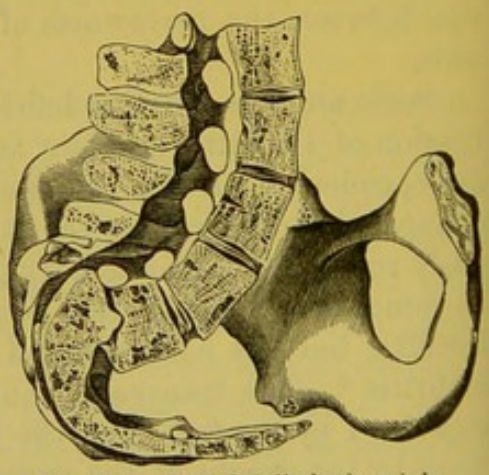


Fig. 230.—Spondylolisthetic pelvis. (Kilian.)

* Litzmann, *op. cit.*, p. 65.

ous union between the bodies of the lumbar and circular vertebræ. The weight of the superimposed trunk being now transmitted to the anterior surface of the sacrum, instead of to its base, the pelvic center of gravity is displaced forward. This is compensated for by a diminution in the normal pelvic inclination, the anterior portion of the pelvis being tilted slightly upward. The pressure upon the anterior surface of the sacrum forces its base backward. The posterior superior iliac spines are thus widely separated, and the apex of the sacrum is thrown forward, encroaching upon the antero-posterior diameter of the outlet. In a case cited by Breslau,* the sacro-iliac synchondrosis possessed great mobility.

The traction upon the ilio-femoral ligaments, which approximates the tubera ischii, and the lateral displacement of the ilia, due to recession of the sacrum, produce a shortening of the transverse pelvic diameter, which becomes more marked in proportion as the outlet is approached.

According to the recent investigations of Neugebauer,† the spondylolisthetic pelvis is far from being a very rare anomaly. Thus Neugebauer has succeeded in collecting from various sources twenty-three anatomical preparations and thirty clinical observations made on living persons.

Etiology —Neugebauer, who has studied with unwearied patience and zeal the anatomical specimens preserved in the museums of Europe, has shown that in true spondylolisthesis the body of the vertebra alone is concerned in the forward displacement, the arch, the spine, and the transverse processes remaining *in situ*. The spinal canal undergoes, therefore, an antero-posterior elongation, and the cord is not subjected to pressure. This elongation takes place at the junction of the arch with the body. It does not appear to be due either to caries or an inflammatory process. The original cause of the anomaly Neugebauer attributes in many cases to a congenital separation of the arch from the body of the fifth lumbar vertebra, due to defective ossification, in rare instances to traumatic fracture of the sacral articular processes, and, in some cases, probably to fracture of the arches due to traumatism. This latter cause he admits, however, to be hypothetical, as where fractures have been observed it is not possible to determine whether they occurred primarily, or whether they resulted secondarily from the strain placed upon them in the forward and downward movements of the vertebral body.

In a few instances the etiology remains unsolved. The deformity never occurs suddenly, but progresses slowly under the pressure of the trunk until the gliding movement is arrested by bony union between

* Breslau, "Monatsschr. f. Geburtsk.," Bd. xviii, 1861, p. 411.

† Dr. Franz Ludwig Neugebauer, "Arch. f. Gynaek.," vol. xix, p. 441; vol. xx, p. 133; vol. xxii, p. 347; vol. xxv, p. 347.

the lumbar and sacral vertebra. Repeated pregnancies furnish mechanical conditions favoring the spondylolisthesis, though pregnancy is not an essential element in the causation, as the accident has been observed in males.

Diagnosis.—As a result of the deformity, the abdomen is protuberant and the thorax is sunken between the prominent iliac crests. The trunk, therefore, appears shortened, while the extremities are relatively of disproportionate length ; the width between the trochanters is increased ; the nates are flattened and pointed below with deep lateral depressions, so that the posterior aspect of the buttocks possesses a heart-shape and the base of the sacrum and the posterior superior spines of the ilium are prominent. Along the spine a deep lumbo-dorsal furrow is observable, and, owing to the diminished pelvic inclination, the external genitals are directed to the front. The gait of patients suffering from spondylolisthesis is peculiar. The steps are short, the toes are but slightly turned out, and the footprints follow one another in nearly a straight line. It is not, however, easy to determine by external examination alone the difference between spondylolisthesis and a deep-seated lumbo-sacral kyphosis. The internal examination is best made, according to Neugebauer, in the upright or lateral position. To determine the existence of the angle formed by the projecting lumbar vertebra, the finger should be introduced along the anterior vaginal wall in the axis of the superior strait directly to the spinal column, and then should be passed downward to the seat of displacement, carefully feeling in the descent the spinal vertebræ and the extent to which the spine covers the pelvic brim.

Olshausen * first announced the fact that the point of division of the abdominal aorta into the common iliac arteries is displaced downward by the descending lumbar vertebræ to such an extent as to enable the palpating finger, introduced into Douglas's *cul-de-sac*, to detect pulsation in these vessels. Hartmann † was enabled to feel the point of the aorta's division on the upper border of the fourth lumbar vertebra, and Breslau ‡ felt a pulsating vessel in the same situation. Neugebauer states that this displacement is not pathognomonic, but may be observed in other instances of spinal lordosis. The spondylolisthetic lordosis may be mistaken for the sacral deformity peculiar to a rachitic pelvis. Breisky # suggests that this error may be avoided by attention to the fact that in the rachitic pelvis the sacral lateral masses pass outward from the projecting promontory, while in spondylolisthesis one can feel at the pelvic inlet only the rounded

* Olshausen, "Monatsschr. f. Geburtsk.," Bd. xxiii, p. 204.

† Hartmann, "Monatsschr. f. Geburtsk.," Bd. xxv, 1865, p. 469 ; Bd. xxxi, 1868, p. 285.

‡ Breslau, "Monatsschr. f. Geburtsk.," Bd. xviii, p. 411.

Breisky, *loc. cit.*, p. 9.

prominence of a single vertebral body without laterally expanding wings. The projecting angle made by the body of the last lumbar vertebra with the anterior surface of the sacrum is also easily accessible to palpation.

Prognosis.—The prognosis in cases of the spondylolisthetic, as in other forms of contracted pelvis, depends upon the degree of the obstruction of the brim, and such collateral conditions as the size of the child, the strength of the pains, and the position of the head at the point of entry into the pelvis. Other things being equal, a deviation of the spine from the median line is a favorable condition.

Swedelin,* from a careful study of the clinically observed cases, concludes :

1. That where the false conjugate measures above 3½ inches no disturbance of labor is to be anticipated.

2. When the false conjugate measures from 3 to 3½ inches, pregnancy may be permitted to proceed to term, as labor at term may be expected to terminate favorably for both mother and child, without the intervention of severe operative measures.

3. Labor at term, with a false conjugate measuring between 2½ to 3 inches, is extremely dangerous for the child ; the prognosis for the mother is likewise bad.

4. With less than 2½ inches in the false conjugate, extraction of the child without craniotomy is hardly possible.

5. In multiparæ the prognosis is the more serious in cases where the previous labor was difficult.

He advises, therefore :

1. Induction of premature labor at the thirty-second week, with a false conjugate of less than 2¾ inches.

2. Induction of premature labor at the thirty-second week with a false conjugate measuring between 2¾ and 3¼ inches.

3. Between 3¼ and 3½ inches, it is best to await the end of gestation, unless the feeble condition of the patient contra-indicates a waiting policy, in which case premature labor should be induced in the thirty-sixth week.

4. Premature labor is not indicated with a false conjugate exceeding 3½ inches.

5. If the end of gestation has been reached with a false conjugate of less than 2¾ inches, wait until danger threatens the patient, and then decide between craniotomy and the Cæsarean section.

6. With a false conjugate of less than 2½ inches, the Cæsarean section is called for.

* Swedelin, "Ein neuer Fall von klinisch beobachteter Spondylolisthesis," "Arch. f. Gynaek.," vol. xxii, p. 250, 1880.

VI. Funnel-shaped Pelvis.

This term has been applied to two varieties of deformed pelves, both of which are exceedingly rare. The inlet of the first variety is either normal or but slightly contracted in all its diameters, but its canal is gradually and progressively narrowed as the outlet is approached. The contraction affects chiefly the transverse diameter; but either this alone, the antero-posterior diameter alone, or both together, may be shortened. The lateral pelvic walls converge considerably, particularly in the vicinity of the outlet. The descending rami of the pubic bones are closely approximated, so that the sub-pubic arch forms an acute angle. The spines and tuberosities of the ischia are in close apposition.* The sacrum is elongated and but slightly curved, its position resembling that of the sacrum in a kyphotic pelvis. It will be seen that these deformities produce a close resemblance to the typical male pelvis. Pelves of this variety are frequently somewhat unsymmetrical.

The second variety of the funnel-shaped pelvis is so exceedingly rare as to require only a passing notice. In this instance the deformity is exactly the reverse of that just described, the inlet being very narrow in either one or in all of its diameters, while the outlet is of normal size or even abnormally wide in one or more directions.†

Etiology.—The causes of this deformity are imperfectly understood. The former variety is believed to be due to arrest of development in the sacral lateral masses and to other causes coöperating to alter the direction in which the weight of the trunk is normally transmitted to the sacrum. This view seems to be confirmed by Schroeder's observation that the funnel-shaped pelvis is of unusual frequency in a certain German province, where the children are carried upon the back in a position intermediate between the erect and the recumbent posture.‡ The weight of the body would in this case be transmitted to the sacrum from above and in front, as in the kyphotic pelvis, rather than from behind and above, as is the case in a natural position, and the pelvis would neither acquire its normal anterior curvature nor its posterior inclination. The same theory explains the failure of the sacrum to exert its usual wedge-like action in separating the ossa innominata, and accounts for the consequent approximation of the tubera and spines of the opposite ischia.

Diagnosis.—In cases of slight deformity the diagnosis is difficult. In well-marked cases the approximation of the ischial tuberosities, the slight divergence of the pubic rami, and the acute sub-pubic angle are readily appreciated. Arrest of the head after it has already descended

* Poppel, "Monatsschr. f. Geburtsk.," Bd. xxviii, 1866, p. 224; Braun, "Arch. f. Gynaek.," Bd. iii, 1870, p. 154.

† Spiegelberg, "Lehrbuch," p. 472.

‡ Schroeder, "Lehrbuch," p. 582.

into the true pelvis will often be the first circumstance serving to direct the attention to the possible existence of funnel-shaped pelvis. Pelvic menstruation, with particular reference to the distance between the spines of the ischia and to the width of the sacrum, will establish the diagnosis.

Prognosis.—In the slighter grades of funnel-shaped pelves, the prognosis is not grave. If the deformity be marked, however, the child's life must almost invariably be sacrificed; and gangrene of the maternal soft parts, with resulting cicatrices and fistulæ, or even with caries of the pubic bones, may be the consequence of the excessive pressure to which these tissues are liable. In a case reported by Scharlau the lesions already mentioned were accompanied by perforation of the fundus uteri from gangrene, and by rupture of the right sacro-iliac artery.*

The treatment consists in the induction of premature labor, or, at term, in a cautious attempt to deliver with forceps. Should moderate tractions fail to advance the head, perforation and extraction with the cranioclast should be resorted to.

VII. Pelves deformed by Osteomalacia.

Osteomalacia is almost confined to females, and appears, ordinarily, in the puerperal state. It usually attacks fully-developed bones, but may, rarely, affect them during their period of growth. It is generally observed in multiparæ, although primiparæ are in exceptional cases its victims. Each succeeding pregnancy is usually attended by a progressive development of the disease, which may, however, become non-progressive, or even be completely and permanently arrested.† In a case of this kind the bone is restored to its normal histological state, although its deformity remains. Osteomalacia may involve the entire osseous system, or be confined to individual bones. In the latter case the long bones and the vertebræ are most frequently diseased.‡ In puerperal osteomalacia the pelvis and the vertebræ are predominantly and often exclusively affected. The disease is regarded as an osteomye-

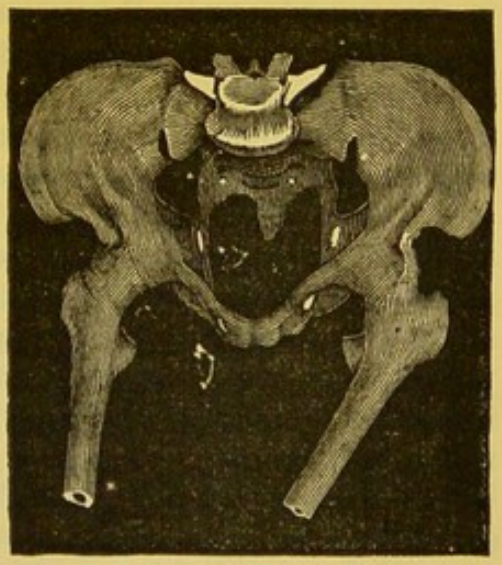


Fig. 231.—Osteomalacia. (Specimen from Wood's Museum.)

* Scharlau, "Monatsschr. f. Geburtsk.," Bd. xxvii, 1866, p. 1.

† Winckel, "Monatsschr. f. Geburtsk.," Bd. xxiii, 1864, p. 321.

‡ Litzmann, "Die Formen des Beckens," Berlin, 1861.

litis, which, beginning in the center of bones, advances toward their periphery. The essential pathological process consists in the absorption of calcareous matter, through the Haversian canals, and in the substitution of hypertrophic medullary tissue for the softened osseous structures.* The natural result of the changes is great friability or pliability of the bones, according to the stage reached by the disease, and their consequent distortion by compression or traction. The bones are of very light weight. Their transverse section reveals a porous, diploë-like structure. Their outer, hard lamella is exceedingly thin, or entirely absent. The bones are of a wax-like softness, being readily cut and molded.† The term rubber or elastic pelvis has been applied to those pelves whose bones have reached this stage of degeneration. In the most advanced cases the osseous tissue is represented merely by membranous sacs of periosteum inclosing medullary tissue and fat.

Morbid Anatomy.—The osteomalacic pelvis presents the following pathological anatomical features: The sacral lateral masses are very narrow, and the entire bone, which is displaced downward between the ilia, is sharply curved. The promontory is, accordingly, deeply depressed and approximated to the symphysis as well as to the apex of the sacrum, which is itself displaced forward and curved upward. The promontory and the apex of the sacrum may, in marked cases, almost touch each other. The ilia are placed almost vertically. Their crests are elongated and sharply curved. The anterior superior spinous processes are approximated. The posterior superior spinous processes are in the same plane with the posterior surface of the last lumbar spinous process. The iliac fossa is divided, near its middle, by a vertical furrow which may be bifurcated at its lower end. A prominence corresponding to either acetabulum encroaches more or less upon the pelvic canal. In grave cases these prominences may even come in contact with the promontory.‡ The pubic bones are in close apposition, and the pelvic inlet is consequently pointed anteriorly, while the symphysis is prominent and sharply angular. The ascending rami of the ischia and the descending rami of the pubes are approximated, and the subpubic arch is partly or completely abolished. The tuberosities of the ischia are approximated. The deformities described may be asymmetrical. The pelvic canal is greatly narrowed, the outlet usually suffering more distortion than the inlet. The pelvic inlet and canal are of triangular form, and assume, in the highest grades of the disease, the shape of the letter Y. The transverse diameter is always contracted, and its shortening is more marked as the outlet is approached. The approximation of the ischial tuberosities and of the

* Schroeder, "Lehrbuch.," p. 615.

† Schieck, "Monatsschr. f. Geburtsk.," Bd. xxvii, 1866, p. 178.

‡ Spiegelberg, "Lehrbuch," p. 488.

pubic bones, together with the anterior displacement of the apex of the sacrum, sometimes almost obliterates the outlet.

Etiology.—The etiology of this pelvic deformity may be divided into—1. That of the original disease; and, 2. That of the resulting distortions. 1. The causes of osteomalacia are obscure. Cold and damp dwellings, insufficient air and light, inadequate aliment, and exposure, are cited as exciting causes;* but it seems probable that these alone are insufficient etiological agencies unless some undetermined predisposing cause be already in operation. The disease is sometimes observed to assume an endemic form, particularly in countries where the above-mentioned exciting causes prevail, as, for instance, in the Rhine provinces and in some parts of Italy. In the United States it is only observed in isolated cases, usually in persons of foreign birth. 2. The immediate causes of the distortions are found (*a*) in the altered structure of the bones, and (*b*) in the various forces acting mechanically upon them. (*a*) The lime-salts, which impart stability to normal bones, are greatly diminished. Although it is not definitely known by what emunctories they are removed, it is probable that they are chiefly excreted by the kidneys. Gusserow states that the proportion of lime-salts in the milk of women suffering from osteomalacia is abnormally large.† Pagenstecher opposes this view.‡ (*b*) The distortions are chiefly produced, when once softening of the bones has occurred, by the muscular traction and by the pressure exerted upon the pelvic walls. This pressure will vary in direction and intensity with the different positions assumed by the patient. If the dorsal decubitus be long maintained, the sacrum is displaced forward and the ilia are folded upon themselves, so that a vertical furrow traverses the iliac fossæ. In the erect position the sacrum is forced downward and forward, dragging with it the posterior parts of the ilia, and increasing the bend in the iliac fossa. The same effect is produced by the upward and backward pressure exerted upon the acetabula by the femoral heads. In the lateral position the ilia are forced inward, and the transverse pelvic diameter is thus diminished. In the sitting posture the apex of the sacrum and the tubera ischii are forced upward. The deviations referred to above result from excess of pressure in some given direction, or from unequal progress of the disease in the various bones.

Diagnosis.—In the earlier stages, the history of violent pains in the pelvis and lower extremities will direct attention to the existence of osteomalacia, and careful mensuration will reveal beginning distortion. Pelvimetry is most satisfactorily performed during anæsthesia, which permits the introduction of the entire hand within the pelvis. If the

* Hennig, "Arch. f. Gynaek.," Bd. v, 1873, p. 519 *et seq.*

† Gusserow, "Monatsschr. f. Geburtsk.," Bd. xx, 1862, p. 19.

‡ Pagenstecher, "Monatsschr. f. Geburtsk.," xix, 1862, p. 128.

disease be more advanced the diagnosis will be based upon the above-mentioned morbid anatomical features, chief among which are the prominent pointed symphysis, the parallel pubic rami, the approximation of the tubera ischii, the accessibility of the promontory to palpation, the curvature of the sacrum, and the folding of the ilia. Spiegelberg insists on the value of the pliability of the pelvic bones as an aid to diagnosis.* The pliability, although slight during pregnancy, is more marked in labor. Its first sign is great sensitiveness to pressure over the symphysis.† Its grade can be determined by the method recommended for pelvic measurements.

Prognosis.—The prognosis for the mother is very bad. The majority of patients succumb to the effects of pressure in labor, to the results of operative interference, or to the exhaustion attending the almost invariably progressive disease. Amelioration of the symptoms and signs sometimes occurs when conception does not recur. In very exceptional cases not only may the pathological process be arrested but the normal histological character of the bone restored. (*a*) Even in such cases, however, the pelvic deformity remains unaltered, and would sadly cloud the prognosis if conception should recur. The prognosis for the child is more favorable. In the beginning of the disease, and in cases of pliable pelvis, the child may be born uninjured.‡ In more advanced cases a fair prospect of preserving its life is afforded by a resort to the Cæsarean section.

The treatment will depend upon the results of a careful exploration of the pelvic space. This should determine, first, whether it is possible to extract a living child through the natural passages; or, second, where that is out of the question, whether it is possible to deliver after craniotomy. In estimating the chances it will be necessary to take into consideration the pliability of the pelvis, it having been found possible in many cases of advanced softening to open up the pelvic canal with the hand and deliver by version. Lazzati and Casati, in Milan, found it was only necessary to perform Cæsarean section twice in sixty-two cases. Litzmann in 1857 reported forty Cæsarean sections in eighty-five cases; fifteen years later Hugenberger reported but four Cæsarean sections in twenty-five cases (Spiegelberg). Lately Porro's operation has been proposed by Levy in osteomalacia as a curative measure; but of this further experience is necessary.

Pseudo-Osteomalacia.—It is possible for a rachitic pelvis, in which the rachitic changes are excessive, to present a shape similar to that in osteomalacia. This form is, however, distinguishable from the latter

* Spiegelberg, "Lehrbuch," p. 489.

† Winckel, "Monatsschr. f. Geburtsk.," Bd. xxiii, 1864, p. 81.

‡ Kezmarszky, "Arch. f. Gynaek.," Bd. iv, 1872, p. 537; Fasbender and Pöllen, "Monatsschr. f. Geburtsk.," Bd. xxxiii, 1869, p. 177; Breslau, *Ibid*, Bd. xx, 1862, p. 355; Schieck, *Ibid.*, Bd. xxvii, 1866, p. 178; Winckel, *Ibid.*, Bd. xxiii, 1864, p. 81.

through the hardness of the bones, their smaller size, the greater distance between the anterior superior spinous processes, and the traces of rickets in other parts of the skeleton.

VIII. Pelves deformed by Exostosis, or by Osseous Tumors.

Fractures of the pelvic bones may be the source of pelvic deformity, either by producing permanent displacement of the bones, or by leading to such extensive deposits of callus as to obstruct the parturient canal.

Multiple exostoses of the pelvic bones are of comparatively frequent occurrence, and are usually attended by multiple exostoses of the entire osseous framework.* The pelves in which they are found are, as a rule, either of the oblique-ovate or of the rachitic variety, and the combination of these deformities is naturally a serious one, since the maternal soft parts are liable to contusion and perforation at many points during parturition. The ilio-pectineal eminence is sometimes so unusually prominent and sharp as to offer an obstacle to parturition. The same is true of the pubic crest and spine. Osteo-fibromata, sarcomata, enchondromata, and carcinomata connected with the pelvic bones constitute tumors of rare occurrence. They usually spring from the sacrum or from the symphysis,† and are of various dimensions. Some of them almost completely occlude the parturient canal, and may constitute formidable obstructions to delivery.

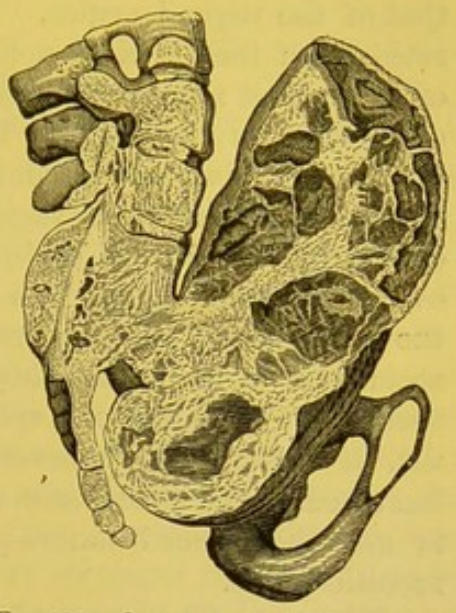


Fig. 232.—Osseous tumors filling pelvic cavity. (Naegele.)

In this connection may be mentioned, as of rare occurrence, anchylosis of the coccyx, a condition which materially shortens the antero-posterior diameter of the outlet.

IX. Absence of the Symphysis.

In this variety of deformed pelvis the symphysis is congenitally absent, and is replaced either by strong fibrous bands extending between the opposing surfaces of the pubic bones, or by the muscles and

* Leopold, "Arch. f. Gynaek.," Bd. iv, 1872, p. 336; Kormann, *Ibid.*, Bd. vi, 1874, p. 472.

† Harris, "Am. Jour. of Obstet.," vol. iv, 1872, pp. 633, 645; Braun, "Monatsschr. f. Geburtsk.," Bd. xxi, 1863, p. 311.

connective tissue of the perinæum. It is, accordingly, designated by Litzmann the split pelvis.*

Morbid Anatomy.—It is usually attended by ectopia vesicæ and by hiatus of the abdominal wall in the linea alba. In rare cases an abdominal hiatus exists without a corresponding opening in the bladder. If the split be located immediately below the symphysis, the urethra is involved rather than the bladder, and is sometimes so defective that cystocele may occur through the abnormal opening in its anterior wall.† Both the external and internal organs of generation are imperfectly developed. If the anterior wall of the urethal canal be absent, the mucous membrane of the fundus vesicæ is directly continuous with that of the vaginal orifice. In other cases the bladder is only separated from the vulva by a narrow bridge. The vulva and anus are often situated more anteriorly than normal, and the perinæum is thus diminished in thickness. The clitoris is bifurcated or absent, the nymphæ are imperfectly developed, and the defective labia majora widely separated. The vagina may be imperforate or partially occluded by a transverse septum. The uterus may be double and the ovaries rudimentary.‡ In a case reported by Winkler, separation of the pubic bones had occurred at the symphysis, as the result of an accident in early life, and they were only connected by bands of fibrous tissue.# The sacrum of a split pelvis is displaced forward between the ilia, its vertical and transverse curvature diminished, and its length increased. The iliac fossæ are widely separated. The entire pelvis is greatly flattened antero-posteriorly, and strongly resembles the rachitic pelvis.

Etiology.—The cause of the existing deformity is found in the increased pressure to which the lateral pelvic walls are subjected owing to the absence of the symphysis. The natural resistance to the separation of the lateral pelvic parietes, offered by the normal symphysis being wanting, the weight of the superimposed trunk naturally forces them apart posteriorly, while the pressure of the femora bends them inward anteriorly. In some instances anchylosis of the sacro-iliac joints occurs, as a consequence of an arthritis resulting from the increased pressure thrown upon them by the lateral displacement of the ossa innominata.‖ In other cases sacro-iliac synostosis is not present, but the firmness of the pelvis is, nevertheless, such as to admit of unimpeded locomotion.

* Litzmann, "Die Formen des Beckens," Berlin, 1861.

† Kleinwächter, "Monatsschr. f. Geburtsk.," Bd. xxxiv, 1869, pp. 81 *et seq.*

‡ Litzmann, "Arch. f. Gynaek.," Bd. iv, 1872, p. 272.

Winkler, "Arch. f. Gynaek.," Bd. i, 1870, p. 346.

‖ Freund, "Arch. f. Gynaek.," Bd. iii, 1872, pp. 398, 406.

CHAPTER XXVIII.

ABNORMALITIES OF THE SEXUAL ORGANS.

Atresia of the genital canal.—Vulvar atresia.—Vaginal atresia.—Cystocele.—Rectocele.—Retention of urine.—Impacted calculi.—Vaginal hernias.—Cystic degeneration of the vaginal wall.—Vaginismus.—Echinococci.—Uterine atresia.—Conglutinatio orificii externi.—Cicatricial atresia.—Rigidity.—Thrombus of the cervix.—Symptoms of atresia.—Note on treatment.—Tumors.—Fibroids.—Cancer.—Ovarian tumors.

Atresia of the Genital Canal. Obstruction of the Generative Passages by Morbid Processes in Neighboring Tissues.

I. Vulvar Atresia.—The term *atresia*, as here employed, implies either partial or complete obstruction of the genital canal.

Atresia of the hymen, usually denominated imperforate hymen, is of more frequent occurrence than any other variety of vulvar stenosis.* Unless unusually thick and rigid, however, the imperforate hymen offers only a trifling obstruction to delivery. Its chief importance is owing to the fact that it leads, in the unimpregnated state, to retention and accumulation of the menstrual fluid, which may occasion serious inflammatory, septic, or reflex nervous phenomena. Adhesions of the labia majora and minora constitute other forms of incomplete vulvar atresia. Their causes are often ulcerative processes resulting from injuries, or developed during the course of variola and other constitutional diseases. Under these circumstances they may consist of unyielding cicatricial tissue, which either ruptures in labor, or, forcing the head backward, leads indirectly to the exertion of injurious pressure upon the recto-vaginal septum or upon the perinæum. If the atresia be congenital, and not the result of cicatricial changes, it will rarely constitute an impediment to parturition. When the entrance to the vagina is very narrow, without exhibiting any pathological condition, as is often the case with aged primiparæ, it may be extensively lacerated in labor. A rigid perinæum is also well known to constitute a serious impediment to the normal progress of parturition. Œdema of the vulva, usually attendant upon albuminuria, produces atresia, and the œdematous labia and perinæum may become gangrenous from excessive pressure during labor. Vulvar hæmatoma, or thrombus, if formed, as it rarely is, before delivery, likewise obstructs the outlet of the parturient canal. A similar effect is produced by cancers and polypi of the vulva, which are, however, not often of sufficient size to occasion serious difficulty.

II. Vaginal Atresia.—This variety of stenosis of the generative passages is either congenital or accidental, complete or incomplete.

* Jenks, "Atresia of the Generative Passages of Women," "Chicago Med. Jour. and Examiner," September, 1880, p. 4.

(*a*) The congenital form may be either incomplete, in which case the stenosis sometimes affects the entire length of the vagina, and sometimes forms a circumscribed ring-like stricture,* or it may be complete. In either case the atresia is due to arrested embryonic development, which, in the latter instance, must have originated at a very early period of fetal life. Congenital narrowing of the vagina independent of any morbid process or any arrest of development is often observed, but is of trifling consequence, being overcome by the hypertrophy and relaxation accompanying pregnancy, and by the natural expulsive forces. Absence of the vaginal canal does not necessarily imply absence or imperfect development of the uterus, Fallopian tubes, or ovaries.

(*b*) Accidental vaginal atresia may be either complete or partial, but is ordinarily of the latter form. Both varieties result from the cicatrization following superficial or deep ulceration produced by constitutional diseases or by local injury. The diseases during the course of which vaginal ulceration occurs are chiefly diphtheria, variola, typhoid fever, cholera Asiatica, and syphilis. The mechanical injuries productive of vaginal stenosis are mainly those incident to protracted labors, to the unskillful employment of instruments, or to the improper performance of obstetrical operations; but caustic local applications, pessaries, excessive coition, or any local irritant of sufficient intensity to produce ulceration, may lead to the same result. In consequence of impaired vitality, ulceration and stenosis of the vagina may follow normal labors unattended by any injurious pressure. Complete accidental vaginal atresias are produced, as a rule, by grave mechanical injuries, but may, according to Spiegelberg,† also follow the acute infectious diseases enumerated above, although the ulcerations attending the latter usually lead to only partial stenosis.

Mention may properly be made, in this connection, of various morbid conditions involving tissues adjoining the vagina and resulting in diminution of its caliber.

Simple prolapse of the anterior vaginal wall sometimes occurs,‡ and, assuming an œdematous condition owing to the obstruction of its circulation, decidedly constricts the parturient canal. Cystocele frequently accompanies the prolapse of the anterior vaginal wall. If the bladder be distended with urine, the cystocele presents a tense fluctuating tumor of sufficient size to completely occlude the vagina. The subjective symptoms of this condition are intense pain with vesical tenesmus and dysuria. In some cases the cystocele is retracted by the longitudinal cervical contractions, or it may be forced still farther downward by the advancing fœtus, producing obstructed labor and even rupture of the vesico-vaginal septum.

* Schroeder, "Lehrbuch," 6te Aufl., p. 491. † Spiegelberg, "Lehrbuch," p. 505.

‡ Benicke, "Ztschr. f. Geburtsh. u. Gynaek.," Bd. ii, Heft 2, 1878, p. 256.

Prolapse of the posterior vaginal wall with rectocele produces vaginal stenosis, especially if the rectum be filled with impacted fæces. This condition is easily recognized by the characteristic feeling of the fecal mass, which admits of indentation by the palpating finger.

Retention of urine becomes oftentimes a grave complication of parturition, in that the distended bladder, by displacing the uterine axis, prevents the presenting part from engaging in the superior strait. The pressure it exerts upon the uterus also interferes with the efficient contraction of that organ. The diagnosis is based upon the presence of a tumor near the uterus, and often situated laterally from it, which disappears as the urine is withdrawn through a catheter. The introduction of the latter is often extremely difficult, owing to the compression of the urethra and the retraction of the meatus urinarius within the vagina.

Vesical calculi, if of any considerable magnitude, seriously obstruct the caliber of the vagina by becoming impacted in the base of the bladder, the urethra, or a cystocele, between the fœtus and the pelvic walls. Under these circumstances not only is the labor obstructed, but contusion and rupture of the soft parts, resulting in vesico-vaginal fistula, may ensue.

Impacted calculi have sometimes been mistaken for exostoses ;* but attention to the fact that they are immovable during the pains and movable in the intervals, together with the use of the vesical sound, will prevent this error.

Vaginal hernia consists of a sac formed by the protrusion of the vaginal wall, lined with the parietal peritonæum and containing some of the abdominal or pelvic viscera. The organs usually present in the sac are coils of the small and large intestine, the middle portion of the rectum with its elongated meso-rectum, parts of the omentum, portions of the urinary bladder, and sometimes blood, with various products of peritoneal inflammation. The location of the hernia is usually in the posterior vaginal wall, although it may insinuate itself between the uterus and the bladder, and, descending, produce hernia of the labia majora. Perineal hernias are formed by hernial sacs which pass behind the ligamentum latum and distend the perinæum. The intestinal vaginal hernia is the most important variety, inasmuch as it may not only obstruct labor, but may itself become incarcerated or strangulated, thus leading to symptoms of the gravest import. The diagnosis, which can be rendered very probable by palpation *per vaginam*, is made certain by a rectal examination.

Vaginal neoplasmata, the most important of which are carcinomata and fibromata, are rare sources of vaginal stenosis, as is likewise thrombus of the vagina. Slight obstruction to labor may result from a pathological condition of the vaginal mucous membrane described

* Schroeder, "Lehrbuch," 6te Aufl., p. 500.

by Winckel,* under the title *colpohyperplasia cystica*, and consisting of the development in the mucous membrane of numerous small and closely aggregated flattened cysts. The cysts are believed to be produced by the distention of glandular depressions in the mucous membrane with mucus, which, according to Zweifel,† eventually produces trimethylamine gas by decomposition. Others consider the location of the gas to be in the interstices of the submucous connective tissue.‡

Vaginismus is rarely a cause of vaginal stenosis in labor, inasmuch as it is itself a cause of sterility. It has, however, been found in certain instances to constitute so serious an obstacle to delivery as to necessitate operative interference. In double vagina the septum is sometimes a source of slight vaginal atresia.

Intrapelvic echinococci constitute a rare cause of vaginal constriction. Wiener # collected seven cases of pelvic echinococci, most of which occupied the loose connective tissue between the vagina and rectum. The leading symptoms due to their presence during pregnancy were deep-seated traction in the pelvis, severe pain, vesical tenesmus, dysuria, and constipation. Menstruation was undisturbed. The tumors were, with one exception, so large as to completely obstruct the vaginal canal, rendering operative interference necessary. In one instance the contraction, from cicatrization of the hydatid cyst following puncture, was so extensive as to produce vaginal stenosis. Hydatids may be mistaken for exostoses of the bony pelvis, for hæmatocele, malignant intrapelvic tumors, pelvic abscesses, or cellulitis. Their differential diagnosis is based upon the presence in the pelvis of smooth, tense tumors not connected with the uterus, the gradual development of the tumors without constitutional symptoms of any gravity, the presence of similar tumors in other organs, particularly in the liver, the hydatid thrill, which is not often observed on account of the strong pressure to which the cysts are exposed, and, finally, upon the examination of the cystic fluid.

III. **Uterine Atresia.**—Uterine atresias, which occur less frequently than those of any other portion of the genital passages,‖ may be congenital or accidental, partial or complete. Complete atresias, observed in parturition, have become so during pregnancy, since conception would not otherwise have occurred.

Conglutinatio orificii externi, or adhesion of the lips of the os externum, is occasioned by the superficial union of the opposing mucous surfaces through the medium of inspissated epithelium or of new connective tissue resulting from adhesive inflammation pro-

* Winckel, "Arch. f. Gynaek.," Bd. ii, 1871, pp. 383, 406.
† Zweifel, "Arch. f. Gynaek.," Bd. ix, p. 39.
‡ Ruge, "Arch. f. Gynaek.," Bd. ix, p. 465.
# Wiener, "Arch. f. Gynaek.," Bd. vi, p. 572. ‖ Jenks, *op. cit.*, p. 5.

duced by vaginitis or cervical endometritis. Schroeder * regards these atresias as always incomplete, and seeks their origin in the gradual induration of tissues immediately surrounding the os, resulting from old inflammatory processes. According to his views, this pathological condition consists of deficient expansibility and not of real contraction of the os externum. On examination no marked induration of the cervix is felt. The os externum is hardly perceptible to the touch and can often only be discovered by inspection. If the examination be made during the first stage of labor the internal os is found widely dilated, while the os externum remains persistently contracted and conveys a sensation to the palpating finger akin to that produced by a narrow and tense rubber band. If the finger or an appropriate instrument be firmly pressed against the os during the pain, it slowly yields and is gradually retracted by the longitudinal cervical contractions. In default of such simple interference the cervical tissues above the os externum become enormously distended, and may finally be ruptured. Zweifel † refers this peculiarly unequal dilatation of the cervical canal to an abnormal presentation of the fetal cranium and to a consequent local expansion of the anterior uterine wall. The os externum having been simultaneously forced backward into the hollow of the sacrum, the yielding anterior uterine wall then forms a diverticulum which contains the presenting fetal part, and no dilating force is exerted upon the external os. Benicke ‡ was unable to discover, in his cases, the posterior deviation of the os which is assumed by Zweifel as the basis of his hypothesis.

Cicatricial atresia of the os externum is rarer than the adhesive stenosis just described. It is usually confined to the lips of the external os, but may involve the cervical canal for a varying distance. Its most frequent causes are *post-partum* ulceration, inflammation, cauterization of the cervix, and mechanical irritation applied for the purpose of producing abortion. The diminution of the uterine discharges during pregnancy affords a favorable opportunity for the development of the stenosis under consideration. If cicatricial atresia exist, the os externum remains undilated in labor, the cervix becomes immensely distended, and may even rupture, unless the os be dilated by artificial means. The diagnosis rests upon the discovery, usually easily made, of the cicatrized os externum. Should the latter have retreated into the hollow of the sacrum, the diagnosis may only be accomplished with difficulty, or the expanded cervical tissues be mistaken for the fetal membranes. This error is avoided by the discovery of the direct continuity of the vaginal wall and the supposed membranes, and by inspection through a proper speculum.

Abnormal rigidity of the os externum is often encountered in mul-

* Schroeder, "Lehrbuch," 6te Aufl., p. 487.

† Zweifel, "Arch. f. Gynaek.," Bd. v, 1873, p. 149. ‡ Benicke, *op. cit.*, p. 252.

tiparæ as the result of genuine cicatricial processes or of fibrous hypertrophy. This condition is especially observed in connection with prolapse of the uterus. A similar rigidity in aged primiparæ is due to atrophic degenerative changes in the cervical tissues, or to hypertrophy of the portio vaginalis.*

Hæmorrhages occurring into the hypertrophied cervical tissue are distinguished as cervical thrombi, and constitute obstacles to delivery. The retraction and dilatation of the cervix may, further, be obstructed by adhesions in the lower segment of the uterus between the decidua and the chorion.

Acute elongation of the anterior lip of the os externum, in consequence of its incarceration between the fœtus and the bony pelvis, and of the resulting œdema of its tissues, is referred to by Hirte † as a rare but serious obstacle to delivery.

Parturition is sometimes delayed by double uterus. The obstruction may in this instance be produced by an hypertrophied unimpregnated horn of the uterus.‡ Again, the oblique position of the impregnated horn may produce abnormal presentations # or materially interfere with the efficiency of the pains.

The uterine atresias produced by carcinomata, fibromata, and ovarian tumors are considered in another chapter.

Symptoms of Atresias of the Genital Canal.—The principal symptoms of atresia in the unimpregnated state relate to the partial or complete retention of the menstrual fluids. If the stenosis be complete the uterus is enlarged and fluctuating, while severe uterine pains attend each monthly period.‖ The Fallopian tubes are dilated. Some of the retained and decomposed menstrual fluid may be forced through the tubes into the peritoneal cavity, producing serious or fatal peritonitis. The mere dilatation of the uterus may become so excessive as to produce peritonitis.^ Septic poisoning is sometimes induced by absorption of putrescent materials from the uterine cavity. A symptom often serving to attract attention to the existence of abnormal vaginal contraction is inability to perform the sexual act.

The most prominent symptom of atresia during parturition consists, in general terms, of mechanical obstruction to delivery, which is more or less serious in proportion to the degree of existing stenosis. The special symptomatology of the individual pathological conditions productive of atresia has been considered in connection with their respective anatomical characters.

* Benicke, *op. cit.*, p. 240. † Hirte, "Arch. f. Gynaek.," Bd. vii, 1875, p. 552.

‡ Müller, "Arch. f. Gynaek.," Bd. v, 1873, p. 132.

Schatz, "Arch. f. Gynaek.," Bd. ii, 1871, p. 297.

‖ Dohrn, "Arch. f. Gynaek.," Bd. x, 1876, p. 544; I. E. Taylor, "Atresia of the Vagina," "Trans. of the Am. Gynæc. Soc.," vol. ix, 1880, pp. 9, 12.

^ I. E. Taylor, *loc. cit.*, p. 16.

Note.—Atresias for the most part require to be treated each by itself, according to the principles of surgical art. In a paper by Professor I. E. Taylor, in the fourth volume of the "Transactions of the American Gynæcological Society," entitled "Atresia of the Vagina, Congenital or Accidental, in the Pregnant or Non-pregnant Female," the author relates a case of seemingly complete imperforation of the vagina complicating labor, where he succeeded, by scraping with the finger-nail during the pains, in passing the index-finger through the intervening membrane to the child's head, and eventually in securing an opening large enough for the birth to be accomplished. I had previously reported two similar cases, one in the "New York Medical Journal," and one to the Obstetrical Society.* The first, where I was aided by Professor Fordyce Barker, occurred in Bellevue Hospital, and the second in private practice. In both, similar success followed a gradual dissection of the vaginal walls with the finger. In such cases usually a depression, or a thinned point in the tissues, indicates the direction to be followed. C. Braun states, however, that he has seen three cases where vesico-vaginal fistulæ were produced by this tunneling process, an admonition to extreme caution in its performance.† For stenoses of the vagina, dilatation should be employed, either by means of compressed sponges, the tampon of slippery-elm (Skene), or the water-bag. When dilatation is already well advanced, incisions may be used to aid in completing the process.

Uterine Tumors complicating Pregnancy, Parturition, and the Puerperal State.

I. **Uterine Myomata.**—1. *In pregnancy.* Because of the disposition of uterine myomata to produce sterility, they naturally constitute comparatively infrequent complications of pregnancy. They are subdivided, according to their location, into subperitoneal, interstitial, and submucous myomata. The presence of either variety diminishes the probability of conception, but none absolutely precludes the possibility of its occurrence.

Subperitoneal myomata prevent conception and interrupt utero-gestation only when they attain large dimensions, and their prejudicial influence is then usually referable to the uterine retroversions or retroflexions which they induce. Interstitial myomata are more likely than the preceding variety to occasion abortion or premature delivery, either by producing uterine flexions,‡ or by acting as the exciting cause of hæmorrhages, which are more severe when the placenta is located over the site of the tumor. This statement applies particularly to *post-partum* hæmorrhages, inasmuch as the muscular atrophy induced by the myoma prevents the ready and complete closure of the uterine sinuses.

Submucous myomata rarely permit of conception, which, in the event of its occurrence, is almost uniformly followed by abortion, due usually to metrorrhagia. In rare cases, however, pregnancy progresses to its normal termination. Myomata ordinarily participate in the uterine hypertrophy of pregnancy, becoming at the same time softer and more succulent. This change in consistence, which is referred

* "Trans. of the New York Obstet. Soc.," vol. i, p. 44.

† Braun von Fernwald, "Lehrbuch der gesammt. Gynaek.," p. 273.

‡ Ponfick, "Beitr. z. Geburtsh. u. Gynaek.," Bd. ii, 1873, p. 92.

to increased vascularity, to colloid transformation, and to serous infiltration, is attended by dilatation of the lymphatics, which may lead to the formation of cysts. The softened tumor readily undergoes changes of form under the influence of increasing intrapelvic pressure and of uterine traction. It may become so flattened that it ceases to be recognizable as a tumor, but regains its earlier shape after delivery.

The diagnosis of uterine myomata, particularly of the interstitial and submucous varieties, is often attended during pregnancy by difficulty, inasmuch as their symptoms and signs are obscured by those of pregnancy. On the other hand, the existence of myomata may prevent the recognition of pregnancy. Fibrous tumors may be mistaken for fetal organs or for intrauterine cystic tumors. The latter error would be particularly unfortunate if it should lead to puncture of the myoma and be followed by metrorrhagia.

2. *In Parturition and the Puerperal State.*—Uterine polypi act as impediments to delivery only when they are situated beside or in front of the advancing child, and are possessed of considerable size and consistence. If the tumor be small, movable, and yielding, it may occasion only trifling obstruction to parturition, and may even be expelled by the advancing fœtus, after rupture of its pedicle.

Interstitial myomata, when corporeal, constitute impediments to delivery only when located in the lower segments of the uterus. Even when thus situated, they often spontaneously recede from the pelvic cavity under the influence of the longitudinal uterine contractions. By exerting traction on the uterine parietes they aggravate the severity of the pains, and, according to Spiegelberg,* sometimes produce rupture of the uterine wall, in which their growth has already determined atrophic degeneration. By interfering with symmetrical uterine contraction, interstitial myomata render the pains irregular and inefficient, besides predisposing to *ante-* and particularly to *post-partum* hæmorrhage. By altering the form of the uterine cavity and preventing the engagement of the head in the superior strait, this variety of myoma frequently produces abnormal positions and presentations. In a case of my own eclampsia resulted, apparently from the same set of causes as those which obtain in multiple pregnancy. They also predispose to the development of retroflexions in the puerperal state. When interstitial myomata are developed in the cervical tissues they almost invariably offer a mechanical impediment to delivery, and are rarely capable of being displaced above the superior strait. If, however, they have become intravaginal and their base be not too extensive, they are often readily amenable to appropriate surgical interference. In default of the latter, fatal compression may be exerted upon the fetal cranium, or the vesico-vaginal septum may be lacerated during labor.

* Spiegelberg, "Lehrbuch," p. 509.

Subserous myomata are ordinarily developed in the posterior uterine wall. If connected with the body of the uterus and located above the retro-uterine reflexion of the peritonæum, they may be spontaneously extruded from the pelvic into the peritoneal cavity. They originate, however, most frequently in the cervical tissues, and, extending downward, become retro-vaginal, more or less completely occupy the

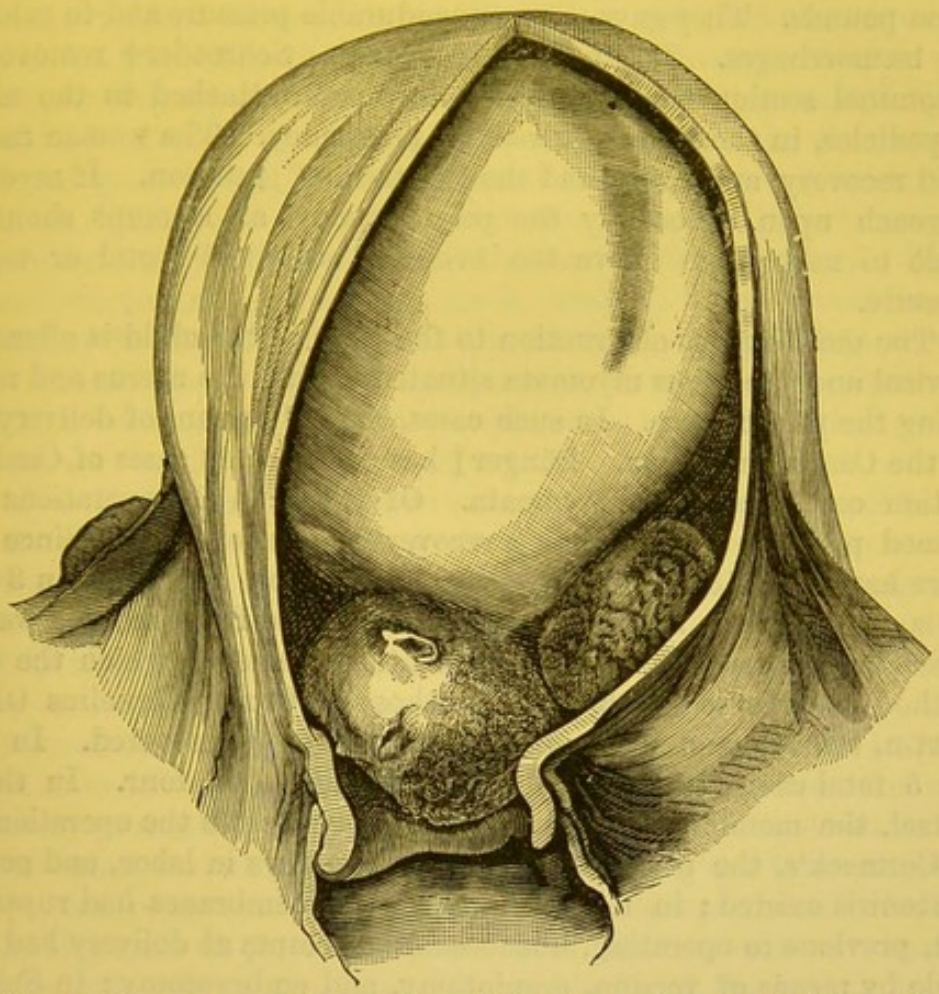


Fig. 233.—Showing myoma of lower portion of the uterus and cervix interfering with delivery. (Doléris.)

pelvic cavity, and offer, provided their size be at all considerable, an insurmountable obstacle to parturition. This variety has been designated as the incarcerated uterine myoma.* The prognosis is grave, a fatal termination having been noted in one third of the mothers, and in more than one half of the children.

Treatment.—Interstitial corporeal myomata, as a rule, do not interfere with the expulsion of the child. Dr. A. Kessler has reported a case which I saw with him in consultation, where, after the expulsion of a four months' fœtus, it was found impossible to reach the placenta. The latter occupied an inaccessible position near the right cornu, far

* Spiegelberg, "Arch. f. Gynaek.," Bd. v, 1873, p. 100.

out of reach of the fingers, while the convexity of the tumor was such as to interfere with the working of curettes. The patient subsequently died of septicæmia. Removal of the entire uterus would, perhaps, have saved her life.

Kaltenbach* has reported a case where he performed the supra-vaginal amputation of the uterus between the fourth and fifth month of pregnancy, on account of myomata, the largest of which weighed seven pounds. They gave rise to unendurable pressure and to exhausting hæmorrhages. The patient recovered. Schroeder† removed by abdominal section three subserous myomata, attached to the uterus by pedicles, in the sixteenth week of pregnancy. The woman made a good recovery, and completed the full term of gestation. If myomata encroach upon or occupy the pelvic cavity, an attempt should be made to raise them above the brim by sustained rectal or vaginal pressure.

The most serious obstruction to the birth of the child is offered by cervical and subserous myomata situated behind the uterus and nearly filling the pelvic space. In such cases, the only means of delivery may be the Cæsarean section. Sänger‡ has collected 43 cases of Cæsarean section complicated by myomata. Of these, in 30 operations performed previous to 1874, but 2 recoveries were reported. Since 1874 there have been 13 operations, with 5 recoveries. Of these, in 3 cases —viz., in Tarnier's, Zweifel's, and Agnew's—the Porro method was followed, and all terminated fatally. Of the 10 cases in which the older method was adopted, in 5—viz., in those of Cazin, Cornelius Olcott, Martin, Sänger, and Moses Baker—the patients recovered. In 4 of the 5 fatal cases, the particulars are furnished in four. In that of Netzel, the membranes ruptured three days before the operation ; in McCormack's, the patient had been fifteen days in labor, and general peritonitis existed ; in T. G. Thomas's, the membranes had ruptured, and, previous to operating, unsuccessful attempts at delivery had been made by means of version, craniotomy, and embryotomy ; in Spiegelberg's, no contraction followed the section, and the patient died from exhaustion due to hæmorrhage.

Polypoid growths should be pushed back into the uterus, if possible, in cases where the pedicle is out of reach. When, however, the tumor is shoved down in advance of the head, and the pedicle is accessible, it should be removed with the *écraseur* or with scissors. Chambazian# reports eight cases of extirpation performed during pregnancy on account of hæmorrhage, with one death, due not, however,

* Kaltenbach, "Centralblatt f. Gynaek.," 1880, No. xv.

† Schroeder, "Die Laparotomie in der Schwangerschaft," "Zeitschr. f. Geburtsh. und Gynaek.," vol. v, p. 399.

‡ Sänger, "Der Kaiserschnitt bei Uterus-Fibromen," Leipzig, 1882.

Chambazian, "Des fibromes du col de l'uterus," Paris, 1882.

to the operation, but to eclampsia. In eight cases of removal during labor there was no death.

Dr. P. F. Mundé* has recently reported a case of pregnancy advanced to the sixth month where an interstitial myoma of the anterior wall of the uterus and of the cervix filled the pelvic cavity almost to the vaginal orifice. After careful deliberation, Mundé decided to remove the tumor by enucleation. This he accomplished successfully; the tumor weighed three pounds. The fœtus and placenta were then easily extracted. The mother made a good recovery. Similar successes have been reported by Schroeder, Grimsdale, Danyon, and Braxton Hicks. Depaul enucleated the morbid growth in the case of fibrous polypus, with a broad attachment (six to seven centimetres) to the cervix. The patient died two months later, but the tumor gave forth an extremely offensive odor at the time of the operation. When neither extirpation nor replacement is possible, before proceeding to craniotomy an attempt at delivery should be made by forceps or version. Chambazian reports 20 forceps cases, in which 12 mothers and 7 children were saved. Of 20 version cases, only 8 mothers and 3 children survived.

Polypoid elongation of the anterior lip, where replacement is impossible, and where the swelling obstructs labor, may call for the destruction of the child, as excision is likely to be followed by dangerous hæmorrhage.

II. Carcinoma of the Cervix Uteri.—1. *In Pregnancy.* Uterine cancer, which is one of the gravest complications of pregnancy, is, if primary, almost without exception of cervical origin. Conception often occurs in the earlier stages of the disease, and, since it is only absolutely prevented by a carcinoma which completely occludes the cervical canal, it occasionally takes place even in the later stages of the neoplasm's growth. The existence of pregnancy usually hastens the development of the cancer, the more rapid growth of which is probably referable to the increased vascularity of the uterus and to the correspondingly augmented activity of its nutritive processes. In rare instances the occurrence of pregnancy seems to arrest the development of the local and general symptoms referable to the cancerous growth. In the majority of cases the neoplasm does not interfere with the completion of normal utero-gestation, although abortion or premature delivery is a frequent result of its development. These issues of pregnancy are most frequently determined by cancerous tumors whose progress has invaded the higher, supravaginal portions of the cervix, and is probably occasioned by the interference, on the part of the neoplasm, with the normal process of uterine growth and expansion. The traction exerted by the enlarging cervix upon the unyielding tissues of the tumor may also produce a solution of

* Mundé, "Am. Jour. Obst.," Oct, 1884, p. 1061.

their continuity, and give rise to formidable hæmorrhage. In very exceptional cases uterine carcinoma seems to protract the period of gestation far beyond its normal limits, in which case the fœtus dies and undergoes the changes usual in retention.

2. *In Parturition and the Puerperal State.*—If the cancer be confined to the lower margin of the cervical canal, the expansion of the latter is not materially interfered with, and delivery may be safely and speedily accomplished. If, however, the morbid process has involved the entire portio vaginalis, or has even extended quite to the os internum, the inelastic tissue of the cancerous growth has replaced the expansile muscular fibers, and an opening of sufficient caliber for the passage of the fœtus can only be produced by rupture and contusion of the degenerated and unyielding cervix. The immediate result of such a laceration is violent hæmorrhage, which is, however, quite amenable to treatment. The consequence of the excessive pressure to which the cervix is subjected during labor is necrosis of the contused tissues, which is frequently followed by fatal septicæmia.

The diagnosis is accomplished by the same means which are employed in the detection of cervical cancer in the unimpregnated condition.

The prognosis is doubtful for both mother and child. The latter is imperiled by its liability to premature expulsion, and by the mechanical obstruction to its birth produced by the tumor. The mother's life is not only shortened by the rapidity of the cancerous growth usually induced by pregnancy, but is jeopardized by her increased liability to abortion, *post-partum* hæmorrhage, and puerperal fever.

Treatment.—During pregnancy, in cases where the disease is confined to the cervical portion, either amputation or excision should be performed. The time selected for operation is usually the fourth month. Abortion does not necessarily follow. In advanced stages, where the carcinomatous process has invaded the contiguous tissues, operative interference should be postponed until the end of gestation. Just in proportion as the outlook for the mother grows questionable, the interests of the child rise in importance. An extensive removal of diseased tissue during pregnancy exposes the mother to the immediate dangers of premature labor and subsequent septicæmia. Upon the advent of labor, if the child be living, and the upper vaginal tissues are largely involved, the Cæsarean section certainly holds out the hope of saving one life, and probably does not greatly increase the peril to which the other is exposed.* Dr. Fordyce Barker states that he has met with three cases of spontaneous delivery where the cervix was carcinomatous, in all of which the mother survived the childbed period. Such good fortune, however, is necessarily rare, and is only

* Herman ("Trans. of the Obstet. Soc. of London," vol. xx, p. 191) reports twelve Cæsarean operations, with four recoveries.

likely to result in patients whose tissues are but moderately affected. Frommel* reports a case from the Berlin Clinic, where, the child being dead, Schroeder broke away with his hands large masses of the neoplasm, and thus provided a passage of sufficient size to permit the extraction of the child by version. The patient was discharged on the tenth day, but died a few days after. Alfred Gönner† recommends that labor be allowed to proceed until dangerous symptoms call for active measures, or the limit of physiological dilatation is reached. Then, if the vagina is not too extensively implicated, by means of incisions and the partial extirpation of the diseased mass with the galvano-caustic wire, the thermo-cautery, and Volsella forceps, room should be made for the extraction of the child by forceps, or after version. Of four cases thus treated, the mothers all recovered from the immediate effects of the operation, and three of the children were born living.

III. Ovarian Tumors.—1. *In Pregnancy.* Ovarian tumors, particularly those of the cystic variety, are quite often encountered as complications of pregnancy. They usually antedate conception, but may make their appearance during pregnancy. Utero-gestation often favors their development by increasing the general vascularity of the pelvic viscera, although an arrest of growth and an actual retrogressive metamorphosis of the tumor seem to be the occasional effect of intercurrent conception.‡ This retrogressive process affects only cystic tumors, and may result from the uterine pressure, which facilitates the absorption of their contents. After delivery the cysts present on palpation a relaxed and flabby condition. The natural tension of the tumor is soon restored by the secretion of additional fluid, except in those rare cases in which the compression of the gravid uterus seems to initiate a permanent process of retrogression and absorption.

Wernich# advanced the opinion that the assumption by benign ovarian tumors of a malignant character is determined by the occurrence of pregnancy, and Spiegelberg‖ regards this transition as positively established. The ovarian tumors under consideration may be bilateral. If they be of moderate dimensions, they may not interfere with utero-gestation or delivery, except by a slight aggravation of the usual disturbances attendant upon pregnancy. An ovarian tumor is, however, liable to occasion abortion or premature delivery if it be confined by adhesions to the pelvic cavity, or be closely connected to the uterus. Under these circumstances abortion results from interference

* Frommel, "Zur operat. Therapie d. Cervix-Carcinoms in d. Complication mit Gravidität," "Ztschr. f. Geburtsh. und Gynaek.," Bd. v, p. 158.

† Gönner, "Zur Therapie der durch Carcinom des Uterus complicirten Schwangerschaft und Geburt," "Ztschr. für Geburtsh. und Gynaek.," vol. x, p. 7.

‡ Schroeder, "Lehrbuch," p. 399.

Wernich, "Beitr. z. Geburtsh. u. Gyn.," Bd. ii, p. 143.

‖ Spiegelberg, "Lehrbuch," p. 297.

on the part of the new growth, with the natural uterine expansion, or from the retroflexion which it induces. In rare instances a rotation of the cyst upon its axis, followed by strangulation of its pedicle, is observed. This deplorable accident leads to a lethal issue by shock, by gangrene of the cyst and consequent septicæmia, or by hæmorrhage into the tumor and the peritoneal cavity, followed by peritonitis. The rationale of the morbid phenomena referable to tumors of larger size is entirely different. These tumors do not often occasion abortion or premature delivery, but gravely complicate the later periods of pregnancy by means of the pressure which they, in common with the gravid uterus, exert upon the abdominal and thoracic viscera. Ascites and dyspnœa are the chief results of the augmented intra-abdominal tension. Œdema of the lower extremities is often observed. The ovarian cyst sometimes ruptures and produces fatal collapse, peritonitis, or septicæmia. The escaped cystic fluid may, however, be absorbed, and pregnancy reach a natural termination.

Diagnosis.—If the ovarian tumor be of small size, it may be completely masked by the growing uterus, or may be mistaken for a portion of the latter. If, on the other hand, the surface of the tumor be irregular and nodular, the uterus may, at an early period of pregnancy, itself be regarded as a part of the cyst. Palpation and auscultation will, however, usually afford satisfactory diagnostic points of differentiation. Especially the softness of the pregnant uterus contrasts with the tense condition of an ovarian cyst. Moreover, the absence of the menses in patients with an ovarian tumor, and an unusually rapid increase in the dimensions of the abdomen, should awaken the suspicion of combined pregnancy and ovarian tumor.

2. *In Parturition and the Puerperal State.*—The dangers resulting in parturition and the puerperal state from ovarian tumors complicating pregnancy are twofold, and consist (*a*) in the obstruction to labor which they occasion and (*b*) in the results of the morbid processes determined in the neoplasms themselves by the excessive pressure of the surrounding tissues.

(*a*) If the ovarian tumor is confined within the true pelvis in such a way as to render its spontaneous or manual displacement impossible, it may offer a most serious impediment to the expulsion of the fœtus. Dermoid cysts manifest a more decided tendency to contract adhesions in the pelvis than other ovarian tumors, and afford on this account, as well as because of the greater consistence of their contents, a worse prognosis than any other variety.* Obstructed labor more frequently results from the presence of small than from that of large ovarian tumors, since the latter oftener escape into the abdominal cavity during pregnancy, and are unable at any subsequent period to effect an entrance into the true pelvis.

* Schroeder, *op. cit.*, p. 501.

(*b*) Even if the obstacle offered to parturition by an ovarian tumor be trivial, the changes induced in its own substance by the parturient act may be productive of very serious results. The pressure and traction exerted upon the pedicle of the cyst are often so severe as to produce its strangulation, followed by necrosis of the tumor, with consequent septic poisoning. Rupture of the sac, with its fatal consequences, may also occur, or such severe contusions of the tumor may be occasioned by excessive pressure as to result in gangrene of its entire mass. The development of the fœtus is, as a rule, not interfered with by ovarian tumors. The latter manifest a tendency to very rapid development in the puerperal state, except in those rare cases characterized by permanent retrogressive metamorphosis and absorption.

Ovarian tumors are a dangerous complication of pregnancy. Playfair reports fifty-seven cases, with thirteen deaths. The treatment, where the tumor interferes with delivery, consists in reposition, or, failing after persevering effort, in puncture of the cyst. The *cul-de-sac* of the vagina affords generally the most convenient point for introducing the trocar. The time selected for tapping should be during the existence of a pain, when the cyst is rendered tense by pressure. Owing to the rapid increase in the size of the tumor which commonly results from pregnancy, and in consideration of the relatively favorable issue of ovariotomy * performed upon pregnant women, the radical operation during pregnancy promises to prove in the future the most advantageous form of treatment.

CHAPTER XXIX.

ABNORMALITIES OF THE FŒTUS WHICH OFFER AN OBSTRUCTION TO DELIVERY.

Premature ossification of the cranium.—Hydrocephalus.—Encephalocele.—Hydrothorax.—Ascites.—Other causes of abdominal distention.—Tumors of the trunk.—Monstrosities.—Double monsters.—Acardiaci.—Anencephalous monsters.—Abnormal positions.—Spontaneous version.—Spontaneous evolution.

I. Fetal Diseases which obstruct the Expulsion of the Head.

Premature Ossification of the Fetal Cranium.—This condition is characterized by the complete or nearly complete closure of the fontanelles. The head, therefore, loses its compressibility, and no longer

* Olshausen operated 14 times. Four of the women aborted and two died. Schroeder operated 7 times. Four women aborted, but all recovered. Mr. Lawson Tait has reported 10 successful cases. Mr. Spencer Wells operated 10 times. Nine of the mothers recovered and went to full term. H. P. C. Wilson, Marion Sims, Washington Atlee, Bird, Galabin, Baum, and C. C. Lee likewise report single successes.

undergoes those changes of form which constitute so important a part in the mechanical processes of delivery. As the anomaly is apt to interfere with brain development in infancy, the late Dr. John E. Blake* advocated early perforation where the interests of the mother had to be consulted. As I have never met with this form of dystocia in a large number of instrumental deliveries, I can not but regard it as extremely uncommon.

Hydrocephalus.—Congenital hydrocephalus of sufficiently marked development to constitute an impediment to parturition is comparatively rare, occurring, according to the statistics of Madame La Chapelle,† only fifteen times in 43,545 deliveries. In consists usually in a serous effusion confined to the cerebral ventricles. The effusion may, however, according to Jaccoud and Hallopean,‡ be situated in the meshes of the pia mater, in the cerebral parenchyma, in the subarachnoid cavity, or between the arachnoid and the dura mater.

Etiology.—The etiological factors of the disease have not been ascertained, although Herrgott# assumes an invariable causative relation between coexisting cretinism and hydrocephalus.

Morbid Anatomy.—The accumulated serum compresses the cerebral parenchyma and produces dilatation of the cranial cavity, which may become excessive. The cranial bones become abnormally thin, being in some instances no thicker than parchment. Their continuity may be interrupted by apertures of varying size, through which the contents of the cranium may protrude, constituting an encephalocele. The skull is of disproportionate magnitude as compared with the face. The head may attain the dimensions of that of an adult. The forehead is prominent and bulging, the sutures are widely open, and the fontanelles of large diameter. The body of the fœtus is usually well developed, and of a size corresponding to the existing period of pregnancy, although spina bifida and other malformations may coexist. Hydramnion frequently complicates hydrocephalus.

Diagnosis.—Cystic tumors, spina bifida, encephalocele, and the skull of a macerated fœtus, are most frequently mistaken for hydrocephalus. The differential diagnosis is based upon different signs, according to the position and presentation of the fœtus. If the head present and be still above the superior strait, abdominal palpation may sometimes detect a large, rounded, and hard tumor above the pubes, while auscultation discovers the maximum intensity of the fetal cardiac sounds above the umbilicus. The abdomen is unusually distended. If the head has descended somewhat into the pelvic cavity, palpation *per*

* Blake, "Am. Jour. of Obstet.," vol. xii, 1879, p. 225.

† Spiegelberg, "Lehrbuch," p. 525.

‡ "Nouv. dict. de méd. et chir. prat.," vol. xiii, article "Encéphale," p. 151.

Herrgott, "Des mal fœtal. q. peuvent faire obstacle à l'accouch.," Paris, 1878, p. 13.

vaginam reveals a fluctuating sac, which becomes notably tense during the pains. In the interval between the uterine contractions, the broad fontanelles, the thin bones, and the wide sutures are readily felt. These signs may, however, fail if the cranial bones be thick and the sutures already ossified. In this case the disproportion between the forehead and face, the bulging frontal bone, and the prominence of the superciliary ridges are important aids to a diagnosis. If the membranes be ruptured, the hairy scalp may be felt. The diagnosis is easier when the cranial cavity is not greatly distended. In case of a breech presentation, the diagnosis, which is then more difficult, must chiefly rest upon the detection, at the fundus, of a tumor larger than the normal fetal cranium. The previous occurrence of hydrocephalus in the same subject and feeble fetal movements may, in this instance, slightly facilitate the task of the diagnostician.

Mechanism of Delivery.—The course of parturition is sometimes not materially impeded even by a largely developed hydrocephalic fœtus. This may be due, if the bones be attenuated, to the ready molding of the fetal cranium to the pelvis, or to rupture of the head and escape of the serum, which event occurs chiefly in breech presentations. The presentation materially affects the course of delivery. If the head be forced with its greatest circumference against the superior strait, it adapts itself less readily to the pelvis than when it impinges laterally or obliquely on the pelvic entrance. The difficulties of delivery are increased if the cranial bones be firm and thick, or the sutures ossified. Breech presentations are favorable to a speedy delivery, in that the head is subjected during its descent to more equable pressure by the pelvic parietes, and therefore assumes a conical shape best adapted to insure its easy expulsion. Spontaneous delivery is, however, rare. In the vast majority of cases operative interference becomes necessary.

Prognosis.—The child's life is usually sacrificed if the anomaly be sufficiently marked to considerably protract parturition. Even if the child be born alive, it will probably succumb at an early period of extra-uterine life. The prognosis with reference to the mother depends largely upon the time at which obstetrical aid is extended, and upon the nature of the remedial measures adopted. If the labor be too long protracted, vesico-vaginal fistula may result from pressure of the fetal head, or the mother may die from exhaustion or from rupture of the uterus. Rupture of the uterus is comparatively frequent, having occurred in sixteen out of seventy-four cases of hydrocephalus collected by Thomas Keith. The laceration usually occurs in the vicinity of the cervix, but is often located at the fundus uteri. The treatment consists in puncturing the head with a fine trocar and allowing the fluid to escape. If practicable, the child should be subsequently turned and extracted by the feet. The forceps is useless, as it can not be

made to take a firm hold. If version is found to be attended with difficulty, the opening should be enlarged, and the head extracted with the cranioclast. If the child is extracted by the breech without previous perforation of the head, in cases of difficulty, Tarnier recommends section of the vertebral column and the withdrawal of the cranial fluid by means of an elastic catheter passed to the brain through the spinal canal.

Congenital Encephalocele.—This abnormality of the fetal cranium consists in the accumulation beneath the scalp of cephalic fluid, with or without an investment of meningeal or of cerebral tissue. The sac containing the fluid is attached to the cranium by a pedicle of varying length and form. The aperture through which the fluid originally contained within the cranium finds exit may be produced by attenuation of the cranial bones attendant upon hydrocephalus, or may be due to arrested development. In some instances the encephalocele is found still communicating with the cranial cavity through its pedicle, but in others the latter is impervious. Encephaloceles vary in size from hardly perceptible sacs to tumors of larger circumference than the cranium itself. They may occupy any part of the periphery of the head, but are most frequent in the frontal and occipital regions.* The head may itself be hydrocephalic or normal. The cause of the anomaly in question is not definitely known, but is inferred to be of inflammatory nature.

Encephaloceles rarely obstruct delivery, because, their most frequent seat being in the frontal or occipital region, they are expelled either before or after the head. Their presence seems to determine nutritive changes in the cranial bones, whereby the latter, being rendered softer and more yielding, are more readily expelled. The amount of obstruction caused by the encephalocele will reach its maximum when the size is large, the pedicle short, and the seat lateral ; but simple puncture usually suffices to evacuate the sac, and obviates further difficulty. The prognosis for both mother and child is far better than in cases of congenital hydrocephalus.

II. Abnormal Conditions of the Fœtus which obstruct the Expulsion of the Trunk.

Hydrothorax, unattended by serous effusion into any other of the closed cavities of the body, is infrequent, and when present is rarely of sufficient extent to offer any impediment to delivery. Spiegelberg encountered only one such case, and refers to but two others observed by Hohl.†

Ascites, although more frequent than hydrothorax, ordinarily constitutes an insignificant obstruction to parturition, on account of the yielding character of the abdominal walls and the small amount of

* Herrgott, *op. cit.*, p. 121.

† Spiegelberg, "Lehrbuch," p. 528.

fluid usually present. It has, however, in some instances markedly retarded delivery.*

Ascites and hydrothorax are more frequently associated than isolated, and present, when combined, no inconsiderable obstruction to delivery. Pericardial effusions of varying magnitude may exist simultaneously with either or both these affections.†

The size of the fetal abdomen may be so much augmented by distention or enlargement of its viscera as to obstruct labor. Among the causes of abdominal distention from this source may be cited:

(*a*) Cystic degeneration of the kidneys;‡ (*b*) dilatation of the urinary bladder;# (*c*) dilatation of the ureters;‖ (*d*) fibro-cystic degeneration of a testicle still retained in the abdomen;^ (*e*) enlargement of the liver, due to degenerative processes;◊ (*f*) enlargement of the uterus, produced by secretions accumulated in its cavity, the cervix being impermeable;↕ (*g*) enlargement of the pancreas;↕ (*h*) enlargement of the spleen;⇕ (*i*) one fœtus included within another. In this case one fœtus is completely invested by the integument of the other, and is attached to the latter by a pedicle, which is usually inserted either in the sacro-coccygeal, perineal, or cervical regions.** A case of extensive anasarca of the fœtus, characterized by the peculiar gelatinous nature of the fluid contained in the subcutaneous cellular tissue, is reported by Keiller to have produced dystocia. Emphysema of the entire fetal trunk may result from putrefaction occurring in the tissues of a child retained for some time *in utero* after the escape of the amniotic fluid. The putrefactive processes owe their origin to the entrance of air within the uterus. The gaseous products of decomposition are developed in all the fetal tissues and in the cavities of its body. The skin is distended, translucent, and glistening. It crepitates on pressure, and gas escapes from incisions carried through the cuticle. The trunk and extremities are largely increased in volume, and their augmented size offers an obstacle to delivery which the uterine forces, probably already exhausted by prolonged expulsive efforts, can not overcome. In such cases the bulk of the child should be diminished

* Martin, "Monatsschr. f. Geburtsk.," Bd. xxvii, 1866, p. 28.

† Herrgott, *op. cit.*, p. 155.

‡ Cummins, "Dublin Jour. of Med. Sci.," May, 1873, p. 499; Voss, "Monatsschr. f. Geburtsk.," Bd. xxvii, 1866, p. 28; Kanzow, *Ibid.*, Bd. xiii, 1859, p. 182; Wegscheider, *Ibid.*, Bd. xxvii, 1866, p. 27.

Whittaker, "Am. Jour. of Obstet.," vol. iii, 1871, p. 389; Duncan, "Edinburgh Med. Jour.," August, 1870, p. 163; Hartmann, "Monatsschr. f. Geburtsk.," Bd. xxvii, 1866, p. 273; Rose, *Ibid.*, Bd. xxv, 1865, p. 425; Olshausen, "Arch. f. Gynaek.," Bd. ii, p. 280; Kristaller, "Monatsschr. f. Geburtsk.," Bd. xxvii, 1866, p. 165; Hecker, *Ibid.*, Bd. xviii, 1861, p. 373.

‖ Ahlfeld, "Arch. f. Gynaek.," Bd. iv, p. 161.

^ Rogers, "Am. Jour. of Obstet.," vol. ii, p. 626.

◊ Schroeder, "Lehrbuch," p. 634.

↕ Gervis, "Obstet. Trans.," vol. v, p. 284.

↕ Martin, "Monatsschr. f. Geburtsk.," Bd. xxvii, 1866, p. 28.

⇕ Voss, *op. cit.*, p. 26.

** Herrgott, *op. cit.*, p. 266.

by punctures of the skin to allow the gases to escape, and when the head presents it should be extracted with the cephalotribe. Tractions upon the extremities are liable to be followed by their separation from the trunk.

Tumors developed in different parts of the fetal trunk may disturb parturition. The most frequent site for these tumors is the sacral and perineal regions, where they are developed between the sacrum, the coccyx, and the rectum. Their size varies from that of a small walnut to that of the fetal cranium at term, and it may even exceed these dimensions. The tumors may be either cystic, fatty, vascular, cartilaginous, osseous, or carcinomatous. So-called cysto-hygromata are also frequently observed in this situation. Similar neoplasms may be located in the axilla, upon the pectoral muscles, and in the anterior or posterior cervical regions. Spina bifida, when accompanied by the formation of a large hydrorachitic sac, constitutes another form of congenital fetal tumor, and is most frequently observed in the lumbo-sacral region. Ectopia of the abdominal viscera, hernias, hydatid cysts, and encysted neoplasms of the abdominal walls sometimes constitute tumors sufficiently extensive to impede parturition. We may also cite anchylosis of the fetal joints, adhesions of the extremities to the trunk or to one another, and *rigor mortis*, as rare abnormalities which interfere with that pliability of the child requisite for its adaptation to the parturient canal, and finally, adhesion of the fœtus to the placenta or to the uterine parietes as causes of dystocia.*

Diagnosis.—An accurate differential diagnosis between these varied morbid conditions can, as a rule, only be made after delivery. If enlargement of the trunk be present, the head or breech is born without difficulty, but, the progress of parturition being then completely arrested, an investigation easily reveals the existence of an abnormally large trunk. A hydrorachitic sac is liable to be mistaken in a breech presentation for the fetal membranes. Its consistence is, however, not altered by the occurrence of uterine contractions, and no fetal parts are felt beneath the membrane, which is found to be continuous with the fetal cutaneous surface.

III. Monstrosities.

Dystocia is more frequently produced by double monstrosities than by any other variety. These are divided by Veit † into three principal classes, characterized, respectively, by—1. Incomplete double formation of the upper or of the lower extremities ; 2. Two separate bodies united either by their upper or by their lower extremities ; 3. Two separate bodies attached to each other either by their abdominal or by their dorsal surfaces.

* Whittaker, "Am. Jour. of Obstet.," vol. iii, 1871, p. 247.

† Veit, Volkmann's "Samml. klin. Vortr.," Volkmann, 1879, Nos. 164, 165.

Diagnosis.—The differential diagnosis of the individual deformities is usually impossible in the earlier stages of parturition. Even in the succeeding stages it is difficult, since separate twins may present essentially the same phenomena. The diagnostician will derive some assistance from the facts that certain women seem predisposed to the development of double monsters, and that certain smaller and easily recognizable deformities of the extremities (as club-foot) are often merely complications of more important ones, and serve to indicate the existence of the latter. The family history may furnish valuable assistance, inasmuch as the deformities under consideration are sometimes hereditary. Double monsters are most frequently observed in multiparæ; but this fact is referred by Veit* to the relative numerical preponderance of the former over primiparæ. When parturition has progressed sufficiently to allow of introduction of the hand within the uterus, should the necessities of the case call for this measure, the diagnosis becomes clear.

Mechanism of Labor.—The natural forces suffice, according to the statistics of Playfair and Hohl,† for the delivery of double monsters in more than fifty per cent. of the cases. This fact may be attributed to the comparatively small dimensions of the fœtus and to the frequent occurrence of abortion or of premature delivery in cases of this nature. The course of parturition in a case of the first variety is similar to that obtaining when the head of a single fœtus is of unusually large dimensions. The second variety does not ordinarily seriously interfere with delivery, particularly if there be a breech presentation. In this case the bodies pass through the parturient canal simultaneously, lying parallel to each other. One head then passes along the hollow of the sacrum and is first expelled, while the other is retained above the brim, its neck being bent into close apposition to the pubes until after the expulsion of its fellow. Should there, however, be a disparity between the lengths of the necks, both the heads may simultaneously pass through the pelvic canal. When they reach the outlet, the head attached to the longer neck is expelled. The second head must then be expelled with the neck and shoulders of the former. Under these circumstances, interference on the part of the obstetrician is usually required.

Head presentations are the most common ones in cases of the third variety, and the course of parturition is as follows: The head of one fœtus is born, that of the other being detained above the pelvic brim. The trunk belonging to the first head then follows. Next comes the second trunk; and, finally, the head belonging to the latter. Spontaneous delivery, when it occurs, is usually effected in this manner. Head presentations of the first variety, i. e., those in which a single trunk possesses two heads, usually pursue the course just described.

* Veit, *op. cit.*, p. 1318.

† Spiegelberg, "Lehrbuch," p. 531.

Prognosis.—The prognosis for the child is very unfavorable, owing to its expulsion in an undeveloped condition and to the compression exerted upon it during labor. The prognosis for the mother is favorable because of the usual small dimensions of the fœtus and of the freedom with which measures for the reduction of its volume are resorted to in view of its probable early demise.

An **acardiacus** is a monster devoid of the heart. It is developed simultaneously with a normal fœtus, and is usually born after the latter. Its development, as already explained,* occurs in the following

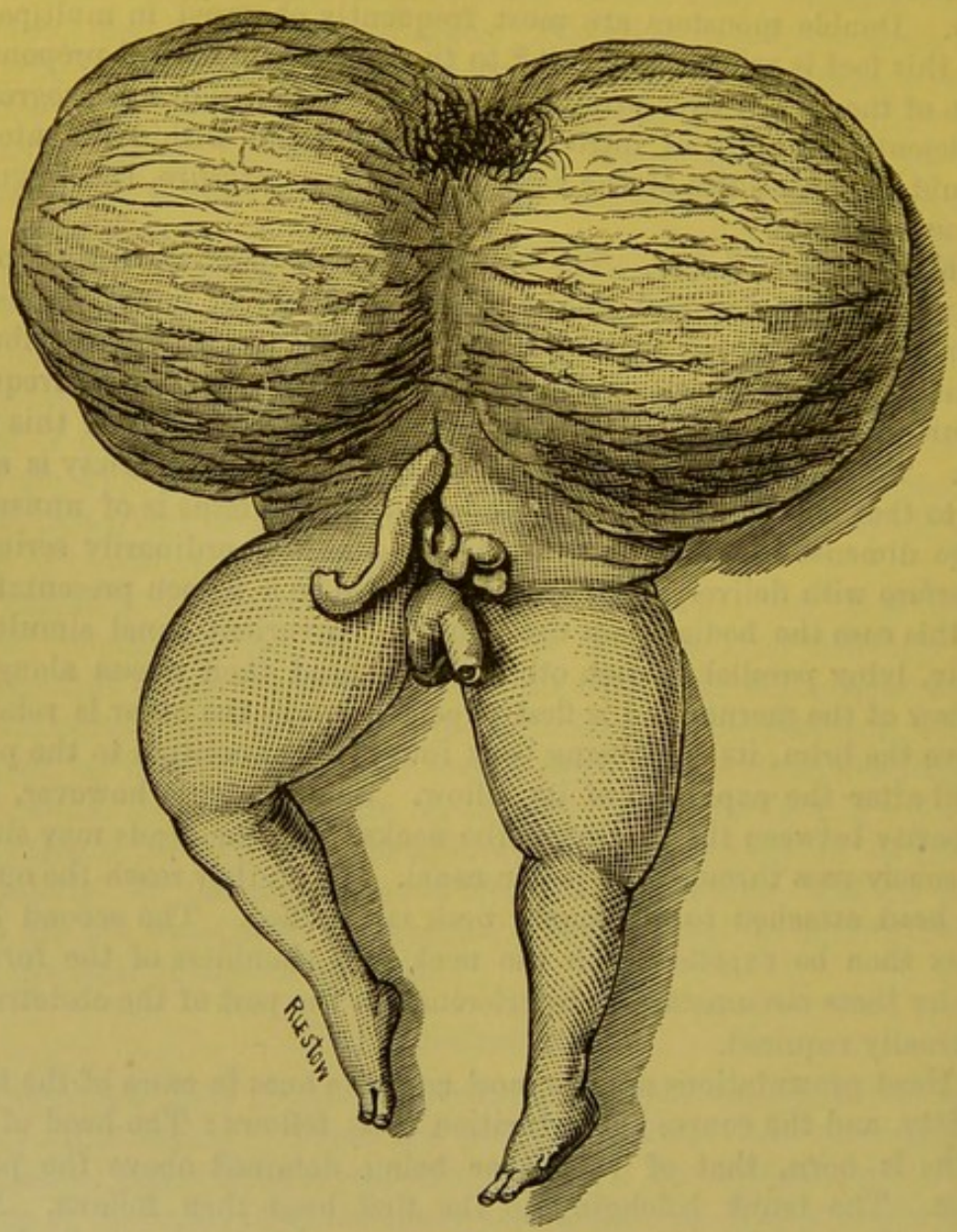


Fig. 234.—Author's case of acardia.

manner: The balance of circulation in the anastomosing vascular systems of twins contained in a single chorion (and therefore of the same

* Chapter on "Multiple Pregnancy."

sex) becomes disturbed, and the pressure in one system so preponderates over that in the other that the circulation of the latter is reversed, and its hearts, lungs, and body atrophy. It now receives its nutritive supplies from the normal fœtus. As the result of congestion in its umbilical vein, its connective tissue often undergoes hypertrophy and œdematous infiltration. The same cause may result in hydrocephalus or in the development of a monster presently to be described as an anencephalus. The most common variety of acardiacus is known as the acephalus, or headless monster. The amorphus is an acardiacus without head or extremities. It is of rounded form, and its surface, though ordinarily smooth, may present faintly marked tubercles, which are regarded as rudimentary extremities. The interior of the amorphus contains a rudimentary intestinal canal, cystic cavities, muscles, and vertebræ. The umbilical cord is attached indifferently to any part of the body. The rarest form of the acardiacus is the acormus, or trunkless monster. It consists of an imperfectly developed head with a rudimentary trunk. Its umbilical cord is attached to the cervical region.

An **anencephalus** or **hemicephalus** is a monster with a well-developed trunk and a rudimentary head. The neck is short and the head rests directly upon the shoulders, which are so unusually broad as to constitute an impediment to delivery. The amount of amniotic fluid is ordinarily large. The face is turned upward and the eyes are prominent. The most common presentations for an anencephalus are the transverse and the breech. Sometimes the face or the exposed base of the skull presents. In such a case the diagnosis may be made by recognizing the sella turcica and other bony prominences of the base. Reflex actions may be produced by irritation of the medulla, as it rests exposed upon the basilar process of the occipital bone.* This deformity produces obstruction by permitting other extremities to enter the pelvic cavity simultaneously with the diminutive head, and by the unusual breadth of its shoulders. The latter are more readily expelled when the parturient canal has been previously dilated by the passage of the breech.

IV. Shortness of the Cord.†

Though dystocia from shortness of the cord is of rare occurrence, it should always be regarded as a possible source of delayed labor. Shortness of the cord may be absolute, as in cases where its length does not exceed a few inches; or a normal, or very long cord, may, by the formation of coils around the fœtus, become taut as the fœtus is expelled from the uterus.

* Herrgott, *op. cit.*, p. 263.

† Matthews Duncan, "Obstruction owing to Shortness of the Cord," "Obstet. Trans.," 1881, p. 243; Chautreuil, "Des dispositions des cordens," Paris, 1875.

In the preliminary stage of labor the effect of shortness of the cord is sometimes perceptible in the irregular heart-action of the fœtus, in the recession of the head not due to the resistance of the soft parts during the intervals between the pains, and in an interference with the mechanism of labor as characteristic of an early period. In the second stage the effects of the shortening may be experienced at the pelvic outlet. Usually, however, difficulty is not encountered until after the expulsion of the head.

As the result of the tension to which the cord is subjected, it stretches, and, as Duncan points out, some gain in distance from child to placenta is obtained by the drawing out of the two insertions, the navel and abdominal wall on the one hand, and the placenta and uterine wall on the other; or, if the cord encircles the child, length may be gained by compression of the encircled parts. Stretching alone may permit natural birth to take place. If not, the continued tension may result in the tearing of the cord, in partial inversion of the uterus, or in the separation of the placenta. According to Duncan, the cord yields to a strain equal to five and a half pounds for the weakest, and fifteen pounds for the strongest.

When the cord becomes taut during the expulsion of the fœtus, the anterior surface of the latter rotates forward so as partially to undo the encircling and diminish the tension. In the completion of the birth the cord lies close to the urethra, and forms a radius around which the body revolves, a movement which Duncan aptly compares to spontaneous evolution in shoulder presentations.

Under these several conditions the fetal mortality is said to be upward of twenty per cent. That of the mother is much less serious. Aside from hæmorrhages due to placental detachment, and rare instances of uterine inversion, the most important consequences are those which result from delayed labor. I have witnessed the following case, which terminated fatally: The patient was a primipara, twenty-two years of age, who, after five days of ineffectual labor, entered the Emergency Hospital. Her temperature was 103·5° Fahr. She was in great agony. The external genital organs were inflamed. The fetal heart had ceased to beat, and meconium escaped from the vagina. The head could be seen through the gaping vulva. After giving ether, I applied forceps, but met with more resistance than I had anticipated. After extracting the head, on passing up the finger I found the cord tense, and coiled a number of times around the child's neck. When about to sever the cord, a sudden pain was followed by the expulsion of child, cord, and placenta together. The next day the external genitals became gangrenous, and on the fifth day the patient died from a slough in the upper portion of the vagina, which communicated with the peritoneal cavity, and had evidently been the result of the long-continued pressure.

A positive diagnosis can only be made when the labor has so far advanced that the cord can be felt with the finger. The treatment consists in loosening the coils, where it is possible, or in severing the cord, if accessible, and speedily extracting the infant. During expulsion the rotation of the child forward may be aided, and assistance may be rendered, by external pressure downward upon the fundus of the uterus.

V. Transverse Presentations.

In so-called transverse presentations the axis of the child crosses obliquely the axis of the uterus. A horizontal position of the fœtus, with both extremities occupying nearly the same level, is the rare exception. Usually the child lies obliquely with the head resting upon an iliac fossa. When the uterus contracts, the shoulder is usually pressed down into the lower uterine segment; hence shoulder and transverse presentations are frequently employed as synonymous expressions. In shoulder presentations prolapse of the lower arm or of the cord are not of infrequent occurrence.

The position of the child with the head to the left, as the more frequent one, is termed the first position; with the head to the right, the second position. According as the back of the child is directed forward or to the rear, we further distinguish dorso-anterior and dorso-posterior positions. The dorso-anterior position is the usual one.

According to Churchill's statistics, the frequency of transverse presentations is 1:252, Spiegelberg found it 1:180, while in France the combined statistics of Depaul, Dubois, and Pinard show a frequency of 1:117 (Charpentier).

The causes of this abnormality are to be found in the absence of the conditions which contribute to the fixation of the cephalic extremity. Thus a predisposition is created by an excess of amniotic fluid, by placenta prævia, by multiparity, by premature births, by death of the fœtus, and by uterine and pelvic deformities.

Diagnosis.—The existence of a transverse presentation can usually be ascertained by means of external palpation. Thus, the hard, round head can be mapped out in most cases in an iliac fossa, and the soft breech of smaller size be felt at a higher level upon the opposite side. Upon vaginal examination, the presenting part is commonly felt high up at the level of the brim, so that it is sometimes necessary to introduce the half or even the entire hand to arrive at certainty in diagnosis. Great care should be exercised in passing the finger through the cervix for purposes of exploration, as it is especially desirable to avoid premature rupture of the membranes. In an early stage of labor the vaginal vault is flattened. With the advance of the first stage the shape of the bag of waters corresponds to the resistance offered by the cervical canal. In multiparæ, and in all cases where softening and dilatation proceed rapidly, the ordinary globular segment may form

in advance of the presenting part; if the cervix remains rigid, the membranes usually make their way through the cervical canal as an elongated pouch, a condition which especially favors the early occurrence of rupture. Sometimes the diagnosis is made clear by the presence of a prolapsed extremity in the bag of waters. After rupture of the membranes, the shoulder is recognized by feeling the scapula with its spine, the arm-pit, the clavicle, and the ribs, and, in many cases, by means of a prolapsed upper extremity.

The position is determined by the direction of the head and of the back. Often these can be made out by external palpation alone; by vaginal examination, the relations of the scapula and clavicle to the uterine walls, and the direction of the arm-pit, furnish the data for the formation of the diagnosis. If the arm is prolapsed, it may be drawn outside the vulva. If the hand then be turned with the palm upward, the arm is always of the same name as the side of the mother to which the thumb is turned. If the presenting arm and the direction of the head be known, the position of the back, whether to the front or rear, is readily deduced.

Spontaneous Version.

The term *spontaneous version* is applied to the process by which either a transverse position is transformed through Nature's unaided efforts into a longitudinal one, or to that by which a normal position is either partially or completely reversed. Spontaneous version, which occurs during pregnancy as a very frequent physiological phenomenon, is observed with comparative infrequency during labor. It may be partial or complete, according as the presenting member is displaced laterally through either 90° or 180°, may occur before or after the rupture of the membranes, and may result in the transformation of a transverse position into either a head, a breech, or a footling presentation. According to the statistics of Hausemann,* cases of spontaneous version after rupture of the membranes are nearly five times as frequent as those occurring before their rupture. The same author states that the head presented in eighty per cent. of the cases occurring before rupture of the membranes, and the breech in seventy-five per cent. of those taking place after the occurrence of that event. Spiegelberg† cites two cases from his own practice in which there was an escape of so-called "false waters," the real membranes remaining intact, and attributes the occurrence of spontaneous version in such instances to the change of uterine form rendered possible by the evacuation of the false waters.

Etiology.—Among the conditions predisposing to spontaneous version is the uterine atony incident to repeated deliveries. About two thirds of all the women in whom spontaneous version occurs are, ac-

* Hausemann, "Monatsschr. f. Geburtsk.," Bd. xxiii, 1864, p. 366.

† Spiegelberg, "Lehrbuch," p. 539.

cordingly, multiparæ,* and their average age is thirty years. Spontaneous version often recurs during several consecutive pregnancies of the same individual. It is more apt to occur during deliveries effected at term than in abortions or premature deliveries. A living fœtus is more frequently the subject of spontaneous version than a dead one, and many authors attribute an important agency in the production of the altered position to the active movements of the child. The uterine contractions are necessarily weak in cases of spontaneous version occurring before the rupture of the membranes, as powerful pains would force the presenting part still farther into the dilated os and fix it immovably in the pelvic brim. On the other hand, the contractions of the uterus during a spontaneous version which takes place after the escape of the amniotic fluid must be strong, as will be explained in our remarks on the mechanism of the process in question. An undilated cervix, powerful contractions of the uterine fibers, and a fully developed child are essential conditions for the occurrence of spontaneous version after rupture of the membranes. Some authors consider the presence of a certain amount of amniotic fluid indispensable to the occurrence of spontaneous version in those cases taking place after rupture of the membranes. It is also necessary in such instances that the shoulder or other presenting part be freely movable, not having yet been firmly fixed in the cervical or pelvic canal.

Mechanism of Partial Version.

1. *Before Rupture of the Membranes.*—In this case the shoulder usually presents, the head being lower than the breech. The os is only partly dilated. The woman having assumed a position upon that side of her body toward which the head is directed, the breech tends to descend under the influence of gravitation, while the head is thus approximated to the cervix. The contractions of the uterine muscular fibers now complete the version by exerting pressure upon the breech. When the uterus has once regained its natural shape, the normal position is retained by the fœtus until the completion of parturition. In other instances, the breech being lower than the head, the same mechanism leads to a breech or to a footling presentation.

2. *After Rupture of the Membranes.*—In this variety of spontaneous version the amniotic fluid has partially or entirely escaped, allowing the fœtus to be tightly grasped by the uterine muscular walls, which, therefore, labor under a mechanical disadvantage. The os is only partially dilated. The pains force the presenting part into close contact with the os internum. Owing to the absence of an equally distending bag of waters, the os does not dilate, and soon assumes a condition of tetanic spasm, during which it can be felt as an unyielding, cartilaginous ring. The contractions of the fibers at the fundus

* Hausemann, *loc. cit.*, p. 212.

uteri having now become more forcible, the fetal head or breech, as the case may be, is subjected to violent pressure. Inasmuch, however, as the unyielding os prevents any progress downward, the presenting part is displaced laterally, and that part of the fœtus which previously occupied the fundus is forced into the pelvic entrance. The uterus next regains its natural form, the os dilates, and delivery is accomplished.

Mechanism of Complete Version.

Cases of complete version, which are very rare, consist in the transformation of one normal longitudinal presentation into the diametrically opposite one, the part originally presenting having rotated through 180°. The mechanism is essentially identical with that just described. Version of this variety is only likely to occur when the amount of liquor amnii is large and the child small, so that it is freely movable. Spontaneous version before the rupture of the membranes occupies only half the time required for its accomplishment after their rupture. Twenty-four or thirty hours are often necessary for the completion of the latter variety. Delivery, too, is accomplished more speedily in cases of the former kind when version has once occurred.

Prognosis.—The prognosis for both mother and child is good in spontaneous version before rupture of the membranes, but is graver when the turning occurs after that event, contrasting unfavorably with manual version, owing to the fact that injurious pressure is liable to be exerted upon the prolapsed cord.

Labor when the Presentation remains Transverse.

If the transverse presentation continues after rupture of the membranes, the entire contents of the amniotic sac escapes, and the uterine walls retract down closely upon the fœtus, or the shoulder is pressed into the pelvic cavity, the contraction-ring recedes, and the back of the child is forced into the cervix and the thinned lower uterine segment. In the latter case danger of rupture becomes imminent. Usually, if the malposition of the child is not corrected by art, or rupture does not occur, the rigid uterine walls closely compress the fœtus, and the mother in the end dies from the ensuing exhaustion, or from metritis, from peritonitis, or from septicæmia. In rare cases, however, spontaneous birth of the child may take place by the process termed evolution.

Spontaneous evolution is the process by which a shoulder presentation is transformed, within the true pelvis, into a combined breech and shoulder presentation, and spontaneous delivery is then effected. Since this may be accomplished in two different ways, there are two corresponding varieties of spontaneous evolution. The first variety was, according to Leishman,* described by Douglas, of Dublin, as

* Leishman, "A System of Midwifery," Philadelphia, 1873, p. 337.

"spontaneous expulsion." Dr. Taylor* takes exception to Leishman's statement, and affirms that the term spontaneous evolution was applied by Douglas to the mode of delivery in question. The second was described by Röderer as "birth with double body" ("*evolutio conduplicato corpore*"), and more thoroughly explained by Kleinwächter.†

Etiology.—Various conditions contribute to the facility with which this process is accomplished by Nature. The most important are powerful pains, a roomy pelvis, and a small fœtus. Of these conditions, the first only is essential; Grenser‡ has demonstrated that a contracted pelvis is not an insurmountable obstacle to spontaneous evolution, provided the conjugate diameter be alone shortened. Nor is small size of the fœtus essential to the occurrence of the process in question. Spiegelberg# states that it is often observed in cases where the fœtuses are mature and well-developed. Softness and compressibility of the child naturally favor the production of spontaneous evolution, as is demonstrated by its frequent occurrence when the product of conception has undergone maceration.

Mechanism.—The mechanism of the former and more ordinary variety of spontaneous evolution is as follows: The presenting shoulder is forced into the depths of the true pelvis by the violence of the uterine contractions, instead of being diverted laterally, as is the case in spontaneous version, and becomes firmly fixed beneath the symphysis,

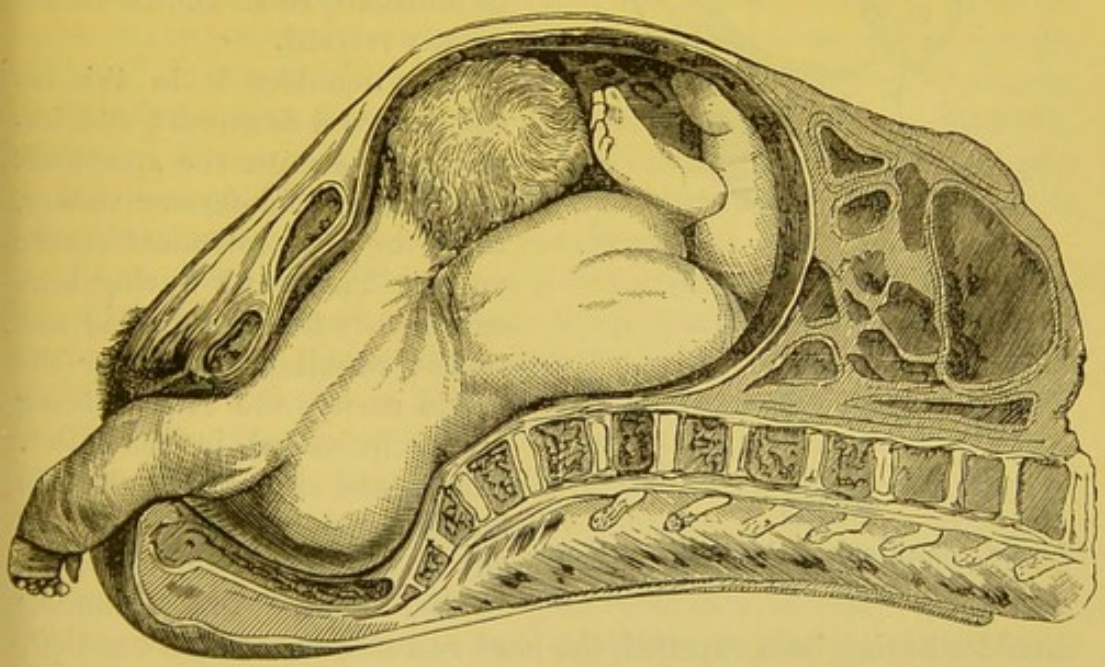


Fig. 235.—Neglected shoulder presentation. Section through frozen corpse. (Chiara.)

* Taylor, "Am. Jour. of Obstet.," July, 1881.

† Kleinwächter, "Arch. f. Gynaek.," Bd. ii, p. 111.

‡ Grenser, "Monatsschr. f. Geburtsk.," Bd. xxvii, 1866, p. 445.

Spiegelberg, "Lehrbuch," p. 541.

while the corresponding arm protrudes through the vulva. The body of the fœtus is then so forcibly flexed that the breech and the head lie in close proximity to each other. The former is in contact with the sacro-iliac synchondrosis, while the latter is immovably held between the breech and the upper border of the symphysis. The neck and shoulder, which rest against the lower border of the symphysis, now become the pivot upon which the fœtus rotates. The trunk of the fœtus is driven beyond the shoulder, and the thorax, breech, and legs are born in the order named. The other shoulder then follows, and the head is finally expelled.

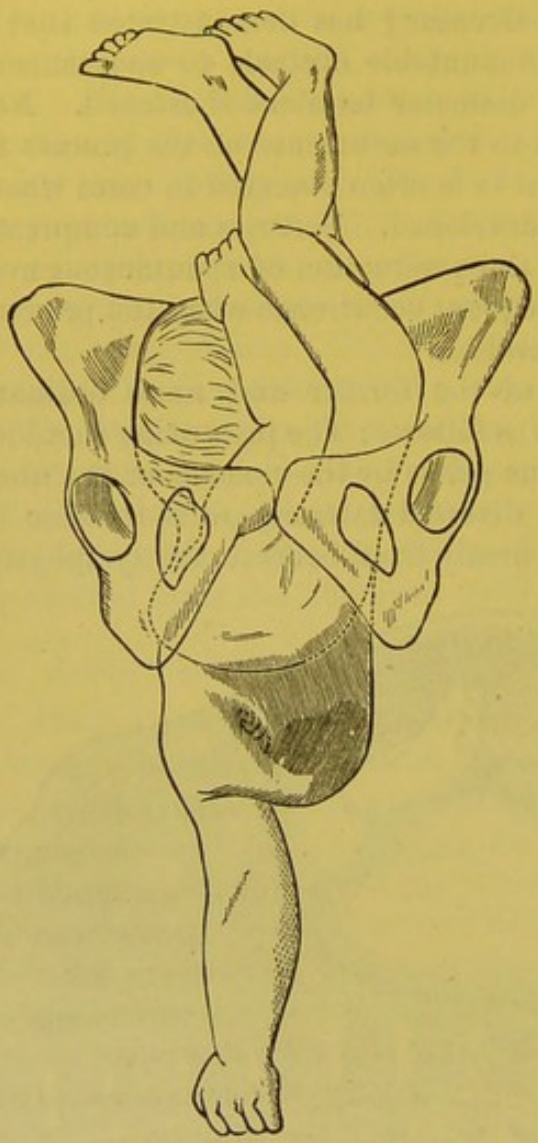


Fig. 236.—Birth with doubled body. (Kleinwächter.)

The mechanism of the second variety of spontaneous evolution, designated by Röderer "*evolutio conduplicato corpore*," which is much rarer than the former, differs from it in some essential features. It is greatly facilitated by softness and compressibility of the child, and therefore occurs predominantly in cases of macerated fœtus. It is rarely observed in other cases, unless the fœtus be unusually small and its tissues greatly relaxed.

The shoulder is in this instance forced downward and imprisoned beneath the symphysis pubis, as in the former variety, while the arm protrudes from the vulva. The trunk having been enormously flexed, the head and thorax simultaneously enter the pelvic cavity, the former being deeply imbedded in the latter. The second arm and shoulder lie between the breech and thorax on the one hand, and the head on the other. The presenting shoulder having been expelled, the head and thorax are born together, and these are followed by the breech and the legs.

Prognosis.—The prognosis in spontaneous evolution is good for the mother, but very bad for the fœtus, since only immature children are, as a rule, able to pass through the ordeal of delivery by this method alive. Kuhn, however, has reported a case of a child born alive,

weighing four and a half pounds and measuring seventeen inches in length; and Simon, according to Spiegelberg, collected one hundred and twenty-five cases in which fourteen children were born living. Three of the one hundred and twenty-five mothers died. In the variety of spontaneous evolution known as "*evolutio conduplicato corpore*," which occurs in the rule in small or macerated children, the prognosis is especially unfavorable. In these latter cases Dr. Taylor* recommends, when the perinæum is distended by the doubled body of the child, to make lateral incisions to the extent of three to four inches at the vulva, and thus remove the obstacle to delivery afforded by the pelvic floor.

CHAPTER XXX.

ECLAMPSIA.

Definition.—Clinical history.—Prognosis, pathology, and etiology.—Treatment.

Eclampsia is the term applied to convulsions, tonic and clonic in character, the foundation of which is laid in processes connected with pregnancy, labor, and childbed (*eclampsia gravidarum, parturientium, vel puerperarum*). By this definition it is intended to exclude the convulsions due to hysteria, true epilepsy, and cerebral lesions, which occurrences in pregnancy are to be regarded simply as accidental complications. In eclampsia there is loss of consciousness during the attacks, with at first a disturbance of the intellectual faculties in the intervals, afterward deepening in severe cases into coma. Before entering upon a discussion as to the probable nature of this affection, it is proper to present a summary of its clinical manifestations.

Clinical History.—Eclampsia is fortunately a tolerably rare event. Its estimated frequency is in about the proportion of once in five hundred pregnancies. The total number of deaths from this cause reported to the Board of Health in New York City, in the nine years from 1867 to 1875 inclusive, was 408. The estimated maximum number of deliveries during that period was 284,000, or nearly one death to seven hundred confinements. The entire number of deaths occurring in pregnant women from all causes during the same period was 3,342, making the proportion of those from eclampsia as one to eight. In the majority of cases, though not invariably, premonitory symptoms announce the impending outbreak. Of these the most important are headache, often limited to one side, vertigo, loss of memory, gloomy forebodings, flashes of light before the eyes, contracted pupils, amblyopia, sometimes amaurosis, ringing in the ears, dyspepsia, nausea, vom-

* Taylor, "Am. Jour. of Obstet.," July, 1881, p. 532.

iting, dyspnœa, œdema of the face, of the labia majora, and of the extremities, and, finally, and of first importance, the presence of albumen and of casts in the urine.

The attacks resemble those of epilepsy, the cry only lacking. When they occur during labor, the first convulsion often is preceded by a short calm, in which the patient ceases to complain, closes her eyes, and seems to have sunk into a peaceful slumber. This deceitful truce, which should always excite the keen attention of the physician, is followed in a few minutes by convulsive movements of the orbicularis oris muscle, giving to the patient a smiling aspect. Suddenly the eyelids open, the eyes become fixed, and the pupils contract. Then, in a few seconds, the eyelids open and shut rapidly, the eyes move from side to side or roll upward, while the pupils dilate and lose their sensitiveness to light. Very rapidly the convulsive twitchings extend to the other muscles of the face, the mouth opens and is drawn to one side, the head is moved from shoulder to shoulder, sometimes with lightning-like alternations. Frequently, for the first two or three convulsions, the movements of the extremities are limited to the pronation and supination of the forearm and to the closing of the fingers upon the thumb. Afterward the arms, crossed upon the thorax, pass from flexion to extension with great rapidity. The movements, as a rule, are more pronounced in the upper than in the lower extremities. Sometimes the latter are fixed with tetanic rigidity, while at others they are flexed at the knee and then drop of their own weight, now upon one side, now upon the other.

As a consequence of the resulting disturbances in the circulation and respiration, the carotids pulsate with great distinctness, the superficial veins of the neck swell, the conjunctivæ become injected, and the face is cyanosed ; the heart's action becomes intermittent, and the breathing irregular and stertorous.

In the tonic convulsions, which occur intercurrently with clonic ones, the head is inclined to one side, the mouth is drawn in the same direction, the jaws are closed, the eyes are fixed, opisthotonus or pleurosthotonus develops, the pulse becomes small and intermittent, the respiration is suspended, the body becomes covered with a cold, clammy sweat, and often involuntary micturition or defecation takes place. The tetanic condition, after lasting from fifteen to thirty seconds, gradually diminishes in intensity.

As the convulsions cease, the distortion of the face disappears, the cyanosis diminishes, the eyelids droop, the mouth opens, and frothy saliva, tinged with blood, escapes from the mouth and nostrils. Stertorous respiration marks the beginning of sopor. At first the patient, unless the attack has been of unusual severity, can be roused when spoken to. The depth of the sopor is proportioned to the violence and frequency of the attacks. When the convulsions are repeated, the

patient in the intervals can no longer be made to respond to inquiries, but passes into a state of complete unconsciousness. The duration of a single attack rarely exceeds a minute, and in a majority of cases lasts from ten to thirty seconds. On account of the implication of the respiratory muscles, attacks of long duration are scarcely compatible with continued existence (Spiegelberg).

After a single seizure the sopor usually disappears in from one half to two hours, and seldom persists beyond a single day. The number of seizures in a single day may, however, be exceedingly numerous. Thus, seventy convulsions have been reported by Braun,* eighty-one by Brummerstedt,† and one hundred and sixty by Depaul.‡

With very rare exceptions—of which, however, I have never seen an example—the urine after the convulsions is found loaded with albumen, and contains an abundance of renal epithelium, often in a state of fatty degeneration, casts, and sometimes blood-corpuscles. In all cases of exceptional severity the urine is scant or absent altogether.

Terminations.—In favorable cases, after the expulsion of the ovum the attacks cease or diminish in frequency and intensity, the pulse and respirations become quiet, and the coma passes gradually into gentle slumber. On awakening the patient complains of headache and of impaired memory, and possesses no recollection of the perils through which she has passed. Pains are felt in the muscles, and in the tongue when the latter has been injured to any considerable extent by the teeth.

But even after consciousness returns, the danger is still not ended. Eclampsia predisposes to *post-partum* hæmorrhage and to puerperal inflammations; or it may leave behind hemiplegia, amblyopia, an enfeebled mental condition, or psychical disturbances, especially mania, which, however, usually terminates spontaneously in the course of the first three days.

In fatal cases death results from carbonic-acid poisoning, due to tetanus of the respiratory muscles or to exhaustion of the nervous system. Bailly relates the history of a patient who died of asphyxia, due to swelling of the tongue.

Of anatomical lesions found in *post-mortem* examinations, the most constant are hyperæmia, fatty degeneration, and atrophy of the kidneys. The latter is rare, and in many cases the renal changes are of moderate extent. In thirty-two examinations, Löhlein# found in eight dilatation of one or both ureters and of the pelves of the kidneys. The same author likewise has demonstrated the existence of enlarge-

* Braun, "Lehrbuch der gesammt. Gynaekologie," p. 822.

† Brummerstedt, "Bericht," etc., Rostock, 1866.

‡ *Vide* Spiegelberg, *loc. cit.*, p. 556.

Löhlein, "Bemerkungen zur Eklampsiefrage," "Ztschr. f. Geburtsh. und Gynaek.," Bd. iv, Heft 1, p. 89.

ment of the heart (the comparisons were instituted with those of other pregnant women), indicative of increased arterial tension. The brain-lesions were in most instances insignificant.

Prognosis.—The prognosis is always serious. In Dohrn's collection of 747 cases the death-rate reached 29 per cent.; in 104 cases collected by Hofmeier* in Schroeder's Clinic the mortality was 32·4 per cent. A better showing is made by Braun,† who was able to report from Vienna in ten years, from 1869 to 1878, 73 cases, with twenty deaths (26 per cent.), five from peritonitis, and fifteen from Bright's disease alone.

The earlier the convulsions occur in labor, the more unfavorable the prognosis. This is well shown by the statistics of Löhlein. Thus, of eighty-three cases where the first convulsions occurred before or during the first stage of labor, 40·5 per cent. of the patients died. Of fifteen cases where the first stage was completed, but one patient died. Eclampsia, which develops first in childbed, usually pursues a favorable course. Löhlein reports eight cases, with one death, which, however, was the result of infection.

The longer the labor the more difficult the delivery, the deeper the coma, and the greater the insufficiency of the kidneys, the more depressing is the outlook.

It is very rare for the convulsions to cease previous to the expulsion of the child. According to C. Braun, after delivery in thirty-seven per cent. the convulsions cease entirely, in thirty-one per cent. they become feebler, while in thirty-two per cent. they continue for a time with undiminished severity. In childbed it is of favorable import when copious diuresis sets in, and is followed by the disappearance of the albumen and of the œdema.

As regards the children of eclamptic women, it is estimated that fully one half are born dead, a result probably due to asphyxia from the accumulation of carbonic acid in the blood of the mother. As the results depend upon the number and duration of the attacks, it is evident that the danger is greatly lessened after the completion of the first stage of labor.

Pathology and Etiology.—As in discussions upon eclampsia it is evident that the treatment advocated by physicians is governed almost exclusively by theoretical considerations, it becomes of the utmost importance to place before the student an exact statement of known facts, with an attempt to estimate at their true value the deductions which various observers have drawn from them.

Now, in the first place, in reviewing the foregoing history of the disease, we are brought face to face with the very striking coincidence in the vast majority of cases between renal insufficiency and the convulsive seizures. This insufficiency may or may not be asso-

* Hofmeier, *loc. cit.* † Braun, "Lehrbuch der ges. Gynaek.," p. 833.

ciated with albuminuria, though the two go pretty constantly together. The honor of first drawing attention to the relations between albuminuria and puerperal convulsions belongs to Dr. John C. W. Lever, who reported in "Guy's Hospital Reports," second series, 1842, fourteen cases, in ten of which the urine was examined. Albumen was found in greater or less quantity in nine cases; in the *post-mortem* made in the tenth case the death was discovered to have been due to acute meningitis.*

These observations were followed by others from British physicians, among whom may be mentioned Simpson, Garrod, Cormack, and Rees; and in France treatises upon the subject were published by Cohen and Delpech, and by Devilliers and Regnault.

In 1851 Frerichs pointed out clearly the close resemblance between the convulsions occurring in pregnancy and the uræmic convulsions of Bright's disease. After reviewing the evidence with scientific precision, he concluded that "true eclampsia occurs only in pregnant women suffering with Bright's disease, and it bears to the latter the same causal relation as convulsions and coma in Bright's disease in general; it is the result of the uræmic intoxication, with which also in its mode of manifestation it agrees." To this view Braun, in the same year, and Wieger, in 1854, brought effective support by the publication of a great number of observations confirmatory, both in respect to the clinical features and the *post-mortem* appearances, of the uræmic origin of puerperal convulsions. In 1857 Braun published one of the most meritorious treatises upon midwifery to be found in any language. In this work the new doctrine was presented with so much skill and clearness that since then, in the minds of the great body of practitioners, the terms eclampsia and uræmia have come to be regarded as synonymous. Now, though the lapse of time has tended to modify in many respects the less essential features of the Frerichs-Braun thesis, and though many of the earlier claims have had to be discarded, the evidence which has accumulated from every medical man's experience during the last quarter of a century has contributed to place the central idea upon an impregnable basis. The differences which separate writers on the subject at the present day are less differences of creed than of definition.

But, in order to understand the present position of the question, it is necessary to review the objections which the uræmic theory has had to encounter. Among its earliest opponents was Seyfert, of Prague, who, occupying the vantage-ground as director of the maternity hospital of that place, second only in size to the great maternity at Vienna, furnished the clinical counter-experiences which have since

* *Vide* Tyson, "The Causal Lesions of Puerperal Convulsions," Philadelphia, 1879. To this excellent summary I desire to acknowledge my indebtedness for a deal of labor saved, as regards the search for references.

proved the most effective weapons in the hands of those who have regarded the new doctrine as specious and heretical. The facts which, he insisted, invalidated the claims of Frerichs and Braun were as follows : *

1. That convulsions may occur without albuminuria.

2. That the albuminuria is in many cases the effect and not the cause of the convulsions.

3. That in many fatal cases the kidney-lesions were absent or wholly insignificant.

4. That convulsions are rare in chronic Bright's disease which had existed prior to pregnancy.

5. That in true uræmia, such as necessarily is produced by the suppression of urine when, in uterine cancer, the ureters are invaded, convulsions do not occur.

That, in the main, these propositions are correct, hardly admits of question. But, in drawing conclusions from these, unnecessary stress is laid upon the presence or absence of albumen in the urinary secretion. It is the renal insufficiency, it should be fixed in the mind, and not the albuminuria, which causes uræmia and convulsions. The mere absence of albumen from the urine does not even exclude the existence of Bright's disease. Braun is careful to note that in certain cases of fatal eclampsia, in spite of the absence of albuminuria, the *post-mortem* examination revealed amyloid degeneration of the kidneys and of the heart-structures ; and, again, in others, of atrophy of both kidneys, where the dropsy, and the albumen, and casts, which had been present earlier in pregnancy, had entirely disappeared at the moment the convulsions occurred. Bailly has shown that not rarely albuminuria in pregnant women may disappear for several hours and then reappear once more, so that it is possible for an examination to be made during the short period when the urine ceases to be albuminous.

On the other hand, chronic nephritis does not necessarily imply insufficiency of the renal secretion. Seyfert reported over 70 cases where women suffering from Bright's disease became pregnant ; only two of these had convulsions. Every observer has seen similar instances of immunity. Nephritis in pregnancy brings with it its own peculiar dangers. Of forty-six cases, chronic in character, reported by Hofmeier, only one third of the patients had eclampsia, but one half died. Including acute and chronic cases together, Braun estimates that only sixty in the hundred develop uræmic convulsions. Hofmeier found, in five thousand births recorded upon the history-books of the Berlin Clinic, 137 cases of nephritis entered. Of these, 104 patients only were attacked with eclampsia. Professor Bamber-

* As I have copied this list from notes taken from the lectures of Seyfert, delivered in the summer session of 1865, I shall not consider it necessary to more than incidentally refer to the corroborative testimony since advanced in support of their validity.

ger* reports from autopsies of the "allgemeinen Krankenhaus" in twelve years 2,430 cases of Bright's disease, of which 152 were found in puerperal and pregnant women, viz., 80 acute cases, 56 chronic cases, and 16 cases of atrophy; puerperal eclampsia was recorded in 23 instances.

Löhlein examined the records of thirty-two autopsies made upon eclamptic women, and found in eight, or in twenty-five per cent. of the entire number, that dilatation of one or both ureters coexisted with renal disturbances. He, therefore, pertinently inquires how far simple mechanical obstruction of the ureters may explain the apparent development of uræmic manifestations in certain cases without the warning furnished by albumen in the urine.

Finally, it is not claimed by even the most stalwart champions of the uræmic nature of eclampsia that the convulsions which occur during pregnancy and labor are invariably the result of the same cause. Thus, Tyson says, "There are no reasons why we should exclude from the causes of the convulsions in the puerperal state those which operate to produce convulsions in the non-puerperal condition." So-called cases of eclampsia without albuminuria, i. e., without uræmia, are admitted by Braun and Spiegelberg, and referred by them to reflex stimulation of the vaso-motor and convulsive centers (Krampfcentren). They advocate, however, separating them off into a class by themselves, under the title of acute epilepsy, or eclamptiform attacks, a distinction they believe warranted by their rarity and their benign behavior. The question of mere names, however, is of small importance. The main point upon which it is necessary to insist is, that it is not reasonable, because in very exceptional cases uræmia is absent in convulsions, to deny to uræmia, in the overwhelming proportion of cases in which it is demonstrably present, its importance as the most distinctive factor.

The objection drawn from the insignificance of the kidney changes, frequently observed in *post-mortem* examinations, loses most of its force when we remember that in a large proportion of cases the retention of excrementitious materials is due to acute suppression. Thus, in the 104 cases of eclampsia reported by Hofmeier, the kidney symptoms developed suddenly. This sudden suspension of the urinary secretion can only result, Spiegelberg† argues, from disturbances in the renal circulation. A rapidly developed affection of the vessels would leave no marked *post-mortem* traces, and would, in cases of recovery, disappear as quickly as it had come. Were the kidney troubles due principally, as was formerly supposed, to pressure of the gravid uterus upon the renal veins, the kidneys should, in *post-mor-*

* Bamberger, "Ueber Morbus Brightii und seine Beziehungen zu anderen Krankheiten," Volkmann's "Samml. klin. Vortr.," No. 173, p. 1541.

† Spiegelberg, "Lehrbuch," p. 561.

tem examinations, exhibit evidences of congestion; whereas usually they are, on the contrary, found to be pale and anæmic. Besides, in cases of pressure from ovarian and pelvic tumors it is usually the ureters and not the veins which are implicated. The precise nature of the circulatory changes is not, of course, definitely known. Spiegelberg suggests that either the walls of the vessels are altered in such a manner as to interfere with the process of diffusion, or that a reflex contraction of the vessels due to a peripheral stimulus operates to cut off the blood-supplies to the kidneys. Frankenhaeuser, having demonstrated a direct connection by means of the sympathetic nerve between the ganglia of the kidneys and the nerve-filaments of the uterus, had likewise suggested in effect that the albuminuria of pregnancy was due not to pressure but to the excitation of the uterine and renal nerve plexuses.

The statement contained in the fifth proposition relates to a curious fact, which has since received confirmation from the pathological investigations of Cornil and Ranvier. In a very large proportion of women who had died from uterine cancer the ureters were found occluded, with attendant dilatation and in some cases with hydronephrosis. The histories of these patients showed that in not one instance had convulsions taken place. But, however remarkable the fact itself may be, it is not pertinent to the question of eclampsia. Seyfert adduced it to prove that uræmia had nothing to do with convulsions, a question which it is hardly necessary to discuss at the present time.

A very different interest attaches itself, however, to the inquiry as to the causes of the outbreak of convulsions. It is well known that not every case of nephritis, or even of kidney insufficiency, is followed by eclampsia, though convulsive attacks are much more common in the uræmia of pregnant than of non-pregnant women. Frerichs believed he had found the secret in supposing a ferment to develop in the blood, which converted the urea into carbonate of ammonia. In 1870 Spiegelberg reported an examination of the blood of an eclamptic woman by the latest methods, and demonstrated the presence of ammonia in quantities sufficient to give color to the supposition of Frerichs; but, subsequent investigations proving negative, he concluded that "ammoniæmia is to be regarded as one of the rarest causes of convulsions."

An apparently much more scientific explanation was afforded by the now well-known Traube-Rosenstein theory, which maintained that eclampsia took place when, in persons rendered hydræmic by the loss of albumen, the aortic pressure was suddenly increased, the increased pressure giving rise successively to œdema of the brain, then to secondary compression of the vessels, and finally to acute anæmia. An anæmic condition of the hemispheres would, it was predicted, pro-

duce coma, while convulsions would ensue if the condition extended to the motor centers.

The plausibility of this hypothesis was increased by the widespread acceptance of the doctrine taught by Andral and Gavarret, that the blood of all pregnant women is hydræmic, and by the fact that the existence of increased blood-pressure during the pains seemed naturally to account for the frequency of convulsions in labor. For a number of years after the announcement of the Traube-Rosenstein theory it received from me complete acceptance; but my faith became afterward weakened by failing to find at *post-mortem* examinations the anticipated brain changes, viz., œdema, anæmia, and flattening of the convolutions. In nineteen examinations, Löhlein reported these alterations in but a single case. In his "Lehrbuch der Geburtshülfe" Spiegelberg sums up the objections in a somewhat contemptuous fashion. First he asks why, if the pathogenetic symptoms, as assumed, are invariably present, eclampsia is of such rare occurrence, and in what way the theory in question affords any explanation of eclampsia in pregnancy and childbed; then he denies that eclamptic women are for the most part hydræmic, that hydræmia and arterial pressure are capable of inducing cerebral anæmia, and that the clinical evidences afforded by the pulse and pupils are those produced by œdema.

Angus Macdonald reported in 1878 that in the examination of the brain in eclamptic persons he found the meninges congested and the venous sinuses filled with blood, while at the same time there was marked anæmia in the deeper layers of the brain-structure. The ventricles, in place of being empty, as should have been the case according to the Traube-Rosenstein theory of œdematous swelling, were found filled with serum. In place of the doctrine of secondary compression, he expressed his belief that the anæmia resulted from arterial contraction due to irritation of the vaso-motor centers from excrementitious principles retained in the circulation by the insufficiency of the kidneys.

The disposition to ascribe convulsions to cerebral anæmia is based upon the experiments of Kussmaul and Tenner, who demonstrated that convulsive twitchings might be produced in animals by tying the carotids or by opening the large vessels of the neck and allowing them to bleed to death. It is, of course, anticipated that anæmia due to systole of the arterioles would be followed by the same results. The phenomena of convulsions are twofold, viz., loss of consciousness, and tonic and clonic contractions. Loss of consciousness is easily to be accounted for by anæmia of the hemispheres, precisely as in cases of ordinary syncope. Convulsions occur, however, when the brain is removed, if only the pons Varolii and the medulla oblongata are preserved. Deiters has shown that the motor fibers of the extremities and the trunk have their first central terminations in the pons. Noth-

nagel* has proved that a collection of ganglionic cells in the substance of the pons furnishes the motor center from which the convulsive impetus takes its departure. According to Schroeder van der Kolk, the groups of gray matter for the cranial nerves are situated in the floor of the fourth ventricle and in the substance of the medulla oblongata. Any influence producing contractions of the arterioles through the vaso-motor nerves would necessarily produce both coma and convulsions. As, however, convulsions may take place without loss of consciousness, Nothnagel concludes that the same cause which acts indirectly through the vaso-motor nerves may simultaneously set in action the centers of muscular movements.

The foregoing considerations justify the older divisions of convulsions into two classes, viz., those due to centric causes, and those proceeding from peripheral irritation. In both cerebral anæmia plays an important part. In the overwhelming proportion of cases, uræmia is the fountain and origin of the evil, the term *uræmia* signifying, of course, the action, not of a single constituent of the urine, but of all the excrementitious principles, combined with that of increased arterial tension. Whether, in exceptional cases, carbonate of ammonia or cerebral œdema is present, is a matter of slight moment. The *rôle* played by peripheral irritation is not, however, to be overlooked. Without uræmia, though rarely, peripheral irritation can provoke eclampsia. In uræmic cases the greater proportion develop during labor. In Löhlein's collection, a hundred and six in number, ninety-three of the patients were parturient. Spiegelberg has frequently seen convulsions awakened in the placental period by the mechanical irritation of the uterus during the employment of the Credé method of expression.

Convulsions occur more commonly in primiparæ than in multiparæ, especially in elderly primiparæ, in twin pregnancies, and in women with contracted pelves. They may occur epidemically in consequence of atmospheric conditions, which probably interfere with the functions of the skin, and thus indirectly increase the labor thrown upon the kidneys.

Treatment.—The occasional examination of the urine of pregnant women is to be regarded as an indispensable precaution. Faint traces of albumen are not infrequently found in the urine of women with harmless catarrhal affections of the bladder. Persistent albuminuria calls for special prophylactic treatment; for, though convulsions are not to be regarded as the necessary consequence of nephritis, the presence of renal disease immensely increases the danger of sudden acute suppression. Nephritis is, moreover, apt to be aggravated by the pregnant state, and Hofmeier has shown that in a considerable pro-

*Nothnagel, "Ueber den epileptischen Anfall," Volkmann's "Samml. klin. Vortr.," No. 39, p. 313.

portion of the cases which have their origin in pregnancy the kidney-lesions, contrary to the accepted belief, do not disappear spontaneously after parturition. Flaischlen has, however, recently challenged Hofmeier's conclusions. The true renal lesion of pregnancy he regards as due to anæmia of reflex origin, the primary consequence of which is anatomically an alteration in the epithelium of the glomeruli, and clinically albumen in the urine without sediment. In its subsequent course degenerative changes take place in the epithelium of the canaliculi, and great quantities of albumen with cylinders and epithelia are found in the urine. It occurs first about the middle, or, more frequently, toward the close of pregnancy. As distinguished from chronic nephritis, in which the specific gravity of the urine is low and the quantity increased, the specific gravity is high and the quantity diminished. The transition of this form into chronic nephritis he regards as not proved, and *a priori* improbable.*

Every precaution should be taken, therefore, to remove from albuminuric patients all sources of mental excitement, to ward off attacks of indigestion, and to defend them from colds. In œdema of the face, the extremities, and the labia majora, a strict milk-diet should be enjoined, and the tincture of the chloride of iron, in full doses, should be given at least four times a day, both for its diuretic and for its hæmatinic properties, and likewise to improve the *tonus* of the weakened vessels. If the milk-diet is badly supported by the patient, she should be instructed to drink freely of the natural alkaline waters possessing mildly diuretic properties, such as the Vichy, the Selters, the Buffalo lithia-water, the Poland water, and others of like action. To remove the transuded serum, the skin should be compelled to aid the kidneys, either by means of the Turkish bath or, where the latter is not available, by the wet-pack. Mild laxatives, such as the Friedrichshall, the Hunyadi, or the Saratoga waters, are useful in constipation of the bowels.

If cerebral symptoms threaten the outbreak of convulsions, the nervous irritability should be held in check by rectal injections of chloral and the bromide of potassium (thirty grains each), and a hydragogue cathartic should be promptly administered. Free catharsis unloads the blood of urea, diminishes the arterial tension, and relaxes the arterioles. The immediate results are usually in the highest degree satisfactory. The pain in the head, the sensory disturbances, the stomach troubles disappear, and the patient becomes calm or sinks into a gentle sleep. Löhlein recommends placing the woman in the latero-prone position, in order to diminish as much as possible the pressure upon the ureters and upon the renal veins.

So far writers are practically unanimous. Whatever differences exist between them relate not to principles, but to the means best

* "Ztschr. f. Geburtsh. und Gynaek.," vol. viii, p. 354.

adapted to accomplish the end in view. When, however, in spite of palliative measures and hygienic precautions, the uræmic symptoms have steadily progressed until the central nervous system has become involved, the question comes up for decision whether to persevere in a plan of treatment designed merely to ward off impending danger, or whether to place the patient without delay in a position of relative safety by the induction of premature labor. The weight of authority, it seems to me, is favorable to procrastination, the interruption of pregnancy being regarded as an extreme measure, justifiable only in cases of utmost peril. But premature labor, with the indications thus limited, is not likely to save many lives. My own convictions are clear that, so soon as grave cerebral symptoms develop, the period of folded hands has passed. The relief to be obtained from chloral and catharsis is, as a rule, of short duration, and we can not go on giving chloral and cathartics to the end of gestation, nor are we sure that the first fortunate results can be reduplicated. Moreover, it is necessary to take cognizance of the well-being of the fœtus, which is threatened by the continued circulation of urea in the maternal blood. The induction of premature labor by means of the bougie, aided, if needful, by the vaginal douche and the dilating bags of Barnes, is attended with but moderate risk if resorted to after the uræmic symptoms have been got fairly under control; if employed as a last resource, where other therapeutical measures have failed, its use is still justifiable, though it then partakes rather of the nature of a forlorn hope.

The indications for treatment during the outbreak are for the most part the same as laid down for uræmic symptoms unattended by convulsions, viz., to lower the arterial tension, to diminish to the fullest extent practicable the irritation of the vaso-motor and convulsive centers, and to restore to the kidneys their normal functions. Spiegelberg claims that these three indications are most completely fulfilled by venesection. A dozen years ago, at a time when the prejudice against "spoliative measures" was still strong, Professor Fordyce Barker pleaded for the restoration of the lancet in the management of puerperal convulsions, insisting upon the unmistakable clinical evidences favorable to its employment. In my student-days in Paris, at the Hôpital des Cliniques, where the ancient usage was in full favor, I well remember my first feelings of alarm at the vigor of the treatment in vogue; but, after carefully watching the cases to the end, I was led to conclude that the claims of bleeding in eclampsia rested upon a substantial foundation.

The special advantage of venesection lies in the rapidity of its action; incidentally it favors absorption and renders the patient more susceptible to the influence of other remedies. It forms, therefore, naturally the first step in the treatment of convulsions. The quantity of blood to be withdrawn varies from eight to sixteen ounces, accord-

ing to the vigor, and, to some extent, according to the size of the individual.

In the May number of the "American Journal of Obstetrics," 1871, Dr. H. Fearn, of Brooklyn, contributed an article on "Veratrum Viride in Large Doses, as a Substitute for Bloodletting in Puerperal Convulsions," in which he recommended the tincture of veratrum in doses varying from fifteen minims to a teaspoonful, repeated every five or ten minutes until the pulse became soft, or vomiting set in. For several hours after the convulsions are arrested, he advises the veratrum to be administered in smaller doses, in order to keep the pulse below fifty to the minute. He claims that the large doses are devoid of danger so long as the convulsions continue. According to Kenyon,* who has recently contributed two cases successfully treated by veratrum, "the drug is quickly absorbed, and enters the circulation rapidly. It enters the vasa vasorum and through them impairs the sensibility of the vaso-motor nerves, the blood-vessels thus losing their tonicity and power of contraction"—all good arguments for its use in convulsions if its safety can be established.

After bleeding, narcotics and anæsthetics should be resorted to, with a view of preventing the renewal of the convulsions. Chloroform and morphia have long been tested in practice, and have sustained their claims to professional favor. From one sixth to one fourth of a grain of morphia should be injected hypodermically, the same quantity to be repeated in an hour in case of the convulsions returning. Chloroform was formerly recommended in full anæsthetic doses, so as to completely paralyze the motor centers. As, however, experience has shown that complete and prolonged anæsthesia is in itself a source of danger, it is advisable, except in cases where labor is nearly at a close, to restrict the chloroform to the pains, and to the restlessness which is often the preliminary of a fresh seizure.

The discovery of chloral has added another invaluable agent to our list of available antispasmodics and anæsthetics. It is my present practice, after beginning with chloroform, to administer thirty grains, each, of chloral and bromide of potassium by the rectum, and to suspend the chloroform so soon as the sedative effects of the latter agents become developed. The frequency with which the chloral should be given depends upon the frequency and violence of the attacks. A single dose will sometimes exercise a restraining influence for hours, while in other cases in the course of an hour or two the dose will require to be repeated. As a subsidiary measure, with a view to the ultimate relief of the kidneys, the lower bowel should be cleared out with an enema, and a cathartic (a drop of croton-oil, or calomel and jalap in case the patient is able to swallow) should be given by mouth.

Breus† warmly recommends the use of the hot bath as a prophylactic measure in the renal affections of pregnancy, and as a measure

* Kenyon, "Treatment of Convulsions with Veratrum Viride," "N. Y. Med. Jour.," October, 1879, p. 370.

† Breus, "Zur Therapie der puerperalen Eclampsie," "Arch. f. Gynæk.," vol. xix, p. 219.

of treatment in conjunction with chloral during the eclamptic attack. The plan he recommends consists in placing the patient up to the neck in a bath of a temperature at first of about 102°, which should be gradually increased to 110° or 112° Fahr. The bed for the reception of the patient should be spread with two blankets covered by a warmed sheet. After a half-hour the patient should be removed from the bath, wrapped in a warm sheet, and placed upon the bed. She should then be enveloped in the blankets with only the face free, and two more blankets should be laid above the preceding. In a few minutes profuse perspiration sets in, and should be maintained for from two to three hours. The covers should then be removed gradually. For thirst he gives soda or other sparkling waters. After the sweating, the patients ordinarily sleep a few hours, when they feel well. A comatose condition is no contra-indication, but renders the procedure more difficult. The diaphoresis rapidly diminishes the dropsical symptoms, and is followed by a decided diminution in the amount of albumen in the urine.

As convulsions which occur after the advent of labor have a tendency to recur so long as the labor continues, and in the larger proportion of cases cease after the birth of the child, every obstetrical resource compatible with the safety of the mother should be employed to hasten delivery. In the early part of the first stage, the pains, if sluggish, should be stimulated by catheterization of the uterus. Braun advocates rupturing the membranes, as he claims that the escape of the amniotic fluid often diminishes the frequency and violence of the convulsions. The water-bags of Dr. Barnes, if necessary, should be used to promote the dilatation of the cervix. Incisions through the border of the os externum and *accouchement forcé* are unnecessary. After the first stage is completed, if no mechanical disproportion exists between the head and the pelvis, a careful attempt to extract the child with forceps should be made. Every precaution should be used to avoid injuring the soft parts. Obstetrical aid is only warrantable where it can be employed without detriment to the mother. In instrumental cases, with the head high in the pelvis, I have had every reason to feel satisfied with the Tarnier forceps, exchanging it, however, for one of English pattern so soon as the head is brought to the floor of the pelvis.

When convulsions occur during pregnancy, the question as to the advisability of at once provoking labor is by no means settled. The material upon which to form an opinion is limited, as in most cases labor-pains occur spontaneously (as a consequence of the convulsions). Where medical treatment alone is employed it is certain that, in the absence of labor-pains, a certain proportion recover, and pregnancy may go on to completion. On this account it is commonly advised not to introduce labor as a complication into a state of affairs already

sufficiently dangerous and difficult to manage. So far as my own experience goes, however, the practice of waiting upon Nature has proved uniformly disastrous, while the induction of labor has furnished me with a certain proportion of recoveries. Braun declares he has never known but one patient to recover between the fourth and sixth months of pregnancy except where abortion had taken place. The question is one, however, concerning which there exists a reasonable degree of doubt, and which can not be settled by the hap-hazard experiences of individuals.

In the treatment of convulsions during the childbed period the agents used should be opium, chloral, veratrum, or digitalis. Chloroform and venesection should be employed with extreme caution, if, indeed, they are ever entitled to confidence at that time.

CHAPTER XXXI.

POST-PARTUM HÆMORRHAGE AND RETAINED PLACENTA.

Normal agencies for checking hæmorrhage.—Disturbances of contractility, of retractility, of thrombus formation.—Treatment.—Method of securing contraction and retraction.—Treatment of cerebral anæmia.—Retained placenta.

THE hæmorrhages which occur immediately after the birth of the child may have their origin in the uterus, the vagina, or the vulva. It is customary, however, to consider those which spring from lacerations in a chapter by themselves, and to apply the term *post-partum* to those hæmorrhages only which arise from the placental site.

Unlike other grave complications of childbirth, *post-partum* hæmorrhage is not an uncommon event. It may follow the simplest of labors, and, in case of an unprepared physician, it may carry his patient in a few moments to the brink of death. It is impossible to conceive a tragedy more terrible than this. Occurring, as the accident does, suddenly, without warning, in the period of joy that follows the birth of a living child, the sudden shifting of the scene becomes appalling. If the mother dies at such a time, the luckless attendant who stands at her bedside, a nerveless spectator, need never expect forgiveness; nor can he shield himself behind the recorded ill-successes of others. Every competent accoucheur knows in his own heart that he has no right to shirk his personal responsibility in cases of fatal *post-partum* hæmorrhage, or to meanly throw the blame upon Providence.

The treatment of *post-partum* hæmorrhage is one of the most satisfactory departments of obstetrical practice. In no other emergency is the saving of life so little dependent upon chance, and so much upon intelligent human intervention. Successful treatment is, however, less

the result of a familiarity with the various procedures extolled by writers, than of a correct understanding of the mechanism by means of which the arrest of the hæmorrhage is to be effected.

Normal Agencies for checking Hæmorrhage.—In normal cases the flow which follows the detachment of the placenta is of brief duration. The torn arterial twigs retract spontaneously, the patulous mouths of the veins become plugged with fibrinous clots, while the so-called venous sinuses, which are simply channels lined with endothelium, without valves or walls, become bent, flattened, and obliterated under the compression exerted by the muscular structures of the uterus.

The first requisite against hæmorrhage is the maintenance of firm, uniform contraction of the uterus. The contractions, which persist with lessened force after the birth of the child, during their continuance alone suffice to prevent hæmorrhage from the placental site. The two diagrams borrowed from Professor Breisky serve to illustrate the mechanism by which this is effected. In the transition from *a* to *b*, the uterus, which shortly before harbored the entire ovum, becomes

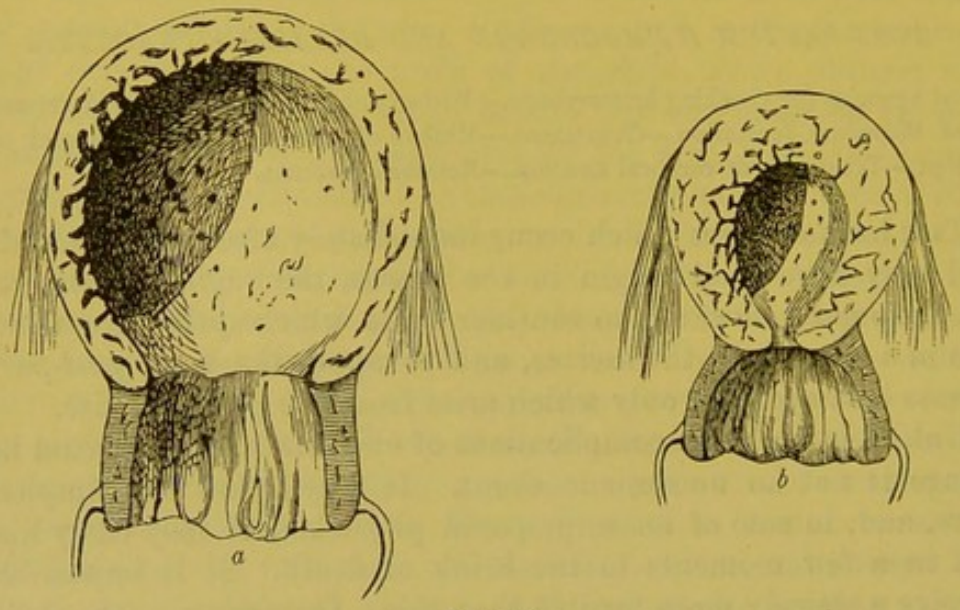


Fig. 237.

reduced to a body not larger than the two fists. But the duration of the contractions is short, with an ever-increasing interval between them. If their cessation were followed by the return of the uterus from *b* to *a*, the blood would once more rush into the sinuses, the mouth of the veins would open, the thrombi would be washed out by the pressure brought to bear upon them, and flooding would of necessity ensue. That this does not take place is owing to the same force which in labor keeps the uterus closed upon its contents during the descent of the fœtus—viz., tonic retraction.

The tonic retraction of the uterus is in part the consequence of shortening of the muscular fibers, and in part of their rearrangement,

a thickening of the uterine walls resulting, as the cell-elements, in place of standing end to end, assume a position more nearly parallel to one another. Retraction is a permanent acquisition of the uterus, and alone suffices to prevent the occurrence of hæmorrhage. The difference between it and contraction is exhibited by the difference in the consistence of the *post-partum* uterus during and between the pains. The contracted uterus is hard and firm like a billiard-ball, while the retracted organ is relatively soft and relaxed. The two properties, though distinct, are not, however, independent of one another. Whenever the contractions are good, the retraction is well marked also. Whatever diminishes the contractile powers of the uterus is followed by a corresponding falling off as regards its retraction.

In cases where the muscular structures of the uterus fulfill their normal functions, the formation of thrombi is of subordinate importance as a means of arresting hæmorrhage. Confined to the adherent portion of the decidua serotina, they impart an uneven surface to the placental site. Thrombi which extend to the intermuscular veins are pathological. It is only when the uterus is flabby, and the muscular action is in default, that the thrombi exercise any marked influence in the control of hæmorrhage, and even then they bear so close a relationship to puerperal thrombosis as to approach dangerously near to the confines of pathology.

The causes of *post-partum* hæmorrhage are to be sought for in disturbances of the mechanism by which hæmorrhage is normally prevented.

Disturbances of Contractility.—Contractions of the uterus may fail from lowering of the muscular irritability. Atony follows most frequently exhausting labor, artificial deliveries, rapid evacuation of the uterus, especially in multiparæ, where the failure to contract has often the significance of a prolonged pause, excessive distention (hydramnios, twins), profuse hæmorrhages, collapse, nervous depression, and severe general ailments.

Again, in other cases, the functional disturbance may proceed from some abnormal condition of the muscular fiber. Thus, the defects of contractility may spring from incomplete development, as in anomalies of formation, in textural changes due to some antecedent disease or puerperal condition, especially as to the result of many previous confinements, or finally from inflammatory infiltrations having their source in the bruising of the lower uterine segment during labor.

The contractions of the uterus may be mechanically interfered with over limited areas by retained portions of the placenta and of the membranes, by peritoneal adhesions, by tumors in the walls of the uterus or in the uterine appendages, or by a distended bladder or rectum.

Disturbances of Retractility.—We have already seen that the *tonus*

of the muscular fibers is lowered, and that their rearrangement is incomplete, whenever the uterine contractions are in default. At the same time the retraction of the uterus may be directly hindered by mechanical causes, especially by those which, like the placenta, the membranes, or coagula of blood, when retained in the uterine cavity, prevent, in spite of continued contractions, a sufficient closure of the veins.

Disturbances in Thrombus Formation.—The disturbances which interfere with the formation of thrombi occur for the most part in those cases in which, owing to the defective action of the muscular structures, the blood-stream arrives at the mouths of the vessels with unchecked rapidity. As a consequence, coagulation does not take place, or the coagula are of soft consistence, and offer but feeble resistance to any sudden increase of blood-pressure, or become mechanically detached by restless movements on the part of the patient, or by straining with the abdominal muscles.

Outlying Causes of Post-partum Hæmorrhage.—The remote causes of *post-partum* hæmorrhage—i. e., those not immediately connected with the uterus—all act by indirectly interfering with either the contractility or the *tonus* of the muscular fiber, or with the thrombus formation. This they do by influences exerted either through the nervous system or through the circulation. Thus, the muscular irritability may be impaired by general debility, by wasting diseases, from impoverishment of the blood due to suffering and muscular effort, from psychical impressions, and from the external influences of heat and vitiated air. The normal *tonus* of the uterine muscles may be overcome, and the formation of thrombi disturbed, by any condition of the circulatory system associated with increased pressure in the venous or arterial trunks. The pressure in the uterine veins may be augmented by the patient's getting up suddenly in bed, by acts such as coughing, laughing, sneezing, vomiting, and defecation, in which the abdominal muscles are called into play, and by all the conditions which produce chronic congestion of the pelvic organs. Increase of arterial tension as a cause of hæmorrhage is rare. Breisky mentions a case where, in a multipara without valvular heart-disease, the cause of the hæmorrhage was apparently due to intense palpitation of the heart associated with the hard, incompressible pulse indicative of arterial fullness.*

Treatment.—It is not necessary to dwell upon prophylactic measures. As has been shown in the survey of the causes of *post-partum* hæmorrhage, they comprise everything that has been said concerning the proper management of labor.

* The foregoing description is little more than a transcript of the principles enunciated in Breisky's clinical lecture, "Ueber die Behandlung der puerperalen Blutungen" (Volkmann's "Samml. klin. Vortr.," No. 14, 1871). I have found them of the utmost service to me in practice during the ten years past, and believe with Breisky that they furnish the key to successful prophylaxis and treatment.

Methods of securing Uterine Contractions.—It is my own practice, and one I would urge upon others, to make provision in the simplest of cases against the possible occurrence of hæmorrhage. In the beginning of the second stage, I examine my Davidson syringe to make sure that the valves are in good working order. I then direct a small table to be set by the bedside of my patient, and place upon it a bowl containing pieces of ice of about the size of a hen's-egg, brandy, sulphuric ether, neutral perchloride of iron, carbolic acid, ergot, a solution of morphia, and a hypodermic syringe filled with a fluid extract of ergot, using preferably a watery solution. Within easy reach I likewise have placed a pitcher of hot water, another of cold water, an empty basin containing the Davidson, or, still better, a fountain syringe, and a bed-pan. All this requires but a few moments' time, and it is of no mean advantage to feel, in case hæmorrhage follows the birth of the child, that all the appliances for prompt action are in order and close at hand.

If hæmorrhage takes place, in spite of the fact that the uterus has been carefully guarded by external pressure during the period of delivery, draw the pillows from under the head of the patient, direct the nurse to open the windows, and inject the ergot in the hypodermic syringe into the outer surface of the thigh. Ergot by the mouth acts too slowly to prove of service in the face of a great emergency; besides, in many patients ergot by the mouth excites nausea, and is not absorbed by the stomach; hypodermically its action is, as a rule, rapidly developed. Then introduce the hand into the uterus. If a full bladder interferes, draw off the urine with a catheter.

The introduction of the hand into the uterus I believe to be a matter of the utmost importance. When combined with external pressure it stimulates the uterus to contract. The placenta, if adherent, should be detached with the tips of the fingers; if loose within the uterine cavity, it should be withdrawn slowly, taking care to remove the membranes entire. Bits of placenta or strips of membrane should be carefully scraped from the uterus, remembering that this is most easily effected during the contraction of the organ. Even if the placenta and membranes are expelled apparently entire, it is still desirable to pass the hand into the uterus to clear out clots, and to make sure that no part of the ovum has been left behind. Once I lost a patient by neglecting this rule. The hæmorrhage was checked by compression, and upon careful inspection of the placenta and membranes I convinced myself that everything had come away. The patient died on the eighth day, of septicæmia. The autopsy revealed the presence of a small placenta succenturiata, of the existence of which, aside from the hæmorrhage, there had not been the slightest indication.

So soon as the uterus has been emptied of everything capable of

preventing contraction and retraction from taking place, withdraw the hand into the vagina, and, with the index and middle fingers in the posterior *cul-de-sac*, press the cervix forward toward the body of the uterus. With the external hand grasp the uterus through the abdominal walls, compress it firmly, and push it downward toward the pelvis and forward against the pubic bone. By this manœuvre

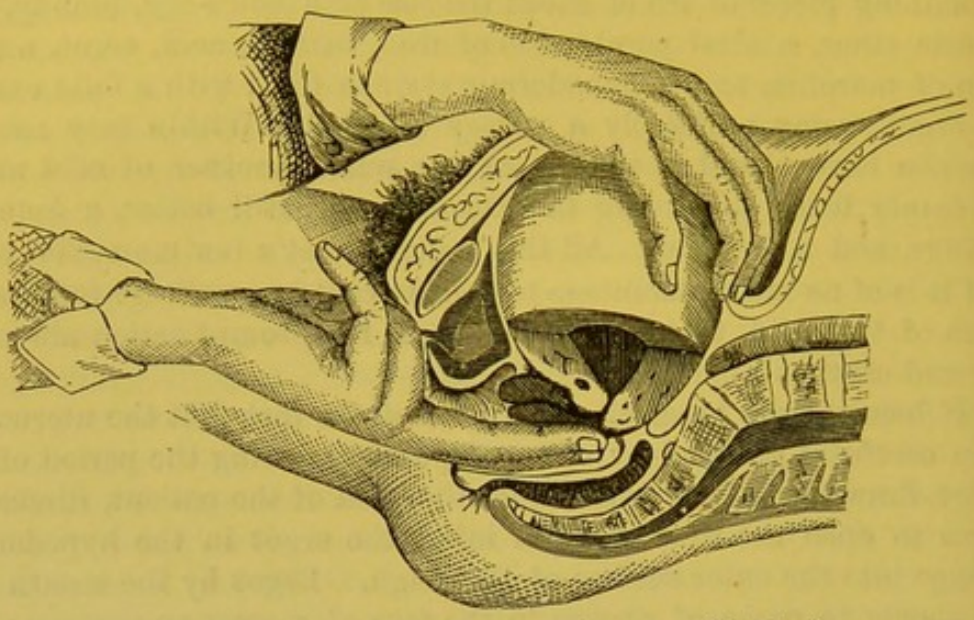


Fig. 238.—Bimanual compression of uterus. (Breisky.)

the cervix is closed, the uterine walls are brought into contact with one another, and contractions are stimulated by the direct irritation of the large cervical ganglion and by the kneading of the fundus. Breisky states that in many cases it is possible to combine compression of the aorta with the foregoing manipulation.

If bimanual compression fails to speedily secure contractions, without removing the internal hand, pieces of ice may be slipped into the vagina, and thence pushed upward into the uterine cavity. With rare exceptions, the uterus responds at once to the stimulus of cold applied to its inner surface. Should it not do so, however, the bed-pan should be placed under the hips, and warm water of about 112° Fahr. should be injected into the uterus, care being taken to expel previously all air from the tube of the syringe. The injection should be made slowly and without force, allowing the fluid to escape *pari passu* with its introduction.

Although, as a precaution, I still keep within easy access one of the per-salts of iron as an additional resource in case of urgent peril, since the introduction of hot-water injections as a reflex exciter of uterine contractions I have never found it necessary to resort to their use. This I consider fortunate, for, though there is abundant testimony as to the efficacy of the per-salts of iron in *post-partum* hæmorrhage, the arrest of the flow appears, in some cases at least, to have

been achieved at too dear a price. Barnes refers the hæmostatic effect of the iron—1. To its direct action in coagulating the blood in the mouths of the vessels; 2. To its action as a powerful astringent on the inner membrane of the uterus, whereby the surface becomes corrugated and the mouths of the vessels are constringed; 3. To the fact that it often provokes some amount of contractile action of the muscular wall. Trask, in recommending the substitution of tincture of iodine for the solution of the perchloride of iron, maintains that it is the third mode of action that should be placed first in the order of importance. This corresponds with my own experience. In two cases where Monsel's solution was used the uterus contracted promptly, and the injection was followed by no disturbing effects. In the third the uterus remained large and flaccid, notwithstanding the hæmorrhage was arrested. For two days the patient did well; on the third the lochia became excessively offensive, the respirations stertorous, and the pupils dilated; general paralysis ensued, and death followed within twenty-four hours of the attack. Although no autopsy was made, it was clear to me at the time that the coagulation had followed the vessels to the substance of the uterus, and that the fatal result was due to the absorption of septic material by the large, soft thrombi, which, by their disintegration, became the means of conveying infection to the remoter portions of the organism. Barnes uses the perchloride of iron after preliminary removal of the clots, in the proportion of one of iron to three of water. Most German authorities recommend the iron in a much more diluted form, and using it in no fixed proportion, but simply to pour the iron, following Seyfert's prescription, into the water until the latter assumes a deep wine-color.

Engelmann speaks enthusiastically of swabbing the uterus with perchloride of iron, operating in the following manner: "I bring the patient," he says, "in position for forceps, introduce a Cusco's speculum, and with wads of cotton, prepared by an assistant, which I seize by my long dressing-forceps, I seek to clear the cavity of the blood which has again accumulated. The assistant has also soaked a number of cotton wads, as large as a walnut, in perchloride of iron, and pressed out the mass of fluid, so as to leave them well soaked, but merely moist with iron; they must be well saturated, but not dripping. So soon as I have cleaned the cavity as far as it is possible amid the constant flow of blood, I seize a wad of new cotton on my forceps, and mop the walls of the cavity thoroughly, removing as much as possible of the clotted blood as I withdraw the cotton. I rapidly take up one cotton wad after another, and swab the uterus until the hæmorrhage ceases. . . . The iron acts as a stimulant as well as styptic, and the uterus speedily contracts."

Wallace* praises vinegar as a certain and safe remedy for *post-par-*

* "Trans. Am. Gynæcol. Soc.," vol. iii.

tum hæmorrhage: "I pour a few tablespoonfuls into a vessel," he says, "dip into it some clean rag or a clean pocket-handkerchief. I then carry the saturated rag with my hand into the cavity of the uterus, and squeeze it; the effect of the vinegar flowing over the sides of the cavity of the uterus and the vagina is magical. The relaxed and flabby uterine muscle instantly responds. The organ assumes what I will term its gizzard-like feel, shrinking down upon and compressing the operating hand, and in the vast majority of cases the hæmorrhage ceases instantly. Should one application fail to secure sufficient contraction, the rag can be withdrawn, and a second or even a third can be made, until the uterus shall contract sufficiently to stop the flow of blood."

Probably the faradaic current is a most efficient agent in securing contractions of the uterus, but, unlike vinegar and hot water, a battery is rarely on hand when needed. An olive-shaped bulb electrode should be introduced into the uterus, and the other pole, a flat disk, pressed upon the fundus; or both poles may be applied directly over the uterus through the abdominal walls.

I have in a number of instances seen Dr. I. E. Taylor succeed in instantaneously causing the uterus to contract by slapping the lower part of the abdomen smartly with a wetted towel.

Compression of the aorta through the abdominal walls is capable of rendering temporary service. The method has been objected to on theoretical grounds: first, because the compression is brought to bear equally upon the vena cava as upon the aorta; and, second, because the pressure does not cut off the blood which goes to the uterus through the aortic uterine arteries. As a clinical fact, however, it is indisputable that the pressure does, temporarily at least, check the hæmorrhage, a result attributed by Frankenhaeuser to the simultaneous stimulation of the aortic uterine plexus, as that portion of the sympathetic nerve is termed which overlies the large vessels of the trunk situated in the lumbar region.

The application of ice to the abdomen, or allowing a stream of cold water to fall from a height upon the hypogastrium, however efficacious they may prove as means of arresting hæmorrhage, are open to the grave objection that they add to already existing shock and to the prostration produced by the loss of blood.

Methods of securing Uterine Retraction.—Uterine contractions afford only a temporary safeguard against hæmorrhage. It is uterine retraction that prevents recurrence. At first the hand furnishes the most available means of exercising external compression. It likewise possesses the advantage of being an intelligent instrument, capable of conveying to the accoucheur instant warning of any tendency to relaxation. But, even after retraction is secured, its maintenance should not be left to chance. Before leaving his patient, the physician should

provide some means of subjecting the uterus to sustained and equable pressure. The usual method consists in surrounding the anteverted organ with folded napkins or rolled stockings, and then applying a bandage tightly to the abdomen to keep them in position. Unless skillfully executed, this method accomplishes little more than to dislocate the uterus laterally. I have been in the habit of using a round bag of rubber covered with brown muslin, which I partially fill with cold water, and apply over the uterus. The dry cold is of value as a means of exciting contraction, while the hydrostatic pressure is evenly distributed over the fundus of the uterus, and helps to fix it in the median line. A reliable compress may be improvised in any household by partially filling a sack with moistened sand or common salt.

Treatment of Cerebral Anæmia.—In consequence of excessive loss of blood, the surface of the body becomes blanched, cold, and bedewed with clammy perspiration; a feeling of muscular prostration is experienced, with distress in the præcordial region; the pulse becomes small and frequent, the respiration rapid, and air-hunger is developed as the result of the deficient amount of oxygen carried by the attenuated blood-stream to the tissues and the medulla oblongata. With these general symptoms are associated special ones due to disturbances of the nerve-centers, as restless movements from side to side, yawning, vomiting, perversions of the special senses, fainting, and convulsions.

Now, it is to these latter symptoms, indicative of intense cerebral anæmia, and directly imperiling the life of the patient, that treatment requires to be addressed. The pillows should be withdrawn from the head, the foot of the bed should be raised, hot bottles should be placed to the extremities, and warm cloths to the head; if syncope occurs, the abdominal aorta should be compressed to reserve the entire blood-mass for the upper portion of the trunk and the brain; cerebral congestion should be promoted by opiates (thirty drops of laudanum by the mouth, or ten minims of Magendie's solution hypodermically injected), and the flagging heart should be stimulated by hypodermic injections of sulphuric ether, brandy, or whisky. The syringe should be filled with the agent chosen, and the injection should be made deep into the subcutaneous cellular tissue on the outer part of the thigh. The effect upon the circulation is almost instantly manifested. Except in cases which have passed beyond all possibility of recovery, the pulse reappears at the wrist, often, however, to fade away again in a few minutes. The stimulant injections in many cases require to be repeated a number of times before the circulation becomes reëstablished. So long, however, as there is a perceptible response to the stimulus, the case is never to be regarded as hopeless.

Dr. Gaspar Griswold has employed successfully in a number of cases, where the heart had apparently beat for the last time, intravenous injections of ammonia, using for the purpose a five-per-cent.

solution (the officinal solution diluted with equal parts of water), and injecting with a hypodermic syringe from fifteen drops to a half-drachm into one of the superficial veins of the forearm.

In the collapse resulting from excessive hæmorrhage, the restoration of blood to the circulation by transfusion is theoretically the rational mode of treatment. In practice, however, the difficulties of the *technique*, the hesitation of bystanders to furnish the required blood, combined with the somewhat unsatisfactory results of transfusion, are all obstacles to its employment. For a long time I carried with me Aveling's very simple and ingenious transfusion apparatus. In the few cases where I had intended to use it, however, the tubing was never in perfect order. The fact that in each instance I succeeded eventually in rallying my patient by methods less open to objection has led me at present to omit it from my list of instruments. Professor Gaillard Thomas recommends the substitution of the intra-venous injection of milk for that of blood, and reports cases illustrating its successful employment. The results of his experiments he sums up in the following propositions :

1. The injection of milk into the circulation in place of blood is a perfectly feasible, safe, and legitimate procedure, which enables us to avoid most of the difficulties and dangers of the latter operation.

2. In this procedure, none but milk removed from a healthy cow within a few minutes of the injection should be employed. Decomposed milk is poisonous, and should no more be used than decomposed blood.

3. A glass funnel, with a rubber tube attached to it, ending in a very small cannula, is better, safer, and more attainable than a more elaborate apparatus, which is apt, in spite of all precautions, to admit air to the circulation.

4. The intra-venous injection of milk is infinitely easier than the transfusion of blood. Any one at all familiar with surgical operations may practice it without fear of great difficulty or of failure.

5. The injection of milk, like that of blood, is commonly followed by a chill, and rapid and marked rise of temperature ; then all subsides, and great improvement shows itself in the patient's condition.

6. I would not limit lacteal injections to cases prostrated by hæmorrhage, but would employ it in disorders which greatly depreciate the blood, as Asiatic cholera, pernicious anæmia, typhoid fever, etc., and as a substitute for diseased blood in certain affections which immediately call for the free use of the lancet, as puerperal convulsions, etc.

7. Not more than eight ounces of milk should be injected at one operation.

After the heart's action has once been established, the efforts of the physician should next be directed to the filling of the emptied vessels. Even when the injections of milk or blood have been resorted to, the

quantity of fluid introduced into the circulation is too small to restore the arterial tension. But, with the restoration of the cardiac pulsations, the absorption from the stomach is very active and rapid. To avoid vomiting, however, it is necessary that fluids administered by the mouth should be given in small quantities and at brief intervals. I usually begin with either hot strong tea, without milk, or with brandy-and-water (1 : 2), at first a teaspoonful at a time, repeating the quantity every minute, then giving a tablespoonful of any warm liquid every five minutes, carefully testing the capacity of the stomach to dispose of its contents, withholding everything with the first premonition of nausea, until milk, broths, tea, gruel, and the like are found to be tolerated in ordinary quantities. Fluid nourishment should be continued hourly, with ice and water in the intervals, according to the thirst experienced, until the radial pulse is restored to its normal fullness. For the successful management of these cases it is necessary that the physician assume the entire charge. It is not possible to give directions to a nurse which may not at any moment require modification.

In cases of excessive loss of blood a tourniquet to each femoral artery, a roller bandage, or, better still, an Esmarch bandage applied the length of the lower extremities, may be temporarily employed with a view to saving the limited amount of blood in the circulation for the important organs of the trunk and for the nerve-centers.

Where the pulse is extremely rapid, the subcutaneous injection of one fiftieth of a grain of digitalin is reported to act favorably by causing contractions of the arterioles and of the uterus.

Opiates should be administered from time to time during convalescence, the frequency and quantity depending upon the intensity of the headache which acute anæmia induces.

The Puerperal Hæmorrhages.—Hæmorrhages occurring after the first day following confinement are the result either of the separation of the thrombi from the placental site or of a congested condition of the endometrium.

Before the consolidation of the thrombi is completed, the mouths of single vessels may be opened by any sudden increase of pressure in the uterine vessels. A relaxed state of the uterus, obstacles to retraction, fecal accumulations, and malpositions of the uterus predispose to the occurrence of hæmorrhage. Common causes of late hæmorrhages are sitting up or leaving the bed at too early a period, exertions in caring for the infant, and straining at stool. In the case of a small, thin woman, who flowed profusely in the second week, I found the uterus crowded backward and downward to the pelvic floor by the compress, which had been too tightly bandaged upon the abdomen by the indiscreet zeal of the nurse.

Where portions of the ovum have been allowed to remain behind

in the uterus, they may lead to the formation of fibrinous polypi, which, as in the non-puerperal uterus, occasion a vascular condition of the mucous membrane, and become the cause of protracted bleeding.

The treatment of late hæmorrhages consists in rest in the horizontal position, in carefully regulated diet, in emptying both bladder and rectum, in the correction of displacements, and in the use of hot vaginal injections. In excessive anteversion a compress above the pubes is indicated; in retro-displacements, lifting the uterus into position, maintaining it in place by a suitable pessary, is often at once followed by relief. If other causes can be excluded, the uterine cavity should be explored, and retained bodies, if found present, should be removed. When the cervix is patulous this can be accomplished by the finger; if the cervix is partially closed, or if inflammation be present, the wire-curette can be used, as after abortion, without preliminary dilatation. In curetting the uterus the operator should be mindful of the delicacy of the newly forming mucous membrane, and should feel carefully for the offending bodies. If intra-uterine injections are further needed to arrest bleeding, the preference should be accorded to the tincture of iodine.

Retained Placenta.

Retained placenta is so frequently a cause of hindered uterine retraction that a few words concerning the etiology and treatment of the condition form an appropriate appendix to the discussion of *post-partum* hæmorrhage.

Cases of so-called placental retention are often simply the result of injudicious management. Thus, they may be caused by pulling in such a way upon the cord as to draw the center of the placenta into the cervix, so that, without allowing air to pass by the placenta to the uterine cavity, extraction is rendered impossible; or, when Credé's method is practiced, the operator may, by pressing the fundus forward against the pubes instead of downward in the axis of the pelvis, produce an acute anteflexion, with stenosis of the lower uterine canal.

True retention may be due to the large size of the placenta or to pathological adhesions, either of the placenta itself or of the chorion.

An adherent placenta is of rare occurrence, and can usually be traced to a bygone endometritis. Separation normally takes place in the areolar layer. If the glandular walls which constitute the septa of the areolæ consist of tough intercellular substance, instead of soft tissue abundantly supplied with cells, the separation does not take place, and the placenta remains adherent. The thick bands which have to be severed in removing the placenta are in general the straight trunks of the villi, which run from the chorion to the serotina, the separation taking place not in the decidual but in the fetal layer. In

placentitis the bands consist of thickened decidual tissue extending between the cotyledons. In either case the serotina is left nearly or quite entire ; in some instances, owing to their firm attachment, whole lobules may be left behind.

Adhesions of the chorion may be due to thickening of the septa in the areolar layer ; to defective involution of the cell-layer of the decidua, thickened portions of which in consequence remain attached to the separated chorion ; to secondary adhesions from consolidated masses of fibrine, the remains of apoplectic effusions into the decidua ; and, perhaps, to excessive development of villi upon portions of the smooth chorion, from which proceed thick bands which are firmly united to the decidua (Spiegelberg). Adhesions of the chorion interfere with the separation of the placenta only when situated high up or around the placental border.

The Artificial Separation of the Placenta.—Whenever compression of the uterus proves unavailing to procure the expulsion of the placenta, the operator should seek to aid the delivery by the resources of art. To leave the placenta within the uterus not only exposes the patient to the risks of hæmorrhage, but to the even greater danger of decomposition and of septic poisoning. A digital examination will indicate the proper course to be pursued. If the placenta be found covering the os, a finger should be introduced to bring down a placental border. If no adhesions exist, moderate tractions upon the cord will then suffice to deliver the placenta. Spiegelberg recommends using the vaginal finger as a pulley to cause the tractions upon the placenta to be made in a vertical direction.

If tractions upon the cord are insufficient, or if the cord begins to tear, the outer hand should make counter-pressure upon the fundus, while the fingers of the vaginal hand are passed upward into the uterine cavity. At first a point should be selected where the placenta is already partially detached, and the fingers should be employed to roll the placenta away from the uterine wall. If the attachment of the placenta is firm, the fingers should be extended with the back of the hand to the uterus, and the separation attempted by a side-to-side movement, as in cutting the leaves of a book. Contractions are here of great service, as they both facilitate the separation and serve to render distinct the border-line between the placenta and the uterus. Hildebrandt advises following the cord upward and separating the placenta with the hand covered by the membranes, as a means of avoiding the dangers of infection and of injuring the internal uterine surface. Spiegelberg says that in his experience this method has succeeded only where the placental attachment was loose and the separation easy.

Bands should be divided by pressing them between the thumb-nail and the index-finger. When the placenta is situated upon the anterior

wall, the patient should be placed upon the side. When the placenta is everywhere adherent, a thickened border should be chosen as the point for commencing the detachment. In a very thin, diffused placenta, it has been proposed by Hohl to inject the vessels through the umbilical vein.

The operation of separating the placenta should never be performed hurriedly. Every pains should be taken to avoid injuring the uterine surface, and as little placental tissue as possible should be left behind.

When the detachment of the placenta is completed, it should be grasped from above, in the full hand, and its expulsion should be effected by external pressure. If portions of the membranes are torn away during delivery, they should be sought for and carefully removed.

In every case of artificial placental delivery the cavity of the uterus should subsequently be thoroughly irrigated with warm carbolized water.

CHAPTER XXXII.

PLACENTA PRÆVIA.—ACCIDENTAL HÆMORRHAGE.—INVERSION OF THE UTERUS.

Situation.—Varieties.—Frequency.—Causes of hæmorrhage.—Clinical features.—Prognosis.—Diagnosis.—Treatment.—Accidental hæmorrhage.—Inversion of the Uterus.

Situation.—Normally the placenta, as we know, is situated at the fundus and upon the side-walls of the uterus. It is said to be *prævia* when it occupies that portion of the uterus which is subject to distention during labor, or, in other words, to the spherical surface of the lower portion of the uterus. Its clinical importance is proportioned to the extent of the placental segment which overlaps the os internum. Hence it is customary to distinguish—

Varieties.—1. *Placenta prævia centralis*, where, after the dilatation of the os internum has become complete, the placenta only can be felt.

2. *Placenta prævia partialis*, where, with dilated os, there is recognizable a portion of the membranes, as well as a segment of the placenta.

3. *Placenta prævia lateralis, or marginalis*, where the placental border stretches down to but not beyond the margin of the inner cervical ring.

Observations which tend to prove the attachment of the placenta in part to the cervical mucous membrane are unquestionably erroneous. This fact, first stubbornly insisted upon by Professor I. E. Taylor, has, at least among physiologists, passed beyond the realm of dis-

pute. Kuhn,* who investigated the subject in conjunction with Carl Braun, found that in no case was the placental portion which occupied the cervical canal adherent to the canal-walls, but that in all *post-mortem* examinations the remains of the placenta prævia materna ended by a sharp border-line at the os internum.

An exact central implantation of the placenta is extremely rare, though its occurrence is not impossible. Usually in the so-called central form not more than one sixth to one fourth of the placental surface overlaps the os internum. The smaller segment is oftener found upon the left side (37 : 56, statistics of L. Müller).†

Owing to the deficient thickness of the decidua in the vicinity of the internal os, the placental villi grow with less profusion at that point, while by way of compensation in more favored localities they attain to an excessive development. The placenta thus assumes a characteristic uneven appearance. If the atrophic conditions exist over a wide extent, the surface of the placenta is, as a rule, correspondingly increased.

Another peculiarity not devoid of practical interest is the frequency with which the placenta is found adherent to the uterine walls. Of 142 cases, L. Müller showed that in 56 adhesions existed. The insertion of the cord into the placenta is usually eccentric, often marginal, and sometimes velamentous. As a consequence, prolapsed funis is a common accompaniment of the anomaly.

Fortunately, placenta prævia is of rare occurrence. Müller, by adding together the statistics of various investigators, found reported 813 instances in 876,432 births, or not quite one case in a thousand. Since the opening of the Emergency Hospital in this city there have been between 1,500 and 1,600 women confined in that institution. So far there has been no case of placenta prævia. Lomer,‡ on the other hand, estimates the minimum frequency in Berlin at one in 723 births.

Etiology.—The causes are unknown. The proportion of multiparæ to primiparæ is very large(6 : 1).# Placenta prævia is most frequent in women who have borne children with great rapidity, and in pregnancies shortly following abortions, conditions which favor relaxation of the uterine walls, dilatation of the cavity, and defective development of the decidua. Müller advances the theory that the

* Braun, "Lehrbuch der ges. Gynaek.," p. 555.

† Ludwig Müller, "Placenta Prævia," Suttgart, 1877. Most of my statistics are taken from this work. They include those of Trask ("Am. Jour. of the Med. Sci.," 1856, vol. viii) and of most of the later writers, up to date of publication.

‡ Lomer, "Combined Turning in the Treatment of Placenta Prævia," "Am. Jour. of Obst.," December, 1884, p. 248.

Müller collected from different reporters 1,574 cases—227 of primiparæ and 1,347 of multiparæ. Jüdell reports the multiparæ at 90 per cent. King ("Am. Jour. of Obstet.," October, 1880, p. 751) reports 183 cases collected in the State of Indiana, in which the proportion was 20 primiparæ to 163 multiparæ.

descent of the ovum is effected by contractions of the uterus soon after conception. Such expulsive pains naturally lead to abortion. In certain cases, however, where the reflexa is absent, we have seen that the ovum may be forced downward into the cervical canal, and lingering there may give rise to "cervical pregnancy." Placenta prævia Müller believes to be due to an abortion begun at an early period, but arrested at the lower uterine segment to which the villi attach themselves, and enable the rescued ovum to continue its development. Ingleby relates two curious cases where the orifices of the Fallopian tubes opened near the os internum, in one of which placenta prævia occurred three times, and in the other ten times.

Clinical Features.—The chief clinical importance of placenta prævia results from the mode of its detachment during labor. In normal positions, the separation of the placenta is effected by virtue of the uterine contractions after the fœtus has for the most part been expelled. In placenta prævia the separation is due to the stretching to which the lower uterine zone is subjected in its conversion from a half-sphere to a cylindrical canal to permit the passage of the child. The extent of unavoidable separation in advance of delivery is consequently measured by the dimensions of the child's head, the largest circumference of which is estimated as equivalent to a circle with a diameter of four and a half inches. According to Duncan, the plane at which spontaneous detachment ceases is reached at a distance of two and a half inches by following the curve of the lower segment, and of one inch and a half if measured in the direction of the uterine axis. Whereas, in normal labor, the contractions of the uterus which determine placental separation close at the same time the orifices of the torn vessels, the stretching of the lower segment in placenta prævia leaves the mouths of the sinuses gaping, from which the blood pours until the stream is arrested either by art or by the supervention of syncope. As the hæmorrhage in such cases is the natural sequence of cervical dilatation, its occurrence during labor was termed by Rigby "unavoidable" in contradistinction to hæmorrhages from detachment of the placenta when situated near the fundus, where the separation is attributable to "accidental" causes.

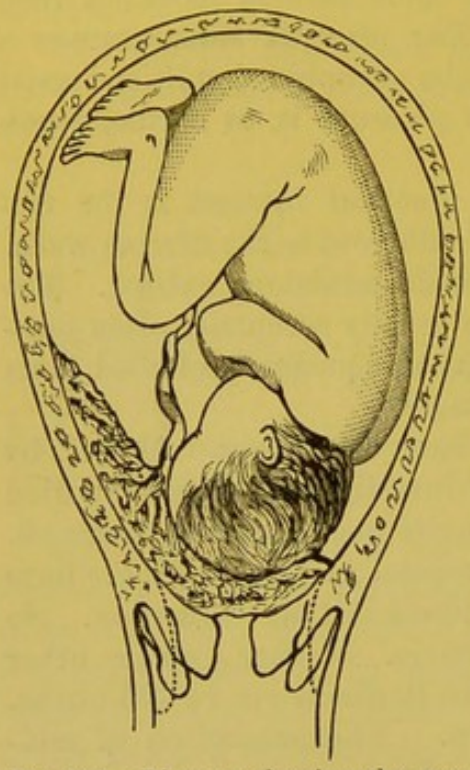


Fig. 239.—Diagram showing the unavoidable placental separation as a consequence of cervical dilatation.

The hæmorrhages of placenta prævia are not, however, limited to the parturient period. Indeed, there is no time in pregnancy when they may not occur. When we consider that every jar of the body affects the lower segment with more force than the fundus, and that the thinned walls of the utero-placental vessels are subject to increased pressure in placental presentations, it becomes evident that a very slight occasion is sufficient to produce rupture and hæmorrhage. Thus placenta prævia is a common cause of the pseudo-menstruation of pregnancy; it creates a predisposition to abortion, and, later in gestation, to premature labor, the hæmorrhages being due probably in the first instance to accidental causes and not to labor-pains. Not every case of hæmorrhage is, however, followed by labor. Indeed, in many instances thrombi form in the open vessels, the bleeding becomes arrested, and pregnancy goes on for a time undisturbed. The tables of Müller show that in complete placenta prævia the first hæmorrhage occurs with the greatest frequency between the twenty-eighth and thirty-sixth weeks, while in the incomplete form it takes place most commonly after the thirty-second week. In placenta prævia lateralis, hæmorrhages are sometimes absent up to the time of labor. Cases of pregnancy, and in part of labor, without hæmorrhage have been observed where the death of the fœtus has been followed by atrophic changes in the placenta. The recurrence of hæmorrhage is oftentimes prevented by secondary shrinkage of the placenta, due to pressure from the effused blood or to thrombosis of the vessels which supply the implicated cotyledons.

The hæmorrhages of placenta prævia are usually sudden, without premonitory warnings, without pain, often without any apparent occasion, sometimes occurring at the time of urination, sometimes during sleep. The quantity of blood lost in a single hæmorrhage depends upon the extent of the placental separation. The first outpouring may lead to intense anæmia, and if repeated at a short interval may cause death. It is estimated that from one to three pounds of blood may be lost in a single attack, and from four to five pounds in the course of labor (Müller). As a rule, however, the hæmorrhages of pregnancy are at first moderate in character, increasing in violence with each repetition. A very formidable variety is the so-called "stillicidium," where the blood issues drop by drop for days and even weeks in succession. The most violent hæmorrhages occur generally in the earlier part of the first stage of labor. As a rule, the extent of the hæmorrhage is proportioned to the area of the placental segment attached to the uterine surface subject to distention. The hæmorrhage generally ceases when the separation of the cotyledons is completed and, after the rupture of the membranes, the pressure of the presenting part is brought to bear upon the bleeding surface. Dur-

ing the height of the pains, too, the hæmorrhage is for the moment arrested (Spiegelberg).*

The number of abnormal presentations in placenta prævia is very large. Thus, in Müller's statistics, in 1,148 cases there were 272 transverse and 107 breech presentations. The frequency of the anomalies is partly attributable to the large proportion of premature labors, and partly to the width and lax condition of the lower segment, and the consequent want of stability in the fœtus.

During the first stage of labor the pains are apt to be feeble and the dilatation tardy. The causes of inertia are to be found in the thinning of the muscular structures in the lower segment from the enormous development of the utero-placental vessels; in the attachment of the placenta over the os, which mechanically hinders dilatation; and in the fact that the ovum does not press directly upon the sensitive nerves of the cervix. Secondary weakness often follows the continued losses of blood and the prolongation of the first stage. When the obstacle afforded by the placenta to dilatation has been overcome, and, consecutive to rupture of the membranes, the uterus retracts, in many cases the scene speedily changes, and, in place of ineffective contractions, normal and often powerful pains develop.

As a rule, quite early in labor the cervix is found soft and dilatable; but to this rule there are numerous exceptions. Strictures and rigidity Müller computes to exist in about twelve per cent. of the cases.

Where the loss of blood in labor is continuous the woman grows restless and complains of headache and vertigo; the respirations become short, interrupted, and sighing, and the pulse small, weak, and thready. Toward the close unconsciousness develops, the brow is bedewed with cold, clammy perspiration, and finally convulsions usher in the fatal termination.

Even after labor is over the danger is not ended. *Post-partum* hæmorrhage may result from atony of the placental surface of the uterus, or, after good contractions have been apparently secured, sudden relaxation may follow, and the blood pour out in a torrent, so that the patient becomes a corpse before assistance can be rendered. Again, in childbed the imperfect contraction of the uterus at times allows the lochia to form a stagnant pool at the fundus, whence an ichorous discharge flows constantly downward over the thinned walls and open mouths of the vessels at the placental wound. The feeble circulation predisposes to the formation of thrombi, which, when poisoned and disintegrated, are conveyed into the general circulation and give rise to the dreaded symptoms of pyæmia. Müller found in

* This view was first advanced by Fountain in the "Am. Jour. of the Med. Sci." It has since been advocated by Duncan, Jüdell, Fränkel, Spiegelberg, and others. Müller and Kuhn, however, dispute it, as justified neither by theory nor by observation.

two hundred and seventy-three of his cases specific information given regarding the puerperal state. "Puerperal fever" was recorded of seventy-nine patients, with fifty-four deaths.

Prognosis.—The prognosis of placenta prævia is necessarily extremely unfavorable. As many as one mother in four dies during or shortly after delivery. Including deaths from puerperal processes, Müller estimates the total mortality at not less than from thirty-six to forty per cent. Nearly two out of three of the children are born dead. More than one half of those born living die within the first ten days. In general terms it may be stated that the prognosis is the more serious, the earlier the hæmorrhages begin in pregnancy, the more profuse the flow, and the shorter the intervals between the attacks. During labor favorable conditions are a vertex presentation, good pains, rapid dilatation, and an unbroken constitution. The maternal mortality is twice as great in placenta prævia centralis as in placenta prævia lateralis. In the city, there is the special danger of infection; in the country, of delay in obtaining medical assistance. Finally, it is impossible to analyze the statistics of placenta prævia without coming to the conclusion that the result depends in a large measure upon the personal qualities of the physician. A self-possessed man, cool, resolute, with clear ideas of the anatomical conditions to be dealt with, will, if summoned in season, apparently deprive even placenta prævia of a good share of its terrors.

Diagnosis.—There are no signs by which placenta prævia can be recognized in the first half of pregnancy. It may occasion abortion, which is then characterized by the absence of pain, both previous to the hæmorrhage and during the period of expulsion. As a rule, the ovum is expelled entire without rupture of the membranes. In the second half of pregnancy, a hæmorrhage occurring suddenly, without ostensible cause and without warning, should always be regarded with suspicion. Upon digital exploration in placenta prævia the vaginal fornix is found soft and boggy, and occasionally thicker upon the one side than upon the other, where the placental presentation is incomplete; ballottement is obscure; the cervix is long, wide, and soft, and contains at times vessels which pulsate distinctly; the cervical canal permits the passage of the finger to the os internum, which at first offers resistance, but yields to gentle force. The diagnosis is rendered positive only in cases where the lower surface of the placenta is actually felt through the cervix, its rough, spongy, granular texture sufficiently distinguishing it from clots and other possible sources of deception.

Treatment.—The history of placenta prævia brings into prominence the central point to be kept steadily in view in practice, that there is no safety for the mother so long as pregnancy continues. In a very large proportion of cases, accidental hæmorrhage occurring in the first

half of pregnancy leads to abortion, the management of which does not differ from that of abortions which take place in normal attachments of the placenta. Of the one hundred and twenty-eight deaths from placenta prævia collected by Müller, not one occurred previous to the seventh month. In the latter half of pregnancy, hæmorrhage likewise leads to premature expulsion of the ovum with such frequency that it is reckoned that only one third of all cases reach the end of gestation.

Most authorities advise, in the presence of the hæmorrhages of advanced pregnancy, that the physician maintain an attitude of expectancy, postponing active interference, except in cases where the loss of blood assumes alarming proportions, until the spontaneous advent of labor. This policy is recommended partly in the interest of the child, and partly because of the tendency in premature labor to rigidity of the cervix, a complication which always in placenta prævia enhances the risks of delivery. The wisdom of delay is, however, open to serious question. The fatality of placenta prævia is due not so much to the impotence of obstetrical art as to the losses of blood which occur suddenly in the absence of professional assistance. The first hæmorrhage, which serves as a warning as to the patient's condition, is fortunately in most instances slight. With each recurrence, however, the flow becomes more profuse. If the hæmorrhages begin before the child is viable, the chances of saving its life are in any event too small to offset for a moment the welfare of the mother. Hæmorrhages occurring as early as the seventh month are, as a rule, the result of complete placental presentation. To trifle with such cases is the best way to maintain the present mournful statistics. After the thirty-second week it is safe to say that the child's life is less imperiled by the induction of premature labor than by exposing it to the dangers of continued gestation.

On theoretical grounds, therefore, the induction of premature labor is to be regarded as obligatory so soon as the diagnosis of placenta prævia is established, or at least with the occurrence of the first hæmorrhage. The practical results of this measure in the hands of its advocates* plead still more effectively in its behalf. Thus, Dr. Gaillard Thomas † reports eleven cases, with but two deaths, one resulting from *post-partum* hæmorrhage coming on several hours after delivery, and one from puerperal fever. Hecker ‡ lost three cases in forty, Hoffmann two cases in thirty, and Spiegelberg four cases in seventy-four early deliveries.# More recently Murphy ‖ has reported fifteen cases

* Premature labor in profuse or continuous hæmorrhage has received the indorsement in this country of Thomas, Taylor, Parvin, Pallen, and Taber Johnson.

† "Trans. of the N. Y. Obstet. Soc.," vol. i, p. 262.

‡ Statistics taken from L. Müller's monograph.

Spiegelberg's statistics do not, however, like those quoted from Thomas, include deaths in childbed. Thus, Spiegelberg's complete death-rate reached sixteen per cent.

‖ Murphy, "Brit. Med. Jour.," 1884, p. 215.

without a single death. In this connection I can not help quoting the following impressive remarks of Dr. Barnes: "If the pregnancy have advanced beyond the seventh month it will, as a general rule, I think, be wise to proceed to delivery, for the next hæmorrhage may be fatal; we can not tell the time or extent of its occurrence, and, when it occurs, all, perhaps, that we shall have the opportunity of doing will be to regret that we did not act when we had the chance."

In the management of placenta prævia it is very desirable that the practitioner should have a perfectly clear idea of the nature of the task he has to perform. The birth of the child can not take place without preliminary expansion of the cervix. The cervix can not expand without detachment of the placenta. The principal objective point of treatment, therefore, is the hæmorrhage which occurs during the stage of dilatation. Plans for restricting the flow within narrow limits have been proposed without number by masters of the obstetric art. The best plans are those which at the same time contribute to shorten labor. The choice must be determined by conditions which necessarily vary in different cases. The physician has at the outset to particularly inform himself as to whether labor has begun or remains to be inaugurated, as to whether the placenta prævia is complete or incomplete, as to whether the presentation is normal and the pains are good, as to whether the membranes have ruptured or are intact, and as to the length and dilatability of the cervix.

If the cervix is long, narrow, and rigid, and the membranes are entire, the vaginal tampon should be resorted to as a temporary expedient. The tampon strengthens the pains, and, by the compression it exerts, causes coagulation of the blood which escapes from the uterine vessels. Professor I. E. Taylor advises packing the vagina with a surgical bandage, leaving one end outside the vulva, by means of which it can be withdrawn without difficulty. Braun, after many years' experience at Vienna with the colpeurynter, maintains the superiority of hydrostatic dilatation. I use dampened cotton, crowding it into the upper portion of the vagina with the aid of a Sims speculum. The choice does not appear to be material. Having once introduced the tampon, the physician should not leave his patient until the labor is ended. After at most four hours the tampon should be removed, and, after rendering the vagina thoroughly aseptic, the cervix should be examined. A second introduction of the tampon is rarely necessary, or, owing to the dangers of septic infection, expedient.

So soon as the os will permit the passage of the finger, the vaginal plug should be discarded. The operator will then have to choose between one of two plans of action, viz., dilatation of the cervix by means of water-bags, or version by Braxton Hicks's method. If dilatation is decided upon, a Barnes rubber bag, expanded sufficiently to render the border of the os externum tense, fulfills admirably the prin-

cipal indications. It acts as an efficient tampon, it strengthens the pains, and it dilates the cervical canal. As the latter expands, a larger-sized dilator should be introduced. It is important, in order to prevent hæmorrhage, to maintain the tension of the external orifice. On account of the softening which exists in the lower uterine segment as a result of placenta prævia, in a large proportion of cases the cervix can be stretched with the utmost facility. If no urgent symptoms call for immediate interference, it is desirable to render the dilatation complete. It is not, however, always necessary. Indeed, Barnes, Taylor, Spiegelberg, and Braun advise to proceed boldly with the delivery so soon as the os externum has expanded to the size of a half-dollar, as by that time the expansion of the os internum is very nearly completed, and as the soft cervical canal does not offer sufficient resistance to materially interfere with the extraction of the child. The distinguished success of the authorities mentioned in the field of practice under consideration lends great weight to their recommendations. It is, however, more than probable that exceptional training and experience count in their case for quite as much as the plans of procedure they individually favor. At any rate, in reviewing the statistics of Trask and Müller it becomes evident that rigidity of the cervix is not a rare event in placenta prævia, and that the *accouchement forcé*, performed with a rigid cervical canal, is perhaps, next to doing nothing, the most responsible cause of the mournful results they have placed on record.

After the cervix has been duly prepared, the membranes should be ruptured, and a part of the amniotic fluid should be permitted to escape. Then, if the placenta possesses a lateral or a marginal attachment, if the pelvis is of normal size and the pains strong and regular, and if the head present, or at least can be brought down and fixed at the pelvic brim by external manipulations, the further progress of the case may be left to Nature. Hæmorrhage will then be prevented by the pressure of the fœtus in its descent through the utero-vaginal canal. At first the method of expression advocated by Kristeller is capable of rendering important service by promoting the speedy engagement of the child's head. Ergot, too, cautiously administered, is useful in strengthening the uterine contractions. Even if tonic contraction follow from its employment—an unlikely event in placenta prævia—the effect would be to close the sinuses and to furnish a fresh barrier against hæmorrhage. The forceps may be applied under the same circumstances, and with the same restrictions, as in other conditions. Where, however, the head is movable, the patient anæmic, and hæmorrhage persistent, version, as furnishing the more rapid mode of delivery, would receive the preference.

In cases of complete attachment of the placenta there should be no trifling with half-way measures. If the cervix is long and rigid,

the vaginal tampon should be employed as a preliminary measure. When the cervical tissues have become softened, and dilatation has begun, the tampon should be removed. At this stage Barnes recommends separating at once that portion of the placenta which is attached above the inner orifice of the cervix. By so doing, "we remove an obstacle to the dilatation of the cervix, for the adherent placenta acts as an impediment." The operation is performed as follows: "Pass one or two fingers, as far as they will go, through the os uteri, the hand being passed into the vagina if necessary; feeling the placenta, insinuate the finger between it and the uterine wall; sweep the finger around in a circle, so as to separate the placenta as far as the finger can reach. . . . Commonly some amount of retraction of the cervix takes place after this operation, and often the hæmorrhage ceases." * Next put in a Barnes dilator and rapidly expand the cervix. Meantime try and bring the breech down into the lower uterine segment by external palpation. Both Taylor and Braun have found external version easy, on account of the inert conditions of the uterine walls. When the cervix has been sufficiently stretched to admit of delivery, two fingers should be introduced, the placenta should be separated, the membranes ruptured, and an extremity should be seized without passing the entire hand into the uterus. Extraction should then follow, the pressure of the fœtus preventing any considerable amount of hæmorrhage.

Usually the right hand is chosen to seek the feet, as the placenta more frequently overlaps the left side. Often a hint is furnished by the fact that the overlapping portion of the placenta is separated to a greater extent than the main body. Many times, however, it will be necessary to change the direction of the fingers before the edge of the placenta is reached. If external version can not be effected, the operator should push the hand forward into the uterus to find an extremity. The arm acts during the search as a temporary tampon. Hæmorrhage, which follows the withdrawal of the arm, will be arrested by the descent of the breech.

The accidental rupture of the membranes before the cervix is prepared for artificial delivery is hardly likely to occur in cases of placenta prævia completa. In cases of marginal implantation, dilatation with water-bags should be employed in such a way as to compress the open sinuses from which bleeding takes place.

In 1861 Braxton Hicks recommended for the treatment of placenta prævia turning the child by the two-finger method in an early stage of

* Barnes, "Obstetrical Operations," p. 503. The artificial separation of the placenta is unquestionably of service where it can be accomplished without difficulty. Much time should not, however, be lost in fruitless efforts, nor is it desirable to persist if the separation can not be accomplished smoothly. Behm, Hofmeier, and Lomer all urge in such cases passing the fingers directly through the placental tissue. The most alarming hæmorrhage ceases when the leg is brought down.

labor, and, after rupture of the membranes, bringing down the breech to tampon the bleeding vessels. This practice has been followed with distinguished success by Hofmeier* and Behm,† and in the University Hospital for Women, in Berlin. The cases reported from the latter institution by Lomer‡ were 101, operated upon by nine different assistants, with a total of 7 deaths. Hofmeier reported 37 cases with 1 death, and Behm 35 cases with no maternal death. Thus, in 178 cases occurring in the practice of 11 individuals, there were 8 deaths, a mortality of but 4·5 per cent. But Lomer had no death in 16 cases. The addition of these latter to those of Hofmeier and Behm gives in the practice of three individuals only 1 death in 93. To be sure, the life of the child is made, by this premature version, a secondary consideration. Hofmeier reports an infantile mortality of 67 per cent., that of Behm was 80 per cent., while in Lomer's report the fetal death-rate was only 50 per cent. However, many of the reported deaths were in non-viable children, or were cases where the death of the child occurred long prior to birth. Hofmeier advocates following up version by the slow extraction of the child. By this means he has succeeded in ending labor in the course of from half an hour to one hour and three-quarters. Behm counsels awaiting the spontaneous expulsion of the child, or at least the complete dilatation of the cervix. Lomer says: "In our cases we exert gentle tractions now and then, until the cervix is completely dilated, and we then slowly increase the number and strength of the tractions." Lomer sums up the advantage of the method as follows: 1. It does away with the tampon, and the consequent dangers of infection. 2. It allows us to operate early. 3. It arrests hæmorrhage with great certainty. 4. It gives time for the patient to rally, for the cervix to dilate, and for pains to set in. It therefore prevents *post-partum* hæmorrhage. I have recently had occasion to test this plan in a case of placenta prævia completa, and am prepared to speak most strongly in its favor, as both mother and child were saved, though I still believe that a certain amount of preliminary dilatation with Barnes's bags tends to enhance the chances of the child without endangering the life of the mother.

After the birth of the child, the danger of *post-partum* hæmorrhage must be kept in mind. Every preparation should be made in anticipation of its occurrence. If bleeding persists after the fundus is felt to be firmly contracted, a speculum should be introduced, and the open sinuses of the lower segment should be swabbed with cotton soaked in

* Hofmeier, "Zur Behandlung der Placenta Prævia," "Ztschr. f. Geburtsh. und Gynaek.," vol. vii, p. 89.

† Behm, "Die combinirte Wendung bei Placenta Prævia," "Ztschr. f. Geburtsh. und Gynaek.," vol. ix, p. 373.

‡ Lomer, "Combined Turning in the Treatment of Placenta Prævia," "Am. Jour. of Obstet.," December, 1884, p. 1233.

some styptic form of iron, as recommended by Engelmann (*vide* "Post-Partum Hæmorrhage"). Ergot should be given for several days, as the danger of late hæmorrhages is specially great following placenta prævia.

The utmost cleanliness and the use of disinfectant vaginal douches must be insisted on during the childbed period, as the exposure of the placental wound to the lochia, which constantly flow over it, renders the patient especially liable to septic infection.

Hæmorrhage from Normally Implanted Placenta.—The placenta, even when implanted over the upper polar circle, the safe placental seat of Dr. Barnes, may become detached to a greater or less extent, during pregnancy or labor, and may then furnish a flow of blood that either remains internal and concealed or may find its way between the decidua vera and reflexa and thus escape into the vagina.

The hæmorrhages from this variety of placental separation are termed "accidental," in contradistinction to the "unavoidable" form, which is the accompaniment of placenta prævia.

The circumstances under which concealed hæmorrhage takes place are given by Goodell* as follows: (*a*) When the placenta is centrally detached, and the blood accumulates in the *cul-de-sac* formed by the firm adhesion of its margins to the uterine wall. (*b*) When the placenta is so detached that the blood escapes into the uterine cavity behind the membranes near the fundus. (*c*) When membranes are ruptured near the detached placenta and the effused blood mingles with the liquor amnii. (*d*) When the presenting part of the fœtus so accurately plugs up the maternal outlet that no existing hæmorrhage can escape externally

The causes of internal hæmorrhage, when such can be determined, are for the most part similar to those considered in connection with abortion. Thus, the circumstances leading to placental detachment Goodell found to be irregular uterine contractions, external violence, and undue exertion; in seven the causes were purely emotional, and ten took place during sleep. It occurs more frequently in multiparæ and in the latter months of pregnancy.

The symptoms are an alarming state of collapse, pain often excessive, absence or extreme feebleness of the pains of labor, marked distention of the uterus, sometimes a lateral bulging of the uterine walls, a show of blood, a serous discharge, and blood in the liquor amnii.

The diagnosis in the concealed form may be extremely embarrassing. The pain is often that of flatulent colic. The accident likewise presents many features which resemble those of ruptured uterus; but rupture, by contrast, rarely occurs until after the escape of the waters,

* Goodell, "On Concealed Accidental Hæmorrhage of the Gravid Uterus" ("Am. Jour. of Obstet.," August, 1869, p. 281). This paper serves as a mine from which most subsequent writers have drawn their data.

the presenting part then receding from the os, and the uterus diminishing in size.

The prognosis is very unfavorable. Goodell reports: "Out of one hundred and six tabulated cases, fifty-four mothers perished; and out of one hundred and seven children six alone are known to have been saved." I have had a case since his paper, where, after labor, I removed at least a basinful of firm clots from the uterine cavity, and yet both mother and child survived.

In cases of external hæmorrhage the diagnosis is easy and the prognosis more favorable, the latter probably because the walls are less flaccid than in the concealed form.

The treatment consists in the subcutaneous injections of ergot, in dilatation of the os with Barnes dilators, in rupture of the membranes, and in version.

In my own case, to which I have referred, the Barnes dilator acted capitally, not only enabling me to expand the cervix, but exciting the uterus to contract vigorously. The serious symptoms set in after the membranes were ruptured, and compelled me to deliver with forceps. In another case I should certainly first dilate, and, after rupture of the membranes, should choose version and speedy extraction, and should avail myself of a skilled assistant, whose duty it should be to compress the uterine walls externally during the act of delivery.

Inversio Uteri.—Inversion of the uterus is a rare occurrence. Braun states that, of two hundred and fifty thousand births in the clinics respectively under the charge of Spaeth and himself, not a single complete inversion has come to their notice. There was one case in one hundred and ninety thousand confinements at the Rotunda Hospital in Dublin.

The production of inversion is favored by a large, relaxed uterus, the result of over-distention, of rapid delivery, or of hæmorrhage. The immediate cause may be either pressure exerted from above or traction from below. The first may proceed from straining efforts, especially in a sitting or kneeling position, or from attempts at placental expulsion before uterine contractions have been secured; the second may proceed from a short or coiled cord during expulsion, from tractions upon the cord after the child is born, or simply from the weight of the placenta. Hennig* concludes that the attachment of the placenta to the fundus, instead of a more lateral implantation, is an active cause of the accident.

Inversion may be partial or complete. In the former the fundus presents a saucer- or cup-like depression; in the latter the entire fundus descends into the vagina; in extreme instances the cervix may be inverted to the vaginal attachment. Dr. I. E. Taylor maintains a

* Hennig, "Ueber die Ursachen der spontanen Inversio Uteri," "Arch. f. Gynaek.," Bd. vii, p. 491.

mechanism for a certain number of cases, which consists in a rolling out of the cervix, with gradual implication of the body and fundus.

The symptoms of inversion are shock and hæmorrhage. The shock is evidenced by the small pulse, cold extremities, vomiting, and sunken features, and is due, in part at least, to the sudden diminution of the intra-abdominal pressure and consequent plethora of the abdominal veins; the hæmorrhage results from imperfect contraction, and is therefore proportioned to the extent of the uterine paresis.

Spontaneous reduction of incomplete inversion is not uncommon. Cases of spontaneous reduction of the complete form have likewise been observed, referable, according to Spiegelberg,* to retraction of the ligaments acting upon the uterus while in a relaxed condition.

The diagnosis is not difficult. The inverted uterus can only be mistaken for a fibrous polypus, but by careful external and bimanual palpation the demonstration of the absence of the uterine tumor above the symphysis would guard against this error.

The prognosis depends upon the promptitude of the operator in restoring the fundus to its normal position. Still, according to Crosse's† statistics, one third of the patients died either at once or within a month of the occurrence of the accident.

Treatment consists in pressing the fundus upward with the fingers or with the closed fist. To avoid tearing the uterus from its vaginal attachments, care should be taken to employ counter-pressure with the disengaged hand upon the upper border of the funnel-shaped depression. If the placenta is detached to any great extent, its separation should be completed before replacement; if adherent, no time should be lost, but placenta and fundus should be pushed back together. If the cervix is contracted about the inverted portion, an anæsthetic should be given, and taxis should be employed. I can speak from experience in favor of Noeggerath's method, which consists in indenting the uterus in the neighborhood of a Fallopian tube, in place of acting directly upon the fundus.

In a case seen by me in conjunction with Dr. Henry E. Crampton, of New York city, thirty-six hours after delivery, I succeeded, after several fruitless efforts, in restoring the uterus by the following method: First, the fundus was pressed upward through the cervical ring by the thumb and fingers. The partially reinverted uterus was clearly felt through the thin abdominal parietes, but it was found impossible to advance the hand through the ring beyond the knuckles. The hand was therefore held steadily in place, with no attempt at a forward movement, for about ten minutes. This was done with the intent to procure a relaxation of the constriction by means of continuous press-

* Spiegelberg, "Lehrbuch," etc., p. 597.

† Crosse, "An Essay, Literary and Practical, on Inversio Uteri," "Trans. of the Provincial Med. and Surg. Assoc., 1847," p. 344.

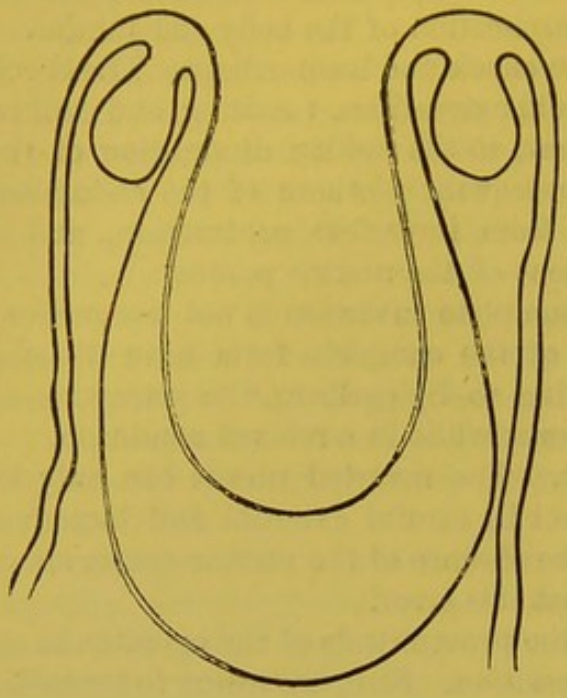


Fig. 240.—Inversion of uterus.

ure. Then the thumb was withdrawn, and the circular uterine fold, which still hung deep into the vagina, was pressed up on one side by the fork formed by the thumb and index-finger. Finally, by indenting the raised fold by the thumb, and at the same time making counter-pressure upon the uterine ring through the abdominal walls, I was enabled to push the entire mass by the ring, and had the pleasure of feeling the remainder of the inverted organ roll spontaneously into position. The diagrams drawn for me by my friend, Dr. L. M. Yale, will help to make intelligible the mechanism of the manœuvre.

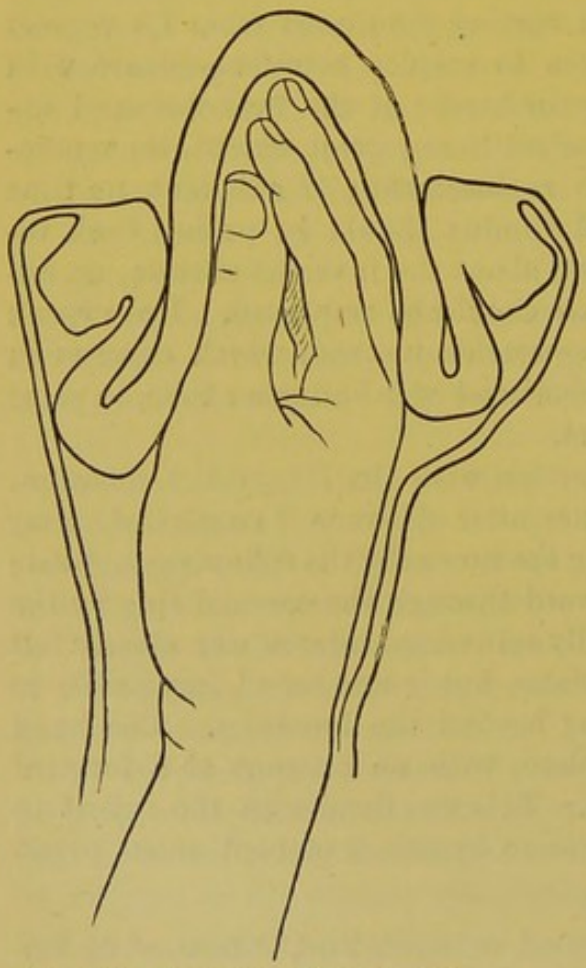


Fig. 241.—First stage of replacement.

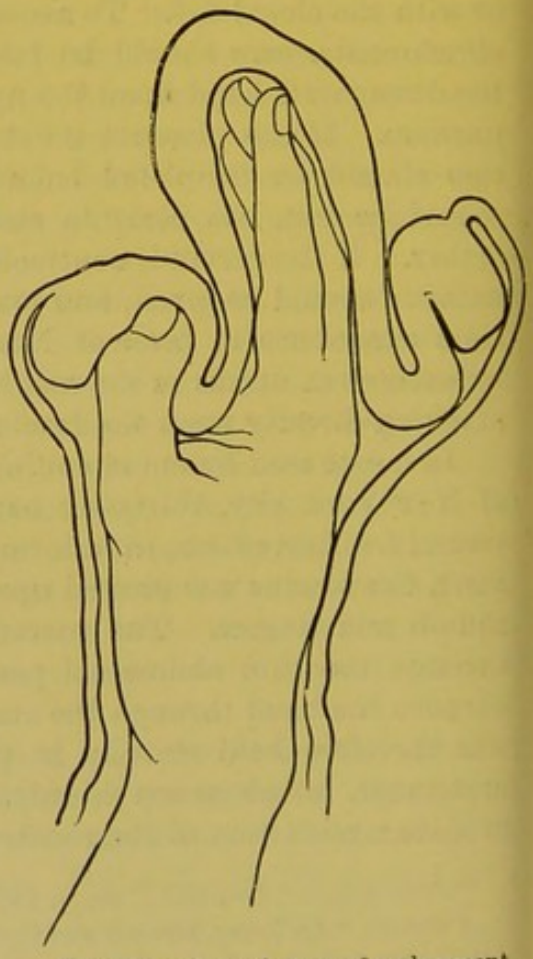


Fig. 242.—Second stage of replacement.

If the reinversion proves successful, the hand should be allowed to remain within the uterus, and external pressure should be employed until contraction is secured. The subsequent treatment does not differ from that for uterine atony, already considered in connection with *post-partum* hæmorrhage.

CHAPTER XXXIII.

RUPTURES OF THE GENITAL CANAL.

Rupture of the uterus.—Etiology.—Pathological anatomy.—Symptoms and diagnosis.—Treatment.—Prophylaxis.—Treatment after rupture.—Rupture limited to the peritoneal covering of the uterus.—Perforation from pressure.—Lacerations of the vaginal portion.—Laceration of the vagina.—Laceration of the vulva.—Thrombus of the vulva and vagina.—Rupture of the pelvic articulations.

The genital canal may be ruptured in any portion of its course. Thus, lacerations may take place through the perinæum and posterior vaginal wall, in the vestibulum, in the fornix of the vagina, in the cervix, in the uterus, and in the pelvic articulations.

Rupture of the Uterus.—Ruptures of the uterus, for the most part at least, start from the lower segment and thence extend upward toward the body and fundus, or downward toward the vagina. They are termed complete when the rent extends through to the abdominal cavity, and incomplete when confined to either the muscular layers or to the peritonæum.

Bandl reported 19 cases in 40,614 labors (1: 2,137), occurring in nine years in the Lying-in Hospital at Vienna. Jolly, in Paris, found 230 cases in 782,741 labors (1 : 3,403), but he excluded from his list lacerations of the cervix. Harris, whose authority as a statistician is of the highest, estimates in the United States one case of ruptured uterus to four thousand births. I found 47 deaths from this cause recorded in New York between 1867 and 1875 inclusive, or about one death in six thousand labors. But it is hardly probable that these figures represent anything like the actual mortality; for, whereas in 1875 eleven deaths were returned, there were but four recorded in 1867, and none in the years 1871 and 1872. It is not likely, moreover, that the 47 cases include any other than spontaneous ruptures, as naturally very few physicians are honest enough to record, as such, ruptures due to violent obstetric manœuvres.

Hugenberger estimated the mortality from ruptured uterus at 95 per cent., C. Braun* at 89 per cent. Their statistics were made up from hospital records. Jolly reported in civil practice 100 saved in

* Braun, "Lehrbuch der gesammt. Gynaek.," p. 699.

580 cases; but this Harris* believes to be too favorable a showing, as the proportionate loss is much less in published than in unpublished cases. The treatment of this condition is, therefore, comparatively ineffective; a careful study of the circumstances which favor its production is, however, capable of at least furnishing the groundwork of a rational prophylaxis.

Etiology.—Rupture of the uterus may take place spontaneously as the result of defective resistance offered by the uterine walls to the pressure of the ovum, or it may owe its origin to some external mechanical force.

Rupture of the fundus is a very rare exception. It is said to take place under special abnormal conditions, as in the one-horned uterus, in imbedded myomata, when cicatrices exist as the result of previous Cæsarean section, and in retrograde changes of the uterine walls.

It is the great merit of Bandl† to have shown that nearly all ruptures begin in the lower segment, and are preceded by an abnormal thinning and distention of that portion of the uterus situated between the ring which bears his name and the os externum. In normal labor it will be remembered that during a pain the fundus and body thicken, while the lower segment is stretched by the ovum. So long as no obstacle exists which hinders the progression of the ovum or the fœtus, this process ends in the conversion of the uterus and vagina into one continuous canal. In such cases the contraction ring is found in the neighborhood of the pelvic brim.

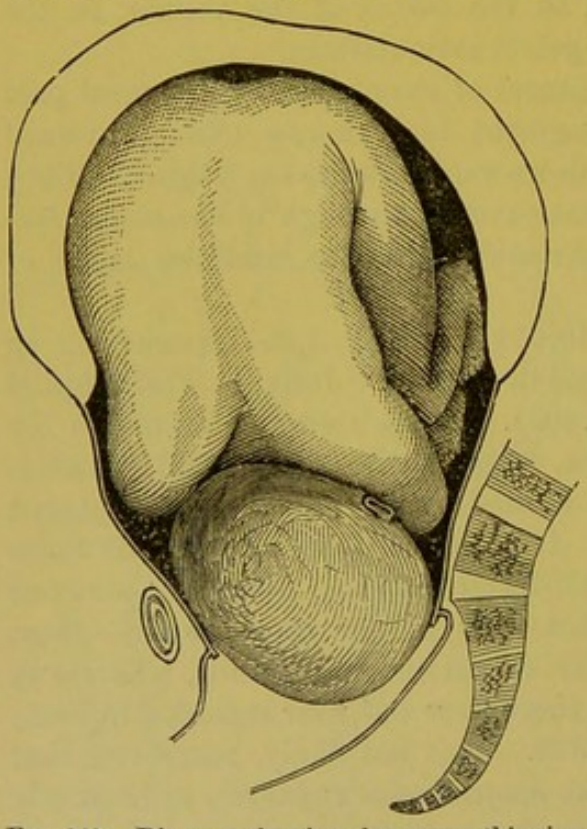


Fig. 243.—Diagram showing dangerous thinning of the lower segment, owing to the non-descent of the head in contracted pelvis. (Bandl.)

If, however, the descent of the fœtus is prevented by any cause, the resistance of the ligaments which hold the uterus in position is overcome by the retraction of the fundus and body, and as a consequence the contraction ring is withdrawn upward, the lower segment is thinned, while in extreme cases the thickened fundus simply covers the pelvic extremity of the child like an inverted

* Harris, "If a Woman has ruptured her Uterus, what shall be done in order to save her Life?" "Am. Jour. of Obstet.," October, 1880.

† Bandl, "Ueber Ruptur der Gebärmutter," Wien, 1875.

bowl. Under these circumstances it is possible at times to detect by palpation the contraction ring a hand's-breadth above the pubes, or even in the neighborhood of the umbilicus. The stretching of the tissues is most pronounced in the upper portion of the lower segment, diminishing below until the vaginal portion is reached, which, of course, is not subjected to tension.

Now, when, as the result of the birth of any considerable portion of the child into the obstetrical cervix—as the stretched lower uterine segment has been termed by Spiegelberg—the tissues of the latter are stretched so as to form little more than a membranous covering, the conditions which threaten rupture are established. Thus, contractility is impaired; with each recurring pain, the child, driven still farther from the uterine cavity, increases the pressure upon the already enormously distended cervix; gradually the thinned tissues separate; the presenting part of the child is forced into the opening; at the height of a pain complete perforation of the cervical substance takes place; the peritonæum is lifted up from the underlying tissue, and finally, in the majority of cases, is torn through, permitting the partial or complete passage of the child into the peritoneal cavity. The emptied uterus then contracts, and the expulsive pains cease. The conditions which, according to Bandl, especially predispose to dangerous cervical tension are pelvic contraction, shoulder presentations, and hydrocephalus. Rupture is favored whenever the tension, as in lateral obliquity and anteflexion of the uterus, and in transverse presentations, falls more upon one side of the lower segment than upon the other.

There are very great individual differences in the distensibility of the cervical tissues. In women who have borne many children, rupture may occur before any great degree of stretching has been reached. In the case of which the *post-mortem* appearances are given in Fig. 244, spontaneous rupture occurred in the tenth pregnancy. Labor commenced at noon, and the membranes, which had begun to protrude through the vulva, broke near midnight. The pains then became slow and feeble. At about three o'clock in the morning sudden collapse occurred. On my arrival, thirty minutes later, I found the pulse scarcely perceptible, the breathing hurried, and the extremities cold. As the head was well down in the pelvis, I applied forceps, and extracted without effort a dead child weighing ten and a half pounds. Previous to the collapse the patient had felt comfortable. At the moment of its occurrence a distinct snapping sound was heard by the hospital physician, Dr. J. D. Griffith, who sat several yards distant from the bedside. The patient stated that she felt a sensation as though a warm fluid was pouring into the abdominal cavity. As the pelvis was ample and the presentation normal, and as there was no irregularity of the labor-pains, the rupture could only be accounted

for by assuming a vulnerability of the uterine tissues, and probably a clamping of the anterior lip between the head and the pelvic wall.

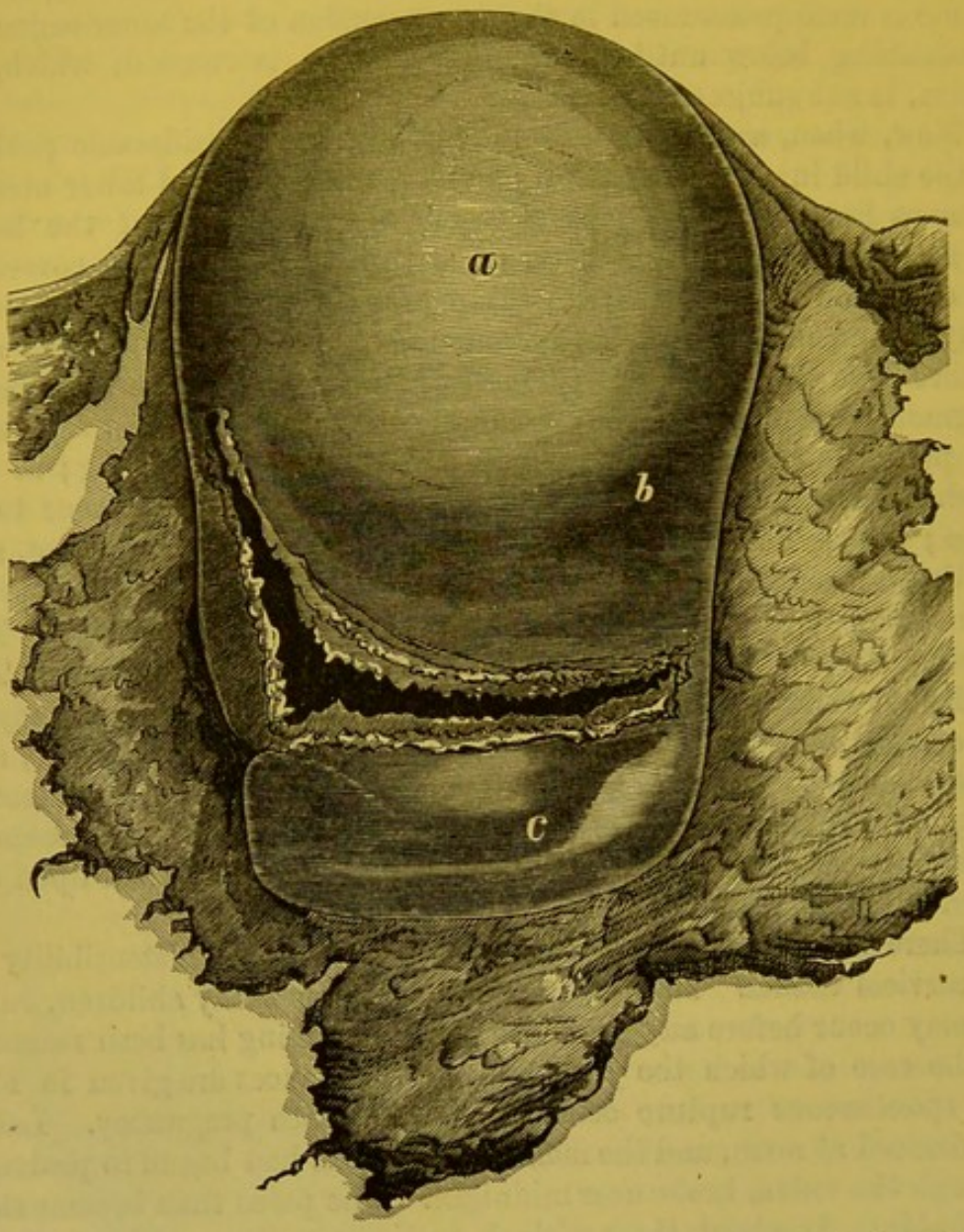


FIG. 244.—Case of ruptured uterus (anterior surface). *a*, body of uterus; *b*, ring of Bandl; *c*, thrombus, shining through the peritonæum.

On the other hand, so great is the distensibility of the tissues in certain cases that the fœtus may pass entire from the uterus into the cavity of the obstetrical cervix without laceration ensuing.

Bandl found that of 546 cases of rupture but sixty-four were in primiparæ. Their preponderance in multiparæ is for the most part the result of the laxity of the round and lateral ligaments of the uterus, which offer accordingly but slight resistance to the recession of the contraction ring; of the stretched condition of the abdominal parietes, which permits obliquities and anteflexion to take place; and

of the separation of the recti muscles, which interferes with the use of the abdominal compress.

Of course, the loss of vitality over limited areas, resulting from the compression to which the uterine walls are frequently subjected in deformed pelves, enhances the disposition to rupture. It is likewise obvious that the existence of extreme cervical distention should not be overlooked in cases where operations are rendered necessary. The old prejudice against all operations within the uterine cavity while the cervix is undilated is based in great measure upon the real danger of laceration which proceeds from the association in many cases of the foregoing condition with difficult labor.

Pathological Anatomy.—Rupture may occur in any point of the obstetrical cervix. More commonly it takes place upon the side. Owing to the right lateral obliquity of the uterus, and the greater frequency in shoulder presentations of head-left positions, the left side is oftener affected than the right. The laceration may follow any direction. Longitudinal tears occur usually in shoulder presentations, or where the head is of disproportionate size; the circular rents are for the most part limited to generally contracted pelves. The combination of a transverse with a longitudinal tear, the two meeting at a right angle, is not uncommon. When the uterine walls possess unusual distensibility, a laceration may take place in the peritonæum while the muscular structures remain intact. Again, in some cases, owing to an excessive elasticity of the peritonæum, the latter may not give way even when the child has partially escaped from the uterine cavity. These incomplete ruptures are only possible upon the sides of the uterus, at the site of the folds of the broad ligament. The peritoneal wound is usually more extensive than the uterine.

Some separation of the peritonæum from the underlying structures is usually found in the neighborhood of the rupture. Its extent is dependent upon the degree of tension to which the membrane was subjected before laceration took place. At the body of the uterus the close connection between the peritonæum and the external muscular layer renders a separation at that point an impossibility.

In the case represented by Fig. 244 the peritonæum was, on the other hand, dissected away anteriorly by effused blood as far as the umbilicus. Hæmatomata are the rule in incomplete ruptures; in complete ones they are also found in cases where the peritonæum has been late in giving way—i. e., after a cavity of considerable size has been formed by its detachment. The borders of the laceration are ragged. The body of the uterus rises high up in the abdominal cavity, and is inclined to the side opposite to that at which the rupture has taken place.

Symptoms and Diagnosis.—The occurrence of rupture may sometimes be foreseen and guarded against by the early recognition of ex-

cessive cervical distention. The development of the latter is possible in any case of obstructed labor. Unless the abdominal walls are very thick, the boundary between the body of the uterus and the thinned lower segment, in the form of a transverse or an oblique furrow, may be made out by palpation through the abdominal walls. Upon the sides the round ligaments, even between the pains, have the feel of tense cords. Usually the stretching of the cervix is associated with violent pain, with increased rapidity of pulse, and an anxious expression of countenance.

If rupture takes place, and a portion of the child is extruded, the uterus inclines to the opposite side, and often vomiting sets in. When the rupture takes place gradually, violent manifestations are exceptional. The pains then continue, as a rule, and force the fœtus into the abdominal cavity.

In cases of sudden rupture the pains cease instantly, and symptoms of collapse make their appearance. Vomiting, prostration, the cool skin, the rapid pulse, the drawn features, all point to internal hæmorrhage and shock. Blood flows from the vagina, and the presenting part recedes from the pelvic brim.

Certainty in diagnosis is reached when the uterus upon palpation is found to be empty, and the outlines of the child can be made out through the abdominal coverings. If rupture takes place after the presenting part has become fixed in the pelvis, internal exploration is often out of the question previous to the birth of the child. Usually, however, the existence of the rent is easily made out by the examining hand.

The passage of the child through the opening into the abdominal cavity is usual; but to this rule there are exceptions. I have seen three cases, two complete and one incomplete, where the child remained within the uterus in spite of the existence of extensive laceration.

The symptoms of incomplete rupture are, at the time of its occurrence, of less severity than the foregoing. The pain and collapse, the cessation of uterine contractions, and the recession of the presenting part are usually absent. Often the rupture may have existed for some time without appreciable phenomena pointing to its existence. The frequent pulse is the most constant sign. As incomplete ruptures have almost always a lateral situation, large vessels are apt to be injured, and the internal hæmorrhage to be profuse.

In very rare cases sub-peritoneal emphysema, due to the entrance of air or gases arising from putrefaction, may be recognized by the hand or by the ear on the anterior surface or upon the sides of the uterus, and extending sometimes into the iliac regions.

Treatment—Prophylaxis.—In view of the serious prognosis in cases of uterine rupture, the question of prophylaxis is one of peculiar interest and importance. The outcome of Bandl's demonstration re-

garding the etiology of the accident is to place in a clear light the responsibility of the physician for its occurrence. If it can not always be foreseen and prevented, there is no excuse for the accident when the development of the recognizable conditions which lead to it is overlooked, or where palpable warnings are neglected.

In multiparæ with contracted pelves, where, as a consequence of previous pregnancies, the ligaments are lax and the lower segment is soft and distensible, it is desirable, so soon as the child is viable, to induce premature labor, and thus to diminish the disproportion between the head and the pelvis.

If the conditions described by Bandl begin to develop during labor, lateral obliquities should be corrected, either by placing the patient upon the side to which the presenting part is turned, or by fixing the uterus with compresses and a bandage in the median line.

If the recession of the body of the uterus continues, and the head is movable, version should be performed, provided always that it can be accomplished without violence. In the introduction of the hand every pains should be taken to correctly appreciate the additional strain to which the cervical tissues are subjected. When an extremity has been seized, and tractions are made, the contraction ring which separates the body from the lower segment interferes alike with the descent of the breech and the ascent of the head into the fundus. If rude force is employed, the increased pressure that temporarily is exerted upon the side of the cervix which is bulged by the presenting part can easily give rise to rupture. To avoid any unnecessary strain during version, counter-pressure should be made over the fundus of the uterus by a trained assistant, while the operator controls the direction of the head by means of his free hand laid upon the abdominal wall.

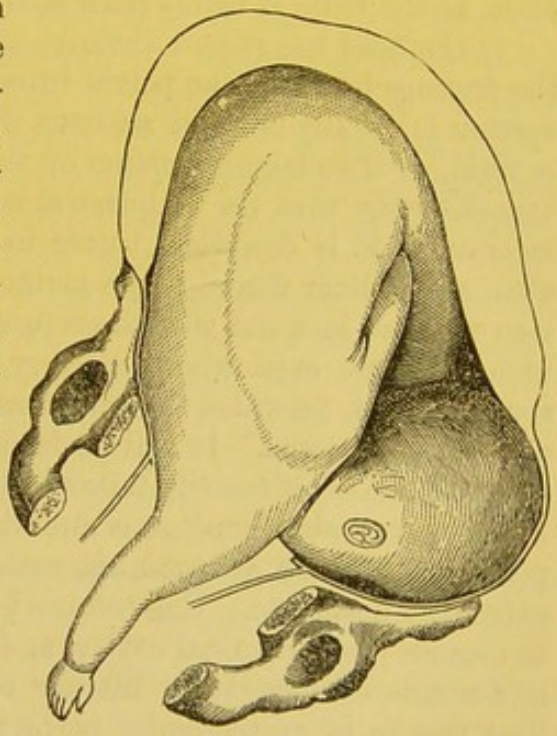


Fig. 245.—Retraction in a case of shoulder presentation. (Bandl.)

If the head is fixed in the pelvis, the forceps is usually available. If, however, the head is movable and version contra-indicated, the forceps is not likely to help the child, and is nearly certain to injure the mother. In a few cases it is possible to press the head into the pelvis by force exerted with the two hands from above the pubes.

If craniotomy becomes necessary, Bandl advises seizing the head in the forceps before using the perforator, as even moderate pressure upward in the tense state of the cervix may lead to laceration.

In neglected shoulder presentations, pains should be taken to ascertain whether the child is living before performing version. This can at times be accomplished by passing the hand upward near the shoulder and feeling for pulsations of the cord. In all extreme cases, the continued retraction of the uterus, by limiting the placental area, is apt to produce fetal asphyxia. If the child is living, the conditions are usually such that version can still be performed, provided care be taken at the same time to press the head from without toward the uterine axis. Excessive distention of the cervix develops much more slowly in primiparæ than in women who have had previous confinements. If the child is dead, or where version is impracticable, decapitation should be employed to release the patient from further danger.

Treatment after the Occurrence of Rupture. — If rupture is suspected to have taken place, the child should be delivered without delay. The means of delivery should be selected with the view to enlarge the opening as little as possible. In vertex presentations, if the diagnosis is clear, it is advisable to perforate and extract with the craniocast, as the child is rarely born alive where rupture has taken place.

If the head has passed through the rent, if the os is dilated, and if the feet are felt near the pelvic brim, the withdrawal of the child by version is usually effected without difficulty. If, however, the cervix is rigid, or if so large a portion of the fœtus has passed into the peritoneal cavity that its withdrawal is liable to increase the size of the laceration, it is doubtless better to incise the abdomen at the linea alba, and deliver through the artificial opening. Indeed, it is a question whether it is not wise to perform gastrotomy in all cases of complete rupture, even where delivery by the natural passages has been accomplished, provided the rent does not close with the contraction of the emptied uterus. It may be fairly stated that an extensive internal hæmorrhage is necessarily followed by the death of the patient. As, however, complete rupture is almost inevitably followed by the intraperitoneal effusion of blood, the patient's condition is thereby rendered extremely desperate. Gastrotomy in such cases enables the operator to cleanse the abdominal cavity, and, if necessary, to introduce sutures as a means of preventing further bleeding from the uterine wound. The results of gastrotomies performed for the removal of the child after its escape into the abdomen are extremely encouraging—Trask's statistics showing 76 per cent. of recoveries, those of Jolly 69 per cent., and the United States statistics, collected with indefatigable zeal by Harris, $53\frac{11}{13}$ per cent. In the autopsies I have witnessed upon women who have died from rupture after delivery by the natu-

ral passages, it has always seemed to me that a timely gastrotomy, performed before peritonitis had set in, would have afforded a good chance of saving the patient's life.

In cases where the rupture is incomplete, or where the uncertainty as to the extent of the lesion leads the physician to shrink from abdominal section, clots in the vicinity of the opening should be removed with the hand, firm contractions should be excited, and the uterus should be fixed in position by means of a bandage and pads of cotton, and dry cold, to restrain hæmorrhage and prevent peritonitis, should be kept continuously applied to the abdomen. At the same time the usual remedies against shock and collapse should be administered, according to the necessities of the patient.

As the uterine opening has a tendency to speedily close, and as death, when not due to shock or loss of blood, is most frequently the result of the septic decomposition of retained fluids, *a priori* drainage ought to prove an essential aid to treatment. Recent successes through its instrumentality have been reported by Frommel,* Mosbach, Graefe, Felsenreich,† Hecker,‡ and Mann.* The plan recommended by the latter, based upon the experience of Gustav Braun's clinic, consists in taking a large-sized piece of drainage tubing, and bending it in the middle so as to leave the extremities of equal length. A large opening should then be made at the arch, which is to be introduced through the point of rupture, and the descending branches of the tube should be fastened together to prevent the formation of a bridge of tissue between them during the process of healing. The upper end of the drainage apparatus should be passed from a half-inch to an inch beyond the torn borders of the uterine wound, and the lower ends stitched with silk to the posterior commissure. Over the vulva and the apparatus there should be placed an antiseptic dressing, which should be changed several times daily. After the first forty-eight hours, by which time it may be assumed that protective adhesions will have formed in the neighborhood, a regular irrigation of the wound with a two-per-cent. solution of carbolic acid should be carried out, with a view to prevent a septic poisoning from the decomposition of the pus and the lochia.

Rupture limited to the Peritoneal Covering of the Uterus.—This very rare form requires but brief mention. In all, but ten cases have

* Frommel, "Zur Aetiologie und Therapie der Uterusruptur," "Ztschr. f. Geburtsh. und Gynaek.," Bd. v, Heft 2.

† Felsenreich, "Beitrag zur Therapie der Uterusruptur," "Arch f. Gynaek.," Bd. xvii, Heft 3.

‡ Hecker, "Centralblatt f. Gynaek.," 1881, No. x.

* Mann, "Centralblatt f. Gynaek.," 1881, No. xvi. Drainage in the cases referred to was employed in complete as well as in incomplete ruptures. The triumph of the principle of drainage is best demonstrated by the fact that in most of the cases gastrotomy was contra-indicated by reason of excessive shock.

been reported. It occurs under apparently normal conditions, without premonitory symptoms. It is supposed to be due to deficient elasticity of the peritonæum, and may take place during either pregnancy or labor. Death in the known cases resulted from internal hæmorrhage, from peritonitis, or from shock (Spiegelberg).

Perforation from Pressure.—In studying the influence of the contracted pelvis, we have already had occasion to consider the origin of circumscribed losses of substance in the uterus due to the pressure of the pelvic walls. In the present connection it is only necessary to state that they are more frequently followed by recovery than the ruptures, in favorable cases exudation closing the opening, and the necrosed tissue passing away through the vagina.

Lacerations of the Vaginal Portion of the Cervix.—Lacerations at the os externum of moderate extent are the nearly constant concomitant of physiological labor. The "show" of monthly nurses consists of mucus tinged with blood furnished from the slight tears which are produced during the passage of the head through the cervical orifice. At times, however, these lacerations may assume a pathological importance, reaching upward to the vaginal junction, or even, in extreme cases, stretching outward through the upper portion of the vagina. At the time of their occurrence, they give rise to no special symptoms. After the birth of the child, they may become the source of *post-partum* hæmorrhage, or they may interfere with involution, and during childbed expose the patient to the risks of infection. In after-life they furnish the foundation of a multitude of uterine disorders (Emmet). They occur most frequently in primiparæ, especially elderly ones; in œdema of the cervix; in cases where the anterior lip, pushed downward by the occiput, is caught between the head and the pubic walls, and thus is prevented from retracting simultaneously with the posterior lip; and as a consequence of obstetrical operations. Severe lacerations extending above the vaginal junction are most frequently produced in pelvic deliveries, where the head is extracted by force through an imperfectly dilated os.

Most commonly these lacerations follow a longitudinal direction. In rare cases, where there is extreme rigidity of the os externum, or where, after the escape of the amniotic fluid, the head distends the anterior lip without pressing upon the os, a transverse rent may occur through which the child may pass. Sometimes a longitudinal tear may be combined with one running transversely, the lip then hanging by a pedicle to the uterus, or the entire lip may be torn off. Isolated cases of so-called annular laceration have been reported, where the transverse rent has extended through the whole vaginal portion, so that the lower segment has been detached in the form of a ring.

In addition to the ordinary principles which should govern the management of every labor, Bandl lays great stress upon the pushing

up of the confined anterior lip as an important prophylactic measure.

Hæmorrhage due to cervical laceration should be controlled by cold-water injections, by plugs of cotton steeped in the solution of the persulphate of iron and applied through the speculum directly to the bleeding point, or, still better, by closing the rent with silver sutures. The latter plan, which appears to have been first successfully tried by Professor Montrose A. Pallen,* has of late years come into general favor. In view of the bad light by which the operation has usually to be performed, the suggestion of Schroeder, to draw the cervix with the volsella forceps outside the vulva, while an assistant pushes the uterus down into the pelvis from above, is worthy of being borne in mind. With the wounded parts thus exposed, moreover, the reparative operation advocated presents scarcely appreciable difficulties to even the least surgical of attendants.

If no hæmorrhage occurs, cervical lacerations are rarely recognized except by physicians who take pains to invariably investigate the *post-partum* condition of every patient. As a rule, they heal rapidly during involution. Perfect cleanliness, maintained by the free use of carbolized washes, promotes the healing process, and is a safeguard against the inflammations of the contiguous connective tissue and peritonæum which arise from infection.

Lacerations of the Vagina.—Vaginal larcerations vary in gravity according to their extent and position. In the upper part of the canal they are, as a rule, continuous with ruptures begun in the uterus or in the vaginal portion. In contracted pelves, where, owing to excessive retraction, the head fills the vagina without entering the pelvic brim, isolated lacerations of the vagina may follow the same general causes as those which give rise to rupture of the uterus. Perhaps the most common vaginal lesion is that produced by the unguarded blades of the forceps when applied diagonally in place of directly to the sides of the child's head.

In most cases these lacerations heal speedily without serious symptoms, provided cleanliness be maintained from the first. Lacerations of the fornix only are of great importance on account of their proximity to the peritonæum, and because of the exposure of the parametrium to septic absorption. The immediate closure, therefore, of these rents with silver sutures ought to be attempted. Owing to the laxity of the tissues, the difficulties of reaching the wound are not excessive, while the dangers to be forestalled are of a peculiarly threatening character.

The origin and nature of fistulous communications with the bladder and the rectum have already been considered in connection with

* Pallen, "Accidents of Parturition requiring Surgical Treatment," "Richmond and Louisville Med. Jour.," May, 1874.

the pathology of labor. Resulting for the most part from necrosis due to pressure, they are rarely the immediate sequelæ of childbirth, the sloughing of the dead tissue taking place during the course of the puerperal period. The treatment in such cases belongs properly to the domain of gynæcology. The closure by suture is only available as a plan of treatment in cases where complete laceration through the tissues into the neighboring organs takes place during labor, as the consequence of rudely performed obstetrical operations.

Lacerations of the Vaginal Orifice.—Owing to the small size of the vaginal orifice, tears through the mucous membrane and erosions of the vulva, and, in primiparæ, the rupture of the frenulum, are to be accounted as the almost inevitable consequences of childbirth. They are the principal cause of the external soreness experienced after labor. In healthy localities they heal rapidly, and are of but trivial importance. The healing process is, even in simple cases, promoted by the use of warm disinfectant douches. Of greater moment are deep perineal lacerations and those of the vestibulum.

Lacerations of the Vestibulum.—Tears limited to the mucous membrane are usually found after labor at the sides of the clitoris. In exceptional cases these tears may involve the underlying erectile tissue (bulbs of the vestibule), and become the source of profuse or, when overlooked, even of fatal hæmorrhage. The blood, which may be either venous, arterial, or of mixed origin, spurts in jets, or oozes as from a soaked sponge. The recognition of the lesion is easy upon inspection. It should always be thought of as a possible cause of *post-partum* hæmorrhage in every case where the flow continues after the contraction of the uterus.

The bleeding may be temporarily arrested by the pressure of the finger until the expulsion of the placenta. Ligatures to the bleeding vessels, owing to the complexity of the structures, are of no avail. In slight cases a stream of cold water is a sufficient hæmostatic. In others, the bleeding requires to be checked by one or two deep sutures introduced so as to bring the torn surfaces into apposition. If the bleeding appears to come from one or two points, the *pinces hémostatiques* are of service. Styptics and astringents are usually effective, but they possess the drawback of augmenting the pain and soreness.

Lacerations of the Perinæum.—In the chapter upon the "Management of Normal Labor," the nature, origin, and prevention of perineal lacerations have already been considered. The diagnosis is made by a careful inspection of the genital organs after delivery. The extent of the lesion is estimated by including the recto-vaginal septum between the thumb and index-finger.

The treatment of perineal laceration consists either in keeping the woman in bed until the wounded surfaces cicatrize, or in bringing the parts into apposition by means of sutures, with the intent to secure

primary union. The first plan is sufficient, if the wound be of slight extent. If, however, the rupture extends to the sphincter ani, and involves the entire perineal body, the vagina is left without support, rectocele or cystocele ensues, the uterus sinks downward and becomes displaced backward, and in the end prolapsus is apt to result. If the sphincter ani and the recto-vaginal wall are involved, inability to restrain the bowels adds to the discomfort of the patient. This sequence of symptoms, so familiar to gynæcologists, forms an urgent plea for the resort to surgical means to repair the injury. Only a very credulous person really believes that he has witnessed union by first intention in extensive ruptures, as the result of tying the knees together and enjoining rest upon the side. The action of the transversi-perinæi muscles tends to draw the torn surfaces apart. Moreover, the necessity of separating the knees in passing urine, and to enable the nurse to cleanse the genitalia, makes it impossible to keep them in contact for any lengthened period.

To the immediate operation there is no valid objection. It is not difficult, it is not extremely painful, and its performance, as a rule, diminishes the risks of infection and shortens the puerperal period. It is true that the object aimed at may not be attained. In private practice, however, failure is the exception. The argument that the operation is in itself a confession does not deserve discussion.

For its performance the patient should lie upon her back, with her hips well over the edge of the bed. Two assistants to hold the knees are of great convenience. In operations requiring the introduction of not more than three or four sutures, anæsthesia may be dispensed with. In lengthy operations, such as are necessitated by lacerations extending up the posterior vaginal wall, ether should be given in place of chloroform, and its administration should be intrusted to an experienced person only. It can not be too often repeated that anæsthesia after labor calls for the exercise of extreme caution.

The wound should be prepared by carefully washing away blood and clots with warm carbolized water, and by removing shreddy portions with scissors. For lacerations not extending through the sphincter ani I use Peaslee's needle, which is furnished with an eye at the point, and is set in a wooden handle. It possesses the advantage of strength, a quality of no mean importance in making the circuit of the redundant tissues with which we have to deal after labor. I use the silver suture, and after repeated trials have not been able to convince myself that it can be equally well replaced by silk.

The first suture should be passed just in front of the anus. It should be entered and brought out about a half-inch from the ruptured borders. The others should follow at from one third to one half inch intervals. Each suture should make the entire circuit of the wound. This can be readily accomplished by guiding the point of

the needle through the residue of the perineal body with two fingers in the anus and with the thumb upon the vaginal surface. To secure a stronger hold for the last suture, the needle should be made to enter the vagina above the upper angle of the rent, and the wire should be made to traverse a portion of undenuded tissue before completing the circuit. In closing the wound, great pains must be taken not to twist the sutures too tightly, as in that case they are apt either to cut out or to produce sloughing.

Sometimes, in rents extending through the sphincter ani and the recto-vaginal septum, the simple perineal sutures will effect a satisfactory union. Thus, in a patient at the Emergency Hospital, with a laceration extending nearly to the cervix, and whose condition precluded a lengthy operation, I obtained an excellent result by passing a single wire above the angle of the wound, and twisting the ends outside the perinæum. As a rule, however, it is desirable to adjust the edges with great care, first closing the rent upon the rectal side, then bringing together the split in the mucous membrane upon the vaginal side with transverse sutures, and finally bringing the lower borders of the perinæum together by a separate operation. This disposition is the so-called triangular suture of Simon.* It requires fine needles, a needle-holder, an adjuster, a wire-twister, and, in fact, all the paraphernalia of the gynæcologist. The length of the operation renders necessary an anæsthetic, which should be ether rather than chloroform. The disgusting condition of a patient with laceration through the recto-vaginal septum, where the healing process has been the result of granulation, justifies the attempt to secure immediate union.

The requirements in the way of after-treatment are very simple. The urine should be drawn every four to six hours with a catheter, until the patient is able to pass her water spontaneously; the bowels should be kept open with salines; and the knees should be tied loosely, to remind the woman of the desirability of keeping them in contact. A little opium may be given, if the pain experienced is considerable. Pain in childbed from any cause helps to depress the vitality. The perineal sutures should be left a week *in situ*. Many promising cases are spoiled by removing the sutures too early. The vaginal sutures may be allowed to remain until the external union is sufficiently solid to permit the introduction of the speculum. Cat-gut sutures for the rectum are to be preferred when they can be obtained, as they obviate the necessity of future removal.

For the more superficial lacerations of the perinæum the *serres fines* invented by Vidal de Cassis, and extensively used in Vienna, have been warmly advocated in this country by Professor M. D.

* *Vide* GARRIGUES'S excellent paper entitled "The Obstetric Treatment of the Perinæum," "Am. Jour. of Obstet.," April, 1880.

Mann,* and by Garrigues.† My own experience with them has not been fortunate; but the better results from their use in the hands of their supporters recommend them to trial.

Thrombus of the Vagina and Vulva.—Hæmorrhagic effusions into the external organs of generation occur with greatest frequency in the labia majora, more rarely in the labia minora, and occasionally between the superficial and median fasciæ of the perinæum. These extravasations may form tumors beneath the subcutaneous or submucous tissues of the vulva or vagina, which vary in size from that of a hen's egg to that of a child's head. As a rule, the blood is poured out into the cellular tissue seated below the diaphragm of the pelvis. The extravasation may, however, stretch upward along the vagina to the cellular tissue of the uterus, then posteriorly beneath the peritonæum to the kidneys, and around in front to the navel and laterally to the iliac fossæ (Winckel). The source of the hæmorrhage may be venous or arterial. The vessel from which the hæmorrhage takes place is usually situated in the lower portion of the vagina; in less frequent cases, in the vulva.

Symptoms.—The first sensation experienced at the time of the rupture is usually one of intense pain, proportioned to the size of the tumor and the rapidity of its formation, though in a case witnessed by Professor Barker ‡ this symptom was absent. As the effusion continues, swelling of the vulva, usually upon one side, results, and the skin becomes blue and nearly translucent. The patient complains of pain, and feels faint, while her lips and cheeks grow white. If the sac contains fluid blood, fluctuation is detected; after coagulation the tumor has a soft, boggy feel. If the tension increases, the skin may yield, the blood and coagula escape, and, if no means be adopted to arrest the hæmorrhage, the patient may die in a few minutes from acute anæmia.

If the thrombus be of small size and situated low down, the after-symptoms may be of slight importance. The fluid may be absorbed, the walls of the cavity unite, and the tumor disappear entirely. Tumors of larger size produce symptoms referable to pressure, such as back-ache, rectal obstruction, and ischuria. The vagina may be so narrowed as scarcely to permit the passage of the finger. Rupture, if not immediate, usually occurs spontaneously in the course of a few days, and is, as a rule, preceded by necrosis of a portion of the detached mucous membrane. The most frequent point of spontaneous rupture is at the junction of the larger and smaller labium. If the necrosed tissues become gangrenous, death from septicæmia may result.

* Mann, "The Immediate Treatment of Superficial Rupture of the Perinæum," "Am. Jour. of Obstet.," November, 1874.

† Garrigues, *loc. cit.*

‡ Barker, "Puerperal Diseases," p. 58.

Winckel* sums up the various terminations of thrombus as follows: 1. Death from hæmorrhage, with or without precedent rupture; 2. Death from decomposition of the sac-contents, with consecutive septicæmia or septico-pyæmia, most frequently after rupture or opening of the sac; 3. Rupture and recovery; 4. Rupture, with formation of fistulæ; 5. Absorption without rupture, followed by recovery.

Diagnosis.—The diagnosis is simple. The rapid development and increase of the tumor, its bluish color, its elastic or fluctuating character, the sharp pain, and the acute anæmia, occurring independently of uterine hæmorrhage, sufficiently point to a sanguineous effusion into the subcutaneous cellular tissue. The extent of the tumor must be determined by rectal and vaginal exploration. It is only at the beginning that it will be found possible to ascertain the seat of the hæmorrhage, whether in the vulva, vagina, or perinæum. Sometimes, after rupture and the discharge of the clots, the bleeding vessel may be detected.

Etiology.—The formation of the thrombous tumor, with rare exceptions, takes place during or shortly after labor. If the vessel rupture in advance of the presenting part, the effusion may be immediate and furnish an obstacle to delivery, or the descent of the fœtus may check the hæmorrhage for a time, to break out afresh after the labor is ended. In rupture due to necrosis consequent upon pressure, the hæmorrhage does not, of course, take place until sloughing occurs. Rupture may follow excessive straining, rapid dilatation of the genital canal, or direct injuries. A varicose condition of the veins does not, as would naturally be inferred, especially predispose to the occurrence of the accident. Thus, it was present in but six of the fifty cases collected by Winckel.

Prognosis.—The prognosis of vaginal thrombus is serious. Deneux reported twenty-two deaths in sixty cases, a mortality evidently excessive; Winckel reported six deaths in fifty cases; Barker reported two deaths in twenty-two cases; and Scanzoni one death in fifteen cases. But statistics like these are apt to give rise to a misleading impression. A thrombus *per se* is rarely a dangerous complication. It may, however, become so either because after rupture no means are adopted to limit the amount of hæmorrhage, or because, in unhealthy localities, the tense membrane covering the tumor is liable to become gangrenous, and the vast vaginal wound furnishes at once a congenial soil for the multiplication of septic germs, and an absorbent surface by which the septic poison generated is afforded a ready entry into the adjacent cellular tissue. Thus, Barker reports nine cases in private practice, in all of which the patients recovered. Of thirteen cases in hospital practice, two patients died of puerperal fever. The prognosis is likewise less favorable in cases where there exists at the same time extensive separation of the peritonæum.

* Winckel, "Die Pathologie und Therapie des Wochenbetts," 2te Auflage, p. 132.

Treatment.—The conditions of successful treatment are, restriction of the hæmorrhage and the prevention of septicæmia. Early recognition of the accident is very desirable.

So soon as effusion is recognized the forceps should be applied, and the head should be extracted as speedily as is consistent with the preservation of the integrity of the maternal tissues. To quote from Professor Barker's excellent treatise: "The exciting cause of the accident is the arrest of the circulation by the mechanical pressure of the presenting part of the fœtus. The sooner the pressure is removed the sooner the danger will be over, and the less will be the injury to the parts." Moreover, as we have seen, the head in its descent acts as a tampon, by means of which the hæmorrhage, whether external or in the submucous tissue, is temporarily held in check. If the tumor in advance of the head is so large that the delivery can not be accomplished without impairing the vitality of the sac-walls, the danger should be averted by incising the thrombus and turning out the coagula.

Hæmorrhage after the birth of the child is apt to be very profuse, especially if the sac has been opened either by spontaneous rupture of its coverings or with the knife. So long as the sac-walls are intact, the pent-up blood exercises a considerable pressure upon the bleeding vessel. For this reason it is well to cover an opening, if one happens to have formed, with lint soaked in a solution of one of the per-salts of iron. The continuance of internal hæmorrhage should then be checked by means of a water-bag (a large Barnes dilator will suffice) introduced into the vagina and distended with ice-water. The hydrostatic pressure rarely requires to be maintained for longer than half a day, during which time it should be repeatedly removed for a few moments to allow the vagina to be cleansed by disinfectant injections. The urine should be drawn with a catheter during the first forty-eight hours, as every straining effort is to be carefully guarded against. A tampon of linen rags, or of cotton, is inadmissible on account of the tendency it possesses to excite rapid decomposition in the lochial discharges. Immediate opening of the thrombus, followed by emptying the sac, and filling the cavity with lint soaked in astringent solutions, are measures which should, on account of the suppuration likely to be thereby excited, be reserved for cases where milder procedures have proved ineffective.

The ultimate opening of the sac, after the hæmorrhage has once been arrested, is rarely to be avoided. Still, cases are on record where tumors the size of a man's fist have disappeared by absorption. As this is the most favorable mode of termination, every effort should be made to secure such a result. To this end quiet should be enjoined, cold should be employed, and pain should be subdued by opiates. If, however, the tumor increases in size, the skin becomes greatly discol-

ored, and vesicles form upon its surface, it is better to anticipate threatened gangrene or rupture by incision. If the circumstances permit of delay, it is better to wait three to four days to make sure of the stoppage of bleeding. The best point for laying open the tumor is upon the inner surface of the labium majus. The incision should be two to three inches in length. In the subsequent treatment of the cavity, disinfection should be scrupulously practiced.

Rupture of the Pelvic Articulations.*—Rupture of the pelvic articulations may take place spontaneously where either inflammation or excessive relaxation of the joints exists at the time of labor. More commonly it is the result of difficult forceps operations performed in cases of contracted pelves. The risk of the occurrence of this accident is especially great when the forceps is applied to the head at the brim and forcible tractions are made in a direction anterior to the pelvic axis.

The symphysis is the articulation which is principally exposed to this form of injury, though it is obvious that no increase in the capacity of the pelvis consequent upon the separation of the symphysis is possible without simultaneous rupture of at least one of the sacro-iliac synchondroses. At the symphysis the rupture is apt to be complete, at the synchondroses the rupture is usually confined to the anterior surface. It may take place in the median line, or upon the side, between the cartilage and the pubic bone. If the injury be slight, the synovial cavity of the symphysis may not be injured. At the synchondroses, opening of the joint-cavity is inevitable. An excessive degree of the lesion is accompanied by laceration of the vagina, the bladder, and the intervening connective tissue.

Occasionally the rupture of the joint is announced by a perceptible sound, by intense pain, and, as the result of the increase in the pelvic space, by rapid advance of the head. In the lighter forms, however, which make up the bulk of the cases witnessed, there are no distinctive symptoms at the time of the accident. The pathognomonic secondary manifestations are outward rotation of the thighs, and localized pain increased by movement of the limbs, and relieved by fixation of the pelvis. Objective evidence of rupture at the symphysis is afforded by the movements produced at the articulation by alternate pressure upon the ends of the pubic bones, and by combined internal and external examination. If the rent extends to the vagina, the laceration may be detected by the touch. Separation of the sacro-iliac synchondroses is rendered probable if violent pain is excited by alternately pressing the anterior portions of the ilia together and then drawing them apart from one another. Bladder disturbances are rare

* Ahlfeld, "Die Verletzungen der Beckengelenke während d. Geburt und im Wochenbett," Schmidt's "Jahrbücher," Bd. 169, 1876, p. 185; Spiegelberg, "Lehrbuch," p. 636.

except in cases where the separation at the symphysis is complete, or where the rupture is followed by inflammation and the formation of pus.

The treatment consists in supporting the pelvis by means of a suitable bandage, in keeping the patient upon her back, and in maintaining strict cleanliness. The bowels should for a time be kept confined. As regards the first indication, Spiegelberg says an ordinary towel properly folded and fastened at the pubes, with care taken to avoid pressure upon the crests of the ilia, will answer all the requirements. Rupture of the pelvic articulations, when not complicated by other lesions, or by puerperal infection, run for the most part a favorable course. During convalescence the patient should wear some form of permanent bandage, such as has been recommended in cases of relaxation of the pelvic symphyses.

CHAPTER XXXIV.

PROLAPSE OF THE FUNIS, ETC.

Prolapsed funis.—Asphyxia neonatorum.—Collapse and sudden death during labor and childbed from thrombosis, from embolism, and from entrance of air into the circulation.—On the extraction of the child in case of death of the mother in pregnancy or labor.—Tympanites uteri.

When the cord is felt within the membranes next to the presenting part, a funis presentation is said to exist. After the membranes have ruptured, the cord descends into the vagina, in front of the presenting part, and is then said to be prolapsed. Generally the cord occupies one of the hollows upon the sides of the promontory; less frequently it descends opposite the lateral walls of the pelvis; the site in front of the promontory or behind the pubes is very exceptional.

As regards the frequency of the accident, the experience of individuals varies widely. Churchill collected 98,512 cases of labor, in which it occurred 401 times, or in the proportion of one to 245·5 cases. Dr. Christisen, of Wyandotte, Michigan, met with it 23 times in 1,516 cases. Meachem met with it 10 times in 931 cases. Mr. Bland met with it, on the other hand, but once in 1,897 cases.*

Prolapse of the cord occurs only in cases where the presenting part does not completely occlude the lower uterine segment. It is favored by a long cord, by a deep placental site, by the insertio velamentosa, by oblique and breech presentations, by prolapse of the extremities, by hydramnios, by multiple pregnancies, and, above all, by the con-

* These statistics I have borrowed from an article on the "Presentation of the Funis," by Dr. J. G. Meachem, reprinted from "The Transactions of the State Medical Society of Wisconsin," 1880.

tracted pelvis. On account of the more frequent concurrence of these conditions in multiparæ, the accident is oftener found in them than in primiparæ.

Duncan* has called attention to what he terms "Expression of the Cord," i. e., where the cord is squeezed out of the uterus long after the escape of the liquor amnii. Of this phenomenon he says that, during labor and after the discharge of the waters, "All parts of the fœtus are propelled, but not at the same rate . . . ; and the rate of progress of parts will vary according to the resistance. More mobile parts will have, in consequence of that mobility, less resistance to encounter, and it is plain that the limbs and the cord are the most mobile of the solid parts."

The diagnosis of prolapsed funis is easy. If necessary, the loop can be drawn outside of the vagina. Previous to rupture it forms a smooth, round, compressible, mobile body, not to be confounded with any other floating object liable to be encountered within the ovum. When the pulsations of the umbilical vessels are distinctly felt, the child is demonstrated to be alive. In the second stage, however, the pulsations may cease for a moment during a pain, to return again in the ensuing interval. As the heart sometimes continues to beat for a few minutes after the circulation in the cord has ended, it is proper to carefully auscultate before assuming death to have taken place (Spiegelberg).

The prognosis, so far as regards the children, is extremely unfavorable, more than one half dying during labor. This fatality is owing to the pressure to which the cord is subjected during the passage of the child through the pelvis. There are, however, a variety of circumstances which substantially modify the extent of the danger. Thus, in transverse presentations the cord is scarcely or not at all exposed to pressure. In breech presentations the prognosis is good, owing to the soft consistence and small size of the pelvic extremity, and to the fact that, where the life of the child is in peril, the conditions are such as to permit of speedy extraction.

The most serious cases are those where prolapse occurs as a complication of head presentations. Engelmann found that the infant mortality in the latter was sixty-four per cent., while in footling presentations it was but thirty-two per cent. Favorable conditions in head presentations are a large, roomy pelvis and preservation of the membranes until cervical dilatation is completed. Of unfavorable import are a deep placental site, a contracted pelvis, and early rupture of the membranes.

Treatment.—From the foregoing it will be seen that the one indication for treatment in this anomaly is to relieve the cord from pressure. The conduct of the physician in each individual case will depend upon the presentation and the modifying circumstances.

* Duncan, "On Expression of the Cord," "Obstet. Trans.," vol. xxi, p. 302.

If the head presents, so long as the membranes remain intact, and the dilatation of the cervix is incomplete, an expectant attitude should be maintained. Premature rupture should be guarded against by placing the patient in the latero-prone position, by forbidding her to strain, and by supporting the membranes by means of a moderately distended Barnes dilator introduced into the vagina. It is not rare in this class of cases, as the head descends, for the cord to be withdrawn upward into a place of safety. The more complete the dilatation before rupture, the more rapid the subsequent delivery of the child, and the greater the chance, therefore, of preserving its life. If, however, upon auscultation, there are signs of failing heart-action, an attempt should be made to push the cord upward with the fingers through the membranes. In case of success, in order to prevent a relapse, the sac should be ruptured, and the head should be brought down so as to fill the cervical canal.

After rupture of the membranes, if the cervix is well dilated, the pains are good, and the head enters quickly into the pelvic cavity, the case may be left to Nature. Spiegelberg mentions five cases, in his own practice, where the birth of the child took place so rapidly that no harm resulted from the descent of the cord. If the pains are feeble, and speedy progress is not made, the forceps should be applied.

If, after dilatation of the cervix, the head remains high and movable above the brim, the forceps should not be employed. It is then dangerous to the mother, and offers but scant hope of proving of service to the child. The choice in such cases falls either upon reposition of the cord, or version.

Reposition of the prolapsed cord, as the milder procedure, should be first attempted. The reposition is most easily accomplished in the knee-chest position, as has been beautifully demonstrated by Gaillard Thomas.* By the simple plan of reversing the direction of the uterine axis, all the conditions which had previously favored the descent of the cord are made to promote its return into the uterine cavity. Thus the intra-abdominal pressure is removed, the amniotic fluid is retained, the head is easily pushed to one side so as to permit the introduction of the hand, and the cord tends to glide by its own weight over the declivity furnished by the anterior wall to the fundus. The loop should be seized in the hollow of the hand, and should be carefully sheltered from pressure. It should be shoved beyond the greatest circumference of the head, and, where possible, to the back of the child's neck. As in all cases where the hand has to be passed through the cervix, the uterus should be sustained by pressure from without. With the advent of a pain all manipulation should cease, to be renewed, however, as relaxation follows. If the replacement proves successful, the hand

* Thomas, "Postural Treatment of Prolapsed Funis," "Trans. of the New York Acad. of Med.," 1858.

should be withdrawn gradually, while the head becomes fixed in the lower segment. This latter result may frequently be expedited by judiciously directed external pressure. As a precaution against relapse, the patient should be placed in the latero-prone position, with the hips elevated by a pillow.

The Postural Treatment of Prolapse of the Funis.—K. F. J. Birnbaum* finds that quite frequent mention has been made by authors of the advantages to be derived from posture in the treatment of cases of prolapsed funis. The works of Camper, published about the middle of the seventeenth century, and referred to by Kiestra, he had no means of obtaining access to. Deventer† considers the subject of prolapsed funis *in extenso*, takes up its different modifications, its effect upon parturition and the life of the child, and the treatment it demands. In cases where the cord was pressed against either ilium, he directed to place the woman upon the corresponding side, with raised pelvis, and with the hand (right hand if on the left side, and *vice versa*) to lift the head, replace the cord, then, as seemed advisable, either to bring the head into the pelvis, or to turn and extract by the feet. When the cord was pressed against the pubes or the sacrum, he advised that the midwife should place the woman upon her knees with her body thrown forward, and that, in this position, the accoucheur should raise the head and return the cord; if the woman should be too weak for this, she should be placed upon the side with one limb drawn up under the body. John Mowbray‡ advises that the woman, if strong enough, should be placed upon her knees and elbows in cases where the cord lies next the sacrum or the pubes. Henry Bracken, a pupil of Boerhaave,# proposed returning the funis in head presentations, with the woman placed upon the knees, and afterward to bring the fetal head into the pelvis. Ludwig Wilhelm von Knoer‖ devoted a long chapter to funis presentations. He says: "Introduce the hand so soon as the membranes rupture, and, according to the position of the child, perform either podalic or cephalic version, placing the woman at the same time upon her knees to prevent the protrusion of the cord." George Daniel Boessel^ recommends turning in cases of funis presentation, and, in cases of difficulty to perform version, with the woman placed upon the knees. In recent times, Van Ritgen has certainly been the most ardent partisan of postural methods of treatment. In his work entitled "Anzeigen der mechanischen Hülfen bei Entbindungen," published in 1820, he recommends them in a great variety of circumstances, but not then for prolapsed funis; but in his "Lehr- und Handbuch der Geburtshülfe für Hebammen" (Mainz, 1838) he says: "When the funis presents, the midwife should instantly send for the accoucheur; meanwhile she should herself place the woman, if strong enough, upon her knees and elbows, and attempt the replacement of the cord; if the woman is too weak to admit of this, she should be placed upon her side, with elevated pelvis. That side should be chosen upon

* "Monatsschr. f. Geburtsk.," October, 1867.

† "Operationes chirurgicæ novum lumen exhibentes obstetricantibus," Lugd. Bat., 1701.

‡ "The Female Physician, containing all the Diseases incident to that Sex," London, 1724.

"Midwife's Companion; or a Treatise of Midwifery," London, 1737.

‖ "Frauen-Zimmer Medicus," Leipsic, 1747.

^ "Grundlegung zur Hebammen-Kunst," Flensburg and Leipsic, 1756.

which the funis is not situated. If the manipulation is successful, the posture should be maintained to prevent a recurrence of the prolapse." He recommends the position upon the elbows and knees for cases of prolapsed funis and transverse presentations in breech or foot presentations, also where the head is movable above the brim, and where there is no attainable presenting part. He advises returning the funis high up with the hand, and then to let it fall into the uterus, where it would no longer be subjected to pressure. After reposition place the woman upon her side, with raised pelvis. Sometimes the postural method suffices without any manipulations. Kiestra * advises the position upon the knees and elbows in cases where the cord is felt near the head previous to rupture of the membranes, to prevent the occurrence of prolapse. After the rupture of the membranes, he says, the same position should be employed to facilitate the return of the cord, and should be maintained until the head is fairly engaged in the pelvis. Where the position could not be endured long enough, he counseled placing the woman in a half-kneeling, half-recumbent posture, with the side supported by cushions. Theobold, in 1860, hit upon the same idea. He considered the most favorable condition for the return of the funis was to place the woman upon her head, but, in view of the difficulty attending the execution of this manœuvre, compromised the matter by suggesting the position upon the elbows and knees.

The advantages of the postural method in the treatment of prolapsed cord are beyond all question. It is, however, difficult to persuade the woman to long maintain so constrained an attitude, and the cases are not rare where, in spite of gravity, the cord is expressed from the uterine cavity. Efforts at replacement should not, therefore, be long continued. It is impossible to handle the cord for any lengthy period without enfeebling the force of the fetal heart. So soon, therefore, as it becomes evident that nothing is to be gained by further persistence, the hand should be pushed up to the feet, and the safety of the child should be secured by speedy extraction. In cases of contracted pelvis the question of version must be decided with reference to the interests of the mother, as a difficult breech delivery complicated by prolapsed funis offers but a sorry prospect of saving the life of the child.

If the membranes rupture and the cord is prolapsed while the cervix is still narrow and rigid, an attempt should first be made to push back the cord with two fingers after placing the woman in the genupectoral position. As a rule, however, instrumental replacement will be necessary. I have been in the habit of employing for the purpose, as recommended by Dudan, a large English catheter, which possesses the advantage of forming one of the ordinary properties of the physician. The method of using the instrument is as follows: A piece of tape should first be fastened loosely around the cord, the stylet should then be made to emerge at the eye of the catheter, and a loop of the tape should be placed in the angle it forms. By returning the

* "Nederl. Weekbl.," April, 1855.

stylet and pushing it forward to the extremity of the tube, the band is held firmly. After replacing the prolapsed cord, the catheter is readily detached by the withdrawal of the stylet. Braun von Fernwald, who is the author of the best of the repositors made expressly for the prolapsed cord, says that the catheter is almost the only instrument to which he now resorts.

Instrumental replacement is apt to prove a veritable labor of Sisyphus. As one loop is pushed up another comes down, or the entire mass is returned with infinite trouble to the uterus only at once to be projected into the vagina. Roberton has proposed a handy plan for such cases, which certainly merits a trial. It consists in first passing a piece of twine doubled through an elastic catheter, so that the loop makes its appearance at the eye. Through this loop, a loop of the cord should be drawn. The ends of the twine should then be knotted to prevent them from slipping; the catheter should be armed with a stylet, and should be pushed upward into the uterus, carrying the cord with it. After introducing the catheter, the stylet should be withdrawn, and the instrument should be left behind to keep the cord from again prolapsing.

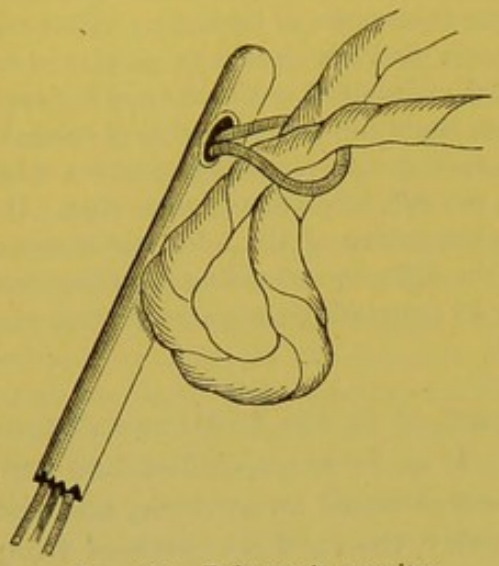


Fig. 246.—Roberton's repositor.

In one case Dr. Ashford* succeeded in attaching the cord to a Gariel pessary. The latter was then carried into the uterus, and inflated to prevent its expulsion.

If neither the cord can be returned nor the child extracted, it is proper to try by Braxton Hicks's method to convert the head presentation into one of the shoulder or, better still, of the breech, in order by so doing to relieve the umbilical vessels from pressure. Of course, if the prolapsed funis is associated with pelvic contraction, the rule heretofore given to consult first the safety of the mother remains the guiding one in practice.

In face presentations version is indicated, as, owing to the imperfect manner in which the face closes the uterine orifice, replacement of the cord is not likely to prove successful. If the opening through which the cord makes its way into the vagina is produced by a prolapsed extremity, the latter, of course, should be pushed back after the cord has been returned. In footling cases the pressure on the cord

* F. A. Ashford, "'Ballooning' the Prolapsed Umbilical Cord," "Am. Jour. of Obstet.," October, 1878, p. 745.

does not begin until long after the extremities can be reached and utilized for extraction. In full breech cases, where the size of the presenting part might interfere with the funic circulation, where it is possible to return the cord with the hand it is equally practicable to bring down an extremity. In cross-births, before the shoulder becomes wedged in the pelvis the cord is in no danger. No treatment is therefore necessary, except that indicated by the faulty presentation.

Suspended Animation, or Asphyxia Neonatorum.

Definition.—The term suspended animation is applied to such grades of congenital asphyxia in the living new-born child as are not incompatible with the continuance of its life.* A larger number of males than of females are born asphyxiated, and the children of primiparæ are more liable to this condition than those of multiparæ.†

Etiology.—A perfect comprehension of the etiology of suspended animation must be based upon thorough knowledge of the physiology of intra-uterine life and of the conditions necessary to its preservation. The fœtus lives only by virtue of its connection with the placenta, in which all the nutritive elements necessary to its life are transmitted to its circulation from the maternal blood, which in turn receives and removes the products of retrograde metamorphosis occurring in the fetal tissues. The placenta performs for the fœtus the functions assumed after birth by the digestive and respiratory organs.‡ The proper performance of these functions is indispensable to the life of the fœtus, which is forfeited so soon as they are completely interrupted or imperiled by their partial abrogation—unless, indeed, the speedy accomplishment of delivery afford the extra-uterine respiratory and digestive functions an opportunity of compensating for the corresponding intra-uterine ones. Since the alimentary fluids contained in the blood-plasma can be longer dispensed with, without prejudicial results, than the oxygen, the cause of fetal death or of suspended animation is chiefly asphyxia from deficient oxygenation.# The causes of the interruption in the diffusion of gases and of the consequent fetal asphyxia are of two varieties : 1. Those which interfere with placental respiration by limiting or checking the maternal supply of oxygen, as in cases of death, of grave anæmia, of *ante-partum* hæmorrhage, or of pulmonary diseases on the part of the mother, whereby the amount of oxygen in her blood is diminished. 2. Those which interfere with or entirely prevent the absorption of oxygen by the fetal

* Schultze, "Der Scheintod Neugeborenen," Jena, 1871, pp. 9, 101.

† Poppel, "Monatsschr. f. Geburtsk.," Bd. xxv, 1865, Supplement. Heft, p. 57.

‡ Zweifel, "Die Resp. des Fœtus," "Arch. f. Gynaek.," Bd. ix, 1876, p. 304; Fehling, "Arch. f. Gynaek.," Bd. ix, 1876, p. 318; Boehr, "Monatsschr. f. Geburtsk.," Bd. xxii, 1863, p. 408.

Schroeder, "Lehrbuch," p. 714.

blood. Among the latter causes may be mentioned torsion and compression of the umbilical cord, partial or complete separation of the placenta, diminution of the fetal cardiac action by cerebral or thoracic compression, and arrest of the placental circulation.* In cases of normal delivery the extra-uterine respiratory function assumes control so soon as the uterine contractions have sufficiently compressed the placenta to prevent proper oxygenation of the fetal blood. The inadequately oxygenated products of disassimilation are here supposed to act as powerful stimulants to the medullary respiratory center, and to produce contractions of the respiratory muscles.† So long as the diffusion of gases is normally provided for by the placenta, no stimulus is conveyed to the medulla. When, however, this source of aëration for the fetal blood is removed, spontaneous respiration must at once begin. Most authorities are of the opinion that this is the preponderating cause of the first extra-uterine respiratory movements.‡ Chilling of the fetal skin by the atmosphere is held by Kristeller,# and regurgitation of the placental blood toward the fetal heart by Lahs,‖ to be other causes of the first spontaneous respirations. Respiratory movements are produced in the manner described, whether the interruption of fetal hæmatosis occur after or before the expulsion of the placenta from the uterine cavity, provided the respiratory center and the muscles of respiration be sufficiently developed to respectively originate and react to nervous impulses. In each instance the thorax is dilated, the pulmonary capillaries are filled with blood by the right ventricle, and whatever surrounds the external air-passages is aspirated, if these be permeable, into the trachea and bronchi. In the former case the surrounding medium is air, the fetal blood is duly aërated and the extra-uterine respiratory functions securely established. When respiration begins in the uterine cavity, however, only a little air, and that in exceptional instances,^ is inspired, while mucus, blood, liquor amnii, vernix caseosa, and meconium are aspirated in considerable quantities. Aëration of the fetal blood can not now be accomplished by either method of respiration. The poisonous products of tissue disintegration accumulate. The irritability of the medullary centers diminishes. Respiratory movements become infrequent, and are finally arrested. The heart becomes paralyzed, and the fœtus dies unless delivery be speedily accomplished. If, now, the child be extracted asphyxiated, but not dead, its condition is said to be that of suspended animation.

* Spiegelberg, "Lehrbuch," p. 663.

† Schroeder, *op. cit.*

‡ Schwartz, "Arch. f. Gynaek.," Bd. i, 1870, p. 362; Boehr, "Monatsschr. f. Geburtsk.," Bd. xxv, 1865, p. 336; Schultze, *op. cit.*, p. 105.

Kristeller, "Monatsschr. f. Geburtsk.," Bd. xxv, 1865, p. 327.

‖ Lahs, "Arch. f. Gynaek.," Bd. iv, 1872, p. 312.

^ Bartscher, "Monatsschr. f. Geburtsk.," Bd. ix, 1857, p. 294.

Provided the interference with placental respiration be of a temporary character, the disturbances of the fetal functions due to intra-uterine respiration may, according to Schultze,* be compensated for in the following manner: Inspirations occur, at first, as above described, from interruption of the placental circulation. Since, however, the medullary respiratory center no longer receives an adequate supply of arterial blood, its irritability diminishes and respiratory movements cease. The aspiration of blood from the right ventricle into the pulmonary circulation is now arrested, and the placental vessels are refilled. Owing to paralysis of the pneumogastric nerves, from over-stimulation, the cardiac activity is restored, and, if the obstruction to the placental circulation be transitory, the placenta will reassume its respiratory function. This hypothesis explains the fact that fœtuses, which are known from observation to have breathed *in utero*, are sometimes not born in a state of asphyxia. Suspended animation may occur without antecedent intra-uterine respiration. This is the case when disturbance or arrest of the placental functions takes place in fœtuses so immature that their medullary centers can not respond to the irritation of insufficiently oxygenated disassimilative products by originating the nervous impulse necessary for the production of respiratory movements.

Another cause of suspended animation unattended by intra-uterine respiration is a very slow progress of the placental respiratory disturbance, and a consequent gradual diminution of the amount of oxygen in the fetal blood. The deficiency in oxygen is, at first, so slight as not to stimulate the medullary center, and when the deficiency becomes more marked the irritability of the medulla has been so much depressed that it is no longer capable of originating a respiratory impulse. In this case the fœtus dies or passes into a condition of suspended animation without having breathed at all.* Compression of the fetal brain due to a contracted pelvis, to intra-cranial hæmorrhage, to the use of the forceps,† or to delivery in breech positions, may occasion death or suspended animation without exciting respiratory movements. The rationale of such cases is as follows: Cerebral compression reduces or even arrests the heart's action by irritating the pneumogastric nerve. The placental respiratory function is thus impaired, the fetal blood is consequently deprived of oxygen, and the irritability of the medulla so reduced that the latter can no longer originate respiratory movements.‡ If intra-cranial extravasations are located upon the convexity of the cerebrum they are comparatively innocuous, since the medulla is not compressed. Their most pernicious effect is naturally observed when they are situated at the base of the brain. It is

* Schultze, *op. cit.*, pp. 102 *et seq.*

† Dohrn, "Arch. f. Gynaek.," Bd. vi, 1874, p., 365.

‡ Frankenhäuser, "Monatsschr. f. Geburtsk.," Bd. xv, 1860, p. 368.

doubtful, according to Schwartz,* whether intra-uterine respiration, without asphyxia, may ever result from cerebral compression, as is maintained by Poppel.†

Morbid Anatomy.—Schultze recognizes two stages of suspended animation, which correspond to the terms *asphyxia livida* and *pallida*, usually employed to designate these respective conditions.‡ The boundary-line between the two stages is marked by the loss, on the part of the muscles, of their tonic contractility. In the first stage the muscular tone is still preserved. Although there are no spontaneous muscular contractions, the extremities are not completely relaxed, nor does the head drop. Reflex movements are easily produced by surface irritation. The skin is dusky-red or cyanotic, the cutaneous vessels are turgid, the conjunctivæ injected, and the eyeballs protruding. The cardiac and umbilical pulsations are slow but forcible. The umbilical vessels are fully distended. Respiratory movements usually occur only after a certain interval. They are at first feeble, superficial, and attended by facial contortions, but soon become more powerful. The increased deficiency in oxygen, occasioned by delivery, often furnishes to the medulla, in this stage of suspended animation, a stimulus of sufficient intensity to cause spontaneous respiratory movements. The same result is attained by irritation of the surface. If respiration does not ensue, from either cause, the child passes into the second stage of asphyxia.

In the second stage of suspended animation, or *asphyxia pallida*, the children are exceedingly anæmic. The conjunctivæ are without luster; the surface is cold; the sphincters are relaxed; the limbs, head, and lower jaw hang loosely down. Reflex movements do not occur. The cardiac beats are frequent and feeble. The umbilical pulse is almost or quite imperceptible. The umbilical vessels are empty. Either no spontaneous respiratory movements occur, or they are few, snapping, and produced by the diaphragm without the participation of the facial, nasal, or maxillary muscles. The respirations are ineffectual, since a *post-mortem* examination reveals little or no air in the bronchi, which are usually filled with fluid matter, and since no râles are heard during the respiratory efforts. The medulla is so completely paralyzed that the stimulus of the increased deficiency in oxygen, attendant upon delivery, merely produces these futile respiratory efforts. Should artificial means succeed in restoring the child, the first signs of its resuscitation will be refilling of the cutaneous capillaries and returning muscular tonicity. The morbid anatomical features of suspended animation vary according as that condition has or has not been attended by intra-uterine respiration. In the latter case the blood is dark and uncoagulated. The pulmonary vessels are

* Schwartz, "Arch. f. Gynaek.," Bd. i, 1870. pp. 365, 377.

† Poppel, *op. cit.*, p. 57.

‡ Schultze, *op. cit.*, pp. 6, 130, 147.

widely distended. The lungs are enlarged, heavy, and of a dark-red color. Numerous pulmonary, subpleural, subpericardial, and subendocardial ecchymoses are present. The pulmonary extravasations are more extensive than in cases of asphyxia accompanied by intra-uterine respiration, for the reason that, in the latter, the aspirated fluids offer a certain support to the distended capillaries. Pulmonary congestion and ecchymosis may be absent if the inspirations were ineffectual, infrequent, and of short duration. The obstruction of the pulmonary circulation further produces venous congestion of the surface, of the abdominal organs, and of the encephalon, resulting in subconjunctival, meningeal, and cerebral hæmorrhages. Ecchymoses may, also, be found beneath and upon the pericranium. Aside from the extravasated blood, no foreign matters are found in the bronchi. The absolute proof that the asphyxia of still-born children, or of those born in a moribund condition, was attended by intra-uterine respiration consists in the discovery, within the bronchi, of substances introduced by thoracic aspiration. When the proof is lacking, inspiration may still have occurred, but the entrance of foreign bodies has been prevented through occlusion of the nose and mouth by portions of the membranes, or by close apposition to them of the maternal soft parts. The quantity of aspirated material will depend upon its character and the force of the inspirations. The tough cervical mucus penetrates only to the trachea and primary bronchi. The liquor amnii, containing meconium, vernix caseosa, and blood and downy hairs, may even reach the terminal bronchioles. If air had found an entrance into the uterine cavity, it is also present in the bronchi, and, exceptionally, in the stomach and duodenum. The dilatation of the Eustachian tubes, as a consequence of the first inspirations, permits, in some instances, according to Wendt,* the penetration of liquor amnii into the middle ear. The pulmonary ecchymoses are less numerous and extensive in asphyxia attended by intra-uterine respiration than in the other variety, for reasons above stated, but congestion and extravasations in the abdominal and cerebral organs are quite as constant and important.

Diagnosis.—An important diagnostic symptom of beginning asphyxia is diminished frequency of the fetal heart-beats, due to inhibition of the placental respiration. This has no significance if it be manifest only during the pains, since it is then a physiological occurrence due to the mechanical compression of the fœtus or to expression of the placental blood into the fetal vessels. If it persist, however, during the interval between the pains, and be progressive, it is of serious import, betokening either considerable compression, or irritation of the medulla by an excess of deoxygenated blood. The diminished frequency is sometimes succeeded by increased rapidity of the cardiac

* Spiegelberg, "Lehrbuch," p. 667.

contractions, indicating paralysis of the pneumogastric, and, consequently, a more advanced stage of suspended animation.* This increased rapidity is, probably, invariably preceded by the diminished frequency of the heart's action already alluded to. The evacuation of meconium is also diagnostic of asphyxia, provided it be not merely the result of the mechanical compression exerted upon the child in breech presentations. The appearance of the meconium is, probably, due to the increased intestinal peristalsis attendant upon asphyxia, although, perhaps, in part occasioned by relaxation of the sphincters and compression of the abdomen by the contracting diaphragm. The discharge of meconium, accordingly, usually attends that form of suspended animation in which intra-uterine respiration has occurred, and is absent in those cases of gradually induced asphyxia unaccompanied by respiratory efforts. The differential diagnosis between these two varieties is completed, after delivery, by the detection of bronchial râles, due to the aspiration of intra-uterine fluids, in all cases of intra-uterine respiration except those in which the external air-passages were occluded. The discharge of meconium is sometimes not indicative of any pathological condition. Schultze † detected intra-uterine respiration by abdominal auscultation, as well as by intra-uterine palpation, and numerous observers have heard the *vagitus uterinus*, or intra-uterine cry, which bears testimony to the entrance of air into the uterus, and to the occurrence of respiratory movements.‡ When delivery has been partially accomplished, the diagnosis of asphyxia is easily made from the failing fetal pulse, the cyanosis, the forcible respiratory efforts, and the relaxation of the child's muscles.

Prognosis.—The prognosis depends largely upon the grade of the asphyxia, although the cause of the latter is of still greater significance. Suspended animation which is not accompanied by intra-uterine respiration offers the best prospects for resuscitation. The chances are smaller if inspiration has occurred, and the worst prognosis is afforded by the occurrence of respiration when the nose and mouth are occluded, on account of the graver derangement of the fetal circulation, and the more abundant pulmonary extravasations. The presence of aspirated foreign substances clouds the prognosis by interfering with efforts at artificial respiration, and by acting as the exciting cause of atelectasis and of lobular pneumonia. The prognosis is also rendered grave by the occurrence of intra-cranial hæmorrhages. The mortality of asphyxiated children in the first eight days after delivery is, according to Poppel's statistics,# seven times greater than that of children born unasphyxiated, and the mortality in the first

* Hüter, "Monatsschr. f. Geburtsk.," Bd. xviii, 1862, Supplem. Heft, p. 48.

† Schultze, *op. cit.*, p. 127.

‡ Kristeller, "Monatsschr. f. Geburtsk.," Bd. xxv, 1865, p. 321; Bartscher, *Ibid.*, Bd. ix, 1857, p. 294; Mayer, *Ibid*, Bd. xxv, 1865, p. 341.

Poppel, *op. cit.*, p. 57.

week in direct proportion to the duration and gravity of the suspended animation.

Treatment.—Three indications are to be fulfilled in the treatment of suspended animation: 1. The child must be speedily delivered, so that it may inspire pure atmospheric air; 2. The aspirated substances which occlude the air-passages must be removed, in order that the air may reach the alveoli; 3. If the asphyxia be so profound that no spontaneous respirations occur, the required air must be supplied, the abrogated function of the medulla restored, and the cardiac activity awakened by artificial respiration.

First Stage.—The first step in the resuscitation of still-born children consists in clearing away the mucus from the upper respiratory passages. This can pretty generally be effected with the little finger. In other cases it may be advisable to lay a towel over the child's lips and practice mouth-to-mouth insufflation. By this method little air enters the lungs, but it is of great service as a means of expelling mucus from the nasal passages. If abundant râles announce the presence of fluids in the larynx, trachea, and bronchi, they should be removed by aspiration with a small elastic catheter (No. 6 or 8) passed through the glottis. I have made great use of the catheter for the purpose mentioned, and believe it has been the means of saving a good many lives. I have never seen any harm from its cautious employment. In introducing the tube, the point should be guided downward by the index-finger placed behind the epiglottis, at the upper posterior border of the larynx. Only a very clumsy manipulator could, as has been suggested, perforate with an elastic catheter the walls of the larynx or trachea. By means of catheterization we are able not only to clear away mucus which, inspired into the smaller bronchial tubes, would eventually lead to death from atelectasis, but we are enabled to transfer air directly from our own lungs into that of the child. Usually this is not necessary. The stimulus imparted to the laryngeal mucous membrane often produces spontaneous respiration. As a rule, after the removal of the aspirated fluids respiration may be excited by ordinary cutaneous stimuli, such as sprinkling the face with cold water, rubbing the back with flannel, pouring a little whisky or brandy from a height upon the epigastrium, flagellation of the nates, or alternately immersing the child in hot and cold water. The cord should not be ligated so long as its vessels continue to pulsate, in order that all available placental blood may pass into the fetal circulation.

Should these measures prove unavailing, artificial respiration must be resorted to. If the child is feeble, and the beating of the heart is scarcely perceptible, it should be wrapped in warm clothes and the catheter should be introduced. The obstetrician, after expelling the reserve air from his lungs, should then take a deep inspiration, and slowly breathe through the tube into the lungs of the child. If the

catheter has been properly introduced the thorax will now be observed to expand. To imitate expiration, slight pressure should be made upon the sternum, and, as the air escapes, it will be heard to make a blowing noise in its passage through the tube. By patience, if only at the outset the heart beat at all, the circulation will be found to become stronger, the child will lose its excessive pallor or lividity, according to the stage of asphyxia, and, as the sensibility is restored, spontaneous respiratory efforts will be made. The danger of injuring the delicate pulmonary tissue, and of producing either interstitial or subpleural emphysema by insufflation, appears to me to be exaggerated. The catheter never exactly fills out the trachea. Any excess of air, therefore, will find its exit by the mouth, rather than through the tissues.

If the child be strong and well developed, and the heart beat strongly, I can heartily indorse the following method recommended by Schultze: After ligation and section of the cord, the child should be grasped in such a manner that the operator's thumbs shall rest, on either side, upon the anterior thoracic wall, while the index-finger occupies the axilla, and the remaining fingers are placed diagonally across the back. The child is then allowed to hang at arm's length between the knees of the obstetrician, its face being turned to the front. In this position the pectoral muscles are made to draw the superior ribs upward, the abdominal muscles draw the inferior ribs downward, and the weight of the liver causes the descent of the diaphragm. By these means the capacity of the chest is increased and inspiration is produced. The child is next swung upward, until the arms of the operator reach an almost horizontal position. The swinging motion is then arrested, flexion occurs in the child's lumbar spinal region, its head is directed downward, and its lower extremities fall slowly toward the obstetrician, until the whole weight of its body rests upon his thumbs. By this motion the chest and abdomen are powerfully compressed, the diaphragm is forced upward, and an efficient expiration results, and any retained adventitious matters are expelled from the air-passages. An inspiration is now produced by reversing the direction of the swing and returning the child to its former position of complete extension, by which manœuvre the chest is caused to expand and the diaphragm to descend. This procedure is repeated eight or ten times, at intervals of a few seconds, after which the child is placed in a warm bath, in order that its surface be not too greatly refrigerated. Should signs of returning vitality be now manifested, alternate immersions in cold and hot water may again be employed. Should no spontaneous respirations occur, the swinging may be repeated, alternating with baths, until breathing begins or the heart ceases to beat. Faradization of the phrenic nerves is recommended by Pernice,* and often furnishes excellent results; but, as a battery in

* Pernice, "Monatsschr. f. Geburtsk.," Bd. xxiii, 1864, p. 317.

good order is rarely on hand in a moment of emergency, the practice is of limited applicability.

Second Stage.—In the second stage of asphyxia, the child should be wrapped in warm flannels, and should be subjected to as little disturbance as possible, since its vitality is at so low an ebb that active movements may easily extinguish the faint spark of existence. After the removal of the foreign substances from the air-passages, insufflation by means of the catheter should be carefully resorted to. When the color returns to the skin, and the heart's action is restored, artificial respiration should be maintained by means of Sylvester's method, which is preferable to that of Schultze in feeble children, as it involves less exposure and less violent manipulations. In Sylvester's method * the child is placed upon its back with the shoulders raised sufficiently to prevent the chin from falling forward on the breast. The tongue is drawn forward to maintain a free entrance of air into the windpipe. To imitate the movements of deep inspiration, the operator grasps the arms above the elbows, and, raising them upward by the sides of the head, he extends them gently and steadily upward and forward for a few moments. At the same time the feet should be fixed. According to Champneys, the effect produced is more than twice as great when the arms are everted as when the arms are inverted. This he attributes to the mode of insertion of the pectoralis major muscle into the outer lip of the bicipital groove, eversion naturally rendering this more tense. Expiration is effected by turning down the arms and pressing them gently but firmly against the sides of the chest. When the process has been repeated a few times, the warm bath should be employed to prevent undue refrigeration of the cutaneous surface. The movements described should be alternated with the baths until spontaneous respiration is maintained or the case becomes hopeless. In prematurely delivered asphyxiated children these methods are inapplicable, since the thoracic walls are so yielding as not to undergo the changes of form requisite to the success of the methods described. In such cases insufflation, through the catheter, following aspiration, of the foreign bodies in the air-passages, is the only available treatment. If the efforts at resuscitation be successful, the child must for the first few days after its birth be kept particularly warm and be regularly nourished. †

* Sylvester, "The Discovery of the Physiological Method of inducing Respiration in Cases of Apparent Death from Drowning, Chloroform, Still-birth, Noxious Gases, etc.," 3d ed., 1853; "The True Physiological Method of restoring Persons apparently Drowned or Dead, and of resuscitating Still-born Children," London, 1858.

† The substitution of Sylvester's method for those of Marshall Hall and Schroeder, as given in the first edition of this work, is due to the very careful and satisfactory investigations of Francis Henry Champneys in reference to the amount of ventilation secured by the different methods of artificial respiration. ("Med.-Chir. Trans.," vol. lxiv.)

Collapse and Sudden Death during Labor and Childbed.

We have already had frequent occasion to mention collapse during or following labor as a sequence of hæmorrhage, or of injuries to which the genital passages have been subjected. Syncope is not an uncommon result of exhaustion following prolonged labor, or even normal labor in women with exceptionally sensitive nervous organizations. Again, it may be caused by the cerebral anæmia produced by the recession of blood from the nerve-centers when the intra-abdominal pressure is suddenly diminished by the rapid emptying of the uterus. Temporary syncope, if followed by complete restoration of the normal circulation, has no positive prognostic significance. Where, however, the pulse continues feeble and rapid, it should be, even in the absence of other grave symptoms, a subject of profound concern. The arteries then gradually become empty, while the large venous trunks fill with blood, and the sluggish current predisposes to the formation of thrombi.

Apart from such rare accidents as cerebral apoplexy, or heart rupture, or fatal endings from hæmorrhage, from pulmonary congestions and œdema, from eclampsia, from inversion and rupture of the uterus, and acute septicæmia, the causes of sudden death are to be found in pulmonary embolism, in the entrance of air into the circulation, and in shock.

On Thrombosis and Embolism.—Thrombi owe their importance to the disposition they possess to disintegrate and form emboli, which are swept along by the circulation until arrested by the diminished caliber of the peripheral vessels. A small clot forming in the left side of the heart may block up an artery in the brain or in either an upper or lower limb. The symptoms of the lesion in the latter case are the absence of pulsation in the artery below the thrombus, with pain, coldness of the surface, paralysis of the nerves of motion and sensibility if the arterial obstruction be sudden and complete, and in some cases gangrene of the extremity affected.*

Of much more common occurrence are venous thrombi. Indeed, it may be stated that thrombosis of the veins furnishes the most frequent cause of sudden death in labor and during the puerperal period. As a rule, the clotting takes place in the femoral, the pelvic, or the uterine veins. Spiegelberg† states that the emboli which become detached during or shortly after labor proceed from clots formed at the site of the placenta.

When the placenta is partially detached during labor, or the uterus does not properly contract after the birth of the child, sudden hæmor-

* Barker, "The Puerperal Diseases," p. 257; Barnes, "Thrombosis and Emboli of Lying-in Women," "Obst. Trans.," vol. iv, p. 30.

† Spiegelberg, *loc. cit.*, p. 661.

rhage, followed by syncope or marked weakening of the heart's action, may lead to the formation of large, soft clots, extending from the open mouths of the sinuses in the direction of the heart. These, by sudden movements, by the douche, or under a powerful contraction, such as oftentimes follows the rupture of the membranes or the expulsion of the fœtus, may be set adrift from their moorings, and be washed upward through the vena cava to the right side of the heart, and thence to the branches of the pulmonary artery.

It has been assumed, though not without question, that, owing to the large proportion of fibrin in the blood during pregnancy and childbed, it is possible, when the heart's action is feeble, for spontaneous coagulation to take place in the pulmonary artery. This theory, originally broached by Meigs, has been warmly supported by Playfair and Barker. Clinically, many striking facts have been adduced in its support. Playfair argues that, when dyspnœa precedes phlegmasia dolens, the same causes which have led to thrombosis of the femoral vein have antecedently been at work in the formation of coagula in the pulmonary artery. But the *post-mortem* evidence of such a connexus is not conclusive. Dr. Mary Putnam Jacobi has reported the case of a patient, dying five hours after labor, where præcordial oppression and dyspnœa had been marked, and yet no lesions whatever were found at the autopsy to account for these symptoms. Nor is it possible, when we consider the frequency with which thrombosis of the uterine veins precedes that of the veins of the thigh, to be sure, in the absence of a *post-mortem* examination, that the dyspnœa observed by Playfair may not have been due to an embolus from a clot formed in a uterine vessel. I would not, however, deny the possibility of Playfair's hypothesis. I only wish to emphasize the fact that, so far as the evidence goes, it lacks the positiveness of a scientific demonstration. According to all ordinary experience, the force of the blood-current in the pulmonary artery, except in the death agony, is sufficient to prevent spontaneous coagulation from taking place. Virchow, has, however, pointed out that any of the few minor veins opening into the right auricle may be the seat of the primary thrombus, and give rise to a large secondary thrombus within the auricle. (Savage.)

The symptoms of stoppage in a large pulmonary vessel are intense dyspnœa, air-hunger (to use an expressive German term), fluttering heart-action, a feeble, rapid pulse, a cold skin, and striking pallor of the countenance. Death may follow in a few minutes, or, where the main trunk is free, the more violent symptoms may in the course of a half-hour subside, to return, however, with the slightest movement or without apparent cause, the patient dying in a few days from abnormal lowering of the temperature, from dyspnœa and cyanosis; or, after a succession of attacks, the thrombus may be absorbed, and, as I have once seen, complete recovery may take place.

The Entrance of Air into the Circulation.*—The passage of air from the uterine cavity into the circulation is rendered possible by the presence of open sinuses, or of sinuses closed by soft, easily detached thrombi. These conditions are always present previous to delivery in case of partial separation of the placenta, and in the puerperal state, especially in the latter, when, owing to debility on the undue prolongation of labor, the expulsion of the ovum has been followed by imperfect retraction.

Air may be forcibly driven into the uterus by means of the uterine, or even the vaginal douche. For this reason the siphon syringe should be discarded from midwifery practice. The objection to the continuous stream furnished by a vessel placed at a height above the patient, based upon the insufficient force of the current, is purely theoretical.

It is not necessary that the nozzle of the syringe should be introduced directly into the uterine cavity for accidents to occur. Wiener† has reported from Spiegelberg's clinic a case where collapse followed the use of the vaginal douche, though the tube was free from air, the hydrostatic pressure having forced air which had previously entered the vagina up into the uterus. When, therefore, the douche is employed to induce premature labor, the stream should at first be propelled gently, and the vulva should be parted to permit the egress of contained air.

Less familiar than these cases of forced air injection are well-accredited instances of spontaneous entrance of air into the uterine sinuses. This accident is rendered possible by the diminution of the intra-abdominal pressure in certain body postures. Of these, the three familiar to us through gynæcological experiences are, respectively, the knee-chest, the latero-prone, and the lithotomy positions. In childbirth, under favoring conditions, the sudden rupture of the membranes which had previously distended the vagina, or the rapid extraction of the child, may be followed by the ingress of air into the uterus itself, in some cases doubtless the recession of the uterus after its evacuation favoring the occurrence of the accident. The entrance of air into the uterus does of necessity do harm, or the harm may be limited to the production of endometritis; still there are recorded cases where the aspiration of air has been followed by almost instant death.

The *post-mortem* examinations of cases of death from air entering the uterine sinuses show but little blood in the left side of the heart; frothy blood from the cut surfaces of the uterus; air in the uterine veins, the vena cava, the right side of the heart, and at the orifice of the pulmonary artery; the lungs anæmic, and containing frothy serum; the brain pale and infiltrated with serum.

* *Vide* Kezmársky, "Ueber Lufteintritt in die Blutbahnen durch den puerperal. Uterus," "Arch. f. Gynaek.," vol. xiii, p. 200.

† Wiener, "Zur Frage der künstlichen Frühgeburt bei engem Becken," "Arch. für Gynaek.," vol. xiii, p. 94.

Corresponding to these anatomical conditions, the hands during life were cold, the pulse scarcely perceptible, the face blue and livid, consciousness was lost, and the respirations were labored and jerky, with all the symptoms of intense dyspnœa.

Nerve Exhaustion and Shock.—Twenty years ago these pathological states played a conspicuous part in the etiology of sudden death during childbirth. Now the fashion has changed. Such terms as "nervous apoplexy" and "idiopathic asphyxia," which were employed as synonymous expressions, belong to an almost forgotten nomenclature. None the less the need remains to account for a class of cases in which death takes place without recognizable organic lesions.

Instances of death attributed to heart paralysis are to be found in the collections of McClintock * and Mordret ; † but to these objections have been made, either that the *post-mortem* confirmation of the diagnosis was lacking, or that the examination was lacking in the completeness necessary to shut out other possible causes of death. Baart de la Faille,‡ however, has more recently collected thirteen cases of collapse in which the occurrence of embolism and the entrance of air could with every probability be excluded. Cases where the absence of all symptoms of pulmonary obstruction furnish certain evidence that neither of these causes was operative may be found scattered through medical literature.#

In the absence of visible lesions, or the characteristic symptoms of the conditions to which death in childbed is usually referred, we have the right to attribute the melancholy issue to the same causes which, outside of childbed, produce identical phenomena. In the torpid form of shock the features are pinched, the eyes sunken and surrounded by dark rings, the skin possesses a marble pallor, the hands and lips are blue, the extremities are cold, sweat stands upon the brow, the pulse is thready and scarcely perceptible, while, in contrast to cases of pulmonary obstruction, the breathing, though it may be shallow, is not difficult or labored, and, in spite of the extreme prostration of the physical forces, the sphincters remain closed, and both consciousness and sensibility are preserved. Sometimes these earlier symptoms are followed by a stage of excitement in which the face, with the exception of the mucous membranes, becomes reddened, the eyes grow bright, the patient becomes restless, complains of constant thirst, and bids her friends farewell in anticipation of speedy death ; but, in spite of the reviving color, the pulse continues too rapid to be counted, the skin

* McClintock, "Dublin Med. Press," 1852. † Mordret, "Mem. Acad. Med.," 1858.

‡ Baart de la Faille, *Vide* Synopsis "Monatsschr. für Geburtskunde," vol. xxv, p. 318.

Vide case reported by O. T. Schultze in "American Practitioner," April, 1884, likewise author's paper on "Sudden Death in Labor and Childbed," "Journal of the American Med. Assoc.," for recent examples.

never regains its normal temperature, and the hopes of speedy restoration to health are dashed by the gradual or sudden suspension of the beatings of the heart.

Modern pathological investigation refers the phenomena of shock to a reflex paralysis of the vaso-motor, and especially of the splanchnic nerves, whereby the great mass of the blood is withdrawn from the surface, and collects in the trunks of the cœliac, the mesenteric, and the renal veins. Hence, the skin becomes cold, and is devoid of color save at the points where a bluish hue is imparted by the stagnant blood still lingering in the veins; the muscles, deprived of blood, feebly respond to the impulses of the will; the empty vessels of the brain explain the sluggish intelligence, the nausea, the vomiting, and the indifference of the patient; and, finally, during the diastole, the heart, pale and contracted, receives but little blood, and the radial pulse fades to nothingness because of the corresponding small amount of fluid propelled during the systole into the arterial vessels.*

From works on military surgery we learn that it is in the defeated army, among homesick soldiers, at the close of a wearisome war, after great exertions and deprivations, that shock is developed in its severest forms; that the finer the organization, the more readily the manifestations occur; that they are promoted by sudden losses of blood, and are in a special degree evoked by abdominal injuries.

It certainly would be singular if similar conditions in childbed were not followed by similar results. After labor, the nervous system of the woman is depressed by pain, starvation, and loss of sleep. The sudden emptying of the uterus is followed by a recession of blood from the head to the venous trunks of the abdomen. Hæmorrhage, followed by weakening of the heart's action, tends still further to increase the venous stasis. In the old days of torture, shock often mercifully put an end to the victim's anguish. Women in childbirth are at times subjected to pain exceeding that of the rack and the thumbscrew; and the wonder is not that the circulation should occasionally show signs of marked and even fatal disturbance, but that the nervous system, attacked from so many directions, should, in the rule, triumph over the adverse forces.

Treatment.—The treatment of pulmonary embolism, whether due to air or a disintegrated thrombus, is necessarily for the most part prophylactic. The proper precautions for avoiding the accidents described are sufficiently indicated in the preceding discussions as to their etiology. It is proper to remember that the nervous organization of woman loses in powers of resistance as the penalty of a higher civilization and of artificial refinement, and that it becomes, therefore, imperatively necessary for the physician to guard her from the dangers of excessive and too prolonged suffering. Especially I would raise my voice in

* Fischer, "Ueber den Shok," Volkmann's "Samml. klin. Vorträge," No. x.

warning against the current opinion that the length of the first stage of labor before the rupture of the membranes is a matter of indifference. In pulmonary embolism the violence of the symptoms at the outset of the attack is often out of proportion to the real gravity of the lesion. A small embolus or air entering the lungs, finely subdivided, may produce symptoms of dyspnœa which may be of temporary duration. In all cases, therefore, warmth should be applied to the surface, and every effort should be made to maintain the action of the heart. To this end injections of ether beneath the skin, and of ammonia into the veins, are to be counted as most powerful adjuvants. In shock, opium, atropia, and digitalis are theoretically indicated, and yet large doses of the latter drug, as have been sometimes recommended, are not unattended with risk, and may precipitate the final catastrophe.

Extraction of the Child in Case of Real or Apparent Death of the Mother during Pregnancy or Labor.

Death of the mother during pregnancy or labor may be threatened, or may actually result, either suddenly or slowly, from various morbid conditions which have been previously considered. Although sudden death of the mother is more frequent at the time of delivery, in consequence of hæmorrhage, exhaustion, eclampsia, or rupture of the uterus, it may occur at any time, particularly when due to pulmonary and cardiac affections, or to cerebral embolism.

It is our present object to consider the methods of treatment best adapted to the preservation of the child's life in those cases necessarily attended by death of the mother, and to the preservation of both mother and child whenever there is any probability of such a result. Our inquiry may, therefore, be limited to those cases in which the child is unquestionably living, and its viability undoubted. While the majority of recent authors upon this subject have recognized the propriety of adopting prompt measures for the immediate extraction of the child after the mother's decease, the same unanimity has not prevailed either in regard to the propriety of operative interference *before* the mother's death, or as to the most appropriate methods of operation. Schroeder* is content with the statement that, in case of maternal demise during parturition, efforts should be made to extract the fœtus *per vias naturales* by version or the forceps. In the event of failure to accomplish delivery by this method, he advises immediate resort to the Cæsarean section. Spiegelberg† recommends the Cæsarean section for all cases of maternal death, excepting those occurring in the second stage of labor, as the surest method of preserving fetal life. He makes no provision for those cases in which the mothers are apparently dead, although actually in a state of syncope or asphyxia.

* Schroeder, "Lehrbuch," p. 712.

† Spiegelberg, "Lehrbuch," p. 269.

Both he and Max Runge* recommend the Cæsarean section, even in cases of impending death of the mother, in the child's interest, and disparage efforts at extraction through the natural passages. Duer† concludes (*a*) that no operative procedure should be undertaken until there is absolute certainty of the mother's death; (*b*) that, death of the mother being assured, the Cæsarean section should be performed with dispatch if the fetal head be above the pelvic brim; (*c*) that, if the head have engaged in the brim, the question of resort to the Cæsarean section or to extraction *per vias naturales* becomes debatable. He condemns the practice, advocated by Rizzoli and Esterle, of resorting to forced delivery when the mother's death is imminent.

One of the most recent and comprehensive articles on the subject of artificial delivery *per vias naturales* is that of Thévenot,‡ who, referring its original introduction to Schenk and Rigaudeaux, and its development to Rizzoli, Heymann, and Depaul, ardently advocates its adoption, to the exclusion of the Cæsarean section. This method he declares to be applicable (*a*) to those cases with normal pelvic conformation in which the mother is dead, the labor somewhat advanced, the os dilated or dilatable, and the head at the superior strait; (*b*) to cases in which labor was only commencing, or had not begun at the time of death; (*c*) to cases, frequently occurring, according to the author, of apparent death of the mother (her real condition being that of syncope), whether labor had or had not begun at the time of her apparent decease; and (*d*) to cases of impending maternal death. Thévenot's arguments in favor of the method of treatment under consideration are, that the operation may be more promptly resorted to than the Cæsarean section, the preparations for and hesitations about which frequently occasion fatal delays; that it is of less vital importance that the death of the mother be positively ascertained than in cases of Cæsarean section; that it is a less repulsive proceeding; that the results are better than in the Cæsarean section; that the method is not productive of medico-legal complications; and that it affords a numerous class of parturient women, who are only apparently dead, a far better chance of recovery than does the Cæsarean section. Thévenot cites fifteen cases of *accouchement forcé* employed upon women at the point of death, in which thirteen infants were alive at birth, and six lived permanently. Five of the fifteen mothers, who were apparently moribund, recovered, and in three other cases the original diseases were retarded, and their most distressing symptoms temporarily relieved.

* Max Runge, "Ueber die Berechtigung des Kaiserschnitts an der Sterbenden und der mit ihm concurrirenden Entbindungs-Verfahren," "Ztschr. für Geburtsk. und Gynaek.," vol. ix, p. 245.

† Duer, "Am. Jour. of Obstet.," January, 1879, p. 10.

‡ Thévenot, "De l'acc. artif. par les voies nat. substit. à l'opération césar. *post mortem*," "Ann. de Gynéc.," tome x, October, 1878, p. 257; November, 1878, p. 339; December, 1878, p. 412.

Tympanites Uteri.—If air enters the uterine cavity previous to the birth of the child, the dangers are not confined to its passage into the venous circulation. Even when this latter accident does not occur, the patient's condition in a lingering labor is perilous in the extreme. The essential condition for the admission of air is rupture of the membranes. As a result in many though not in all cases, untimely respiratory efforts are excited in the child. In very rare instances it is said that the cry of the child, *vagitus uterinus*, has been heard within the uterus. Death speedily follows premature respiration, and, under the combined influence of air, heat, and moisture, decomposition rapidly develops.* The gases generated by putrefaction are sometimes of enormous volume, and the uterus furnishes a tympanitic resonance upon percussion. As a result of prolonged labor, of the distention of the uterine walls, and of septic poisoning, the pains become feeble and the patient suffers from dyspnœa, owing to the pressure upon the diaphragm by the enlarged uterus and the colon, which likewise is found distended with gases. A stinking discharge, sometimes mingled with gas-bubbles, is always present.

The prognosis depends upon the intensity of the process and the length of time allowed to elapse before operative measures are employed to remove the source of danger. Of sixty-four women, according to Staude's report, thirty-two died, eighteen had severe puerperal affections, and only fourteen recovered without further complications. The indications for treatment are, to extract the child as soon as practicable when air has once entered the uterine cavity, to wash out the uterus with disinfectant fluids, to use all available means to secure continued retraction of the uterus, and to follow every antiseptic precaution during the puerperal period.

*Staude found putrefactive changes developed in fœtuses born from three to twenty-one hours after the access of air to the uterus. "Ueber den Eintritt von Luft in die Gebärmutter," "Ztschr. f. Geburtsh. und Gynaek.," Bd. iii, p. 204.

DISEASES OF CHILDBED.

CHAPTER XXXV.

PUERPERAL FEVER.

Definition.—Frequency.—Morbid anatomy.—Endometritis and endocolpitis.—Metritis and parametritis.—Pelvic and diffused peritonitis.—Phlebitis and phlebo-thrombosis.—Septicæmia.—Earlier views concerning the nature of puerperal fever.—The nature of puerperal fever as regarded from the standpoint of modern investigation.—General symptoms.—The symptoms of endometritis and endocolpitis; of parametritis and perimetritis; of general peritonitis; of septicæmia lymphatica; of septicæmia venosa; of pure septicæmia.

Definition.—Puerperal fever is an infectious disease, due, as a rule, to the septic inoculation of the wounds which result from the separation of the decidua and the passage of the child through the genital canal in the act of parturition.

To maintain this definition it is, however, necessary to group by themselves cases of childbed fever dependent upon causes which are operative in the non-puerperal condition, though the latter imparts to these causes oftentimes an exceptional activity and virulence. In this category are to be placed especially scarlatina, typhus, typhoid, and malarial fevers. It is to be borne in mind that the zymotic fevers may provoke in the puerperal woman the same inflammatory lesions commonly associated with puerperal fever.* This is in accordance with the well-known surgical experience that a febrile paroxysm from any cause exerts an unfavorable influence upon a wounded surface.

Like all brief statements, the writer is well aware that the foregoing definition is necessarily imperfect, and stands in need of further limitations to meet the requirements of exactness. Exceptions, however, either apparent or real, will be noted hereafter in their proper connections.

Frequency.—In a careful search through the records preserved by the Health Department of New York city, I found that from 1868 to 1875 inclusive the total number of deaths for nine years was 248,533. Of these, 3,342 were from diseases complicating pregnancy, from the accidents of child-bearing, or from diseases of the puerperal state; or, in other words, 1 : 75 of all the deaths occurring during that period was the result of the performance of what we are in the habit of regarding as a physiological function.

The deaths from miscarriage, from shock, from prolonged labor,

* Hervieux, "Traité clinique et pratique des maladies puerpérales," pp. 1073 *et seq.*

from instrumental delivery, from convulsions, from hæmorrhage, from rupture of the uterus, and from extra-uterine pregnancy, and deaths from eruptive fevers, from phthisis, and from inflammatory non-puerperal affections complicating childbirth, made a total of 1,395, or about 42 per cent. of the entire number. The remaining 1,947 cases, variously reported as puerperal fever, puerperal peritonitis, metro-peritonitis, phlebitis, phlegmasia dolens, pyæmia, and septicæmia, represent the very serious sacrifice of life resulting from inflammatory processes which have their starting-point in the generative apparatus. If we apply the general term, puerperal fever, to this class of cases, it will be seen that the malady is the cause of nearly one one-hundred-and-twenty-seventh of all the deaths occurring in the city. The actual number of births for the nine years in question was roughly estimated at 284,000*—an estimate erring upon the side of liberality. The total number of deaths to the entire number of confinements was, then, at least in the proportion of 1 : 85, or, from puerperal fever alone, in the proportion of 1 : 146. Garrigues† examined the records of the various city institutions during the period in question, and from them estimated the number of births which took place in hospitals at 10,572. The recorded deaths were 420. Deducting these from the totals given above, the general death-rate in civil practice from puerperal causes in New York city was in the proportion of 1 : 94. Max Boehr,‡ in his now-famous statistics, reckons that one thirtieth of all married women in Prussia die in childbed. The Puerperal Fever Commission# appointed by the Berlin Society of Obstetrics and Gynæcology arrived at the conclusion that from 10 to 15 per cent. of the deaths occurring in women during the period of sexual activity were due to childbed fever, and that this disease destroyed nearly as many lives as small-pox or cholera. But puerperal fever differs from either small-pox or cholera in that the latter presses largely upon the aged and the very young, while the former gathers its victims exclusively from a selected class—viz., from women in adult life, the mothers of families, whose loss, as a rule, is a public as well as a private calamity.

For those who regard statistics with habitual distrust it may per-

* This estimate was based upon the assumption that the natural birth-rate is 33 to the 1,000—a proportion believed by the statisticians of the Board of Health to be approximatively correct, though probably somewhat in excess of the reality. P. Osterloh has recently stated that my statistics were computed in so arbitrary a manner as to render deductions from them valueless. In this, however, he is mistaken. The most conscientious care was taken in their preparation; wherever the possibility of error existed the fact was distinctly indicated, and all calculations were made in such a way that whatever corrections might be required would strengthen the conclusions.

† "On Lying-in Institutions," "Trans. Am. Gyn. Soc.," vol. ii, 1878.

‡ "Untersuchungen über die Häufigkeit des Todes im Wochenbett in Preussen," "Zeitschr. f. Geburtsk. und Gynaek.," vol. iii, p. 82.

"Zeitschr. f. Geburtsk. und Gynaek.," vol. iii, p. 1.

haps be well to state that the foregoing frightful picture is no exaggeration, but is less somber than the actual truth.

Before proceeding to consider the nature of puerperal fever, it is desirable to first recall the anatomical lesions with which it is associated. These, it will be found, are for the most part inflammatory processes having their starting-point in injuries of the genital passage produced by parturition, complicated in many cases by septic changes in the blood, by secondary degeneration of parenchymatous organs, and at times by phlegmonous and erysipelatous affections in remote as well as in the adjacent serous and cutaneous tissues.

Morbid Anatomy.—The primary lesions connected with puerperal fever are so various that the student will find it convenient to classify them according as they are situated in the mucous membrane of the utero-vaginal canal, the parenchyma of the uterus, the pelvic cellular tissue, the peritonæum, the lymphatics, or the veins. Not, indeed, that such an arrangement is strictly in accordance with clinical experience—as a rule, the inflammatory processes are rarely limited to a single tissue—but because the prognosis and treatment are determined in great measure by the tissue-system which is predominantly affected. The significance of puerperal inflammations, wherever seated, likewise depends upon whether they are local and circumscribed or whether they present a spreading character.

Personally, I have found the following classification of Spiegelberg* of great utility as a means of keeping in mind the principal points to which inquiry should be directed in estimating the significance of the febrile conditions of childbed :

1. Inflammation of the genital mucous membrane.—Endocolpitis and endometritis.

a. Superficial.

b. Ulcerative (diphtheritic).

2. Inflammation of the uterine parenchyma, and of the subserous and pelvic cellular tissue.

a. Exudation circumscribed.

b. Phlegmonous, diffused ; with lymphangitis and pyæmia (lymphatic form of peritonitis).

3. Inflammation of the peritonæum covering the uterus and its appendages.—Pelvic peritonitis and diffused peritonitis.

4. Phlebitis uterina and para-uterina, with formation of thrombi, embolism, and pyæmia.

5. Pure septicæmia.—Putrid absorption.

Endocolpitis and Endometritis.—In the superficial, catarrhal form of inflammation the mucous membrane of the vagina is swollen and hyperæmic, the papillæ are enlarged, and the discharge is profuse ; in the vaginal portion of the cervix the labia uterina are œdematous and

* "Ueber das Wesen des Puerperalfiebers," Volkmann's "Samml. klin. Vortr.," No. 3.

covered with granulations which bleed at the slightest touch ; in the cavity of the body there are increased transudation of serum and abundant pus-formation. The deep structures of the uterus are usually not affected. Sometimes the inflammation extends to the tubes—*salpingitis*—or, passing outward through the fimbriated extremities, it may spread over the adjacent peritonæum.

The small wounds at the vaginal orifice are at times converted into ulcers with tumefied borders. These so-called puerperal ulcers are covered with a greenish-yellow layer. They are associated usually with œdematous swelling of the labia. Under favorable sanitary conditions the deposit, which consists in the main of pus-cells, clears away, and the surface heals by granulation. The ulcerative form of inflammation is very rare outside of crowded hospitals.

Diphtheritic ulcers are situated with greatest frequency in the neighborhood of the posterior commissure, or around the vaginal orifice. In rarer instances they are found upon the anterior wall and in the fornix of the vagina, in the cervix, and upon the site of the placenta. The borders are red and jagged ; the base is covered with a yellowish-gray, shreddy membrane ; the secretion is purulent, alkaline, and fetid ; and the adjacent tissues are œdematous. From the vulva they may extend to the perinæum, or pursue a serpiginous course down the thighs. In the uterus and about the cervix they vary as regards size, and are either of a rounded shape or form narrow bands. The intervening portions of tissue which have not undergone destructive changes swell and stand out in strong relief. Where the entire inner surface has become necrosed, it is often covered with a smeary, chocolate-brown mass, which, when washed away with a stream of water, leaves exposed either the deepest layer of the mucous membrane or the underlying muscular structures.

The difference between the superficial ulcerations of the genital canal and the diphtheritic form involving destruction of the deeper tissues is due to the presence in the latter of minute organisms termed micrococci, the relations of which to puerperal infection will be considered in a subsequent division.

Metritis and Parametritis.—In ulcerative endometritis, and even in the extreme catarrhal form, the parenchyma of the uterus likewise becomes involved. The changes which are designated under the term metritis consist in the first place of œdematous infiltration of the tissues. As a consequence, the organ contracts imperfectly and becomes soft and flabby, so that sometimes, upon *post-mortem* examination, it bears the imprint of the intestines.

In diphtheritic endometritis the gangrenous process may attack the muscular tissue, and give rise to losses of muscular substance—a condition known as necrotic endometritis or putrescence of the uterus.

Inflammatory changes are rarely lacking in the intermuscular con-

nective tissue, which exhibits in places serous or gelatinous infiltration, with afterward pus-formation, and with here and there small abscesses. The sero-purulent infiltration of the connective tissue is specially marked beneath the peritoneal covering of the uterus either behind or along the sides at the attachment of the broad ligaments. In the same situations the lymphatics, which normally are barely perceptible to the naked eye, are sometimes enlarged to the size of a quill, and are characterized by varicose dilatations occurring singly or presenting a beaded arrangement. In the substance of the uterus the dilated vessels are liable to be mistaken for small abscesses. The pus-like substance contained in the lymphatics is composed of pus-cells and of micrococci. From the cellular tissue surrounding the vagina, or that beneath the peritoneal covering of the uterus, the inflammation may spread by contiguity of tissue between the folds of the broad ligament, and thence pass upward to the iliac fossæ. Usually the process is unilateral. After the inflammation has crossed the linea terminalis it may take a forward direction above the sheath of the ilio-psoas muscle to Poupart's ligament, or it may creep upward, following the course, according to the side affected, of the ascending or descending colon, to the region of the kidney. It is rare for inflammation of the cellular tissue to travel around the bladder to the front. In such cases it pursues its course between the walls of the bladder and the uterus, and along the round ligament to the inguinal canal. In a few cases the cellulitis mounts above Poupart's ligament, between the peritonæum and the abdominal wall.

The course of the inflammation is not simply fortuitous, but follows prearranged pathways in the connective tissue. König* and Schlesinger† have shown that when air, water, or liquefied glue is forced into the cellular tissue between the broad ligaments the injected mass has a tendency to invade the iliac fossæ. In Schlesinger's experiments, if the canula of the syringe was inserted into the anterior layer of the broad ligament, the glue spread between the folds to the abdominal end of the Fallopian tube; thence, following the track of the vessels, it passed to the linea terminalis; and finally mounted upward along the colon or swept forward to Poupart's ligament until the advance was stopped at the outer border of the round ligament. If the injection was made to the side of the cervix through the posterior layer at the junction of the cervix and the body, the posterior layer gradually bulged out, the peritonæum was lifted from the side wall of the pelvis, and the glue passed beyond the vessels to reach the iliac fossa. If the injection was made to the side of the cervix through the anterior layer, the glue passed between the bladder and the uterus, and forward along the round ligament to the inguinal canal, while another portion of the fluid passed between the layers of the broad

* "Arch. der Heilkunde," 3. Jahrg., 1862. † "Gynaekologische Studien," No. 1.

ligament, and reached the peritoneal covering of the side walls behind the round ligament. If the injection was made in the median line in a peritoneal fold of Douglas's *cul-de-sac* the fluid traveled forward upon one side along the round ligament and thence to the posterior wall of the bladder.

The term parametritis, introduced into use by Virchow, is, properly speaking, limited to inflammation of the connective tissue immediately adjacent to the uterus, the older one of pelvic cellulitis furnishing a more comprehensive designation for cases where, as a consequence of a progressive advance from the point of departure in the genital canal, the remoter regions have likewise been invaded. Connective-tissue inflammation presents, as the first essential characteristic, an acute œdema, the fluid which fills the gaps and interspaces consisting of transuded serum rendered opaque by the presence of pus-cells or possessing a gelatinous character. In the mild, uncomplicated cases, the œdema disappears rapidly. Where the cell-collections are of moderate extent, the entire process may vanish without leaving a trace of its existence. If the cell-elements, on the other hand, are present in great abundance, they, as a rule, first undergo fatty degeneration, and, after the absorption of the fluid portion, form a hard tumor composed of a fine granular detritus, which under favorable circumstances likewise, after a few weeks, becomes absorbed. In rare cases abscess-formation in the tumor results.

In the cellulitis resulting from septic infection, especially in cases complicated by diphtheritis, the tissues seem as if soaked with dirty serum, and contain scattered yellowish deposits, which soon present, even to the naked eye, the appearance of pus-collections. This sero-purulent œdema is always associated with lymphangitis, the lymphatic vessels possessing varicose dilatations and beaded arrangements similar to those already described in the uterine tissue. The foregoing changes are most distinct in the firm connective tissue adjacent to the uterus and at the hilum of the ovary, while they are less clearly traced in the looser structure of the broad ligament (Spiegelberg).

In favorable cases the inflammation is circumscribed, or at least is limited, by the nearest lymphatic glands. In cases of intense infection it spreads rapidly, and justifies the title bestowed upon it by Virchow of parametritic malignant erysipelas.

Pelvic and Diffused Peritonitis.—Inflammation of the pelvic peritonæum may result from severe attacks of catarrhal endometritis, the inflammatory process either traversing the uterine tissue or passing through the Fallopian tubes to the adjacent serous membrane; or it may proceed, secondarily, from the stretching and irritation occasioned by an associated parametritis.

As a rule, pelvic peritonitis is not attended with much exudation. The latter is situated upon the folds of the peritonæum limiting the

cul-de-sac of Douglas, upon the ovaries, and upon the broad ligaments. In favorable cases it consists of fibrinous flakes and fluid pus. If the latter is abundant, it may become encysted by the formation of adhesions between the pelvic organs.

General peritonitis may result from the extension of a pelvic peritonitis, or from the transport of poison through the lymphatics into the peritoneal sac. In the first case the entire peritonæum is injected, and the contents of the abdominal cavity are loosely bound together by pseudo-membranes, composed of pus and coagulated fibrine. The intestines are at the same time distended and the diaphragm is pushed upward. In the so-called peritonitis lymphatica the inflammatory symptoms are at the outset lacking. The abdominal cavity is found filled with a thin, stinking, greenish or brownish fluid composed of serum and micrococci. The intestines are lax and œdematous, and the muscular structures are paralyzed, with the resulting tympanitic distention. The peritoneal covering of the intestines is devoid of luster, and covered with injected patches, or is stained of a dark-brown color. Death often ensues before the occurrence of exudation.

Septic forms of pelvic inflammation are often associated with oöphoritis, the dilated lymphatics either extending to the substance of the ovaries, where they may lead to the production of small abscesses, or, as a result of blood dissolution, the organs become soft, pulpy, and infiltrated with discolored serum, and present hæmorrhagic spots distributed over the surface.

Phlebitis and Phlebo-Thrombosis.—The formation of thrombi in the uterine and pelvic veins is sufficiently common during the puerperal period. The coagulation may result from compression or from enfeeblement of the circulation. A predisposition to its occurrence is created by relaxation of the uterine tissue. A normal thrombus is in itself harmless. In time it becomes organized, and the occluded vessel is converted into a connective-tissue cord, or a channel may form through it which permits the passage of the blood-stream. When, however, pus or septic matters obtain access to a thrombus, it undergoes rapid disintegration, and the particles get swept away into the circulation until arrested in the ramifications of the pulmonary artery. Wherever these poisoned emboli happen to lodge, inflammation is set up in the adjacent tissues, and abscesses result (pyæmia multiplex). Sometimes countless collections of pus may form in the lungs. Less commonly abscesses are found in the liver or spleen, originating either from emboli which have already made the pulmonary circuit, or from thrombi in the pulmonary veins.

Inflammation of the veins (phlebitis) sometimes occurs when the vessels have to traverse tissues in or near the uterus infiltrated with purulent or septic materials. The endothelium then undergoes proliferation, and thrombosis is produced. Phlebitic thrombi do not neces-

sarily break down, and may in that case act as a barrier to the progression of septic germs into the circulation (Spiegelberg). As a rule, however, under the influence of inflammation and infection, they become converted into puriform masses.

The thrombi grow by accretion in the direction of the heart. They may extend from the uterus through the internal spermatic, or through the hypogastric and common iliac veins, to the vena cava. Sometimes the thrombus may be traced back to the placental site.

Septicæmia. — From these local conditions, sooner or later, secondary affections develop in distant organs. The general affection is, in great part at least, likewise of local origin. Sometimes, however, where the poison, which enters the system through the lymphatics and veins, is very active and abundant, death may follow from acute septicæmia before the changes in the sexual organs have had time to develop. The fatal result in these cases is probably due to paralysis of the heart. After death *post-mortem* decomposition rapidly sets in, the blood is sticky, and swelling is found in the various parenchymatous organs.

The secondary affections consist in the metastatic abscesses already noticed as produced by infected emboli, in circumscribed purulent collections due to the conveyance of septic materials into the blood-current through the lymphatics, in ulcerative endocarditis, in inflammations of the pleura, the pericardium, and the meninges, and in purulent inflammation of the joints.

A study of the nature of puerperal fever will best show how intimately these seemingly distinct processes are linked together.

Earlier Views concerning the Nature of Puerperal Fever.*—According to the teachings of Hippocrates, Galen, and Avicenna, of Ambrose Paré, of Sydenham, and of Smellie, the fevers of puerperal women were attributable to the suppression of the lochia. For twenty centuries this doctrine was accepted almost without dispute, the best clinical observers confounding a symptom which is often lacking with the cause of the disease itself.

In 1686, Puzos † taught that milk, circulating in the blood, is attracted to the uterus during pregnancy and to the breasts after confinement, but that milk metastases may form in other parts, and produce the symptoms of malignant or intermittent fever. In 1746, A. de Jussieu, Col de Villars, and Fontaine advanced in support of this theory the fact that they had found, on opening the abdomen in women who had died from an epidemic which raged that year in Paris, a free lactescent fluid in the lower portion of the abdominal cavity and clotted milk adherent to the intestines. This doctrine,

* For data given, and for a great variety of historical information, *vide* Hervieux, "Traité clinique et pratique des maladies puerpérales."

† "Premier mémoire sur les dépôts lacteux."

which seemed to be based upon, and to accord with, observation, found many adherents in France. It lost ground, however, when, in 1801, Bichat pointed out the true nature of the abdominal effusions of women who had died in childbed, and demonstrated that they were to be found likewise in peritoneal inflammations occurring in men and in non-puerperal women.

While, during the second half of the eighteenth century, the doctrine of milk metastasis held full sway in France, in England and Germany the dominant leaders in medicine referred the causes of puerperal fevers to inflammations of the womb and of the peritonæum. With the advances made in pathological anatomy in the beginning of the present century, France taking the lead, stress was likewise laid upon inflammation of the veins and of the lymphatics. The vitality of the doctrine of local inflammations is well shown by the records kept by the Health Board of this city, where a large proportion of the deaths returned from childbed fever are entered under the head of metritis, of peritonitis, of metro-peritonitis, and of puerperal phlebitis.

In opposition to the doctrines of the so-called localists, the theory that puerperal fever is an essential fever, and as much a distinct disease as typhus fever, typhoid fever, or relapsing fever, has been strenuously advocated by some of the most distinguished clinical teachers who have devoted their attention to obstetrical science.

Fordyce Barker, the most recent exponent of the essentiality of puerperal fever, in his classical work upon the "Puerperal Diseases," states the arguments against the local origin of the diseases as follows: 1. That puerperal fever has no characteristic lesions; 2. That the lesions which do exist are often not sufficient to influence the progress of the disease or to explain the cause of death; 3. That there may be inflammation, even to an intense degree, of any of the organs in which the principal lesions of puerperal fever are found, and yet the disease will lack some of the essential characteristics of puerperal fever; 4. That the lesions are essentially different from spontaneous or idiopathic inflammations of the tissues where these lesions are found; 5. That puerperal fever is often communicable from one patient to another through the medium of a third party, and that this is not the fact in regard to simple inflammations in puerperal women.

However, neither Barker, nor those who entertain views similar to his, question the local origin of many febrile affections in childbed, but claim that purely local inflammations have each their characteristic symptoms, which differ from those of true puerperal fever, that puerperal fever is a zymotic disease of unknown origin, and that local lesions, where they coexist, are not the primary source of trouble, but are secondary to changes in the blood.

In 1850, James Y. Simpson* published a short paper "On the

* "Edinburgh Medical Journal."

Analogy between Puerperal and Surgical Fever." This article may well be regarded as the foundation of the modern doctrine concerning puerperal fever, and is well worthy of perusal at the present day; for, though in the then existing state of pathology many of the links were wanting which have since raised the argument to nearly a mathematical demonstration, the paper furnishes a brilliant example of the scientific foresight which is able to discern the truth even where the evidence lacks completeness.

In 1847 Semmelweis, who was at that time clinical assistant to the Lying-in Hospital at Vienna, made the startling assertion that "puerperal patients were chiefly attacked with puerperal fever when they had been examined by the physicians who were fresh from contact with the poisons engendered by cadaveric decay; that fever ensued in the practice of those who after *post-mortem* examination washed their hands in the usual manner, whereas no fever or but few cases of disease followed when the examiner had previously washed his hands in a solution of chloride of lime." In the face of insult, ridicule, and abuse, Semmelweis maintained this position for years, almost unaided, with fanatical persistency. It was easy for his opponents, for the most part managers of the great lying-in asylums, to show from clinical experiences the weakness of so one-sided a theory. But the employment of the equivocal demonstration *falsus in uno, falsus in omnibus*, served only as a temporary defense against the laxity which prevailed in hospital management only a quarter of a century ago. Though Semmelweis died with no other reward than the scorn of his contemporaries, it is impossible at the present day to so much as contemplate the abuses he attacked without a shudder.

In 1860 Semmelweis published the result of his ripened experience in a treatise entitled "Die Aetiologie, der Begriff und die Prophylaxis des Kindbett-Fiebers," in which, abandoning his earlier exclusive position, he maintained that puerperal fever arises from the absorption of putrid animal substances, which produce first alterations in the blood, and secondly exudations. He distinguished between cases in which the infection was introduced from some external source, and which he believed to be the most frequent variety, and those where the poison was generated in the system. The sources from which the infection is derived he believed to be—1st, from the dead body, regardless of age, sex, or disease, no matter whether the latter is of puerperal or non-puerperal origin, the virulence depending upon the stage of decomposition; 2d, diseased persons, whose malady is associated with decomposition of animal tissue, no matter whether the affected person suffers from childbed fever or not, the decomposing matter alone furnishing the product from which infection is derived; 3d, physiological animal substances in the process of decomposition. As carriers of infection he regarded the fingers and hands of the phy-

sician, midwife, or nurse, sponges, instruments, soiled clothing, the atmosphere, and, in brief, anything which, after being defiled with decomposing animal matter, was brought into contact with the genitals of a woman during or subsequent to parturition. Absorption takes place from the inner surface of the uterus or from traumata in the genital canal. Infection seldom occurs in pregnancy, because of the closure of the os internum, the absence of wounded surfaces, and because of the rarity with which examinations are made; during dilatation infection is common, but exceptional during the period of expulsion, because the inner uterine surface is at that time rendered inaccessible by the advance of the child; in the placental and puerperal period infection occurs from utensils and instruments, but chiefly through the access of atmospheric air when the latter is loaded with decomposing organic matter. In rare instances auto-infection may result from spontaneous decomposition of the lochia, of bits of decidua, of coagula of blood, of necrosed tissue, or in consequence of severe instrumental labors. In a word, puerperal fever was, according to Semmelweis, no new specific disease, but a variety of pyæmia.

I have been thus particular in giving prominence to the labors of Semmelweis partly from justice to a man who was hated and despised in his lifetime, and partly because I believe that few outside of Germany are really cognizant of the immense service he rendered to humanity, or that to him is really due a large part of what is now current doctrine concerning the nature and prophylaxis of puerperal fever.

The Nature of Puerperal Fever as regarded from the Standpoint of Modern Investigation.—The older beliefs in the suppression of the lochia and the metastases of milk have long since been relegated to the domain of old nurse's lore, and do not call for serious discussion. The localist theory, that puerperal fever is a metritis, a peritonitis, a phlebitis, or an inflammation of the lymphatics, is, as mortuary records show, still adhered to by many practitioners, and, as we have seen, is justified by the fact that puerperal fever is, with rare exceptions, associated at some period of its progress with certain inflammatory processes which have their starting-point in the generative apparatus. But the localist theory leaves out of view the existence of blood-poisoning, and yet the coexistence of a blood-poison with the local lesions is an essential feature of puerperal fever. It was this defect which gave to the advocates of the specificity of puerperal fever their real importance. The outcome of modern investigation tends, however, to prove that the puerperal poison is of a septic nature, and that the usual points of introduction of the poison are the lesions of the parturient canal. This does not, indeed, exclude other points of entry, for clinical experience renders it probable that, under certain conditions, the poison may be primarily introduced into the blood through the respiratory and digestive organs. Puerperal fever is really a sur-

gical fever, modified, however, by the peculiar physiological conditions which belong to the puerperal state. The argument against its septic origin is based chiefly upon mistaken ideas concerning the nature of septicæmia. So long as the symptoms of the latter were derived for the most part from the effects observed as a consequence of injecting putrid materials into the veins of dogs, a confusion arose from the fact that the results obtained were commonly those of putrid intoxication, and not those of true septicæmia. Under such circumstances it was not difficult to formulate definitions of septicæmia which could be shown to be at variance with the phenomena which ordinarily exist in puerperal fever.

The argument that the infectious diseases of childbed are of a septic nature can best be understood by presenting the proofs in their orderly sequence.

1. *It is demonstrable that septic poisons are capable of producing the lesions ordinarily associated with puerperal fever.* Thus, it is a matter of ordinary expèrience that the retention of a small bit of the membranes within the uterus will produce fetid lochia, and, as the result of infection, a febrile condition, which, as a rule, subsides with the expulsion of the offending body and the use of disinfectant washes. A virulent form of fever is not unfrequently occasioned by retained coagula or placental débris which have undergone decomposition. I was once sent for to see a puerperal patient suffering from fever on the fourth day following her confinement. On entering the room I found the stench intolerable ; turning down the sheets, I discovered that the patient was lying in a decomposing mass, and learned that her doctor had forbidden, after the birth of her child, the removal of the soiled linen and blankets. The patient died in the third week from pyæmia multiplex.

Haussmann * reported a case of auto-infection in the rabbit which terminated fatally. A portion of the membrane, retained in the left cornu, led to diphtheritic losses of substance in the lower portion of the vagina, to hæmorrhagic enteritis, and to peritonitis. The same author produced death from septicæmia by injecting into the gravid uterus of one rabbit serum from the abdomen of another which had died from infection. The *post-mortem* examination showed the muscles filled with granules and the peritonæum injected, but no fibrino-purulent exudation. Injections into the uterus of pus from the abdomen of a woman who had died from infectious puerperal disease produced no effect upon rabbits two weeks gravid, while in the second half of pregnancy premature delivery and death occurred, in one case in one and a half, in another in two and a half, days. In the animal which died in thirty-six hours there was commencing perime-

* "Entstehung der übertragbaren Krankheiten des Wochenbettes," "Beitr. zur Geburtsk. und Gynaek.," Bd. iii, Heft 3, p. 345.

tritis and peritonitis, while in the one that died after the lapse of sixty hours the abdomen was found to contain fibrine and pus.* D'Espine injected into the uterus of a rabbit, which had just produced her young, pus from the abdomen of a woman who had died from puerperal disease two days before. This was subsequently followed by other injections of fetid fluids during the four days following. On the twelfth day the animal died. The autopsy revealed peritonitis, most marked in the pelvic cavity, inflammatory alterations in the vagina, uterus, and tubes, small abscesses in the body of the uterus, softened clots in the veins of the broad ligaments, and infarctions of the liver.† Schüller found that subcutaneous injections of septic material in female animals during pregnancy produced a diphtheritic ulcerative process on the uterine surface, which determined the separation of the placenta; diphtheritic patches, likewise, were found in the cornua of the uterus.‡

Thus we find that in the human subject and in experiments made upon animals, septic poisons introduced into the system following or near delivery produce lesions similar to those found in puerperal fever. As a further coincidence, we notice that, as in puerperal fever, the lesions from direct septic poisoning have nothing characteristic about them, producing in one case pyæmia, in another partial peritonitis, in another general peritonitis, in another diphtheritis, while in others the lesions are comparatively trivial, these differences being due to variable facta, such as the qualities of the septic poisons, the points of entry into the organism, and the resistance offered by the invaded tissues.

2. *Septicæmia is a disease characterized by the invariable presence in the organism infected of minute bodies generally termed bacteria.*#

Until very recently the whole subject of septicæmia has been in a state of well-nigh hopeless confusion. From Gaspard and Panum, through a long list of experimenters, hardly any two arrived at precisely similar results. Something like an approach to order has, how-

* "Contribution à l'étude de la septicémie puerpérale," Paris, 1873, p. 28.

† *Ibid.*, p. 394.

‡ "Experimentelle Beiträge zum Studium der septischen Infection," "Deutsche Zeitschr. für Chir.," Bd. vi, p. 141.

In 1865 Mayrhofer ("Monatsschr. f. Geburtsk.," vol. xxv, p. 112, 1865), at that time clinical assistant to the Lying-in Service of Braun, in Vienna, stimulated by the researches of Pasteur, maintained that septic endometritis was the result of putrid fermentation within the uterine cavity, and drew attention to the vibrios—a term which he applied to the round as well as to the rod-like bacteria—as the source, and not the product, of putrefaction. He claimed that while in puerperal processes vibrios are always present, in healthy women they never occur before the second, third, or fourth day, and not always even then. The chief progress that has been made as regards our knowledge of puerperal fever in the last ten years has been in the direction of strengthening Mayrhofer's argument by careful experiment, and by defining the action of microscopic fungi in the production of septic morbid processes.

ever, been produced since it has begun to be understood that the effects produced by septic fluids vary with the quality of the poison and the method of experimentation, and that to obtain identity in the result there must be identity in all the conditions. Thus, Samuel has shown that the same organic substance produces different effects at different stages of decomposition; again, that the enteritis which is commonly quoted as characteristic of septic poisoning occurs, as a rule, in animals when the septic fluid is injected directly into the blood, and is rare when it finds its way into the circulation through the lymphatics, as is the case usually in clinical experiences.* There is one experimental point of extreme practical importance too in connection with puerperal septicæmia—viz., that if the injection of a septic fluid be made directly into a vessel, toxic effects speedily follow, but are transitory, unless the amount of the fluid be large, or its virulence exceptional, or the animal very young;† whereas very small amounts injected subcutaneously, by developing rapidly spreading phlegmonous inflammation, resembling malignant erysipelas in man, are capable, after a period of incubation, of producing fatal results; or they may, if injected into a shut cavity or underneath a fascia, lead to the development of an inflammation of an ichorous character. In other words, the eliminating organs suffice, under ordinary conditions, to remove from the blood the same amount of septic fluid which would prove fatal if injected into the tissues.‡ To produce similar results the injections into the blood need to be repeated at intervals. This experience leads us to the conclusion that in the tissues septic poison possesses the capacity of self-multiplication, and that in the local inflammation set up a reservoir is formed from which poison is continuously poured into the circulation.

This capacity of self-multiplication which septic fluids possess has recently been found to be coincident with the presence of certain parasitic bodies, generically termed bacteria. All carefully made experiments serve to show that if a septic fluid be deprived of these organic bodies by boiling or filtration while it continues capable of producing inflammation, the inflammation is usually of diminished intensity and remains local in its character;# whereas the bacteria retained upon the filter possess all the virulent properties of the original fluid.‖ This

* *Loc. cit.*, p. 349.

† Traube and Gescheidlen, "Versüche über Fäulniss und den Widerstand des lebenden Organismus," "Schles. Ges. f. vaterländische Cultur," Feb. 13, 1874.

‡ In some instances in which absorption from the tissues is very rapid the effects of subcutaneous injections may be similar to those produced by injections made directly into the circulation, and the local lesion be insignificant.

In filtration through porous earthenware cylinders the filtrate possesses no phlogogenic properties.

‖ Tiegel, "Correspondenzblatt für Schweizer Aertze," 1871, S. 1275; Klebs, "Archiv für exp. Pathol. und Pharmakol.," Bd. i, Heft 1, S. 35.

does not alone necessarily prove that the virus resides in the bacteria, for it does not exclude the possibility that both the virus and the bacteria remain upon the filter.

So far, attempts at isolating the microspores of septicæmia and cultivating them separately in vehicles composed of water holding in solution inorganic constituents, or sterilized fluids containing organic matters, or of the semi-solid gelatinous substances recommended by Koch, have been only partially successful in proving them to be the sole source of infection. Some earlier experiments of Tiegel and Klebs* were attended with positive results, and more recently confirmatory evidence has been furnished by Pasteur and Doléris.† Hiller, rarely quoted now, arrived at different conclusions. He found that bacteria washed in pure water were innocuous.‡ But pure water had long before been proved by observers to be inimical to the well-being of the organisms in question. Schüller says that Hiller's experiments prove apparently that while a putrid fluid may be in the highest degree poisonous, its component parts—viz., either the fluid or the bacteria singly—are neither deadly nor poisonous.# The fact is, that isolation experiments are subject to what has hitherto been in most experiments an unavoidable source of error. As Davaine noted early in his observations, the physiological action of bacteria is very dependent on the constitution of the medium in which they are developed, which is in entire harmony with what is known of organisms much higher in the scale. "Many plants," says Burdon-Sanderson,‖ "containing active principles, become inert when transplanted from an appropriate soil." Bucholtz, in a series of experiments designed to test the influence of antiseptics upon the vitality of bacteria, found not only a difference between those taken directly from the infusion and those cultivated in artificial fluids, but between bacteria derived from the same source and cultivated in modifications of the nutrient medium.^ Then, too, it is not always safe to transfer to the human spe-

* "Archiv für exp. Pathologie und Pharmakologie," "Beiträge zur Kenntniss der pathogenen Schistomyceten," Band iv, Heft 3, S. 241 und ff.; Tiegel, *loc. cit.*

† In this connection may be mentioned some very interesting experiments by Dr. George Gaffky ("Experimentellen erzeugte Septicæmie, Mittheilungen aus dem Kaiserlich. Gesundh.-Amte"), in which micrococci from the blood of septicæmic mice were successfully cultivated in a gelatine preparation, and produced, when inoculated in small quantities, the symptoms identical with those obtained by inoculating the blood itself.

‡ "Exp. Beiträge zur Lehre von der organisirte Natur der Contagion und von der Fäulniss," "Archiv für klinische Chirurgie," Bd. xvii, Heft 4, S. 669 u. ff.

"Exp. Beiträge zum Studium der septischen Infection," "Deutsche Zeitschrift für Chirurgie," Bd. vi, S. 162.

‖ "Lectures on the Relations of Bacteria to Disease," "British Med. Journal," March 27, 1875. See also Klebs, "Beiträge zur Kenntniss der pathogenen Schistomyceten," "Arch. für Pathol. und Pharmakol.," Bd. iii, S. 321.

^ "Antiseptica und Bacterien," "Arch. f. exp. Pathol. und Pharmakol.," Bd. iv, Heft 1 und 2.

cies the results of experiments made upon the lower animals. Indeed, among animals, not only in different species, but in varieties of the same species, differences in the susceptibility to septicæmic poisons are found ranging from gradations as to the intensity of the effect produced to absolute immunity. In anthrax, a disease analogous to the one in question, the bacterial origin has been established beyond dispute by the inoculation of isolated bacilli, which multiply in the blood and permeate in enormous numbers the lungs, liver, kidneys, spleen, and glandular structures. If the same unequivocal testimony has as yet not been obtained from isolation experiments as regards septicæmia, it is reasonable to suppose that this is due to the defects in the technique, for which it is presumable the ingenuity of investigators will in future find the remedy.

It is, however, from the constant presence of the bacteria in infected wounds, and their distribution through the tissues, that the argument in favor of connecting septic symptoms with the bacteria has been mainly deduced. Here the ground is sufficiently solid, and, judged by ordinary laws of scientific evidence, the pathological importance of the microspores may be regarded as established. To be sure, we find them in tongue-scrapings of healthy individuals, but tongue-scrapings are poisonous if injected into the tissues. That they do not ordinarily prove so in the mouth is no more singular than that woorari can be swallowed with impunity. Tiegel* has endeavored to show that round bacteria are found normally in the internal organs of the body; but Koch† states that he has on many occasions examined normal blood and normal tissues by means which prevented the possibility of overlooking bacteria, or of confounding them with granular masses of equal size, and that he has never in a single instance found organisms.

It is stated that bacteria are sometimes absent from the blood withdrawn during life in septic diseases. As, however, their constant presence has been confirmed in the vessels and glomeruli of the kidneys, it is fair to assume that those organs, acting as filters, must have received the colonies observed in them from the general circulation.

The difficulty of obtaining bacteria from the blood in many cases during life in septic diseases does not, however, as was once supposed, invalidate the theory of their pathogenic importance. Septicæmia is at present employed as a collective term for a number of processes which may occur singly or in combination with one another. When a relatively large quantity of a putrid fluid is injected into the veins of an animal, death follows from the action of a chemical poison (sepsin). The blood during life rarely displays the presence of bacteria, the latter disappearing in the circulation. In animals thus

* "Arch. f. path. Anat. u. Physiol. u. f. klin. Med.," vol. lx, p. 453.

† "On Traumatic Infective Diseases," "New Sydenham Soc. Publication," p. 15.

poisoned, blood does not possess infectious properties. This form is termed putrid intoxication. That the poison in these cases is, however, produced by the bacteria is shown by experiments of Gutmann,* who demonstrated that bacteria from a drop of putrid blood cultivated in Cohn's solution developed in the fluid a poison which, when injected into the veins of dogs, occasioned death with all the symptoms of putrid intoxication. Still more conclusive were the experiments of Koch. This observer injected four drops of putrid blood beneath the skin of mice. The latter died in from four to eight hours. There were no bacteria in the blood, and the blood was not infectious. When, however, a single drop was injected, the mice often remained unaffected, but in a third of the cases they became ill after twenty-four hours, death occurring in from forty to sixty hours. The blood during life communicated the same disease to other mice, and bacilli were always present in large numbers. In these cases the dissolved poison in the fluid injected was too small in amount to destroy life, and death resulted only after a period of incubation as a consequence of the multiplication of bacilli in the blood and in the tissues.

In another class of cases Koch experimented, not with putrid blood, but with a fluid produced by macerating a piece of mouse-skin in distilled water. Of this he injected a syringeful into the back of a rabbit. The result was peritonitis, swelling of the spleen, gray, wedge-shaped patches in the liver, and in the lungs were found dark-red patches the size of a pea, devoid of air—all appearances in harmony with what is designated as pyæmia. Oval micrococci were found in great numbers everywhere throughout the body. But the point of special interest in the present connection is the fact that wherever these micrococci come in contact with the red blood-corpuscles the latter stick together and become arrested in the minute capillary network. The thrombi thus formed are further enlarged by the deposition of micrococci, which multiply, block up individual capillary loops, and invade contiguous tissues. In the blood-current itself, however, the micrococci do not increase in numbers, and can not always be found in the circulation upon a single examination, but Doléris† assures us that in puerperal fever by repeated trials, especially after a chill, he has never failed to demonstrate their presence.

As to the exact manner in which these minute bodies exercise their pernicious influence, whether they operate mechanically, or whether they produce a virus in the process of nutritive activity, or whether, as is probable, both suppositions are correct, must be decided by future investigations. It is enough for us to note that the connection between sepsis and bacteria is intimate and vital.

3. *Pathogenic bacteria are invariably associated with puerperal*

* *Vide* Semmer, "Putride Intoxication," etc., "Virchow's Arch.," vol. lxxxi, p. 109.

† "La fièvre puerpérale," etc., p. 120.

fever, and to them the infectious qualities of the disease are due. I have been explicit regarding the evidence concerning bacteria in septic diseases, because it places the question of the infectious group of puerperal fever cases in the following position : Experiences occurring clinically, as well as those produced upon animals, teach us that certain lesions and symptoms, similar to those we are accustomed to regard as characteristic of puerperal fever, result from septic poisoning. In a large class of cases, however, the connection between childbed fever and sepsis has been deduced rather from analogy than direct proof. For those who chose to regard such as due to a specific poison peculiar to the puerperal state there was really no objection. If, however, bacteria are characteristic of septic poisoning, the question presents itself in a different light, and we have to inquire whether, in the less obvious cases, bacteria are present in puerperal fever in the proportions and groupings that we find them in other diseases due to putrid infection. Now, it is precisely proof of this nature that has recently been abundantly rendered.

Waldeyer,* Orth,† Heiberg,‡ and von Recklinghausen # found the tissues and lymphatics of the parametria filled with pus-like masses, which consisted, in addition to pus-cells, chiefly of bacteria. Bacteria swarmed in the fluid of the peritoneal cavity. In one case examined by Waldeyer six hours after death, while the body was still warm, the peritoneal exudation was like an emulsion, and furnished an abundant deposit which consisted almost entirely of bacteria. Orth injected ten minims of peritoneal fluid from a woman dead of puerperal fever into the abdomen of a rabbit. As the animal was dying he broke up the medulla oblongata, and found in the peritoneal fluid enormous quantities of these organisms. In puerperal fever round bacteria have been likewise found, though in less quantities, in the lymphatics of the diaphragm and in the fluids of the pleura, the pericardium, and the ventricles of the brain. In *post-mortem* examinations of fresh subjects the serous fluids, withdrawn under proper precautions, do not contain round bacteria except in cases of septic infection.‖ Orth found in the purulent contents of the vessels of the funis, in children who died of sepsis, precisely the same formations as existed in the exudations of the mother.

Doléris, in a remarkable essay already referred to, published in

* "Ueber das Vorkommen von Bacterien bei der diphtheritischen Form des puerperal. Fiebers," "Archiv für Gynaekologie," vol. iii, p. 293.

† "Untersuchungen über puerperal. Fieber," "Virchow's Archiv," vol. lviii, p. 437.

‡ "Die puerperalen und pyæmischen Processe," Leipzig, 1873.

For the views of von Recklinghausen I am indebted to his pupil Steurer. *Vide* the writer's paper on "The Nature, Origin, and Prevention of Puerperal Fever," "Trans. of the International Med. Congress," Philadelphia, 1876.

‖ Klebs, "Beiträge zur Kenntniss der pathogenen Schistomyceten," "Archiv für exp. Pathol. und Pharmakol," vol. iv, p. 441 *et seq.*

1880,* furnishes not only conclusive evidence of the presence of bacteria in the various tissues and serous cavities of women dying of puerperal fever, but has added the evidence of their pathogenic character by cultivating them apart in sterilized fluids, and by reproducing in animals, by means of subcutaneous injections of the isolated bacteria, the infarctions, the blood-changes, and the suppurative processes of the original disease.

So far, the generic term bacteria has been employed to indicate the disease-germs which are the active agents of infection in puerperal fever. It is not, however, intended to assume that the germs of septic processes are all identical, or that they all produce precisely the same pathological conditions. Koch, indeed, maintains that a distinct specific bacterial form is found in such closely allied affections as pyæmia, septicæmia, gangrene, and erysipelas, the different forms possessing, however, this link in common, viz., that they are alike generated in putrefying media. Singularly enough, the bacterium termo and the bacterium commune—to which the fetidity of matters undergoing putrefaction is due—are in themselves harmless. They are rapidly destroyed in the circulation, and are not inoculable. Fetid discharges from wounds are not, therefore, necessarily dangerous. The putrid odor serves a useful purpose, as it gives warning of the existence of conditions which favor the development of life-destroying organisms; but the latter may develop without the concurrence of the forms which give rise to putrefaction, a fact of considerable importance in view of the common belief that septic infection is excluded by the absence of fetid odors.

In puerperal fever Doléris found the prevailing pathogenic organisms consisted of bacilli or rods, and micrococci or round bacteria in the varieties of micrococci, simple points; diplococci, double points; and chains or wreaths. The bacilli he regarded as the source of acute, rapid septicæmia, while pus-production was associated with the multiplication of the round bacteria, and especially of the diplococci.

4. *The presence of germs in puerperal fever serves not only to fix cases hitherto doubtful in the category of septic diseases, but affords the most satisfactory explanation of the protean phenomena of puerperal fever itself.*

We have seen, from both Koch's and Gutmann's experiments upon animals, that death may occur independently of bacteria by the rapid absorption of a chemical poison developed in a putrefying fluid. Clinical experiences, such as the speedy death sometimes observed when retained coagula or portions of placenta undergo decomposition within the uterine cavity, render it probable that similar cases of putrid intoxication are not unknown in puerperal women, though, so far, the anatomical demonstration of the fact has not been furnished.

* "La fièvre puerpérale et les organismes inférieurs."

In cases, however, where puerperal fever has a distinct period of incubation, and progresses step by step to the fatal ending, bacteria are always found invading the tissues of the genital canal. In rare cases they pass by the Fallopian tube to the peritoneal cavity and excite salpingitis and peritonitis. More commonly from local lesions they enter the canalicular spaces of the connective tissue forming the frame-work of the genital canal, which is continuous with the subperitoneal connective tissue of the pelvis. From the canalicular space they enter the lymphatics. Cellulitis is excited by their presence, and the lymphatic glands become inflamed and enlarged. In pernicious forms they produce a sero-purulent œdema, which spreads rapidly with a wave-like progress after the manner of erysipelas; or in milder cases the progress of the disease-germs is arrested by the lymphatic glands or the resistance offered by the tissues themselves, and the ordinary circumscribed phlegmon is produced. By the lymphatics which accompany the vessels of the Fallopian tubes they reach the ovaries (puerperal ovaritis), and by the broad ligaments they pass to subperitoneal tissues of the iliac and lumbar regions. Through the same system they are conveyed to the great serous cavities of the body. In the peritonæum they give rise, unless death occurs too speedily, to pyæmic peritonitis, which, unlike the traumatic form, is attended with but little pain, and for which the claim has been set up that it is peculiar to puerperal fever. The wide stomata upon the abdominal surface of the diaphragm allows the facile entrance of the organisms into its lymphatics. Waldeyer found in diaphragmitis the lymphatics of the diaphragm filled with bacteria. And thus, following the lymphatic system, if we only admit that bacteria are the active agents of sepsis, the frequency, in severe types of puerperal fever, of inflammation of the serous membranes of the peritonæum, the pleuræ, the pericardium, the meninges, and the joints, finds an easy explanation. Nor is it altogether accident which determines in different cases the precise serous membranes which are affected. The widespread ramifications of the lymphatic system would naturally give rise to eccentric inflammations in place of those following the apparent continuity of tissues.

The ductus thoracicus is the principal channel through which the bacteria enter the blood. It is possible that they may further obtain access into the circulation through the radicles which furnish the communications between the capillaries and the lymphatics. We have seen that bacteria are found with difficulty in the blood during life. A few hours after death they swarm in that fluid. That they do, however, enter the general circulation during life is incontestable. Steurer writes: "As the kidneys are the great filters of the human system, I never neglected to examine them, and almost invariably found micrococci filling the arterioles and glomeruli." This is in cor-

respondence with what occurs in other septic diseases, and accounts for the albuminuria and interstitial nephritis which often supervene in the advanced stages.

The action of the bacilli upon the blood differs materially from that of the round bacteria. So soon as the latter come in contact with the red corpuscles, the corpuscles stick together and form larger or smaller clots in the blood. They then are no longer able to pass through the minute capillary networks, but are arrested in the larger or smaller vessels (Koch). The micrococci in the resulting infarctions multiply, and migrate into the vessels and cellular tissue of the neighborhood. Thus fresh foci of infection are formed. Or by their destructive action they may, when situated near the serous surfaces, penetrate into the serous cavities, and in this way indirectly occasion peritonitis, pleurisy, meningitis, and purulent inflammations of the joints. When the micrococci enter directly into the circulation, they sometimes, in passing through the heart, adhere to the endocardium and the valves, where they cause exudation and ulceration, and give rise to the so-called endocarditis ulcerosa puerperalis.* The red globules of the blood undergo changes of shape, assume a stellate aspect, and rapidly disappear. The white globules are greatly increased in numbers, and the blood itself becomes nearly colorless. A certain amount of light is thrown upon these blood-changes by Doléris, who added micrococci to the fresh blood of a frog and watched the ensuing changes under the microscope. The micrococci could be seen in the act of penetrating the red globules, which thereupon lost their color and became shrunken, and, following the discharge of the organisms, which meantime had multiplied in an astonishing manner, little or nothing of the original globules remained.

In the bacillar form of septicæmia the blood is dark, and has a semi-gelatinous appearance, compared by French writers to partially cooked gooseberry jelly. The red globules, though they exhibit the various stages of deformation, are not diminished in number. The disease is further characterized by ecchymoses and minute apoplectic effusions, and by the absence of pus-formation. In the artificial septicæmia produced by Koch in mice by means of bacilli, the rod-like organisms were found to enter the white corpuscles, and to compass their destruction. They did not cause the red globules to adhere together, and there was no clogging of the capillary circulation. All the principal structures of the animals subjected to experiment were infiltrated with bacilli. The distribution of the latter was apparently accomplished by the blood-vessels, and not by the lymphatics, the bacilli probably effecting their entrance into the vessels by virtue of their penetrative power, in place of traversing performed pathways.

* Heiberg, "Die puerperalen und pyæmischen Processe," Leipzig, 1873, pp. 22 and 34, with references to cases reported by Wiege and Eberth.

Possibly it is this action of the bacilli which causes the weakening of the vessel-walls, as evidenced by the large number of red corpuscles which pass out from them.

In puerperal fever it is rare to find either round bacteria or bacilli acting singly as the agent of infection. As a rule, both forms exist together in varying proportions, the predominant form, however, determining in general the character of the symptoms.

Thrombosis of the veins may be a physiological phenomenon, or may be due to an alteration of the blood, to weakness of the heart, or to local influences. So long as the clot remains firm its influence is limited to disturbances of the circulation. The pyæmic symptoms—viz., suppuration of the coagulum, the separation of emboli, and the formation of metastatic abscesses—are always dependent upon the presence of round bacteria. In phlebitis the latter are found in the endothelium and in the sheaths of the veins. The inflammation of the veins is followed by thrombosis. According to Doléris, micrococci derived from the blood are deposited upon the central extremities of the clots; beyond these dépôts a fresh inflammation is set up, followed by fibrinous coagulation. Thus the micrococci become imprisoned between two plugs. The same process may be repeated until a series of abscesses is formed. For a time no mischief may ensue. Finally, however, the resistance of the outworks is overcome, an embolus becomes detached, and an infectious abscess is opened into the blood—an event which is announced by an intense chill and the familiar systemic derangement.

In septic diseases death takes place from apnœa, partly from the inability of the blood-corpuscles to carry oxygen to the tissues, and partly from paralysis of the nerve-centers.*

In hospital epidemics of puerperal fever, diphtheritic patches, situated upon the lesions of the vulva and in the course of the utero-vaginal canal, are sometimes observed. Steurer found these patches were always associated with loss of substance, and were composed of disintegrated fibrine, white and red blood-globules, and colonies of round bacteria in great abundance. Morphologically, these so-called diphtheritic patches are identical with those which appear in the throat. Pallen † has reported an instance of the simultaneous occurrence of puerperal diphtheritis in the mother, and throat diphtheritis in the two-weeks'-old child. In lying-in hospitals it is the genital organs, as the locus resistentiæ minoris, and not the throat, which are the usual points of attack.

The question as to the extent to which erysipelas and puerperal fever are cognate diseases is in a fair way to be solved by recent investigation. Orth took the contents of a vesicle from an erysipelatous

* Schüller, "Exp. Beiträge zum Studium der septischen Infection," "Deutsche Zeitschr. f. Chir.," vol. vi, p. 149 *et seq.* † "Trans. N. Y. Obst. Soc.," 1876–'78, p. 78.

patient which contained bacteria in great abundance, and employed the same for injections under the skin of rabbits. In this way he succeeded in producing in these animals a species of erysipelas malignum. In the subcutaneous œdema and affected portions of the skin he found enormous masses of bacteria, so far exceeding in quantity the amount introduced as to prove an abundant new production.* Samuel produced similar results by the injection of ordinary putrid fluids containing round bacteria. An affection resembling simple erysipelas he obtained most frequently by the application of fluid to a wound torn open after the second or third day.† Lukomski found that erysipelas could be produced by fluid containing micrococci even when putrefaction did not exist. The contents of erysipelatous vesicles containing no micrococci excited no morbid manifestations. Where the erysipelatous process was fresh and progressing, micrococci were found in great abundance in the lymphatics and canalicular spaces. Where the process was retrogressive, there were no micrococci to be found, even in cases in which inflammation existed to an intense degree. ‡ Doléris submitted to the culture-process of Pasteur fluid obtained from vesicles which developed in the course of facial erysipelas in a man of forty years. Micrococci in chains were found in the liquids employed identical with those he had discovered in puerperal fever. In many cases I have seen an erysipelatous inflammation start from a puerperal diphtheritic ulcer upon the introitus vaginæ, and extend outward over the buttocks, the thighs, and the lower portion of the abdomen.

Virchow# has so far given in his adhesion to the new school as to say: "Especially in this connection are to be mentioned the diphtheritic process and the erysipelatous, especially erysipelas malignum. The granular deposit in diphtheritically affected tissues, of which I formerly spoke, has more and more proved to be of a parasitic character. What we formerly regarded as simple, organic granules, as infiltration or exudation, has since proved to be a dense aggregation of micro-organisms which penetrate into the tissues and cells to compass their destruction."

Thus we find in surgical fever, in puerperal fever, in diphtheria, and in erysipelas, the presence of a common element which links them together, and which establishes the relationship which has long been recognized as existing between these various processes.

5. *The differences between surgical and puerperal septicæmia are due to differences partly structural and partly physiological in the wounded surfaces exposed to septic contamination.*

* "Untersuchungen über Erysipel.," "Arch. für exp. Pathol. und Pharmakol.," Bd. i, S. 81.

† "Arch. für exp. Path. und Pharmak.," Bd. i, S. 335 u. ff.

‡ "Untersuchungen über Erysipel.," "Virchow's Archiv," Bd. lx, S. 430.

"Die Fortschritte der Krieg's Heilkunde," Berlin, 1874.

A certain amount of misapprehension has arisen from the circumstance that, along with many coincidences in the symptoms of puerperal and surgical fever, there are observable differences which, from a purely clinical point of view, would justify a separate classification of the two affections. It will not do, however, to ignore the fact that the conditions which prevail in the parturient canal subsequent to labor have no strict analogue in the lesions which the surgeon is called upon to treat, and that therefore a complete identity as to all the clinical features of puerperal and surgical fever would hardly be within the range of possibility.

In the puerperal state it is necessary to take into account the blood-changes induced by pregnancy, the effects of shock and exhaustion in protracted labors, the frequency of hæmorrhage, the deep situation of puerperal wounds, the presence of clots, decidua, and dead tissue in a state of disintegration or decomposition, the ease with which deleterious matters are absorbed by the wide lymphatic interspaces, the serous infiltration of the pelvic tissues, the exaggerated size of the lymphatics and veins, and the proximity of the peritoneal cavity.

Samuel,* in speaking of the immunities and dispositions to septic poisoning, says: "The statistical frequency of septic puerperal disease is due to the length of the parturient canal, to the fact that through this long passage there must pass all the pathological and physiological excretions, and to the soiling of these parts with fingers, instruments, and secretions which have become the bearers of sepsis." He found, on the other hand, that it was extremely difficult to produce a progressive ichorous condition by daily painting an open stump with a septic fluid,† though the same was readily obtained when an infinitesimal quantity of septic fluid was injected underneath a fascia.

6. *In the present state of our scientific knowledge it is necessary to admit that there is a limited number of febrile and inflammatory disturbances occurring in puerperal women, the bacterial origin of which may be fairly questioned.* As illustrations of this class may be mentioned: 1. Cases of catarrhal endometritis due to errors of diet and exposure. Indeed, I have frequently, in hospital practice, been able to trace severe cases of cellulitis, pelvic peritonitis, and general peritonitis, occurring in the winter season, to the patient getting out of bed dripping with perspiration, and clad only in a night-dress, and going thus barefooted over a cold, uncarpeted floor to the water-closet. 2. Cases of puerperal disorders proceeding from emotional causes, the nervous system furnishing the first impulse to the disturbed action. 3. Cases of excessive vulnerability in non-pregnant women; individuals are sometimes found so susceptible that a para-

* "Ueber die Wirkung des Fäulniss-Process auf den lebenden Organismus," "Arch. f. exp. Pathologie," vol. i, p. 343.

† *Loc. cit.*, p. 339.

metritis follows a simple application of the tincture of iodine to the cervix. 4. Cases of pelvic peritonitis starting from old intra-peritoneal adhesions. 5. Cases of peritonitis and retro-peritoneal inflammations secondary to ulcerative processes in the cæcum or the descending colon. This condition is apt to be masked during pregnancy, but starts into activity during childbed as a consequence of fecal accumulation or of excessive purgation.

It is by no means easy to decide as to the precise nature of local inflammations following lacerations of the cervix and the bruising or crushing of the soft parts in long or instrumental labors. The marvelous absence of heat, pain, redness, and swelling in wounds treated in strict accordance with the principles of Lister, the very slight reaction when the atmosphere is pure, and the severity of these symptoms in overcrowded hospitals, tend indeed to strengthen the belief that even the simplest inflammations proceeding from wounds owe their origin in great part to septic germs. But, on the other hand, in hospital practice it is not uncommon to observe puerperal inflammations and febrile conditions which possess this distinctive peculiarity—that they in no wise visibly affect the health of puerperal patients in their vicinity. The symptoms of blood-poisoning, too, are either absent or present to a subordinate extent. Probably the difficulty is best solved by assuming, with Genzmer and Volkmann,* that there is such a thing as an aseptic surgical fever due to the absorption of the products of physiological tissue-changes at the seat of injury. In surgical cases, even where the precautions of Listerism have been faultlessly observed, febrile movements of considerable intensity, but of no prognostic signification, are of frequent occurrence. While in puerperal women we can never exclude the possibility of the septic infection of puerperal wounds, it is in accordance with clinical experience to assume that a high fever belonging to the aseptic class may coincide with a septic process of insignificant proportions.

General Symptoms.—As in other infectious diseases, there is, from the time of the entry of the poison into the system up to the outbreak of fever, a distinct period of incubation. The first febrile symptoms usually occur within three days of the birth of the child. An attack coming on a few hours after childbirth is indicative of infection during or previous to labor. The third day is the one upon which, ordinarily, the beginning of the fever is to be anticipated. After the fifth day an attack is rare, and at the end of a week patients may be regarded as having reached the point of safety. Apparent exceptions to this rule are probably referable to cases of mild parametritis, in which the initial fever and the pain were insufficient to attract attention to the existence of local inflammation.

* Genzmer and Volkmann, "Ueber septisches und aseptisches Wundfieber," "Samml. klin. Vorträge," No. 121.

The symptoms of puerperal fever vary with the character of the local affections, and with the extent to which the general system participates in the disturbed action. The different groups of puerperal processes possess the following pathognomonic symptoms—viz., increased temperature, enlargement of the spleen, disturbed involution, and sensitiveness of the uterus upon pressure (Braun).

In most cases the fever is ushered in by chilly sensations, or by a well-defined chill. This symptom, however, does not possess much prognostic importance. A chill is significant of a sudden change between the temperature of the skin and that of the surrounding medium. It may, therefore, be absent in pernicious forms of fever, provided only that the temperature changes are inaugurated slowly, whereas it may follow a trifling increase of the body-heat if, as sometimes happens in sleep, the moist skin is exposed to cool currents of air. Repeated chills indicate phlebitis and pyæmia.

In order to grasp the many symptoms of puerperal fever, it is necessary to keep separately in mind the clinical features of each of the local processes, although in fact the latter rarely occur singly, but to a greater or less extent in combination with others.

The Symptoms of Endometritis and Endocolpitis.—The uncomplicated catarrhal inflammation of the uterus and vagina is the most frequent and the mildest of the diseases of childbed. In endometritis the uterus is large, flabby, and sensitive upon pressure ; the after-pains are often unusually severe, involution is retarded, and the lochia become fetid, remain sanguinolent for a longer period than usual, and at the outset may be temporarily suspended. Sometimes the large intestine is distended with flatus. In endocolpitis the vaginal discharge is thin and purulent, the patient experiences pain and burning in the acts of defecation and urination, and, where the wounds of the vulva and vagina assume an ulcerative character, there is often found at the same time inflammatory œdema of the labia.

The fever in these cases is ushered in frequently, but not always, by chilly feelings, and the temperature reaches its height usually upon the evening of the third or fourth day, is remittent, almost intermittent in character, and rarely exceeds 102° to 103° Fahr. In mild forms the occurrence of the fever is often overlooked, or is referred to disturbance produced by the secretion of the milk. In severer attacks the febrile symptoms may continue from three to seven days. At the end of a week the swelling of the labia subsides, the discharge becomes thick, and ulcers, if present, begin to assume a healthy granulating appearance.

In diphtheritic ulcerations, and in endometritis due to decomposing remains of the ovum, the local condition is often complicated by the invasion of the neighboring tissues.

The Symptoms of Parametritis and Perimetritis (Pelvic perito-

nitis*).—The symptoms of these two affections, as would be naturally expected from the proximity of the peritonæum to the pelvic connective tissue, for the most part overlap. It must be very rare for one form to occur entirely independent of the other. For this reason it will be found convenient to consider first the symptoms common to both morbid processes, and subsequently to direct attention to what are believed to be points of distinction between them.

During the period of incubation there are usually no prodromic symptoms. Elevations of temperature in the course of the first twelve hours following labor are equally frequent under perfectly normal conditions. Suspicious symptoms are disturbed sleep, excessively painful after-pains, and a pulse of 80 to 90.

The beginning of the fever occurs in 90 per cent. within the first four days of childbed; most frequently upon the second or third day, and taking place upon the fourth day in scarcely 12 to 15 per cent. of the cases. If five days have elapsed without fever, the period of danger, with very rare exceptions, may be regarded as having passed.

At the outset the fever, especially in perimetritis, is ushered in by chilly sensations or by an intense chill. The temperature rises rapidly, though the highest point is usually not reached before the second, and in rare cases not before the third day. In most cases the heat in the axilla exceeds 103°, and may even mount up to 105°. The decline occurs gradually, the fever ending in 70 per cent. in the course of a week, in 20 per cent. in two weeks, and only in 10 per cent. extending beyond that period. Protracted cases indicate abscess formation.

The fever does not, however, always pursue a regular course. In place of progressively declining until the termination is reached, the high temperature of the second day may be attained upon one or more occasions. The morning remissions are at first slight, but become marked as the disease approaches its close. In cases of long duration the morning hours are often free from fever, a circumstance calculated to mislead a physician who sees his patient but once a day. A pulse of 80 to 90 beats, a disturbed sleep, lack of appetite, and sensitiveness to pressure upon the sides of the uterus are, however, symptoms which should serve as a warning of some disturbing cause, and should lead the physician to renew his visit in the latter part of the day.

If, from a mistaken notion that the morbid process has come to an end, the patient is allowed prematurely to resume her household duties, the pains across the abdomen and along the hip and thigh return, and an examination reveals the existence of exudation in the pelvic cavity or upon an iliac fossa.

* The following clinical history, together with the statistical details, is borrowed in great part from the description of Olshausen ("Ueber puerperale Parametritis und Perimetritis," Volkmann's "Samml. klin. Vortr.," No. 28), the exactitude of which I have had abundant opportunity to verify.

Errors of this kind are most frequent in cases of parametritis associated with slight peritoneal inflammation, as the local pain is then insignificant, and the initial chill, happening on the third or fourth day, is apt to be ascribed to engorgement of the breasts.

Relapses after the complete disappearance of febrile disturbance occur in 15 to 20 per cent. They are usually shorter, but sometimes more obstinate, than the original attack. As a rare exception may be mentioned cases with evening remissions and morning exacerbations.

In circumscribed pelvic inflammations the pulse rarely exceeds 120 beats to the minute. A pulse of 140, of more than half a day's duration, betokens severe septic complications, and is therefore of evil omen. In some cases the slow pulse observed after labor makes its influence felt in the first day or two of the fever, so that the curious phenomenon may be witnessed of a temperature of 104° coinciding for a time with a pulse ranging between 50 and 70 beats to the minute.

As regards other symptoms, headache and sleeplessness are rarely absent. Profuse sweating follows the first febrile attack, and frequently recurs during the course of the disease.

Pain is present at the onset in the majority of cases, and is then usually most violent. The spontaneous pain, which is due to the affection of the peritonæum, subsides in great part in the course of one or two days, but the sides of the uterus remain sensitive to pressure. In the rare cases of pure parametritis, however, this symptom may be absent altogether. The pain, like that from the inflammation of serous membranes, is of a lancinating character. Sometimes it is associated only with the contractions of the uterus. After-pains occurring under usual circumstances, as in primiparæ or after the third day, are to be regarded with suspicion.

Vomiting occurs occasionally, but is comparatively rare unless the peritonitis becomes diffused and spreads to the region of the stomach. The appetite is lost, and only returns, as a rule, with the departure of the fever. The tongue is coated and moist, and constipation is common. In other cases there is diarrhœa with rumbling in the bowels, but without pain or tenesmus. The urinary secretion is rarely interfered with, and when this is the case it indicates the extension of the inflammation to the peritonæum covering the bladder.

Most cases of perimetritis and parametritis terminate in five or ten days, the fever and other symptoms gradually subsiding. When, as may happen in exceptional instances, the temperature falls suddenly from a high degree to one below the normal level, the body grows icy cold, the pulse becomes small and irregular, and symptoms of collapse develop. But in twelve to twenty-four hours the symptoms of collapse subside, and the disease reaches its end with a disappearance of the alarming manifestations.

If the fever subsides within a week, exudation is somewhat rare.

Its continuance beyond that date should lead to a careful exploration of the pelvic organs. The exudation is usually demonstrable in the course of the second week or at the beginning of the third week. It is recognized, according to its location, by external or by internal examination, or, where the deposit is considerable, by both methods. In most cases the deposit is extra-peritoneal, and is situated between the folds of the broad ligament, above and to the sides of the vaginal *cul-de-sac*. It has generally a rounded form, though with less convexity than fibrous and ovarian tumors. Sometimes, however, the tumor is flat below, like a board. It seldom exceeds in size that of a large apple. In fresh exudations the sensation produced is often that of a hard tumor surrounded by a softer layer, due to continued succulence of the soft parts. In a few weeks they may reach or exceed the hardness of a fibroid tumor. The older the tumor, unless suppuration sets in, the less sensitive it becomes. Often the exudation extends to the pelvic walls. The uterus, as a rule, is fixed, and, in cases of large tumors, becomes pushed toward the opposite side, while, as a consequence of later shrinkage, the fundus may be drawn permanently toward the affected side.

The *cul-de-sac* of the vagina is rendered broader and flatter by the pressure of the deposit, or, when the tumor is deep enough, the vaginal surface may be rendered convex. Behind the uterus the exudation is as it were flattened antero-posteriorly, and in some cases it may be felt in the form of rigid bands between the posterior ligaments which inclose the *cul-de-sac* of Douglas. The ante-uterine tumors have a spherical shape and depress the vagina anteriorly.

Tumors situated in the iliac fossa have a more or less convex form, and may be of such considerable size that the swelling may be recognized by the eye through the abdominal walls. As the exudation between the broad ligaments may in these cases have been slight from the beginning, or may have subsequently disappeared by absorption, the iliac tumors have often apparently a spontaneous origin.

Sometimes the uterus is surrounded by exudation, and the entire pelvis appears as though it were a mold filled with a solid mass. The fornix is then often pressed downward, and irregular rounded masses are to be felt through the vaginal walls.

The recognition of parametritic tumors through the abdominal coverings is possible when they are situated above Poupart's ligament, in the upper portion of the broad ligaments, and in the iliac fossæ.

The pain and the functional disturbances in the pelvic organs depend upon the size and situation of these inflammatory deposits. Of the functional troubles may be mentioned frequent and painful micturition, obstinate constipation and difficult defecation, contractures of the ilio-psoas muscles when the exudation is seated beneath the sheath or between the muscle and the pelvic bones, disturbances of

motility in the abductor muscles, paresis of the lower extremities, and radiating pains in the upper portion of the thigh and in the renal and lumbar regions, produced by pressure upon the obturator, the crural, the cutaneous, and the sciatic nerves.

So long as fever is present the exudation rarely diminishes. If absorption takes place in one point, growth almost certainly follows in some other direction. When, however, the apyretic period is reached, the exudation, as a rule, disappears rapidly, so that often in the course of six weeks no trace of its existence remains. In a smaller number the solid mass may persist for months or even years.

After the fever has departed the patient usually feels well. The sleep and appetite return, the night-sweats disappear, the pulse often falls to 50 or 60 beats, and the temperature is in many cases for a time subnormal in character.

Where the fever persists for from five to six weeks, there is always a suspicion of abscess formation. With the exception of afternoon fever and night-sweats, the patient may feel very comfortable. Then the exudation becomes sensitive, the spontaneous pains recur, sleep is lost, and locomotion, defecation, and urination occasion acute suffering. The fever becomes violent, chills announce the presence of pus, and finally, about the seventieth or eightieth day, perforation of the abscess takes place. The usual seat at which the pus is discharged is just above Poupart's ligament; next in frequency perforation takes place into the colon, and in rare instances into the bladder, the uterus, and vagina. Fortunately, of very rare occurrence is the discharge of pus into the peritoneal cavity, which is naturally followed by acute peritonitis. Another likewise unfrequent but most dangerous accident is the septic infection of the abscess—an occurrence referred by Olshausen to the diffusion of intestinal gases through the walls of the tumor.

In suppuration of parametritic exudations the pus commonly forms in small scattered collections, and rarely gives rise to large abscesses.

Although parametritis and perimetritis are usually found associated together, there are always cases in which the one form of inflammation so far predominates over the other as to justify an attempt to establish a clinical distinction between them.

In the beginning of the attack, sharp pain, high fever, and tympanitic distention of the lower abdomen are symptomatic of inflammation in the pelvic peritonæum. Whether the cellular tissue is simultaneously implicated can only be determined by a digital examination after the abdominal sensitiveness has subsided. The absence of the objective signs of cellulitis would then contribute to prove that the case had been one in which the peritonæum had been in the main affected. On the other hand, moderate fever, pain elicited only on pressure, and tympanitic distention confined to the colon, coinciding

with exudation between the folds of the broad ligament, would be indicative of a nearly pure cellulitis.

A palpable exudation is by no means the necessary product of peritoneal inflammation. Indeed, in many cases, the distinctive symptoms of the latter may be present for from four to eight days, and may then subside without leaving a trace of its existence at the pelvic brim.

The demonstration of a fluid effusion by noting the change of level upon shifting the position of the patient is rarely possible, either because the quantity is too small or because it quickly becomes confined by pseudo-membranous adhesions between the intestines.

Bandl* mentions as a sign of local peritonitis, sometimes noticeable, a number of resistant points or tumors near the pelvic brim or above one of the iliac fossæ, due to a matting together of the intestines or to their adhesion to the uterine appendages. They are distinguished from solid tumors by their emitting a tympanitic sound upon percussion and by their changing position in consequence of an accumulation of urine in the bladder or of fæces or gases in the bowels. Again, all tumors may be reckoned as intra-peritoneal which very rapidly form behind or to the side of the uterus from inclosed exudation-products, and which at the same time rise far above the level of the pelvic brim. If, however, they start from the *cul-de-sac* of Douglas, and do not much exceed the lineal terminalis, or if they occupy an iliac fossa, it becomes very difficult to decide whether they are of intra- or extra-peritoneal origin. The peritoneal exudation, however, long remains soft and fluctuating. It arises, as a rule, behind the uterus, and does not exhibit a tendency to spread to the sides or to the anterior or posterior pelvic walls.

Still more difficult is it to decide as to the seat of exudations met with beneath the abdominal walls. When diffused and continuous with a pelvic deposit, the diagnosis is uncertain. It is only safe to assume the peritoneal origin of extravasations of a rounded form, of a fluctuating consistence, and when they are situated high up and are disconnected from exudation at the pelvic brim. An opening of the abscess through the navel would indicate a peritoneal source, while the discharge through the abdominal parietes would point to a seat in the connective tissue.

After the perforation of an abscess the fever and pain subside; the wound, if external, either closes in the course of one or two weeks, or fistulæ form which become the source of protracted suppuration.

In psoas abscesses the exudation extends beneath the sheath of the muscle or between the iliacus and the bone. In puerperal patients they proceed from an inflammation originating in the broad ligament. They are situated too deep to be easily palpated. The pains they occasion are referred rather to the hip or knee than to the abdomen.

* "Handbuch der Frauenkrankheiten," red. von Billroth, 5ter Abschnitt.

The contracture of the psoas muscle furnishes a diagnostic sign which distinguishes this form from the superficial abscesses of the iliac fossæ. The pus eventually is discharged beneath Poupart's ligament, in the lower portion of the inguinal fossa, at some point upon the crest of the ileum, or exceptionally along the thigh. Often the discharge is maintained for months.

The Symptoms of General Peritonitis.—This form generally begins with the usual symptoms of pelvic inflammation, but the tenderness, which at first was limited to the side of the uterus, gradually spreads over the entire abdomen. The abdominal pain is of a tearing, lancinating, sometimes colicky character. It is increased by the slightest bodily movement, by jarring of the bed, or even by the weight of the bedclothes.

As a consequence of the peritoneal inflammation and of the accompanying exudation, the muscular walls of the bowels become paralyzed, and tympanitic distention results from the accumulation of gases. In the dependent portions of the peritoneal cavity it is often possible to demonstrate by percussion the presence of fluid exudation, though distinct fluctuation is rarely to be made out. The size of the abdomen is due much more to the tympanites than to the amount of effusion. Sometimes the liver, with the diaphragm, is pushed by the swollen bowels to the level of the fourth or third rib, and exercises such a degree of compression upon the posterior portion of the lungs as to place the patient in danger of suffocation. The respirations are jerky and attended with a moaning sound.

The loss of muscular power in the intestines permits the contents of the middle portion to pass unchecked toward the duodenum, and thence, upon accidental contractions of the abdomen, they may pass to the stomach and be ejected by vomiting. The first vomited matter has a dark-green color, and that ejected afterward presents the color of intestinal matter. Constipation at the outset may be subsequently followed by colliquative diarrhœa.

The fever begins, as a rule, though not always, with an intense chill, the temperature rises to 104°, and the pulse becomes small, hard, and resistant. Its frequency rapidly increases, varying from 120 to 160 beats to the minute. The skin is sometimes dry, sometimes dripping with perspiration. In fatal cases, as the end approaches, the temperature frequently falls, while the pulse becomes more rapid, the face assumes a pinched, anxious expression, sweat gathers upon the forehead, the extremities grow icy cold, and the patient dies in collapse. The duration of peritonitis averages not more than from four to six days.

In cases of recovery the pulse improves, the vomiting ceases, and the tympanitis disappears. The diffuse exudation then becomes converted into circumscribed tumors, which on palpation are felt on the

side of the pelvis and extending upward to the level of the umbilicus. Upon internal examination, the uterus is often found depressed by the weight of the fluid, which likewise may bulge the *cul-de-sac* of Douglas into the pelvic cavity. Sometimes the exudation may become encysted above the pelvis and leave the contents of the latter free. In still other cases the uterus may become attached high up to the abdominal walls, so that the vaginal portion disappears and the os is reached with difficulty.

The peritoneal exudation may, as in pelvic inflammations, become absorbed and disappear. When, however, it is surrounded by loops of intestines it is apt to undergo purulent and septic changes, and the abscesses may then become discolored and filled with stinking gases. The patient, whose previous improvement has been watched with delight, now loses appetite, the pulse becomes frequent, the strength fails, and death may follow from septic fever or from rupture of abscess into the abdominal cavity.

In the pyæmic form—a still more deadly variety of peritonitis—the symptoms differ materially from those which have been recounted. As, however, it constitutes only a single one of the pathological changes connected with the poisoning of the blood through the lymphatic system, its consideration belongs properly to the study of the septic infection.

The Symptoms of Septicæmia Lymphatica.—The symptoms of blood-poisoning in the infectious diseases of childbed vary to a considerable extent according to the channel through which the septic germs enter the general circulation. In the murderous epidemics which prevail in lying-in hospitals the lymphatics are, as a rule, the vessels primarily invaded. It is to this form that the cases already described belong, where, with diphtheritic patches upon the utero-vaginal canal and sero-purulent œdema of the parametrium, there are associated pyæmic peritonitis and deformation of the blood-corpuscles; or where, following the migrations of the round bacteria, the serous cavities become successively involved, septic vegetations gather upon the heart, and the glomeruli of the kidneys become choked with micrococci. The lymphatic form of septicæmia develops soon after labor, and is always ushered in by a chill. The temperature rises to 104° or even higher, and the pulse is thin and frequent. The abdomen swells rapidly, without being especially painful. Indeed, painless distention of the intestines is one of the characteristics of an acute invasion of the lymphatics. Peritoneal effusion is absent in cases which run a rapid course, and is distinctly recognizable only in a peritonitis of long continuance. The effusion is not so much due to exudation as to a transudation of serum with which micrococci are commingled. At the same time the tongue is moist, but slightly coated, and at times quite clean. Sometimes there is diarrhœa, due to catarrh or to a diphthe-

ritic affection of the colon. When the bowels have been constipated, the administration of a purgative may provoke discharges which it may be found difficult to arrest. The skin is bathed in perspiration. At the beginning and during the course of the disease, bleeding at the nose is not of infrequent occurrence.

Toward the end the pulse runs up to 140 to 160 beats, while in many cases the temperature falls. Immediately after death the heat of the body may for a short time exceed the highest point reached during life. The respirations are superficial and jerky. In many instances the face, the neck, and the fingers are blue from defective oxygenation of the blood. At the same time the skin becomes clammy and the extremities cold.

The sensorium, in cases which run a rapid course, is usually affected at an early period. The patients appear somnolent, are restless in bed, have light delirium, and respond only when spoken to loudly. As a rule, they make but little complaint, and, were it not for the dyspnœa, would have nothing to disturb their sense of comfort. Very few, even as death approaches, have any idea of the danger that threatens them. Now and then, in place of stupor, great restlessness, and even a maniacal condition, is developed. Albumen is usually found in the urine.

Pleurisy, so frequently associated with lymphatic septicæmia, is frequently double, more rarely single, and begins, as a rule, with sharp pain in the side and an aggravation of the previous dyspnœa. Pericarditis is less frequent, and occurs usually, without symptoms, toward the close of life. The joint affections are characterized by redness and swelling, and by pain, which is sometimes so great that touching the inflamed part suffices to arouse the patient from sopor. Sometimes fluctuation is felt, but death occurs before perforation and discharge of the pus.

The most frequent ending is death, which follows in from two to twenty-one days, and, as a rule, between four and seven days. Recovery is, however, possible.

The Symptoms of Septicæmia Venosa (Phlebitis uterina, Pyæmia metastatica).—The putrid infection of a thrombus at the placental site may take place within twenty-four to forty-eight hours after labor. Usually, however, the approach is insidious, and the disease develops from an apparently insignificant endometritis or parametritis; or the patient, with the exception perhaps of a tired feeling, of slight chilly sensations, and of profuse perspiration, may not have been conscious of any indisposition for days preceding the attack, or even until the first getting up from childbed. The initial chill in typical cases is characterized by its violence and duration. In some cases it may last for hours. It is accompanied and followed by high temperature, the febrile attack ending with profuse perspiration as in intermittent fever,

with which it is apt to be confounded. The fall in temperature often assumes the form of a prolonged remission.

In many cases the pulse rises and falls with the variations in the body heat, while in others it remains permanently above the average. A frequent pulse is always a suspicious symptom in childbed, even where the other symptoms are apparently normal.

Erratic chills announce the lodgment of emboli in distant organs. With the formation of metastatic abscesses in the lungs and other parenchymatous organs the typical character of the disease changes. In place of chills occurring at irregular intervals, followed by remissions and periods of apparent improvement, the fever is continuous, the pulse becomes small and rapid, while sopor, slight delirium, a dry skin, a dry, brown, cracked tongue, and a moderately tympanitic abdomen, give the case the appearance of one of typhus fever.

Peritonitis is present in hardly one third of the cases. The abdomen is therefore flat and soft, and often is not sensitive upon pressure. Icterus, due to disintegration of the blood-corpuscles, is an ominous symptom.

Death usually occurs in the second or third week. In the typhus-like cases, however, it may follow the first attack speedily. Recovery is possible where the organs secondarily affected are not of too great importance.

A combination of the lymphatic and venous forms of septicæmia is not uncommon in cases running a protracted course.

The Symptoms of Pure Septicæmia.—Under the title of pure septicæmia should be placed cases in which the absorption of putrid materials into the blood gives rise to symptoms of intense blood-poisoning without the development of local lesions. A common example of this form is met with in the fever which results from the presence in the uterus of decomposing coagula or portions of retained ovum, the fever subsiding with the removal of the disturbing cause. In like manner we sometimes meet with cases of intense septic poisoning followed by speedy death, in which the *post-mortem* examination reveals only changes in the blood and softening of the parenchymatous organs. The symptoms are often similar to those produced by the injection of putrid materials containing rod-like bacteria into the vessels of animals. As the long bacteria do not possess the capacity of self-reproduction in the blood, to produce fatal results the quantity of putrid fluid injected must be large or be frequently repeated. This form is said not to be inoculable.

CHAPTER XXXVI.

PUERPERAL FEVER (Continued).

Causes.—The atmosphere.—Inoculation.—Season of the year.—Social state.—Relations to zymotic diseases.—The prevention of puerperal fever.—Treatment.—Vaginal and uterine injections.—Iodoform bacilli; opium; leeches; stupes; laxatives; quinine; salicylate of sodium; Warburg's tincture; veratrum viride; digitalis; antipyrine; alcohol; cold.—Treatment of peritoneal effusions and inflammatory exudations.

Causes of Puerperal Fever.

The Atmosphere.—The effects of a poisoned state of the atmosphere as a cause of puerperal fever is best observed in the so-called nosocomial malaria of hospitals. In days gone by, before I had learned by experience that the safe conduct of a lying-in service depends upon the fastidious exclusion of every source of contamination, I had frequent occasion to witness febrile outbreaks among puerperal women in the Bellevue Hospital, which were instantly arrested by the simple transfer of the inmates of the affected ward to a wholesome locality, though no changes were simultaneously made in either the personnel or the utensils of the service. In these instances it seems fair to assume that the previous unhealthy condition was not due to the direct transfer of an inoculable matter from patient to patient by the attendants, but by something residing in the air of the vacated apartment. In the inquiry as to the production of this condition it can be assumed that it is not caused by aggregation alone. The medical wards of Bellevue, always crowded, have often furnished in times of need safe receptacles for puerperal patients. It is certainly not due to the presence of the ordinary constituents of the atmosphere. We must therefore look for some additional element capable of unfavorably affecting the economy. What this element really is, is demonstrated by a familiar clinical experience. When the disturbance produced by nosocomial malaria is not at an early stage arrested by change of locality, the secretions of patients affected become inoculable. Then the epidemic spreads rapidly, and assumes continuously a more and more severe type. If during an epidemic the external genitals be carefully watched, now and then diphtheritic patches will be noticed to form upon them. At first these patches may disappear or yield readily to treatment. When an epidemic has assumed a pestilential form the patches, which may in isolated cases make their appearance at any time in a hospital, are rarely absent in fatal cases. The composition of the patches tells the tale of what it is in the atmosphere which accomplishes the charnel-house work. Favoring conditions have led to the multiplication of disease-germs in the air, and have fitted them to become the active producers of disease.

In a patient dying in the early stages of an epidemic there may be

no diphtheritic manifestations, though the tissues and secretions are filled with bacteria. As, however, the epidemic gains headway, the lesions of the generative apparatus, and especially of the external organs, which are most exposed to air, become covered with patches which swarm with micrococci. Under the conditions named it is certainly more in accord with ordinary scientific reasoning to conclude that the micrococci play an important part in the production of puerperal fever than that the puerperal fever produces the micrococci.

To be sure, bacteria or their spores are always present in the air, and it may be fairly asked how patients are ever spared from their perverse industry. The answer is, that the effect produced by the atmosphere of a hospital is dependent partly upon the quantity, and partly upon the quality, of the suspended germs. Floating spores, when sparsely distributed, rarely possess the power of invading a healthy organism. In the inauguration of an epidemic the first patient severely attacked is usually one whose powers of resistance are broken down by prolonged labor, by hæmorrhage, by poverty, or some other condition leading to impaired vitality.

Puerperal-fever epidemics due to contamination of the atmosphere, and not to direct contagion, do not at once reach the maximum of intensity. At first the temperature tables indicate the prevalence of milk fever; next follow cases closely resembling those of mild paludal poisoning; and, finally, if these warnings are unheeded, and reliance is placed upon antiperiodic remedies rather than upon prompt closure of the threatened ward, the pestilence develops. In the conduct of lying-in hospitals it should never be forgotten that with the multiplication of the septic germs the danger increases.

At the same time, the quality of the agents which pervade the air where hospital patients are confined is an important element in the genesis of febrile outbreaks. The bacterium termo, which causes putrefaction, is not in itself, as we have already mentioned, a source of danger. A stinking odor is not necessarily incompatible with a low mortality-rate. The importance of the common forms of bacteria, according to Pasteur, results from the fact that by their power to consume oxygen they pave the way for the active development of the pernicious germs, nearly all of which thrive only in media in which that element has been materially diminished. Again, there is reason to believe that the same germs are not* always equally active for evil. Gravitz claims that the ordinary varieties of aspergillus and penicillium found everywhere on the surface of the ground, on moistened walls, on food of every variety, on decaying leaves and fruit, and whose spores are universally present in the purest air, can by a succession of cultures be gradually brought to flourish in a warm alkaline fluid, and

* Gravitz, "Ueber Schimmel-Vegetationen im thierischen Organismus," "Virch. Arch.," vol. lxxxi, p. 355.

that they then acquire the capacity to penetrate living tissues, to proliferate in them, to excite local necroses, and to cause death in the course of three days. The resistance of micrococci to carbolic and salicylic acids is found experimentally to depend in a measure upon the nature of the vehicle in which they are cultivated (Buchholz). The action of septic fluids varies, too, with the age of the infusions, with the materials employed, and with the conditions under which the poison-germs are generated.

Micrococci multiply in hospitals when organic materials favorable to their growth are present in sufficient quantities. Perrin, Quenquand, and others have shown that the hospital wards in Paris, especially those upon the surgical and maternity divisions, contain an infinite number of vibrios, bacteria, and all the coccus forms (Charpentier). Robin* has demonstrated the existence of albuminoid matters in water condensed upon vessels containing freezing mixtures and placed in overcrowded wards of hospitals. When the results of crowding become manifest, these albuminoid matters not only impart a fetid odor and putrefy with great rapidity, but rapidly impart putrefaction to healthy muscle and normal blood with which they are brought into contact. Pasteur was able, by the microscopic examination of the lochia from patients in the services of Hervieux and Lucas-Championnière, to predict, from the character of the contained organisms, an impending attack of fever in advance of the slightest symptom betokening danger.

It is unquestionably the lochial discharge which makes it such a difficult task to keep a maternity ward in a healthful condition. Putrid blood has been found to be the most favorable material for septic experiments. It was noticeable in Bellevue Hospital that febrile outbreaks always arose in, and were usually confined to, the ward in the hospital which, by a bad arrangement, was assigned to patients for the first four or five days following confinement—i. e., during the period of the lochia cruenta. As puerperal fever is rare after the fifth day, this at first sight would seem natural. But if a patient was transferred directly after confinement, during one of these unhealthy periods, to the ward containing the patients who had passed the first five days, but had not completed the ten days, she would escape the fever. It was always the same ward that required to be disinfected. In a communicating apartment all the confinements took place, and at all times, therefore, the conditions were present for loading the atmosphere with the products of decomposing blood. In the summer months, so long as the windows were open and the air was diluted by the continuous passage of fresh currents, the patients enjoyed immunity from nosocomial malaria. In the autumn, so soon as it became necessary to close the windows partially on account of the cool nights, it was not uncommon for the more trivial disturbances, such as so-called milk

* "Leçons sur les humeurs," Paris, 1867, p. 195.

fever, the hospital pulse, and catarrhal affections of the genitalia, to manifest themselves. Through the months of February, March, and April the mortality was usually greatest. During the winter months there was, as a rule, crowding of patients, insufficient ventilation, stagnation of the air, and the rapid accumulation of disease-germs. That the later winter months should prove the most perilous is in accordance not only with the theory of continuous accumulation, but with the experimental fact that weeks sometimes elapse before a decomposing substance acquires the highest degree of virulence.

Apart from the nosocomial malaria of hospitals, there is reason to believe in the influence, at times, of certain general widespread atmospheric states which affect the entire community. In the year 1871 the mortality from childbed in New York was 399; in 1872, 503; in 1873, 431; in 1874, 439; and in 1875, 420. Now, the excess in the deaths for 1872 was due wholly to an increase in the cases of metria, those from ordinary accidents remaining nearly the same as in the preceding years. The disease certainly did not extend into the city from the hospitals serving as foci, for the mortality at Bellevue Hospital was hardly more than half the usual average. There was no especial mortality that year from either diphtheria, erysipelas, or scarlatina, but the aggregate mortality was the largest known in the history of the city. There is no positive data connecting the civil deaths from puerperal fever in 1872 with parasiticism, but the prevalence of epizoötics, of epidemic catarrhal affections, of peculiarly fatal forms of pneumonia and other diseases which are now attributed to the presence of minute organisms in the atmosphere, renders such a source highly probable.

It is proper to say here that, though the argument is very strong in favor of regarding the genitalia of puerperal women as the exclusive point of entry of infectious materials into the system, it seems impossible at the present time to make all the facts coincide with such a theory. I have the records of a number of cases occurring during an epidemic of puerperal fever in which patients were either attacked with fever previous to parturition, or in whose cases the unusual length of labor, the frequency of *post-partum* hæmorrhage, and the imperfect contraction of the uterus immediately after confinement, were signs of some abnormal influence exercised upon the economy at an early period of labor previous to the existence of traumatism. That deleterious materials may find other channels for entering the system than a wounded surface is evidenced by the cachectic condition not unfrequently produced in physicians by too assiduous attendance in dissecting-rooms and places in which *post-mortem* examinations are conducted. One severe and rapidly fatal case of puerperal fever which occurred in Bellevue Hospital I find it impossible to attribute to any other cause than that the woman, for five months previous to her confinement, served

as a helper in a lying-in ward. The *post-mortem* examination disclosed no special local lesions, but her symptoms were those of intense septicæmia. French writers report instances of toxæmic conditions developing in young midwives during puerperal-fever epidemics. While we are not prepared to go as far as Tarnier, who says, "It is probable that the lungs, by their extent and activity, offer conditions most favorable to absorption, and that often, if not always, it is by them that poisoning occurs," it does not yet seem time to give up the idea that under exceptional circumstances the respiratory and the digestive tracts may allow the passage of materials of a septic character.

Inoculation.—Another and frequent source of puerperal fever is by direct inoculation. Any material of a septic character, introduced into the genital passages of a woman during or after confinement, may produce a general infection of the system. But the point upon which I wish especially to dwell is, that it is possible to trace epidemics of puerperal fever directly to the carrying of puerperal poison from patient to patient through the medium of attendants. In such cases changes in wards and the most rigid sanitary precautions avail but little, so long as the affected personnel is continued in charge. Unless this fact is fully recognized, all the cleverest devices in hospital construction will fail to prevent the occurrence of disasters. In theory, the doctrine of the contagiousness of puerperal fever has ceased to be the subject of dispute; and yet, no longer than thirty years ago, it was combated as a pernicious heresy by both Meigs and Hodge, of Philadelphia, at that time regarded as the best authorities upon obstetrical questions in this country. Hodge, addressing his students, said: "The result of the whole discussion will, I trust, serve not only to exalt your views of the value and dignity of our profession, but to divest your minds of the overpowering dread that you can ever become, especially in women under the extremely interesting circumstances of gestation and parturition, the ministers of evil—that you can ever convey, in any possible manner, a horrible virus, so destructive in its effects and so mysterious in its operations as that attributed to puerperal fever"; and Meigs, in his letters to students, writes: "I prefer to attribute them to accident or to Providence, of which I can form a conception, rather than to a contagion of which I can not form any clear idea, at least as to this particular malady." Contrasted with these rhetorical utterances, in an essay published in 1843, by Prof. Oliver Wendell Holmes, entitled "Puerperal Fever as a Private Pestilence," the opposing testimony in favor of contagion was presented with equal literary and scientific skill. The evidence was complete and conclusive, and has exercised a most beneficial influence upon the practice of midwifery in America. With his many claims to our admiration and esteem, there is probably no title which Prof. Holmes wears with greater pride than that of pioneer

in a movement that has done so much to prevent the slaughter of innocent women and the wrecking of happy homes.

Thanks to changed theoretical views, physicians seem now rarely to be the carriers of contagion. At least, in studying the records of New York city for nine years, I find that the occurrence of two deaths from puerperal disease, following one another so closely as to lead to the suspicion of inoculation, occurred to thirty physicians; a sequence of three cases occurred in the practice of three physicians: one physician lost three cases, and afterward two, in succession; one physician had once two deaths, once three deaths, and twice four deaths, following one another; finally, a physician reported once a loss of two cases near together, then of six patients in six months, and then of six patients in six weeks. Thus in the practice of more than twelve hundred physicians in nine years I find, excluding cases occurring in hospitals, that the experience of thirty-six only lends color to the idea that puerperal fever is due to criminal neglect on the part of the medical profession. Undoubtedly in many of these cases, too, the responsibility is only apparent, as when a practitioner has, for example, had the misfortune to lose in one week a woman from puerperal convulsions, and another in the following week from placental hæmorrhage. Singularly enough, not one of the sequences mentioned occurred in the practice of a physician connected with a lying-in hospital. In face of the charge that the physicians holding obstetrical appointments in public institutions are active disseminators of puerperal fever through populous communities, I find that the total loss from all puerperal causes, occurring in the private practice of ten physicians intimately associated with such institutions, numbered during the nine years but twenty-one cases. Of these, thirteen were the result of ordinary accidents, and only eight cases of metria proper, of which one was developed before the physician was called in attendance; whereas a single physician, holding no hospital appointment, lost during the same time twenty-seven cases, of which twenty-one were cases of metria.

There is, however, a survival of the older ideas, chiefly to be seen among the laity, in propositions to secure absolute immunity from puerperal fever in hospital patients by confining them in wooden structures or by conducting births under carbolic-acid spray.

I have been interested in endeavoring to ascertain how far experience corresponds with Semmelweis's original theory that puerperal fever owes its origin to poisonous materials obtained from dissecting-rooms and introduced into the genital canal by the hands of physicians attending cases of labor. With this view I have made personal application to a number of gentlemen who have engaged in midwifery practice while performing the functions of demonstrators of anatomy in our medical schools. H. B. Sands, of the College of Physicians

and Surgeons, reports that in the five years during which he held the office of demonstrator he attended about sixty cases of labor. All did well. He lost his first patient, from childbed, a short time after he had resigned his position in the dissecting-room. J. W. Wright, the present professor of surgery in the Medical Department of the New York University, who held for one year the position of demonstrator in the Woman's College, writes me that "during the year I attended one hundred and four cases, including twenty-two forceps cases, two of craniotomy, two of podalic version, and four of breech presentation. Of this number I lost two cases, one from phlegmasia dolens complicating uræmia, from both of which troubles the patient had suffered during her previous labor, and one from double pneumonia, the result of unusual exposure following confinement. Out of these one hundred and four cases I can recall but three or four cases of metritis, and those of a mild character; I have never thought they had any special connection with my duties in the dissecting-room. I may add that for ten years I have attended a pretty large number of confinements each year, and that during the whole of this time I have been in the habit of making autopsies as occasion has offered, and of handling and examining pathological specimens both in and out of the dissecting-room, notwithstanding which my death-record among this class of cases has been unusually low." Samuel B. Ward, formerly demonstrator at the Woman's College, at present professor of surgery in the Medical School at Albany, writes: "While I was daily in the dissecting-room during the winter sessions of the school from 1868 to 1872, I attended thirty-two confinements, of which I have notes. All of the patients recovered, nor did any of them suffer from any complication that could be traced to infection." It is familiarly known that after Semmelweis had introduced the practice, among the physicians attending patients at the large lying-in hospital in Vienna, of washing the hands in a solution of chloride of lime, there was a great diminution in the mortality which prevailed, notwithstanding which G. Braun reports, however, that in 1857, in the month of July, in two hundred and forty-five deliveries there were seventeen deaths. The following month Klein gave orders to suspend the use of disinfectants. By chance, in August there were only six deaths out of two hundred and fifty confinements, and in September, of two hundred and seventy-five patients, none died. From 1857 to 1860 the mortality was slight, though disinfectants were not used, while during the three following years, in spite of the systematic and persistent employment of these agents, the death-rate once more assumed formidable proportions.*

Of course, I do not wish to underrate the importance of Semmel-

* Braun, "Rückblicke auf die Gesundheits-Verhältnisse unter den Wöchnerinnen," u. s. w., S. 32, 33.

weis's labors. There is no question that it is a perilous experiment to pass from a dissecting-room to a patient in labor without employing rigorous measures to disinfect the hands and all parts of the person brought into contact with the dead body. But it is well to call attention to the fact that puerperal fever is not due to any single, simple cause, nor can be effectually guarded against by a single precaution; and, again, that an infectious poison does not of necessity exist in every cadaver examined. Hausmann found that injections into the vagina of gravid rabbits, in the latter half of pregnancy, of serum from the corpse of a person who had not died of septicæmia, produced no fatal results, while rapid death resulted from injections, under the same conditions, of pus from the abdomen of a woman who had died from puerperal infectious disease.*

Barnes and other English writers lay considerable stress upon cases of puerperal fever due neither to contagion nor to atmospheric conditions, but to the poisoning of the patient by her own secretions. There is justification for this view in the fact that even normal lochia contain bacteria, and, when inoculated into animals, produce in them affections of an ichorrhæmic and septicæmic nature. When death takes place the tissues of animals thus treated are found to be filled with round bacteria. Furthermore, the disease artificially produced is in itself infectious, and can be continuously propagated in other animals. But it may be asked, "Does not this admission cut both ways? How is it possible, if even normal lochia possess virulent qualities, that childbed is ever unattended by accessions of fever?" To this we can only answer that the reasons for immunity in ordinary cases are only known in part. Karewski† and other experimental investigators have shown that the virulence of the lochia increases proportionately to the number of days that have transpired since the birth of the child, and that during the first three days the lochia are comparatively harmless. Meantime, the retraction of the uterus, the closure of the sinuses, and the formation upon the wounded surfaces of protecting granulations, all act as natural barriers to the penetration of poison-germs. But, aside from these reasons, there is undoubtedly an unknown quantity calling for further investigation, which, in the absence of positive knowledge, we are content to term the predisposition of the individual patient. The vagina after childbirth possesses all the conditions most favorable for the production of putrefaction, viz., the access of air, fostering warmth, and stagnating fluids charged with dead tissue. It is probable that the first of these needful conditions is, in normal labors, happily wanting in the uterine cavity. In these days of intra-

* "Untersuchungen und Versuche über die Entstehung der übertragbaren Krankheiten des Wochenbettes," "Beitr. zur Geb. und Gynaek.," Bd. iii, Heft 3, S. 374.

† "Experimentelle Untersuchungen über die Einwirkungen puerperaler Secrete auf den thierischen Organismus," "Zeitschr. f. Geb. und Gynaek.," Bd. vii, 2ter Th., S. 331.

uterine medication it is well to bear in mind the relatively greater frequency of infection through vaginal and cervical wounds, as compared with that which takes place through the denuded intra-uterine surface. The term auto-infection may, with propriety, be employed as a distinctive appellation to designate those attacks of fever which, in the absence of any demonstrable cause, occur in the early days of childbed, and which there, *quoad vitam*, pursue a favorable course, and to cases of so-called late infection—i. e., where, after the fifth day, the accidental opening of a healing wound permits the tardy absorption of poisonous secretions; but with the reserve that the primary cause is, in point of fact, atmospheric, and the predisposing condition the susceptibility of the individual. Cases of auto-infection are in this country extremely rare, if not unknown altogether, in salubrious or rural districts.

On another occasion I have shown that in New York city the death-rate from puerperal fever is nearly twice as great during the six months from December to May, inclusive, as from June to November. The greatest mortality occurred in February and March, comprising rather more than one fourth the entire amount. The smallest number of deaths occurred in September and October, in which months but one thirteenth of the entire number took place.

That puerperal fever, in its harvest of death, does not spare the wealthy and well-to-do classes is too familiar a truth to be worthy of discussion. That, however, the wealthy do enjoy special immunities as compared with the less-favored members of society, I have shown by comparisons made between sections of the city which, though lying side by side, exhibit in a marked degree the two extremes of wealth and poverty. Thus, the mortality among the representatives of the lower social strata, in proportion to population, was from three to six times as great as that among the more fortunate classes.

Relations to Zymotic Diseases.—In investigating, some years ago, the nature, causes, and prevention of puerperal fever,* I prepared, from the statistics of the Health Board of New York city, tables extending over a period of nine years to answer the inquiry as to whether there was any relation between the frequency of deaths from scarlatina, diphtheria, and erysipelas and those from metria. Previous to their publication I was anticipated in my deductions by a paper upon the same subject by Matthews Duncan.† Neither Duncan nor myself found any such relation existing between the statistical frequency of puerperal fever and the zymotic diseases mentioned. There was, however, nothing in our investigations to invalidate any direct testimony which tends to show that, in individual cases, a real connection be-

* "Trans. of the International Med. Congress," Philadelphia, 1876.

† "On the Alleged Occasional Epidemic Prevalence of Puerperal Pyæmia, or Puerperal Fever and Erysipelas," "Edinburgh Med. Journal," March, 1876, p. 774.

tween puerperal fever and the zymotic diseases may exist. Indeed, it seems to me to be fairly established that a poison may be conveyed from patients suffering from either of the foregoing morbid processes which may be absorbed by the puerperal woman, and may in her give rise to an infectious fever possessing an intense degree of virulence. My friend Prof. Barker has recently drawn attention to the important relations of intermittent fever to the puerperal state. I have not, however, thought it advisable to complicate the present discussion with any extended notice of his very valuable observations. So far as malarial fever occurs unequivocally as such in puerperal women, there is no more reason for establishing a special category for puerperal malaria than for puerperal typhoid or puerperal small-pox. In the class of cases characterized by sharp chills, intense fever, irregular remissions, and profuse perspiration, which pursue a pernicious course unaffected by antiperiodic remedies, the nature is extremely dubious. The same symptoms are likewise characteristic of certain forms of pyæmia, and I can not learn that such cases are familiar in the practice of those of our physicians who practice outside of cities in districts where malarial affections are most prevalent.

The Prevention of Puerperal Fever.

Of the 3,342 deaths from puerperal causes in New York city from 1868 to 1875, inclusive, 420 occurred in hospital, or one eighth of the entire number. Of the 1,947 cases of metria, about 300, or not quite one sixth, were contributed to the hospitals. After such a showing, the first impulse would be to cry out loudly for the suppression of the maternities. But a wiser policy suggests an inquiry as to whether the large mortality mentioned is an evil of necessity. The following reports will show how much may be done in the present state of our scientific knowledge to so control the conditions which favor the generation of puerperal diseases in large hospitals as to make them safe asylums for the needy.

Goodell* has stated that at the Preston Retreat in 756 cases of labor there have been but 2 deaths from septic disease. Winckel,† of the Lying-in Institution in Dresden, reported, in 1873, 18 deaths from metria, or 1·8 per cent., but from the 10th of January to the 7th of July in 570 births there was but 1 case of septic disease; in the year 1872 the death-rate exceeded 5 per cent. The reduction in mortality was no fortuitous circumstance, but was due to rigid measures for the prevention of disease. Stadfeldt‡ reduced the mortality from puerperal fever in the Maternity Hospital of Copenhagen from 1 to 37, the

* "On the Means employed at the Preston Retreat for the Prevention and Treatment of Puerperal Diseases," p. 13.

† "Berichte und Studien," Leipsic, 1874, S. 183.

‡ "Les maternités, leur organisation et administration," Copenhagen, 1876.

proportion between the years 1865 and 1869, to 1 in 87 between the years 1870–'74. Johnston * reports, in the Rotunda Hospital of Dublin, during the seven years of his mastership, 7,860 births with 169 deaths, of which 85, or 1 in 91, were from metria. Braun von Fernwald † in sixteen years reports 61,949 confinements in the vast Maternity Hospital of Vienna, with 825 deaths from puerperal fever, or 1·3 per cent. In a visit made by me to the Vienna Maternity in 1883, I was informed that the recent mortality, including difficult operations, had been reduced to one half of 1 per cent. Spiegelberg ‡ lost, in 901 confinements at Breslau, only 5 cases of puerperal fever. Beurmann # reports that in the Hôpital Lariboisière, under the administration of M. Siredey, the death-rate in 1877 was 1 in 145, and in 1878 1 in 199 confinements; in the Hôpital Cochin, under the charge of M. Polaillon, the total mortality from 1873 to 1877 was 1 to 108·7. In 1877 there was but 1 death from puerperal causes in 807 confinements. Upon Prof. Streng's division of the magnificent maternity in Prague, I was told that, in 1882–'83, in over 1,100 confinements there had been no death from septic causes.

When the maternity service was transferred in 1872 from Bellevue Hospital to Blackwell's Island, it became necessary to make some provision for so-called street-cases—i. e., women taken suddenly in labor without homes, and representing the extremes of penury and want. At first they were received, in part, by the various private institutions of charity in New York city, but these, in 1877, decided to exclude them thenceforth, on the ground that their condition at the time of their reception was such as to endanger the lives of the inmates for whom the charities were specially provided. An old engine-house was then put in readiness by the city, and, under the name of the Emergency Hospital, was placed under the charge of Henry F. Walker ‖ and myself. The number of confinements in the Emergency has averaged 220 annually. The death-rate from all causes has been 2 per cent., which, though large, is not an unfavorable showing when we remember that the patients all belong to the homeless class, that all were taken in labor before their entrance, and that many of them were in a deplorable condition at the time of their admission. The hospital, too, receives a considerable number of patients annually who are sent there only after protracted, and often severe, operative measures have been fruitlessly attempted outside its walls.^ The building possesses, for maternity

* "Clinical Reports," from 1870 to 1876, inclusive.

† "Lehrbuch der gesammten Gynaekologie," S. 885.

‡ *Ibid.*, S. 748.

"Recherches sur la mortalité des femmes en couches dans les hôpitaux," Paris, 1879.

‖ Dr. Walker has since resigned, and my present colleague is Prof. William M. Polk.

^ Dr. Garrigues has furnished a most extraordinary example of the efficacy of the antiseptic treatment at the New York Maternity Hospital. From the years 1875 to 1882, inclu-

purposes, two fairly ventilated rooms. Excellent nurses are furnished by the New York Training School for Nurses. Since the introduction of efficient antisepsis in October, 1883, there have been, to date (May 1, 1885), 317 confinements in the hospital. There have been 5 deaths—3 from eclampsia, 1 from intestinal ulcerations, possibly the result of corrosive-sublimate irrigations, and 1 from exhaustion. This latter patient had been thirty-six hours in labor before she was brought to the hospital, and died four hours after admission. Of the patients who died from eclampsia, all had had many convulsions before their reception into the hospital. The most encouraging result of the antiseptic measures employed has been the nearly uniform absence of even trivial temperature elevations.

Surely, these results do not support the idea that it is better for a woman to be confined in the street-gutter than to enter the portals of a lying-in asylum. Goodell's experience shows that a hospital for respectable married women may be so conducted that its inmates may enjoy absolutely a greater degree of safety than do women in their homes surrounded by all the aids that wealth can command. Equally good results are not to be obtained in hospitals which are open to unfortunates of every class. But there is much misapprehension and confusion of ideas respecting the fate of these women when no charitable provision is made for them. In Copenhagen the Maternity Hospital is closed for from six to eight weeks in the summer-time. During this period unmarried parturient women receive pecuniary as-

sive, the number of confinements was 2,827; the deaths 116, or a little over 4 per cent. The highest percentage was reached in 1877—viz., 6·67; the lowest in 1881, when it fell to 2·36. In 1883, of 345 women confined, 30 died. In September of that year there were 9 deaths, and of 5 puerperæ who were seriously ill, 1 died later. At this time he introduced a series of reforms of which the following, omitting details, gives the essentials: Wards fumigated with sulphurous-acid fumes, and the floors and furniture washed with a solution of corrosive sublimate (1: 1,000). Every patient, on entering the lying-in ward after the bath, had her abdomen, buttocks, genitals, and thighs washed with sublimate solution (1 : 2,000). During labor, vagina irrigated with latter solution. In prolonged labors, irrigation repeated every three hours. Great care of hands on part of doctor and nurses. Glycerine and corrosive sublimate (1 : 1,000) used for lubricating fingers before making internal examinations. Antiseptic pad applied to the head during its egress, and to the vulva until the secundines had been expelled. Absorbent cotton covered with netting soaked in corrosive-sublimate solution applied to external genitals during childbed period. This latter applied and removed with the same care as in dressing a wound after a capital operation. Irrigation, first of the vagina and afterward of the uterus, immediately after labor in cases where the hand or instruments had been passed into the uterine cavity.

When the details of this treatment were first published by Garrigues, many took a humorous view of it, but mark the result: In the following 162 confinements there were no deaths, and from October to July, inclusive, of 409 patients confined, though many operations were performed, 5 died; but of these, 3 only were from septic causes, and they, Garrigues believes, were the result of the neglect of certain of the prescribed details.

sistance from the hospital to enable them to obtain a place in which to be confined. Now, Stadfeldt reports a larger mortality among this class than among those delivered in the hospital. Yet they are confined at a favorable season of the year, without any communication with the furniture, the sage-femmes, or the physicians of the hospital. As they fortunately receive nothing but money, that can hardly be suspected of communicating contagion. What their fate would be in New York city, perhaps, may be judged from the following facts: Excluding cases confined in hospitals, nearly one thirtieth of all the deaths and one twenty-fourth of the cases of metria between 1867 and 1875 are reported by four practitioners. Ten practitioners out of twelve hundred signed the death-certificates of one fifteenth of the women dying from puerperal causes, and one tenth of the cases of metria. But it is not to be supposed that these deaths were all the result of malpractice and incompetence. The true history of most of them, probably, was that the doctor was engaged to attend the case of confinement for a small fee, with the understanding that he should make no calls subsequently, unless specially summoned by the friends of the patient. The latter, left to ignorant care or, perhaps, without any assistance whatever, and exposed to all the pernicious influences bred by poverty, when illness supervened probably did not call the physician to her aid until the time for help had passed, so that in the end his professional functions were confined to procuring the requisite permit for burial.

Humanity demands that charity should furnish places of refuge in which poor outcasts can receive assistance during the perils of child-bearing. If we must, then, have maternities, we should make them safe, and this can be in great measure accomplished by remembering the twofold source of danger arising from a poisoned atmosphere and direct inoculation. A hospital must be clean, spacious, and well-ventilated, or its atmosphere will become charged with the spores of septic fungi and produce nosocomial malaria. The most rigid sanitary precautions observed by the attendants will not prevent a badly ventilated ward from becoming unwholesome, unless unoccupied wards are kept, to which patients can be transferred upon the first admonition of danger. Goodell states that at the Preston Retreat the wards are used invariably in rotation. In connection with the Maternity at Copenhagen there are a number of small supplementary hospitals scattered through the city, which serve as safety-valves for the central institution. Artificial methods of ventilation render the task of keeping the wards wholesome comparatively easy. They do not need, however, to be complicated and expensive. The good repute of the Rotunda Hospital, it seems to me, is in large measure due to the natural ventilation afforded by open fireplaces.

In the Vienna Clinic, according to C. Braun, the mortality between

1834 and 1862 averaged 6 per cent., and in 1842 the enormous total of 521 deaths to 3,067 confinements was reached. With the introduction in 1862 of what is known as Böhm's heating and ventilation system an immediate improvement was experienced. In the sixteen years from 1863 to 1878, inclusive, the total mortality has been 1·6 per cent., though in that time 5,464 practitioners have received an obstetrical training in its wards. In commenting upon this change, Braun says: "I have now, from practical experience, arrived at the knowledge of the fact that the rapid and thorough prevention of putridity by adequate ventilation is to be regarded as a good preventive measure against puerperal fever; that it is not the number of patients in a lying-in hospital, nor yet the number of patients in a single room, but the deficient circulation of air—a fault which may inhere to separate compartments in the smallest maternities—which is the important feature in the spread of puerperal fever; that puerperal women are to be protected from childbed diseases not by isolated buildings and gardens, nor by walls, but by the permanent introduction of great quantities of pure, warm air." He then adds, what is in thorough accord with my own experience, "Before new institutions are built, greater attention than heretofore should be paid to the ventilation of the old structures, and, where this is found defective, a system should be substituted corresponding to the scientific requirements."

In the year 1872 puerperal fever destroyed 28 women of 156 who were confined in the Bellevue Hospital. The service was then broken up, and a great outcry arose against "tainted hospitals." Wooden pavilions were accordingly erected on Blackwell's Island for the reception of lying-in women. These buildings were constructed upon what is known as the cottage plan. They were favorably situated in an airy location remote from the general hospital. They were, however, heated by large iron stoves, and no means of ventilating the wards was provided, except by lowering the windows. In less than three months from their occupancy an epidemic of puerperal fever made it necessary to remove the service for a time to the Charity Hospital. The same result followed every subsequent attempt to utilize them for maternity purposes, until, after three years' trial, it was found necessary to abandon them altogether.

In private practice it is likewise important that the lying-in room should be provided with plenty of light and air. The physician should insist upon the value of ventilation as a means of contributing to the speedy recovery of childbed women. By hermetically sealing the windows, through false fears of his patient's taking cold, he exposes her to the risk of becoming poisoned with her own exhalations.

But the early experiences of the Hôpital Cochin and the Hôpital Lariboisière, costly, palace-like structures, with every appliance of

art, prove that fresh air alone does not protect patients from the consequences of inoculation.

The great improvement in the condition of maternity patients in recent years has been due to the application of Lister's principles to obstetric practice. Complete antisepsis in the surgical sense is, of course, impracticable. Adequate antisepsis has, however, been proved to result from the observance of a variety of precautions which have been the slow outcome of experience. These, in brief, in hospitals, consist in protecting the patient from every known form of contamination, and in the prompt removal and isolation of every puerperal woman who manifests febrile symptoms.

In citing the examples of the Hôpital Cochin and the Hôpital Lariboisière, I was led to the selection because these hospitals most strikingly illustrate the extent of the triumph of the new doctrines. Whereas at the Lariboisière the mortality in 1854, the year of its opening, exceeded 10 per cent., as a result of the prophylactic measures adopted by M. Siredey, the mortality was 1 to 145 in 1877, and 1 to 199 in 1878. And at the Hôpital Cochin, in 1878, Lucas-Championnière, with 770 confinements, was able to report but two deaths from puerperal causes.

As regards details, the bedsteads should be of iron, and should be frequently scrubbed with a carbolic solution; after each confinement the paillasse upon which the woman lay should be washed in boiling water and the straw should be burned; in place of the usual rubber covering to the bed, Tarnier recommends tarred paper, which is antiseptic, and costs so little that it need be used in but a single case; all soiled linen should be instantly removed from the ward, either to be burned or disinfected by prolonged boiling; sponges should be banished, as, when they have once been soaked with blood, not even carbolic acid can make them safe; nurses employed in the puerperal wards ought not to have access to cases of labor, as D'Espine and Karewski* have shown that the lochia of even a healthy person on the third day will poison a rabbit; a patient attacked with fever should be immediately removed, and the nurse in attendance should go with her. At the Emergency Hospital, with the first appearance of catarrhal affection of the genital organs, or of so-called milk fever, the wards are immediately emptied and fumigated with sulphurous acid. In spite of recent skepticism regarding the value of the fumes of sulphurous acid as a germicide and disinfectant, I do not hesitate to express, after long experience, my firm conviction as to their efficacy.

Doléris† formulates the indications for effective prophylaxis as follows: 1, prevent the introduction of germs (antisepsis before confinement); 2, paralyze their action (antisepsis after confinement); 3,

* D'Espine, "Contributions à l'étude de la septicémie puerpérale," p. 18; Karewski, *loc. cit.*

† "La fièvre puerpérale," 1880, p. 303.

shut up the doors—veins, lymphatics, and Fallopian tubes (employment of means which promote uterine contraction).

The first duty of the physician is to refrain from attending a case of labor when fresh from the presence of contagious diseases or from contact with septic materials, whether derived from the dissecting-room or the clinic. Skepticism regarding these sources of danger is sure in the long run to be severely punished. In a doubtful case the least concession should consist in a full bath and a complete change of clothing. A special coat for confinement purposes, stained with blood and amniotic fluid, is liable to convey infection. In every case of labor, whether in hospital or private practice, the hands and forearms should be freely bathed in a carbolic solution before making a vaginal examination. A nail-brush should form a part of the ordinary obstetric equipment. Frequent examinations during labor should be avoided. All instruments employed during or subsequent to confinement should be carefully disinfected. In prolonged labors, after operation, in cases of dystocia, or where the membranes have ruptured prematurely and the fœtus is dead, it is a useful precaution after delivery to wash both uterus and vagina with warm carbolized water or solution of corrosive sublimate (1 : 2,000). In Vienna both Spaeth and Braun, after difficult labors, introduce a suppository of iodoform, 2 to 2½ inches in length, into the uterine cavity. The formula recommended consists of—

℞	Iodoformi,	20 grammes ;
	Gummi Arabici,	
	Glycerinæ,	
	Amyli puri,	āā 2 grammes ;
	Ft. bacilli,	No. iij.

In their introduction the half-hand (left) should be passed to the cervix ; the iodoform bacillus should be seized by a pair of polypus forceps and pushed into the cervical canal. The hand in the vagina should then be used to shove the suppository upward past the internal os. No symptoms of poisoning from the iodoform have been observed. The disinfection is complete and prolonged. In hospitals the woman should be bathed before entering the lying-in ward, and the vagina should in all cases be disinfected with carbolic acid or corrosive sublimate both before and immediately after labor. The conduct of labor under carbolic-acid spray is commended by Fancourt Barnes. Doléris advises the application of a compress soaked in carbolic fluid to the external genitals during the progress of labor. Tarnier advises dressing the vulva, so soon as the head begins to emerge, with a pledget soaked in carbolized oil (1 : 10). With the recession of the head during the interval between pains a portion of the oil is carried upward into the vagina.

In the puerperal period the warm carbolized douche stimulates

uterine retraction, and promotes the rapid healing of wounds in the vaginal canal; in hospital practice it possesses the additional advantage of preventing the accumulation of putrid albuminoid matters in the air. In private practice the patient should employ a new syringe; in hospitals every woman should be supplied with a glass tube to be attached to the irrigator. When not in use these tubes should be immersed in carbolic acid. The stream injected into the vagina should be continuous, like that furnished by the fountain syringe.* The Davidson syringe should be discarded in midwifery practice. With my hospital patients, in place of cloths to the vulva, I am now in the habit of using iodoform gauze, or an antiseptic pad prepared by soaking absorbent cotton in corrosive-sublimate solution.

Pedantic as these directions may seem, they are justified by experience, and the carrying out of the details given easily becomes a matter of habit. That by such precautions puerperal fever is destined to be erased from the list of dangerous diseases attacking the woman in childbed is saying more than is warranted. Nevertheless, it is true that a physician ought never to lose the sense of personal responsibility for its occurrence. Indeed, puerperal fever ought to be regarded as a preventable disease, and an attack as the evidence that some source of danger has been overlooked, though, owing to the imperfection of our knowledge, it may easily happen that even with the keenest scrutiny the precise cause in an individual case may escape detection.

Before terminating this section upon the prophylaxis of puerperal fever, I take great satisfaction in furnishing from Tarnier's recent treatise the following description, by Pinard, of the ingenious pavilion designed by Tarnier to make it possible to secure for hospital patients, at the minimum expense, the benefits of isolation, and to provide for each room in the pavilion all the conditions favorable to rapid and complete disinfection.

The pavilions are two-storied and of a rectangular shape, twenty-four feet in width by forty-six feet in length. The front and rear face to the north and south, the ends to the east and west. Two main partitions divide the interior into three divisions. Each end division is subdivided by a central partition into two chambers, so that each story has five compartments—a central one for the attendants, and four at the four corners destined for the reception of patients. On

* I know that of late there has been a strong reaction against the use of vaginal injections in normal childbed, but personally I have experienced none of the disagreeable effects ascribed to them. Indeed, both my hospital and private patients alike speak of them as soothing and grateful. I therefore have had no ground to discontinue them. That they are indispensable I do not claim. They are no longer used in Vienna, in Prague, nor in the New York Maternity, and yet, none the less, their results have since been in the highest degree satisfactory. At these institutions, however, vaginal disinfection is vigorously resorted to during and immediately subsequent to labor, and during childbed some form of antiseptic pad over the vulva is employed.

the ground floor the central compartment consists of a vestibule facing to the north, and an office facing to the south. On the former are placed the staircase, the water-closet, and a reception-closet. In addition to the main entrance there are three interior doors—one leading to the water-closet, one to the closet, and one to the office. The latter, for the occupation of the person on duty, contains a heater, a portable bath, a table, chairs, and wardrobe. Two windows face the south. The office has two doors, one opening into the vestibule, and the other, in the opposite side, opens directly outward. The four corner rooms for patients have each a door and a window, the latter looking from the end of the partition and reaching to the floor, and the former opening out from the façade. These four rooms are therefore not only independent of one another, but have no communication with the vestibule or the central office. On the second floor the arrangement is similar, except that the rooms open upon a balcony, by means of which communication from the outside is rendered possible. Upon each façade a glazed screen furnishes shelter in rainy weather. The screen extends to the roof, but is not in direct contact with the walls, a space being left for a current of air. The eight rooms for patients, four on each story, are severally fourteen feet long, eleven and a half feet wide, and ten feet high. Below, the floors are of asphaltum ; above, of flags or slates. The walls and ceilings are stuccoed and covered with oil-paint. The corners are rounded to prevent the accumulation of dust. To facilitate washing, the floors slant toward a gutter communicating by means of a pipe with the sewer. In each room panes of glass enable patients and the office attendant to see one another, so that surveillance is secured without sacrificing the principle of isolation. The furniture of the rooms consists of an iron bedstead with metallic springs. The pillow, bolster, and paillasse are stuffed with straw. In addition, each room is provided with a night table, a round table, a chair, a stool, and a crib, all of iron. A bell-rope at the bedside, the wire of which passes to the office by the outside of the building, enables the patient to summon assistance. Each room likewise contains a washstand, with faucets for hot and cold water, the latter supplied from a cistern on the roof, the former from the office heater. The patients remain in the rooms where they are confined until they are discharged. When this takes place the chamber is aired, the furniture is removed and washed with care, the straw is burned, and the walls are washed with an abundant supply of water. If a patient is taken ill, she is carefully isolated, and has assigned to her her own especial attendant and physician, who do not come into contact with other puerperal patients.

That the plans of construction in the Tarnier pavilions would require some modification to adapt them to the rigor of our winters seems probable, but the principles which they illustrate are sufficiently

vindicated by the results so far reported, viz., 6 deaths in 1,062 confinements, whereas in the old Maternity the death-rate, formerly amounting to 5 per cent., still aggregates 2 to the 100.

Treatment.—When the septic germs characteristic of putrid infection have once entered the blood, they are beyond the reach of the physician. Except, however, in cases of acute septicæmia, where the quantity of poison introduced at the outset is excessive, the patient rallies from the immediate shock, and, provided no fresh pyrogenic material finds its way into the system, recovery is to be anticipated. The indications for treatment are, therefore, to neutralize the puerperal poison at the point of production, in order to prevent its causing further mischief, and to adopt measures calculated to enable the patient to tolerate its presence, when once absorbed, until it is either eliminated or loses its harmful properties.

Toward the fulfillment of the first indication it is to be recommended that in every case of fever of puerperal origin the vagina be cleansed with a 2 to 3 per cent. solution of carbolic acid or corrosive sublimate (1 : 3,000) every four to six hours. The douche in itself is absolutely harmless. To avoid carbolic or corrosive-sublimate poisoning, it is, however, necessary to make sure that no portion of the injected fluid be retained in the vagina. In most cases the infection starts from the wounds of the vagina and of the cervix. Then, too, the tendency of the secretions to stagnate in the vaginal *cul-de-sac*, bathing as they do the cervical portion, is a prolific source of septic trouble. In all but the mildest cases the vaginal orifice should be examined with reference to the existence of puerperal ulcers. All necrotic patches should be touched with hydrochloric acid, with a 10 per cent. solution of carbolic acid, with iodoform, or, what I personally prefer, a mixture composed of equal parts of the solution of the persulphate of iron and the compound tincture of iodine. The latter acts as a powerful antiseptic, while the former, by corrugating the tissues, closes the lymphatics and shuts up the portals through which the septic germs penetrate into the system.

Intra-uterine injections should be resorted to with extreme circumspection. They are not indicated by a simple rise of temperature. A very large proportion of the febrile attacks which occur in childbed run an absolutely favorable course. Unless the infection—and this is not the rule, but the exception—proceeds from the uterine cavity, they are unnecessary. In circumscribed inflammations, where the morbific poison loses its virulence at a short distance from the puerperal lesion, they are often injurious. It is difficult, if not impossible, to so conduct them as to avoid opening up afresh recent granulating wounds. Yet the practice of local disinfection is warmly advocated by Fritsch, Schüller, Langenbuch, and Schroeder as a prophylactic against puerperal affections. On the other hand, Braun von

Fernwald, with his vast opportunities for judging obstetrical questions, writes with reference to this: "We must protest against injections made by physicians into the uterine cavity. Such meddlesomeness is more likely to do harm than good." This corresponds with my own experience. In theory, the proposition to treat the uterus as one would any other pus-secreting cavity seems rational, but I have found that every attempt to carry the theory to its logical conclusion in hospital practice has been followed by a rise in the puerperal death-rate. Runge reports an epidemic of puerperal fever in Gusserow's clinic brought about by the employment of intra-uterine irrigations, during which the mortality rose to 3·8 per cent. With the abolition of the irrigations the mortality sank to ·39 per cent. In 1880, Fischel* introduced the so-called permanent irrigations into the Prague maternity. Of 880 patients, 9 died of sepsis. The irrigations were then prohibited. The following year, of 933 patients, only 2 died from the same cause, and in 1882, of 521 patients, there were no deaths from sepsis. Fehling, who limited the use of intra-uterine injections to special momentary indications, reported, in 1880, 415 confinements without a single death.

Among the accidents which have been referred to the use of injections are convulsions, shock, and carbolic-acid or corrosive-sublimate poisoning; but the chief danger lies in the possibility of conveying the infectious materials from the vagina to the previously normal uterus. There seems to be no question as to the superior effectiveness of corrosive sublimate as a germicide. It not only acts more rapidly than carbolic acid, but its action is more permanent. In the usual proportion of 1 : 3,000 it is apt, when repeated frequently as a vaginal douche, to corrugate the vagina and cervix. In sensitive women the solution may occasion an intense burning sensation in the genital organs, lasting for several hours. When used for intra-uterine irrigation, great pains should be taken that no portion of the fluid remain behind in the uterine cavity. Since its introduction into the Emergency Hospital there has been one death from ulceration in the colon, which possibly was attributable to its use. It is to be hoped the claim that corrosive sublimate is an efficient antiseptic in the proportion of 1 : 10,000 may prove well founded.

Note.—The reports in the "Centralblatt für Gynaekologie" of thirteen severe cases of corrosive-sublimate poisoning occurring in midwifery practice, with four deaths, has led to a reaction from the extreme confidence with which it was at first employed. Thus Thorn† insists that it should be banished in irrigations of the genital canal, and that obstetricians return to carbolic acid. The positive advantages of corrosive sublimate, however, as a germicide furnish a

* "Zur Therapie der puerperalen Sepsis," "Arch. f. Gynaek.," vol. xx, p. 41.

† Thorn, "Ein Wort gegen die jetzt übliche Art der Anwendung des Sublimats in der Geburtshülfe," "Volkmann'sche Sammlung," No. 250.

powerful plea for its retention as a childbed antiseptic. The dangers from its employment have, for the most part, been found to result from the use of strong solutions (1 : 1,000) in large quantities, from the retention of a portion of the fluid in the uterine cavity or in the vaginal canal, and the forcible pressure of the fluid through the tubes into the abdominal cavity. Herff,* after a careful study of the reported cases of poisoning, believes that the dangers may be eliminated by the following precautions:

1. The quantity of fluid used for a single irrigation should not exceed two quarts.

2. The irrigation should not be prolonged.

3. During the irrigation the utmost pains should be taken to secure the free exit of the fluid from the entire utero-vaginal canal.

4. Corrosive-sublimate injections should not be employed in cases of atony of the uterus, and should, if possible, be omitted in anæmic women, in those suffering from kidney affections, and in patients who have previously been subjected to mercurial treatment.

5. As a general rule, the injections should be superintended by the attending physician in irrigation of the uterine cavity, and when strong solutions are employed. In cases of need, skilled nurses may be deputed to conduct the vaginal irrigations, but the solution should not exceed in strength 1 : 5,000.

6. Only a continuous stream with moderate pressure should be employed.

In pressing the necessity of caution and discrimination, I have not, however, intended to discourage the employment of intra-uterine antisepsis in cases where it is strictly indicated. Thus, it would be folly, in a fever due to the decomposition of placental débris, of shreds of decidua, of strips of membrane, or of retained coagula, or in diphtheritis of the mucous membrane, to treat the general symptoms and neglect the local cause of difficulty. In a specific case it may prove difficult to decide as to the correct course to pursue. In general it may be stated that it is proper to wash out the entire length of the genital canal when fever follows prolonged operations conducted within the uterine cavity or the birth of a dead fœtus, and in cases of fever associated with a fetid discharge which persists in spite of the vaginal douche, with the presence of recognizable portions of the ovum or its dependencies in the lochia, with the repeated discharge of decomposed coagula, or with a large, flabby uterus. It will, however, be seen that, with proper disinfection during and immediately after labor, the occasions for late intra-uterine injections are extremely rare.

The operation of cleansing the uterus should be conducted with the most scrupulous care. The syringe employed should produce a continuous and not an interrupted stream, and all air should be expelled from the pipe. The tube to be passed through the cervix should be of glass, of the size of the little finger, and bent somewhat to conform to the pelvic curve. The vagina should first be subjected to a

* Herff, "Ueber Ursachen und Verhütung der Sublimats-Vergiftung bei geburtshülflichen Ausspülungen des Uterus und der Vagina," "Arch. f. Gynaek.," vol. xxv, p. 487, 1885.

thorough disinfection, by way of precaution against conveying septic materials into the uterus. The introduction of the tube should be made with the guidance of two fingers passed through the external os. But slight force is requisite to reach the internal os. It is neither necessary nor desirable to push the tube to the fundus. The fluid injected should be tepid, and, if carbolic acid is used, of the strength of two or three drachms to the pint; if corrosive sublimate is employed, the strength should not exceed 1 : 3,000. It should be introduced very slowly, and pains should be taken to insure its unimpeded escape, which can usually be accomplished by pressing the anterior wall of the cervix forward by means of the glass tube. Langenbuch recommends securing permanent drainage by leaving a bit of rubber tubing in the cervical canal—a plan concerning the merits of which I am not able to speak from experience. The tube is said to be well tolerated, and to possess the advantage of enabling subsequent injections to be performed without disturbing the patient.

In many cases the results of intra-uterine treatment are very striking. Often the temperature falls notably within an hour or two of the operation. This result is, however, rarely permanent. Usually the fever recurs, and the operation has to be repeated. The patient should be carefully watched, and with the first sign of returning danger the injection should be repeated. Two or three injections may thus be called for in twenty-four hours, and they may require to be continued for a week. Still, by the means indicated, a certain pretty large proportion of women seemingly destined to destruction in the end make favorable recoveries.*

Ehrendorfer † relates a case of septic endometritis and erysipelas starting from the genital organs, in Spaeth's Clinic, where, after seven days of ineffective uterine irrigations, two bacilli, containing together ten grammes of iodoform, were introduced into the uterus. The washings with carbolic acid were then stopped. On the next day the discharge was diminished and the odor was less marked. On the fourth day two new iodoform bacilli were introduced. The patient, in spite of the fact that the erysipelas spread over nearly the entire body, eventually recovered.

Of the symptoms, the first in order which calls for treatment is

* The admirable monograph of Dr. T. G. Thomas, entitled "The Prevention and Treatment of Puerperal Fever," has already done much good in calling the attention of the profession at large to the practice of local disinfection. His experience, however, based upon a very large consulting practice, has perhaps been of a kind to furnish him with an undue proportion of puerperal cases calling for intra-uterine treatment. With increasing care in the management of labor and of the birth of the child there seems reason to hope that the necessity for the treatment he so eloquently advocates may, in the near future, disappear entirely.

† "Ueber die Verwendung der Jodoform-Staebchen bei der Intrauterinen nach Behandlung im Wochenbette," "Arch. f. Gynaek.," vol. xxii, S. 88.

usually the peritoneal pain. It is, as we have seen, commonly of a lancinating character, and is associated with hurried breathing and extreme frequency of the pulse. So soon as the pain is once fairly under control, the violence of the onset begins to abate. It should be met, therefore, by the hypodermic injection of from one sixth to one third grain of morphia in solution. The anodyne action should be maintained by doses administered by the mouth in quantities and at intervals suited to the severity of the case. The most important object to be secured is freedom from spontaneous pain. It is, moreover, good practice to push the opiate until pain elicited by pressure is likewise controlled, provided it can be accomplished without producing narcosis. In susceptible patients and in localized inflammations the quantity required may not be very great, while in acute general peritonitis the tolerance of the drug exhibited by puerperal women is sometimes extraordinary. Thus, a patient of Alonzo Clark took the equivalent of 934 grains of opium in four days; a patient of Fordyce Barker 13,969 drops of Magendie's solution in eleven days; and one of my own, at the Maternity, the equivalent of over 1,700 grains of opium in seven days.* In this latter instance the patient was to all appearance moribund when the treatment was begun. Thus, the features were pinched, the face was drawn, the pupils were dilated, the finger-tips were blue and cold, the respirations were rapid, and the pulse was scarcely perceptible. In this condition the large doses of opium did not produce narcosis, but were followed by restoration of the circulation, by normal breathing, and by the disappearance of the symptoms of shock. Any attempt to relax the treatment was at once succeeded by a recurrence of the alarming symptoms. At the expiration of the disease the opium was discontinued abruptly without detriment to the patient.

In contrast to cases of acute peritonitis, an extreme susceptibility to opium is often observed in the pyæmic variety. Here opiates seem to me rarely to do good. They do not hinder the migrations of the round bacteria, there is rarely pain to relieve, and I have sometimes thought that their administration was simply the addition of a second poison to the one which already was overwhelming the nervous system.

In pelvic peritonitis, in the course of forty-eight hours plastic exudation is thrown out and the pain to a great extent subsides. From this time very moderate doses of opium, as a rule, are needed to make the patient comfortable.

In France, leeches applied to the abdomen are much used as a means of relieving peritoneal sensitiveness. That they do this is beyond question. Their disuse in this country is due probably more to popular prejudice than to their inefficacy.

In the beginning of an attack a turpentine stupe to the abdomen is

* The details of this case have been reported in the "Am. Jour. of Obst.," Oct., 1880, p. 864, by Dr. F. M. Welles, who conducted the administration of the opium.

a source of comfort to many women, while the sharp counter-irritation exercises possibly a favorable influence upon the course of the disease. At a later period I commonly employ flannels wrung out in water and covered with oil-silk to prevent speedy evaporation. It is an old experience, that in the beginning of a puerperal fever the provocation of loose stools by purgatives is frequently followed by a fall in the temperature and a great improvement in the patient's condition. The result, however, is far from uniform, as in other cases these artificial diarrhœas have a tendency to aggravate the peritoneal symptoms. Owing to this uncertainty in their action, purgative remedies should be administered with caution, not from any theory as to their eliminative powers, but because of the ascertained existence of fecal accumulation. In pelvic inflammations castor-oil in two- or three-tablespoonful doses, or five to ten grains of calomel rubbed up with twenty grains of bicarbonate of sodium, as recommended by Barker, may be given when thus indicated. After the bowels have once been freed, however, the purgative should not be repeated. In cases of intense local inflammation and in general peritonitis, enemata should alone be employed for the removal of constipation.

Every increase of body-heat is associated with rapid tissue-waste, with enfeebled heart-action, and with exhaustion of the nerve-centers. Since the modern recognition of the deleterious effects of high temperatures *per se*, antipyretic remedies in place of the old-time cardiac sedatives have come to play the leading rôle in the treatment of fevers.

Of internal antipyretic agents, quinia enjoys a deservedly high repute. In the remitting forms of fever it may be administered in five-grain doses at intervals of four to six hours. Given thus in medium doses, it moderates the fever, diminishes the sweating, and in most patients lessens gastric and intestinal disturbances. In continued fevers it should, on the contrary, be given in a single dose large enough to procure a distinct remission. By making a break in the febrile symptoms, if only of a few hours' duration, a retardation of the destructive processes is accomplished. At the first administration twenty to thirty grains may be given. In favorable cases the temperature falls in the course of a few hours below 101°. When the high temperature is only temporarily held in check, at the end of twenty-four hours, if all symptoms of cinchonism have disappeared, the same dose should be repeated. If the doses mentioned, given in the manner prescribed, produce no perceptible effect upon the fever, their continuance may be regarded as unnecessary.

C. Braun and Richter speak favorably of the action of salicylate of sodium.* It possesses antipyretic properties, though in a less degree than quinia. It is, however, rapidly absorbed, circulates through all

* Richter, "Ueber intrauterine Injectionen," etc., "Zeitschr. für Geburtsk. und Gynaek.," Bd. ii, Heft 1, p. 146.

the parenchymatous organs, and finally is discharged unchanged in the urine. It is said by Binz, in small doses, to hinder the action of the disease-producing ferments, while it leaves untouched the normal ferments of the organism. It is of special service where quinia is not well tolerated, or when given fifteen to twenty grains at a time every four to six hours as an adjuvant to large single doses of quinia. The remedy should be continued until all traces of febrile disturbance have disappeared.

A more powerful remedy than salicylic acid, where quinia has failed, is the Warburg's tincture. Some patients find, however, that it is somewhat difficult to retain upon the stomach.

Not many years ago, owing to the encomiums of Fordyce Barker,* the tincture of veratrum viride was in great favor in puerperal fever as a means of reducing the excited pulse of inflammation. The plan recommended was to administer five drops hourly, in conjunction usually with morphia, until the pulse was brought down to 70 or 80 beats to the minute. If the pulse had once been reduced, then three, two, or one drop hourly would be found sufficient to control it. Vomiting and collapse from its use were no cause for alarm, as they were temporary symptoms, and were followed by a fall of the pulse to 30 or 40 a minute, which was rather of favorable prognostic significance. In the rapid pulse of exhaustion, however, veratrum should not be given. Since the introduction of the thermometer into practice the reduction of the pulse by veratrum has been found to be associated with a fall in the temperature of the body. Of late, however, veratrum has gone rather out of vogue, not because it is not a very effective agent, but because its administration is an art to be acquired, and can not safely be intrusted to an unskilled assistant. Then, too, in the last ten years there has grown up a better acquaintance with less dangerous remedies.

Braun recommends in severe cases, where quinia alone is without effect, to give in addition from twelve to twenty-four grains of digitalis in infusion per diem until its specific action is produced. Unlike veratrum, digitalis effects a permanent slowing of the heart. By prolonging the cardiac diastole and contracting the arterioles, it allows the left ventricle to fill, restores the arterial tension, diminishes correspondingly the intra-venous pressure, and promotes absorption. Its tendency to produce gastric disturbances and the distrust felt as to its safety have prevented its becoming popular in practice.

Alcohol as an adjuvant to treatment is indicated in all cases, whether quinia or salicylic acid or veratrum be simultaneously employed. It stimulates and sustains the heart, it retards tissue-waste, and is in itself an antipyretic of no mean value. Usually I give it in conjunction with quinia, one or two teaspoonfuls hourly of either

* "The Puerperal Diseases," p. 347.

whisky, rum, or brandy, in accordance with the recommendation of Breisky.* But many years before I had learned from my friend, Prof. Barker, that the specific influence of veratrum was in many cases not obtained until the use of alcohol was combined with it.

It is probable that antipyrine has a future in the treatment of puerperal fever, but at present it is only possible to speak of it provisionally. Given in 15- to 30-grain doses, repeated at hourly intervals until a decided impression has been produced (often a single dose is sufficient), I have known it to reduce the temperature after all other antipyretic agents had failed; but in all the instances where the better-known remedies had proved unavailing, the fall of temperature produced by the antipyrine did not prevent a fatal ending.

The antipyretic action of drugs is probably due for the most part to some direct influence they exert upon the oxygenation of the tissues. Of course, the less the fire the less the heat. It is well, however, to support their internal administration by the external employment of cold. Cold owes its effect in fevers partly to the abstraction of heat from the body-surface, and in a still more important degree to the impression which it produces upon the nervous system. In healthy persons the action of cold is to increase the consumption of oxygen and the production of carbonic acid. The additional heat thus generated renders it possible to sustain the vicissitudes of climate. In fevers the primary effect of cold is similar in character. Its main therapeutical action is derived from its secondary influence upon the nerve-center which regulates the body-heat. If the cold employed be sufficiently intense or sufficiently prolonged, there follows, not always immediately, but in the course of an hour or two, a marked lowering of the temperature, which can only be accounted for by assuming an indirect influence exerted through the sympathetic nerve and the medulla oblongata. This peculiarity renders the external application of cold a most valuable addition to the therapeutical resources available in fevers.

In cases of moderate severity, frequently sponging the patient with cold water will be found to be a grateful practice. An ice-cap to the head, where the blood lies near the surface, will often affect the entire temperature of the body. From immemorial times it has been employed to control delirium and promote sleep. An ice-bag placed over the inguinal region is locally beneficial to deep-seated pelvic inflammations, and, according to Braun, is capable of effecting a rapid fall of temperature. Ice-cold drinks should be freely allowed.

Schroeder recommends a permanent stream of cold water in the uterine cavity by means of a large irrigator and a drainage-tube; others advise cold rectal injections maintained for long periods by the aid of a tube with a double current.

In fevers of great violence the systematic application of cold by

* "Ueber Alcohol- und Chinin-Behandlung," Bern, 1875.

means of baths or the wet pack is capable in some cases of rendering important service. The temperature of the bath should range from 70° to 80°. Its duration should not exceed ten minutes. The patient should, when removed to the bed, be wrapped in a sheet without drying, and should be comfortably covered. In employing the wet pack, two beds should be placed side by side. The body and thighs of the patient should be wrapped in a sheet wrung out in cold water, and be allowed to remain in the pack from ten to twenty minutes. As the sheet becomes heated, the patient should be placed in a fresh one upon the second bed, and the transfers should be continued until the desired fall of temperature is effected. Braun claims that four packs are equivalent in action to one full bath.

Both these methods are, however, open to the objection that they can not be carried out without considerable disturbance of the patient—a point of no small importance in cases of peritonitis. G. B. Kibbie has invented a fever-cot which obviates the ordinary difficulties of this mode of treatment. The cot is covered with "a strong, elastic cotton netting, manufactured for the purpose, through which water readily passes to the bottom below, which is of rubber cloth so adjusted as to convey it to a vessel at the foot." T. G. Thomas,* who has employed this apparatus extensively to reduce high temperatures after ovariotomies, explains as follows the *modus operandi:* "Upon this cot a folded blanket is laid, so as to protect the patient's body from cutting by the cords of the netting, and at one end is placed a pillow covered with India-rubber cloth, and a folded sheet is laid across the middle of the cot about two thirds of its extent. Upon this the patient is now laid; her clothing is lifted up to the armpits, and the body enveloped by the folded sheet, which extends from the axillæ to a little below the trochanters. The legs are covered by flannel drawers and the feet by warm woolen stockings, and against the soles of the latter bottles of warm water are placed. Two blankets are then placed over her, and the application of water is made. Turning the blankets down below the pelvis, the physician now takes a large pitcher of water, at from 75° to 80°, and pours it gently over the sheet. This it saturates, and then, percolating the net-work, it is caught by the India-rubber apron beneath, and, running down the gutter formed by this, is received in a tub placed at its extremity for that purpose. Water at higher or lower degrees of heat than this may be used. As a rule, it is better to begin with a high temperature, 85°, or even 90°, and gradually diminish it. The patient now lies in a thoroughly soaked sheet, with warm bottles to her feet, and is covered up carefully with dry blankets. Neither the portion of the thorax above the shoulders nor the inferior

* "The Most Effectual Method of Controlling the High Temperature occurring after Ovariotomy," "N. Y. Med. Jour.," August, 1878.

extremities are wet at all. The water is applied only to the trunk. The first effect of the affusion is often to elevate the temperature—a fact noticed by Currie himself—but the next affusion, practiced at the end of an hour, pretty surely brings it down. It is better to pour water at a moderate degree of coldness over the surface for ten or fifteen minutes than to pour a colder fluid for a shorter time. The water slowly poured robs the body of heat more surely than when used in the other way. The water collected in the tub at the foot of the bed, having passed over the body, is usually 8° or 10° warmer than it was when poured from the pitcher. On one occasion Dr. Van Vorst, my assistant, tells me that it had gained 12°. At the end of every hour the result of the affusion is tested by the thermometer, and, if the temperature has not fallen, another affusion is practiced, and this is kept up until the temperature comes down to 100°, or even less. It must be appreciated that the patient lies constantly in a cold wet sheet; but this never becomes a fomentation, for the reason that, as soon as it abstracts from the body sufficient heat to do so, it is again wet with cold water and goes on still with its work of heat-abstraction. I have kept patients upon this cot enveloped in the wet sheet for two and three weeks, without discomfort to them and with the most marked control over the degree of animal heat. Ordinarily, after the temperature has come down to 99° or 100°, four or five hours will pass before affusion again becomes necessary."

Since reading this account, I have made a good many trials of the method upon puerperal women, and have not found that it agrees with all in an equal degree. In some instances the affusions have been followed, in spite of hot bottles to the feet and the administration of stimulants, by such a degree of depression and impairment of cardiac force, as shown by the persistent coldness of the extremities, that it has been necessary to discontinue them. On the other hand, I can look back upon cases, apparently so desperate that the condition of the patients was looked upon as hopeless, where they proved the means of saving life as by a miracle. Of course, the difference depends upon whether the high temperature is the sole cause of the alarming symptoms, or whether the latter are in part due to blood-dissolution and secondary changes in the parenchymatous organs.

The use of the coil in fever, whether of rubber or of metal tubing, I can highly recommend. Either the night-dress or a towel should be placed between the coil and the skin. A current of cold water passing through the tube rapidly abstracts the surface heat, and is usually grateful to the patient. The lowering of the temperature by this means is much slower than by cold affusions. Disturbance of the patient is, however, avoided, and the method, so far as I have tried it, has been free from the objections incident to the direct application of water to the skin.

It is hardly necessary to state that in puerperal, as in other fevers, the patient's strength requires to be sustained and the waste of tissue to be repaired, as far as possible, by the regulated administration of liquid food, as milk and beef-tea, in such quantities as can be borne by the stomach, and at one to two hours' intervals.

In the treatment of encysted peritoneal effusions, and in inflammatory exudations into the pelvic and adjacent cellular tissue, after the acute symptoms have subsided the attention should be directed to the afternoon fever and to promoting the assimilation of food. So soon as the sweating and fever are checked, the absorption of the plastic materials begins. The most important agents for accomplishing this object are quinia, in moderate doses, combined with some form of alcohol and with tepid sponging. Deep-seated pain in the iliac region is best relieved by a large blister upon the side over the point where the tenderness is felt. Prolonged rest in bed should be enjoined. Even after convalescence is well advanced, so long as the exudation remains unabsorbed the resumption of household duties is pretty certain to be followed by a relapse or by the development of a chronic condition of a most intractable description. The sooner the patient's stomach can be got to digest and absorb beefsteak and iron the more speedy will be her recovery.

In pelvic exudations the hot vaginal douche, warm baths, and the application of flannels wrung out in water to the abdomen aid in diminishing the local pain, and, perhaps, in causing a disappearance of the tumor. The action of mercurials or of iodide of potassium in melting away plastic inflammatory materials is sometimes very striking, but more frequently they either do no good or else do harm by disturbing the digestion.

If fever, chills, and sweating announce the presence of pus, the most careful exploration should be made to determine, if possible, the seat of suppuration. It is of great advantage to treat pelvic abscesses as abscesses are treated elsewhere in the body. If the redness of the skin above Poupart's ligament indicates a tendency to point in that direction, an aspirator-needle should be introduced to make sure of the diagnosis. If the sac is near the surface, a free incision should be made and the pus should be allowed to escape. In many cases I make these incisions three to four inches in length. The redness of the external skin makes it certain that the abscess has become adherent to the abdominal wall, and that the incision consequently will not communicate with the peritonæum. After the abscess has been opened it should be cleansed twice daily, and the cavity should be filled with oakum. If, after a time, the granulations become flabby, Peruvian balsam or iodoform should be introduced into the sac at each change of the dressing. I can recommend this plan as essentially a mild procedure. With a large opening for the discharge of pus, the fever and

sweating disappear, the appetite returns, and the abscess fills rapidly by granulation. With a small incision hectic is apt to persist, and the abscess to end in the formation of interminable fistulæ.

If softening and bagginess or distinct fluctuation indicate that the pus can be reached through the vaginal *cul-de-sac*, the aspirator-needle should be inserted deeply at the suspected point, and, if a large amount of pus is detected, an incision should be made with a long-handled bistoury, using the needle as a director, and making the opening large enough to permit the introduction of a drainage-tube. I prefer for this purpose a self-retaining Nélaton catheter, which is easily passed by means of a uterine sound inserted into the eye at the extremity. Through the tube—without disturbing the patient—the pus-cavity can be washed as frequently as required, and with drainage and cleanliness cases of the longest standing may be expected to recover.

P. F. Mundé* has reported a number of cases of chronic character where the aspiration of pus has been followed by rapid absorption of the intra-pelvic exudation. The presence of pus was suspected because of a boggy, doughy feeling in the exudation tumor.

CHAPTER XXXVII.

PUERPERAL INSANITY.—PHLEGMASIA ALBA DOLENS.—DISEASES OF THE BREASTS.

The insanity of pregnancy, of childbed, of lactation.—Phlegmasia alba dolens.—Defective milk secretion.—Galactorrhœa.—Sore nipples.—Subcutaneous inflammation of the breast.—Submammary abscess.—Parenchymatous mastitis.—Galactocele.—Prophylaxis of ophthalmia neonatorum.

The Insanity of Pregnancy, Childbed, and Lactation.

When we remember the marked perturbation of the nervous system, in even normal pregnancy, from reflex causes, from disorders of the digestion, and from depravation of the blood, it is not strange that the same conditions which give rise to moral perverseness, to the loss of memory, to hysteria, or to hypochondria, should likewise prepare the way for the outbreak of the more pronounced forms of mental derangement. In character the psychical disturbances of child-bearing women do not differ from those which develop under ordinary circumstances; but so active are the causes during the period in question that, of the insane who crowd the public asylums, in one eighth, according to Tuke, the malady is of puerperal origin. In

* "Diagnosis and Treatment of Obscure Pelvic Abscess," etc., "Arch. of Med.," December, 1880.

many women there exists in advance an hereditary disposition to insanity, the events of pregnancy and childbed, which are commonly associated with the ultimate attack, acting simply as the sparks which fire the mine.

During pregnancy the prevailing form of mental disturbance is melancholia, with sometimes a tendency to suicide. The prognosis is favorable when the disease develops in the early months and follows physiological depression and hypochondria; unfavorable in severe attacks occurring first in the latter half of pregnancy, or where pregnancy intervenes in the case of insanity previously existing. As a rule, these patients can be best cared for in well-regulated private institutions, where they are not subjected to the good-intentioned expostulations of intimate friends.

The pains of labor in excitable persons are said to give rise at times to a transitory delirium; but this certainly is of very rare occurrence in these days of anæsthetics. The indications for treatment are, of course, to relieve the pain, and to hasten the birth of the child.

Mania may occur in any severe puerperal affection. It has been observed not only in the various forms of metritis, but even, according to Winckel, as a result of sore nipples and very painful inflammations of the breasts. The delirium in these cases rises and falls with the fluctuations in the underlying malady, and is thought to be dependent upon associated cerebral hyperæmia. The maniacal manifestations may consist, when there is freedom from suffering, of agreeable hallucinations—the patient often singing or wearing on her face a rapt expression; or, if the pain is great, she may on the other hand see forms which threaten her, so that in terror she cries for help, springs from bed, and strips off her clothes in the effort to escape the source of danger. The prognosis depends, of course, upon the gravity of the morbid condition of which the mania is only a symptom. The treatment, with the exception of dry cold to the head, is that of the main affection.

Again, puerperal mania may proceed from an hereditary predisposition or from diseases antedating pregnancy, in either case the puerperal state acting as the proximate but not as the fundamental cause of the outbreak. The attacks may be accompanied by erotomania, by nymphomania, by religious anxiety, or by the *délire de persécution*. It may be evoked by psychical impressions. It occurs at an early period of childbed, when the strength is wasted by pain, excitement, or fever.

Finally, puerperal mania may be caused by exhausting losses of blood, by intense pain, by eclampsia, or by anything which occasions cerebral congestion. In this, the so-called idiopathic form of puerperal mania, the attack is generally preceded by sleeplessness, indistinctness of speech, by restless movements, and the refusal to take food. At

the beginning of the attack the delirium is usually of a noisy character, the patients screaming, praying, or preaching in a declamatory fashion ; or they try to get out of bed and to escape from the room by the doors or windows. Sexual excitement is rare, the disposition to strip off the night-dress and expose the person proceeding not from an erotic impulse, but from a desire to escape from some fancied restraint. Attempts to control these patients by force are apt to excite them to renewed violence. This acute stage is followed by melancholia, characterized by weeping, praying, and fears concerning the commission of the unpardonable sin. As a result of the mental depression, suicidal tendencies develop in a considerable proportion of the cases. The period at which the outbreak first attracts notice occurs most frequently within the first two weeks.

The indications for treatment are to check profuse, exhausting discharges, to support the patient's strength, and to insure perfect quiet. With the first sign of trouble the child should be taken from the breast, liquid food should be given at frequent intervals, care should be taken to keep the bladder and the rectum empty, the room should be darkened, and its temperature should be regulated. The activity of the skin should be promoted by means of the sponge-bath. The sacrum should be watched and strapped with adhesive plaster if bed-sores threaten. Furniture, pictures, or any articles which disturb the patient should be removed from her sight. There is no condition in which trained nursing can do so much toward effecting recovery. The nurse's duties are to administer food, to see that urination is regularly performed, to keep the patient covered, and to prevent her from doing harm to herself or others. Members of the household who can not resist the impulse to show the insane woman the folly of her delusions should be regarded as disqualified from entering the sick-room. Pastoral visits are rarely beneficial. If the patient becomes violent, it is usually possible for the family physician to obtain obedience without the exercise of restraint or force. So important is the question of personal influence in the management of puerperal insanity, that the success of home treatment is almost wholly dependent upon the control which the physician has acquired over the *morale* of his patient previous to the occurrence of her malady. Narcotics do not cure, but when they produce a few hours' sleep they certainly promote recovery. There is hardly one in the entire list which has not, at some time, done me good service. My preference is for chloral and the bromide of potassium (āā gr. xxx) in solution, and administered by the rectum. To procure an effect from moderate doses, it is, however, necessary that the narcotic be given, not during the period when the patient is most voluble and restless, but either after she has become quieted by judicious management or during a natural interval of calm. Cold to the head is often very effective in relieving headache and cerebral conges-

tion. If the stage of exaltation passes into that of melancholia, the question of continued home-treatment becomes a serious one. The mother sometimes exhibits not only indifference, but even a positive dislike, to her child, which makes it a risky thing to leave them alone together. Again, owing to the suicidal tendencies which often go with melancholia, it never is safe to allow the patient to pass out of observation, as is shown by the following case: A young woman after her first confinement had an attack of mania for which she was sent to a private asylum. Shortly after, she was removed by her friends to her own home. There her sweetness and passive resignation disarmed suspicion. One day, however, she dropped her sewing, put on her hat, and, bidding her mother a pleasant good-by, walked quietly down to the river—a half-mile away—and composedly lay down in the shallow stream near the bank, so that the water covered her face. From this position she was rescued by some men who were mowing in a field near by, and by them was carried insensible to her home. The next day she was returned to the asylum, where she soon made a good recovery.

The insanity of lactation is either the result of cerebral anæmia or a relapse from a previous attack. It begins, as a rule, six to ten weeks after confinement. In most cases it assumes the form of melancholia. The prognosis is good if the disease is treated in season, by stopping lactation and by removing the debility upon which it depends.

In general, the prognosis of puerperal mania is favorable, more than sixty per cent. of the cases ending in recovery. In private practice the number is probably much larger. During convalescence care should be taken to secure to the patient rest, sleep, nutritious food, and a daily evacuation of the bowels, and little by little she should be brought back once more to old habits and the responsibilities of existence.

Phlegmasia Alba Dolens.

Phlegmasia alba dolens is the term applied to a swelling of one or both lower extremities, occurring usually between the tenth and twentieth day after confinement, and characterized by pain, tension of the skin, and a milk-like whiteness of the surface. Owing to its color and its supposed origin, it has received the popular name of *milk-leg*. Phlegmasia is an affection of the connective tissue, and is associated in most, but not in all, cases with thrombosis of the veins.

The origin of the swelling is somewhat obscure. In a certain proportion of cases phlegmasia is obviously the extension of an inflammatory process from the genital organs to the perinæum, the nates, and the upper portion of the thigh. If confined to the subcutaneous and intermuscular cellular tissue, the vessels may not become affected. When, however, the morbid changes follow the sheaths of the vessels,

the walls of both veins and lymphatics thicken, and in most cases secondary thrombus formation results.

In other instances the thrombus formation is apparently the primary lesion. It may occur spontaneously from slowing of the blood-current. A predisposition to thrombosis is created by varicose veins. The vessels usually involved are the crural and its branches, the tibial and peroneal veins. Again, the intra-venous coagula may start from the placental site, and, extending along the pampiniform plexus to the hypogastric vein, may thence occlude the crural to Poupart's ligament, or, passing upward by the spermatic veins, they may obstruct the vena cava. Sometimes the occlusion of one crural vein is succeeded by that of the other, phlegmasia in that case developing in both extremities.

Thrombus formation may begin during pregnancy, and is then usually attended with pain at the seat of trouble, and with stiffness in the toes or the dorsum of the foot. As a rule, however, the disease is rare before the second week following labor. Often it is preceded by gastric disturbances, as lack of appetite, a furred tongue, and constipation, by chilly sensations, and by a heavy feeling in the affected limb. A careful examination sometimes reveals the existence of inflamed or thrombosed veins in the leg, in the popliteal space, or upon the inner surface of the upper portion of the thigh. If the affected veins are superficial, the redness and swelling may be obvious to the eye.

The first characteristic symptom is the development in the limb of a dull, dragging pain, which is increased by motion. Tenderness to pressure is only experienced along the course of inflamed vessels.

In primary thrombosis the swelling usually begins at the ankle, and spreads rapidly to the knee and upward to the inguinal region; in secondary thrombosis, extending from the uterine sinuses, and in the superficial form of phlegmasia, the swelling, on the contrary, travels commonly in the reverse direction, viz., from the inguinal fold to the ankle.

The onset may or may not be announced by a chill. Fever often precedes and accompanies the attack. It is, however, in uncomplicated cases, of a mild type, and sinks to the normal point long before the swelling of the limb subsides. Severe chills and intense fever, with marked remissions, are symptomatic of metastatic pyæmia. Other complications may essentially modify the course of the disease. The pain, the tenderness, and the febrile disturbance are usually greatest in the phlegmonous form of swelling, which starts from the genital organs.

The ordinary termination of phlegmasia is by absorption of the thrombus, with restoration of the circulation. As this takes place, the tension of the skin subsides, and the parts pit upon pressure, as in ordinary œdema. As the swelling and pain subside, the mobility

of the limb becomes restored. The period of extreme tension lasts, as a rule, for from five to eight days. Recovery takes place slowly, the dispersion of the tumor requiring from three to six weeks.

A less common result consists in the permanent obliteration of the vessel by the conversion of the thrombus into a solid connective-tissue cord, in which case the extremity may long continue heavy, and locomotion be attended with difficulty.

In rare instances the process may terminate in suppuration and abscess formation. The prognosis of a pus collection in the vicinity of a vessel, resulting from periphlebitis, is usually favorable, the symptoms that it occasions disappearing when the abscess is opened and the pus is allowed to escape. When the suppurative process is of a spreading character, undermining the skin and attacking the intermuscular cellular tissue, the destructive changes may assume frightful proportions. Thus, in hospital practice, we sometimes witness cases where the muscles are dissected from one another, and are bathed in an ichorous fluid, with greenish particles of necrosed tissue adhering to them, death ensuing from intense septicæmia.

Sometimes a thrombus becomes infected and undergoes puriform softening, with detachment of small particles, which, entering the circulation, give rise to infarctions and metastatic abscesses; or a large fragment may be separated accidentally from a normal clot, and, passing by the vena cava and the right side of the heart, may cause sudden death by plugging the pulmonary artery.

The prognosis, from what has been said, is evidently dependent upon the origin of the phlegmasia and upon the nature of the complications. The principal indications for treatment are, opium to alleviate pain, cathartics, if needed, to unload the bowels, quinine, iron, and good food to sustain the strength, and rest for the swollen extremity. The latter should be raised somewhat higher than the body, and during the early stages of the swelling should be wrapped, as recommended by Dr. F. Barker, in cotton-batting and oil-silk. The tenderness should be mitigated by the application of soothing liniments. If vesicles form upon the surface, they should be punctured and the fluid be allowed to escape. When the extremity begins to pit on pressure and the tenderness to subside, absorption should be promoted by gentle frictions with alcoholic lotions and by bandaging the entire limb evenly with a flannel roller. Until every trace of tenderness and thickening has disappeared from the veins, the patient should under no circumstances be allowed to leave her bed. The danger of death from sudden obstruction of the pulmonary artery is always present until the thrombus has disappeared or become firmly organized.

For some time after recovery has taken place the limb will swell, as the result of standing or of protracted exercise, a condition which, as a rule, is greatly benefited by the patient wearing a long elastic stocking.

Diseases of the Breast.

Defective Milk-Secretion.—A scanty milk-secretion, due to lack of mammary development, to extreme youth, to polysarcia, or to the mature age of the mother, is not amenable to treatment. Temporary insufficiency, resulting from defective nutrition, may sometimes be remedied by a regulated nitrogenized diet, by the tincture of iron, an out-door life, and by the consumption of large quantities of fluid. A diet composed for the most part of milk is strongly to be recommended. If the baby is feeble, and sleeps or cries when put to the breast, it is a good plan for the mother to borrow for a time a healthy infant with strong suction-powers to stimulate the glands to perform their functions. Cataplasms of castor-oil leaves or fennel-teas possess no claims to confidence.

Galactorrhœa.—An abundance of milk is not pathological, the quantity quickly accommodating itself to the wants of the child. A constant dribbling of milk from the nipple, or *galactorrhœa*, an affection which may continue long after lactation has been suspended, acts, like any other profuse discharge, in exhausting the strength and in producing a wasting of the tissues. The treatment consists in interrupting lactation, in compression of the breasts, and in the employment of such dietetic measures as are best calculated to repair the general health ; of special measures, saline laxatives and the internal administration of iodide of potassium are of most repute.

Sore Nipples.—Under the term *sore nipples* are included a number of lesions which, in spite of their seeming triviality, possess considerable importance, not only on account of the suffering they occasion, but because they furnish the starting-point of most cases of mammary abscess.

A simple erythema, associated with great tenderness, is a common trouble at the beginning of lactation, to which, however, primiparæ are more subject than multiparæ. It is a good plan to anticipate this difficulty by instructing the patient to wash the nipples daily, during the last weeks of pregnancy, with some astringent or alcoholic solution. In childbed, in addition to strict cleanliness, great benefit is derived from folding a linen rag around the nipple and keeping it constantly wetted with Goulard's extract, a teaspoonful to a tumbler of water, until the sensitiveness and redness have disappeared. Before applying the child to the breast, care should be taken to wash away the deposited carbonate of lead.

In many women, owing to the maceration and loosening of the epithelium from the oozing of the colostrum, suckling of the child is followed by the formation of small vesicles, which eventually rupture and produce isolated erosions. Under favorable conditions, these erosions become covered with crusts beneath which the healing process

takes place. If, however, the crusts are removed by suckling before a new layer of epithelium has had time to form, the simple excoriation may be converted into an ulceration with deep destruction of tissue. If the child be suffering from sprue, the transfer of the oïdium albicans may impart to the wounds of the nipple an aphthous character. If the primary vesicles, in place of remaining isolated, coalesce, the nipple may become bared of its epithelium over a considerable extent of its surface. The papillæ then enlarge and give a raspberry-like appearance to the exposed structure.

Fissures of the nipples are excruciatingly painful, and are capable of exciting even a high degree of fever. They occur with greatest frequency in nipples which have been flattened by the pressure of corsets, or in which the natural fissures between the papillæ are of unusual depth. Most commonly they are seated at the base of the organ. Either they may develop from the erosions just described, or the clefts upon the surface may become covered by crusts composed of dirt and colostrum, which, when torn away by the nursing child, detach the delicate underlying epithelium.

As regards the treatment, it is well to bear in mind that, with cleanliness and the removal of irritating matters from the wounded surface, the worst cases of sore nipples will get well in from twenty-four to forty-eight hours, provided lactation is suspended. The object of treatment, therefore, is to cure the lesion without interfering with the nursing of the child. This is comparatively easy when but one nipple is affected, as the child need only be applied to the sound side. In that case, however, the excessive tension which results from the suspension of lactation should be relieved by stroking the breast from the base toward the apex with the hands, or by getting the nurse to draw the milk with her mouth, or by means of a breast-pump with a wide, trumpet-shaped extremity. The healing process can at the same time be promoted by lead-lotions, by a solution of tannin, or by some astringent ointment. My rule is to keep upon the nipple a rag wetted with the Goulard's extract, as described for erythema, during the patient's waking hours, substituting therefor a carbolized ointment during the hours of sleep, when the drying of a lotion would cause the rag to adhere to the raw surface. If the child be troubled with sprue, special attention must be taken to cure its mouth, and the development of the oïdium albicans upon the nipple should be prevented by frequent washings with solutions of boracic acid or of the sulphite of sodium.

Cracks are much more rebellious to treatment than simple erosions. If of any extent, the nipple should be drawn to one side, so as to expose the fissure, which should be touched with the point of the mitigated stick of nitrate of silver. As the effect of the latter is intended to be local, it should be applied dry, the lymph furnished

by the denuded surface affording the requisite moisture. I mention this trivial detail, as, in hospital practice, I have sometimes seen the entire nipple robbed of its epithelium, owing to the mistake made by the house-physician of first dipping the pencil in water, and then allowing the strong solution to diffuse itself over the sensitive surface. The compound tincture of benzoin, strongly recommended by Professor F. Barker, makes a good stimulating application to cracks of the nipple. Though somewhat painful when used for the first time, it is afterward easily tolerated.

If both nipples are simultaneously affected, lactation can not, of course, be entirely interrupted without drying up the milk, but the intervals between the acts of nursing should be lengthened as much as the comfort of the mother will permit. If the milk will not come without tugging, the flow should be furthered, before applying the child, by stroking the breasts. Of nipple-shields I am not able to speak with much enthusiasm. Many, if not most, infants resent the ordinary rubber ones, and refuse to suck through them. A more acceptable form is one provided with a rubber tube and mouth-piece, such as commonly goes with nursing-bottles, but it is apt to drive away the milk if its use is long persisted in. Legroux recommends a bit of gold-beater's skin, fastened to the breast by means of collodion, and perforated with a needle over the portion which covers the openings of the lactiferous ducts. But, even without these aids, in time a cure can usually be effected by perseverance in the use of the remedies already mentioned. It is necessary to stop nursing altogether only when the nipples are hopelessly flat and misshapen, or when mastitis threatens.

For eczema, lead, zinc, or white-precipitate ointment may be employed. In obstinate cases a solution of corrosive sublimate (gr. v ad ℥ j) is recommended by Hebra.

Subcutaneous Inflammation of the Breasts.—The subcutaneous inflammation may be confined to the areola, which then becomes red, swollen, and excessively sensitive. This form generally terminates in suppuration, and may form fistulous communications with the lactiferous ducts. Sometimes the inflammation begins in the sebaceous follicles, giving rise to small boils around the nipple.

In other cases inflammation may extend beyond the areola, and either give rise to localized abscesses, or, when due to the septic infection of excoriated nipples, assume an erysipelatous character.

The treatment of both these forms consists in the application of warm lead-lotions, and in the early evacuation of the pus. To avoid cutting into the milk-ducts, the incision should radiate from the nipple.

Inflammation of the Submammary Connective Tissue.—This rare condition owes its origin, according to Billroth, in most, if not in all,

cases to abscess formation in the deep-lying glandular structures, the pus perforating the fascia-like connective tissue at the base of the organ into the loose connective tissue situated between the gland and the pectoral muscle. The breast is in consequence lifted from the trunk, and can be moved to and fro as though it rested upon a water-bed. The skin is not reddened, but is sometimes markedly œdematous. The pain is deep-seated and dull; the fever is high and continuous; the axillary glands swell, and movements of the arm are hindered by the increase of the pain they occasion. Stoltz is said to have removed from such a sac twenty ounces of pus. So soon as the pus-formation is recognized, and the fact can be early determined by means of an aspirator-needle, a free incision should be made at the lower portion of the gland, and the wound should be treated with the antiseptic precautions which will be given in connection with parenchymatous mastitis.

Parenchymatous Mastitis.—Inflammation of the glandular structures of the breast develops usually in the first four weeks after confinement. It is characterized by pain, high fever, and nodular enlargement of the affected lobules. The attack usually begins with a sharp chill. These symptoms are sometimes observed three to four days after the birth of the child, at the beginning of lactation, but then are usually temporary, the commencing mastitis terminating in spontaneous resolution. Mastitis leading to abscess-formation belongs, for the most part, to a later period, occurring most frequently in the third or fourth week, long after the first inflammatory symptoms have subsided.

Puerperal mastitis is quite commonly believed to be due to emotional causes, to cold, to blows, or to "caking" from milk retention —all suppositions of extreme convenience as relieving the physician from responsibility for their occurrence. They certainly, however, play a subordinate *rôle* in the etiology of the affection, the lesions of the nipples furnishing, with perhaps rare exceptions, the starting-point from which the inflammation travels to the glands, either passing to the deep-seated tissues by the lymphatics, or following the track of the lactiferous ducts to the glandular acini.* The exact anatomical structure of the resulting nodular masses is, for the most part, matter of conjecture. Only this much is known certainly, that they are composed in part of glandular structures and in part of the swollen interstitial tissue; that the lactiferous ducts are either constricted or

*Baum ("Zur Aetiologie der puerperalen Mastitis," "Arch. f. Gynaek.," vol. xxiv, p. 262) discovered diplococci in the pus obtained from a mammary abscess. These diplococci were subjected to pure culture, and in the fifth generation were inoculated, by means of a hypodermic syringe, into his own skin and into that of two other persons. The inoculations were followed by hardening, fever, suppuration, and the formation of sinuous cavities.

closed ; that suppuration takes place both in the connective tissue and in the acini ; and that the large abscess-cavities form from the coalescence of small pus-collections. The walls of the abscess are, therefore, never smooth, but are uneven, with projecting portions of glandular tissue which has, as yet, not undergone disintegration. The milk-secretion is arrested in the affected lobules. If, as sometimes happens, a large duct is perforated, pus may be discharged with the milk, or, in case the abscess opens externally, a milk-fistula may be produced. When several foci of inflammation exist, they may suppurate in succession, so that abscess after abscess may develop, and the morbid condition be protracted for weeks, and even months. If the abscesses break spontaneously, at a point unfavorable for the discharge of pus, fistulous passages are liable to be produced. In hospitals, as the result of long-continued suppuration and necrosis of tissue, entire lobes may undergo destruction, with subsequent cicatricial formation and ensuing deformity of the breast ; or, with the access of unwholesome air to the abscess-cavities, the sloughing tissues may become gangrenous and death may follow from septicæmia.

The first important point as regards the treatment of parenchymatous mastitis is to take the child from the breast. If this is done early, in a very large number of cases the inflammation will disappear without advancing to suppuration. If lactation is continued, especially when sore nipples persist as a complication, the chances of avoiding abscess-formation are extremely small. In cases of pain due to excessive fullness of the milk-ducts, partial relief should be given by means of mammary expression. For the pain, opium, for the fever, a full dose of quinine, should be administered. A saline cathartic acts as a derivative and diminishes the hyperæmia of the breasts. As the pain of the inflammation is augmented by the weight of the organ, the breast should be raised and supported by a suitable bandage. Much comfort is often afforded by the local application of belladonna, in the form either of an ointment, or of the liniment diluted with three or four parts of opodeldoc. Considerable relief is likewise obtained by laying a flannel wetted with a lead-and-opium wash over the breast, and placing on the outside some water-proof substance to prevent speedy evaporation. A large flaxseed-poultice lessens pain by reason of its heat, but should not be employed, at least so long as the hope of absorption has not been abandoned. Indeed, previous to suppuration, dry cold (ice-bag), which is both sedative and antiphlogistic, deserves the preference.*

So soon as there are evidences of pus, such as bogginess, œdema, or reddening of the skin, the abscess should be opened with antiseptic precautions. If the inflamed acini are situated near the surface,

* *Vide* Corsen, "The Treatment of Mammary Abscess," "Am. Jour. Obst.," January, 1881, for account of favorable experiences.

fluctuation is early apparent. In deep-seated abscesses, the precise situation of the pus collections is not easy to determine. If the matter is doubtful, it is better to first insert an aspirator-needle into the breast rather than to subject the woman to a painful operation, which, if misdirected, may require to be repeated.

In Billroth's clinic* the following plan is adopted in opening abscesses of the breast: The surface should first be cleansed with soap and drenched with a solution of carbolic acid or of thymol. The incision should be a half-inch in length, and should radiate from the nipple. A drainage-tube should be instantly introduced, and the pus should be gently expressed, after which the breast should once more be bathed with a disinfectant fluid. The entire breast should then be enveloped in antiseptic gauze covered with water-proof material. Finally, after packing the periphery with oakum, especially beneath the breast and in the axilla, the dressing should be fastened with a bandage extending over the thorax from the neck to the umbilicus. In doing this, care should be taken to pack sufficient cotton beneath and around the sound breast to prevent its surface being pressed into contact with that of the thorax. If the abscess is large and sinuous, the dressing should be changed in twenty-four hours, and then should be left in place for from three to five days. By these means the organ is equably compressed, the pus is prevented from decomposing, and the discharge is promoted, all conditions which tend to produce a painless course and a rapid recovery. If, while the bandage is applied, the patient once more suffers from pain and fever, it should be removed, and any new abscess in the process of formation should be opened and treated in the same manner.

By the practice recommended, even in bad cases, the ugly scars and deformities of the breast, which sometimes follow the older poultice treatment, are avoided.

In fresh cases the pus is never decomposed, and irrigation of the wound is unnecessary. In old cases, on the contrary, which have been treated by small incisions and without antiseptic precautions, the pus is often acid, and possessed of irritating properties. For these neglected abscesses I can enthusiastically recommend the method of Billroth, which consists in placing the patient under an anæsthetic, enlarging the openings so as to permit the passage of the finger, and breaking down the thin partitions between the abscesses, so as to convert them as far as possible into large communicating cavities; while this process is going on, the tube of an irrigator should be passed by the side of the finger, and the cavity should be washed with a three-per-cent. solution of carbolic acid until at last the fluid comes away clear and unstained. Drainage-tubes should then be introduced, and the breast treated in the antiseptic manner already described. By this

* Billroth, "Handbuch der Frauenkrankheiten," zehnter Abschnitt, p. 23.

plan I have succeeded in closing up sinuses of long standing in the course of two to three weeks.

It is hardly necessary to add that the recovery of the patient is always aided by good food and an abundance of fresh, pure air.

Galactocele.—In very rare cases, owing to the obliteration or stoppage of one of the milk-ducts, the sinus may become distended with milk, and form a cyst termed a galactocele. Usually it is of small size, but in the often-quoted case of Scarpa the breast attained such dimensions as to reach to the thigh. Upon puncturing the tumor with a trocar, ten pounds of milk were removed, which in all respects resembled human milk of normal quality.

The Prophylaxis of Ophthalmia Neonatorum.—In 1881 Crédé* recommended that, in lying-in asylums, as a preventive measure, the eyes of all children immediately after birth should be washed with pure water, and that thereafter a single drop of a two-per-cent. solution of nitrate of silver should be dropped between the parted lids by means of a glass rod. This plan has since been tested in the principal maternities of Europe with the most satisfactory results. It possesses no apparent drawbacks. In exceptional instances, swelling of the lids, injection of the conjunctiva, and a hypersecretion of mucus or serum, have been observed, but the reaction has been trivial, and has disappeared in from twenty-four to forty-eight hours.

* Crédé, "Die Verhütung der Augen-Entzündung der Neugeborenen," "Arch. f. Gynack.," vol. xvii, p. 50, and vol. xviii, p. 367.

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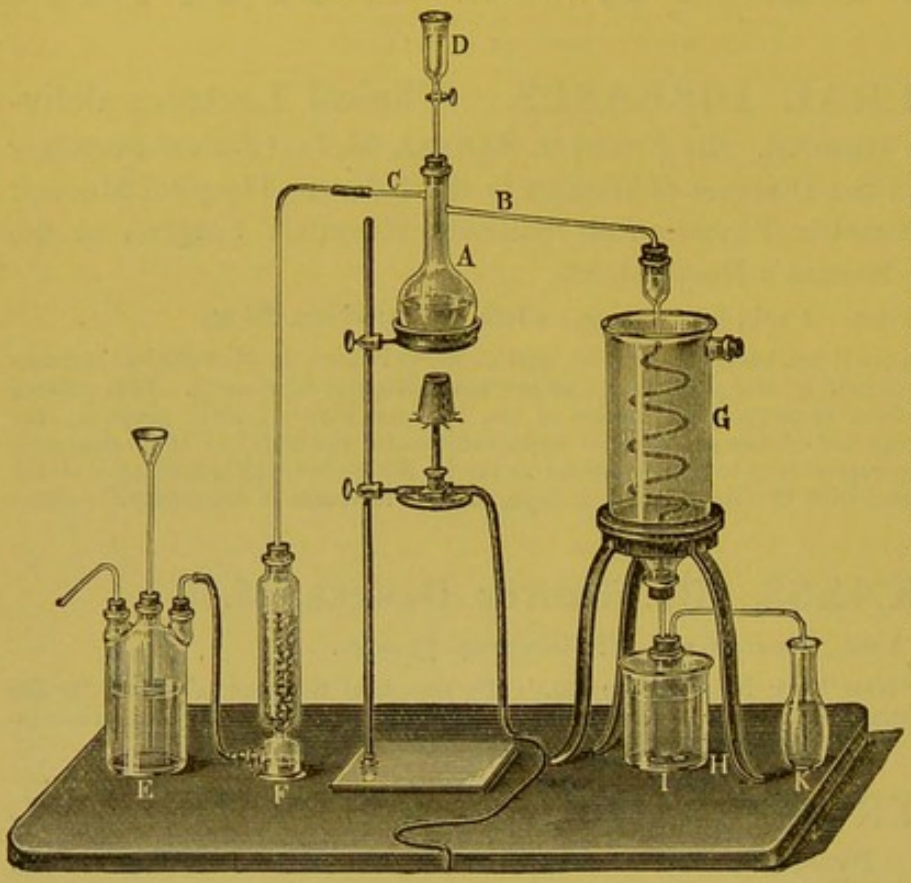

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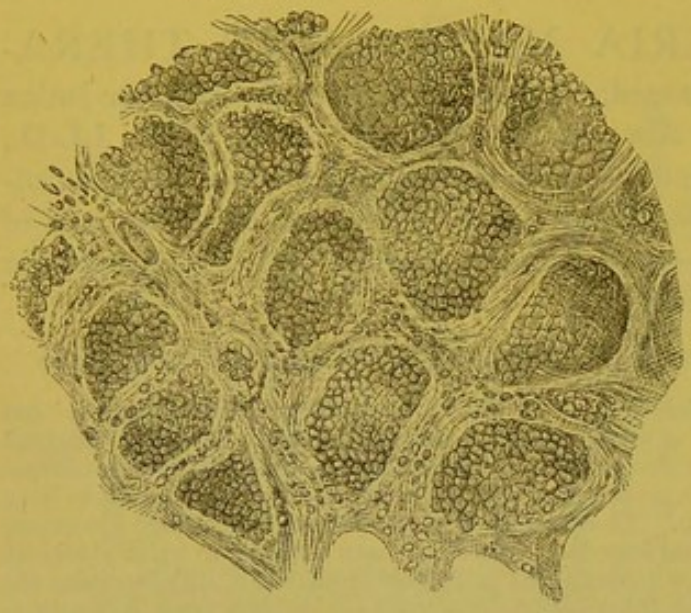

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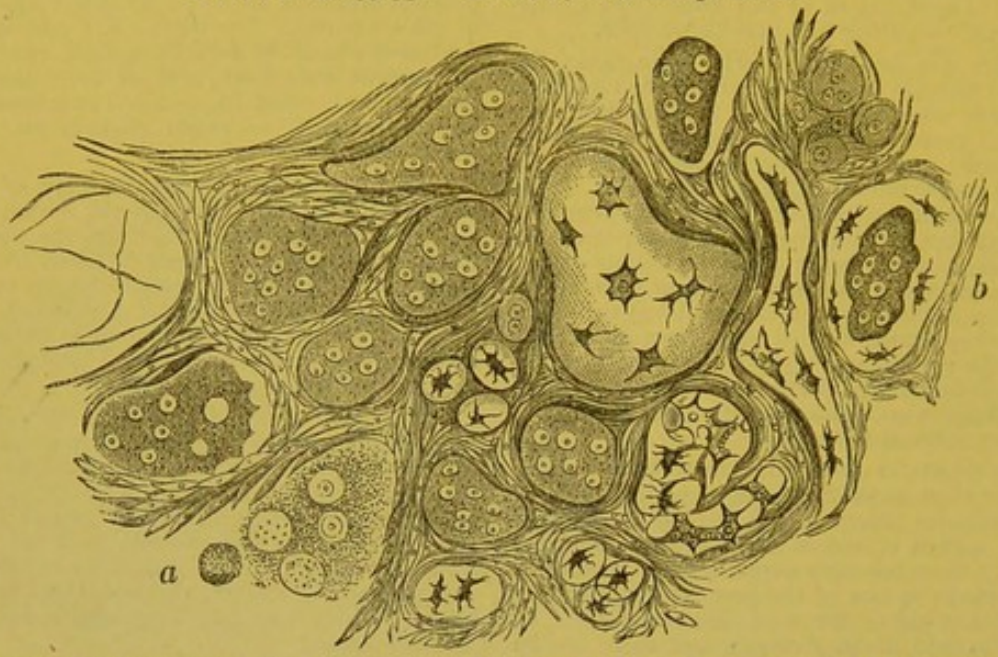

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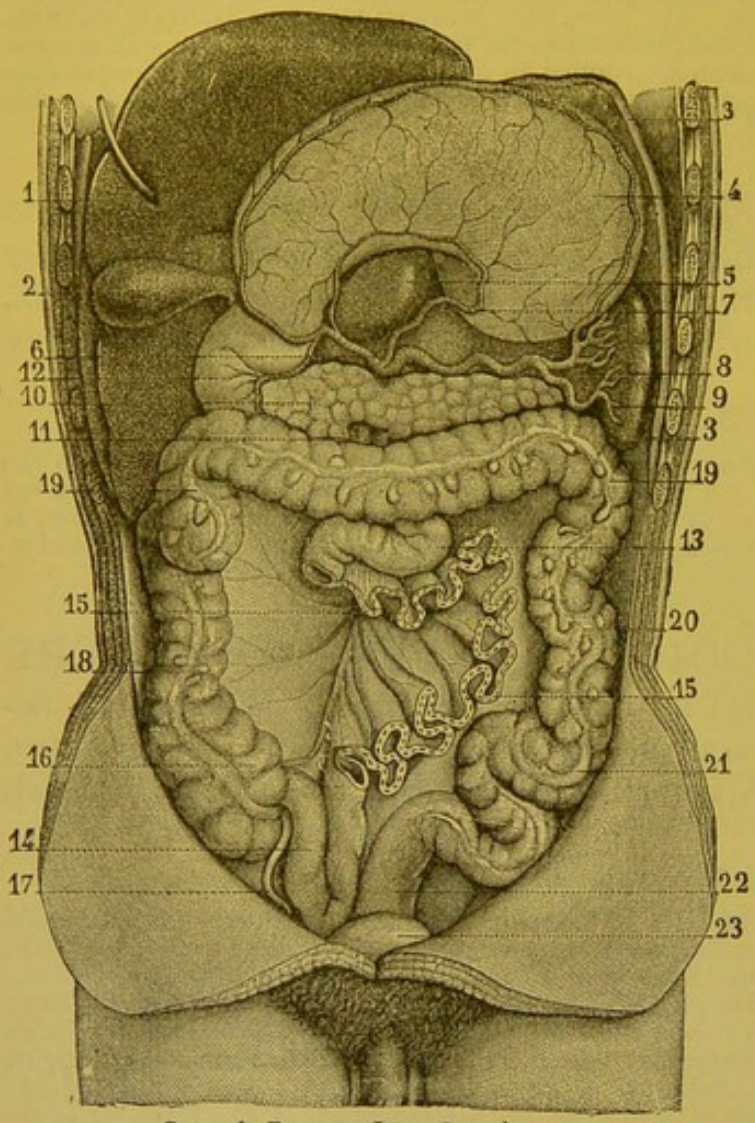

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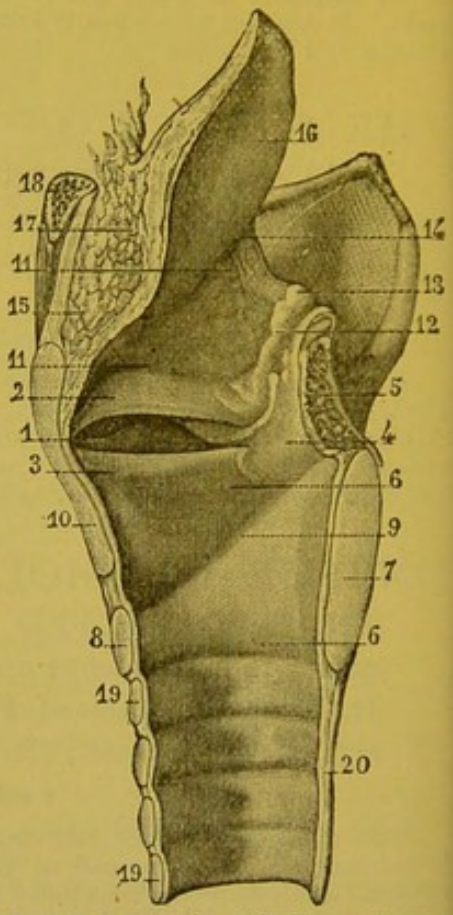

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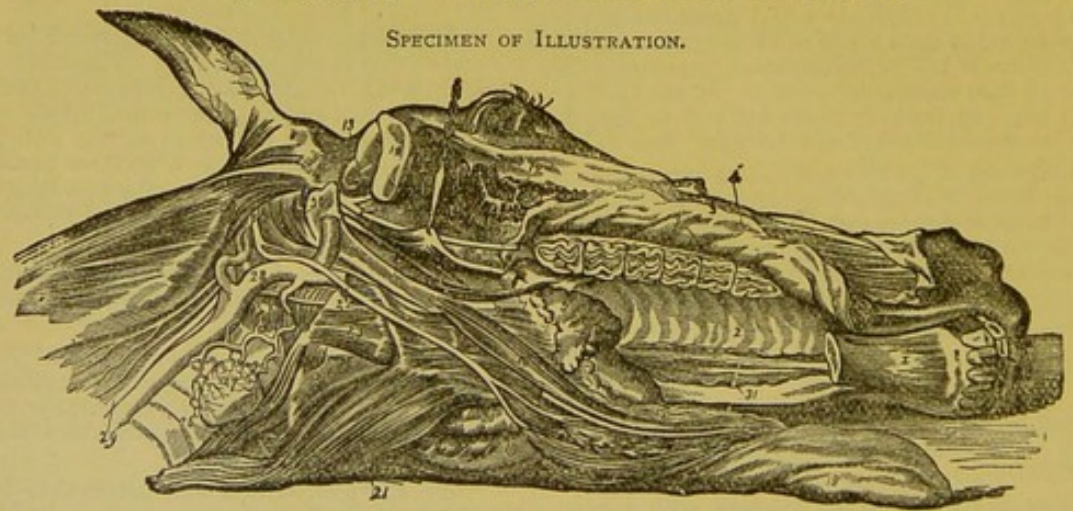

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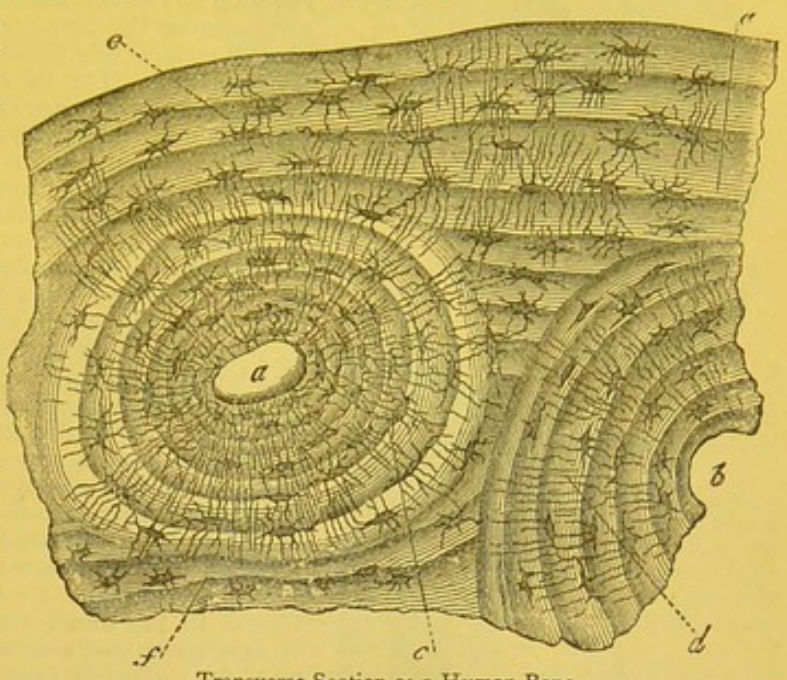

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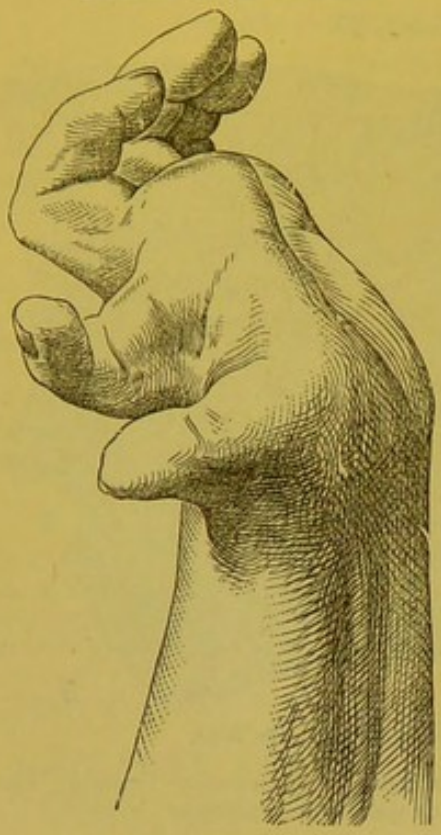

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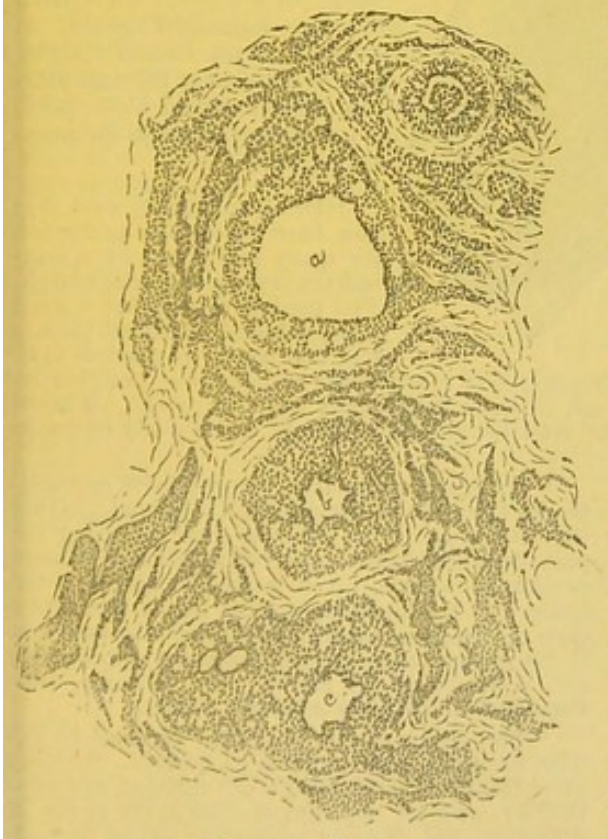

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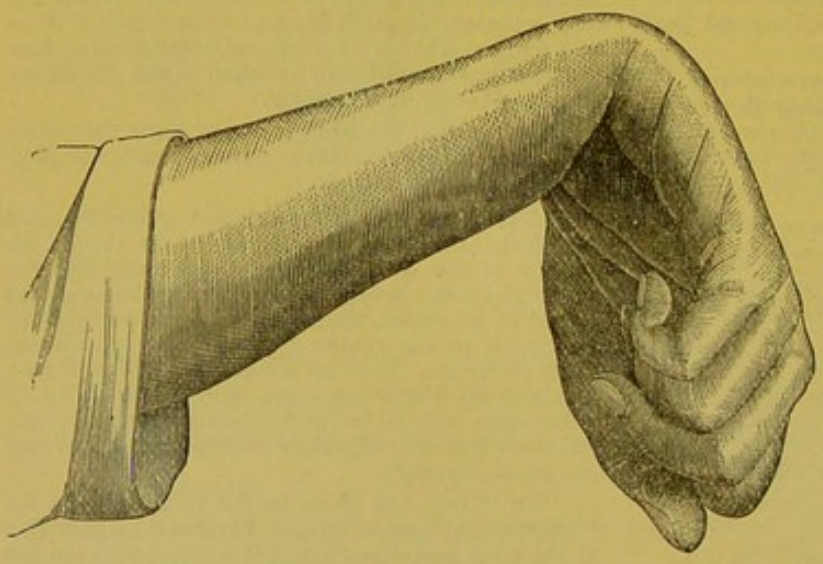

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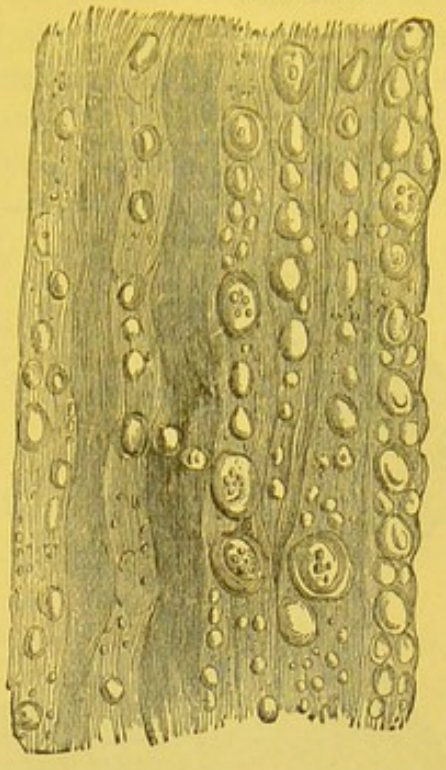

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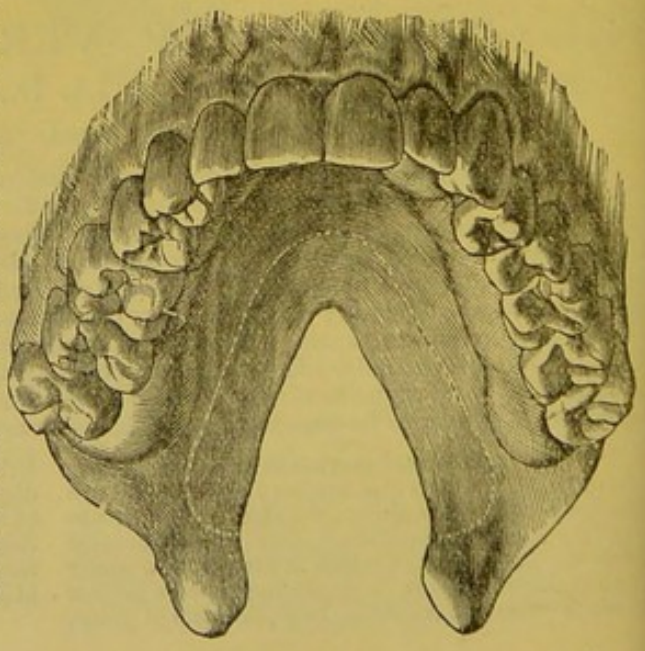

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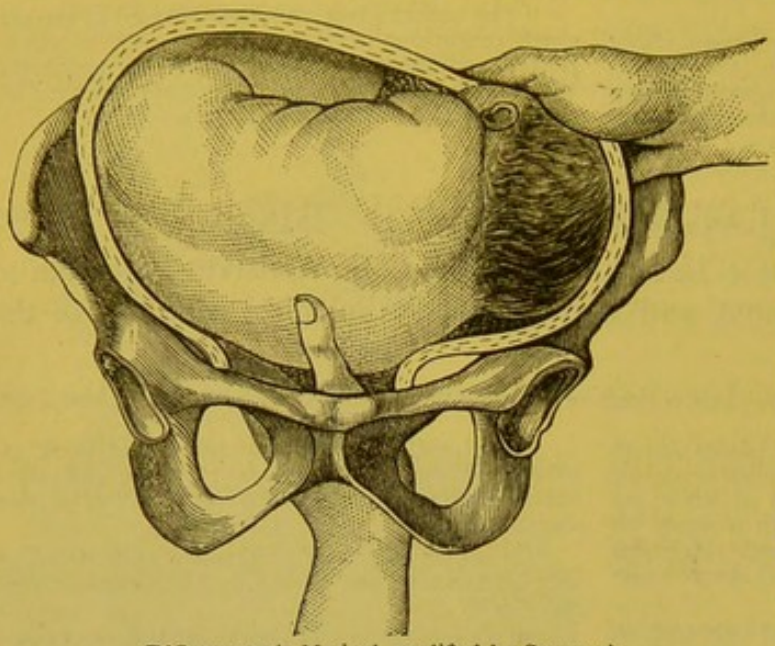

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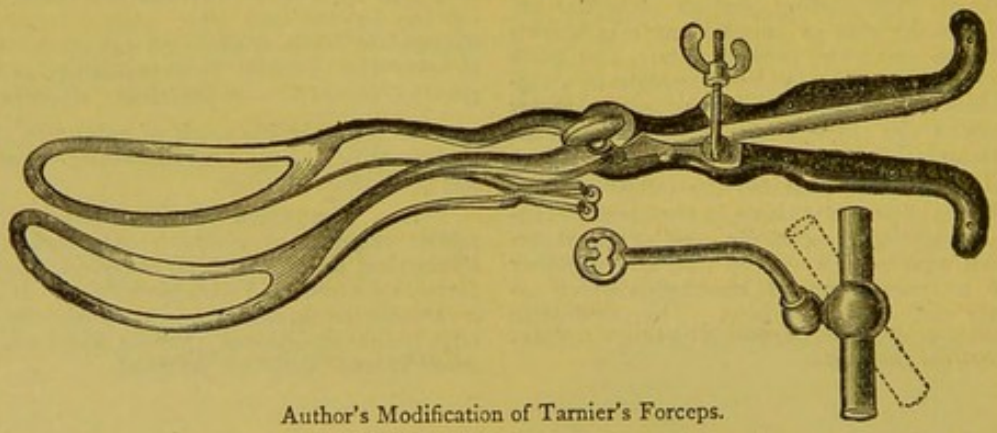

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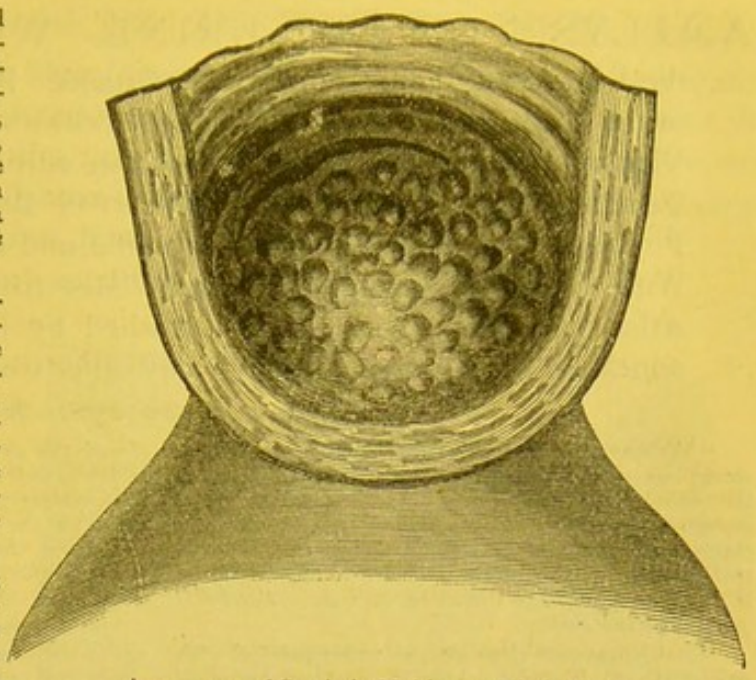

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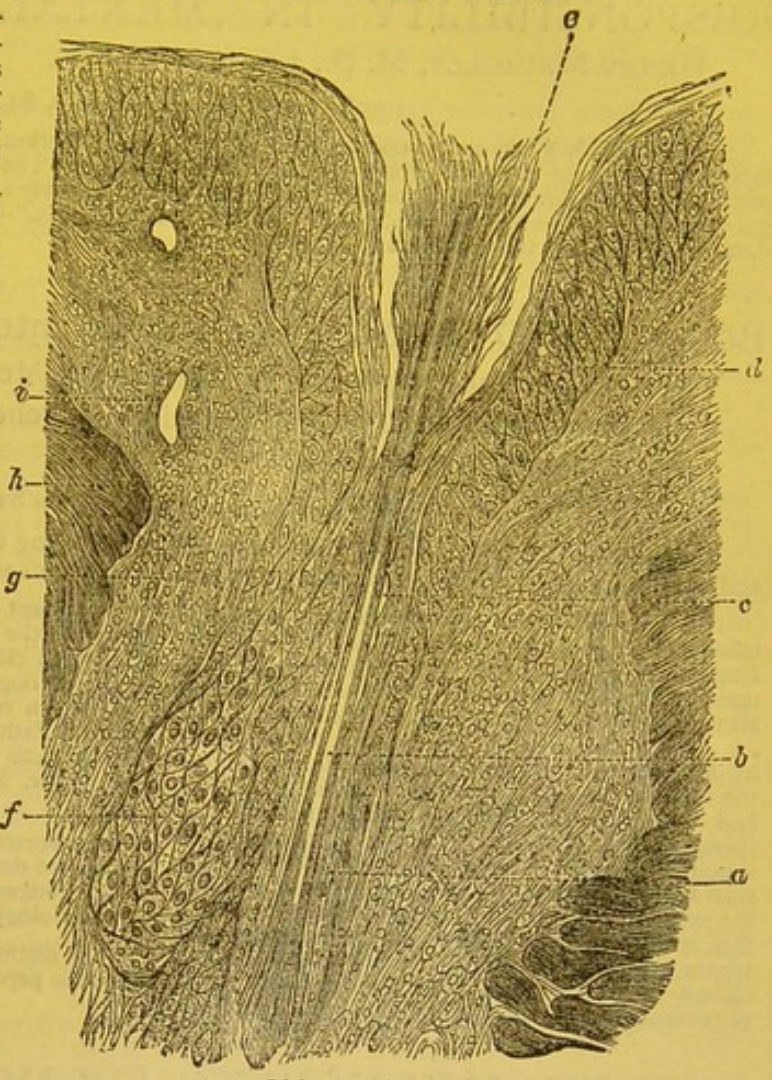

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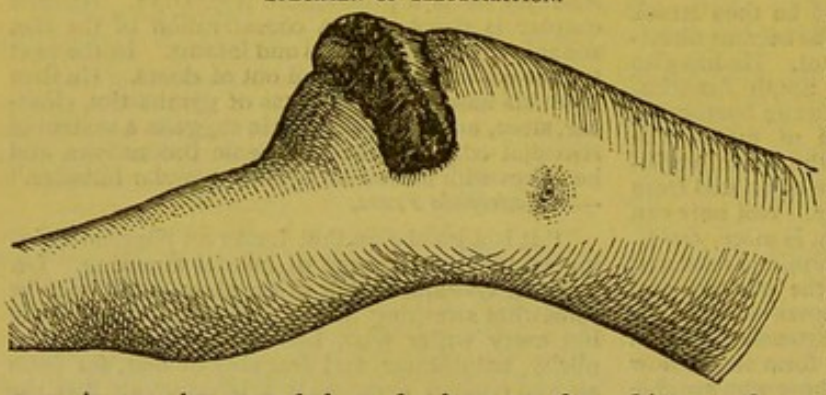

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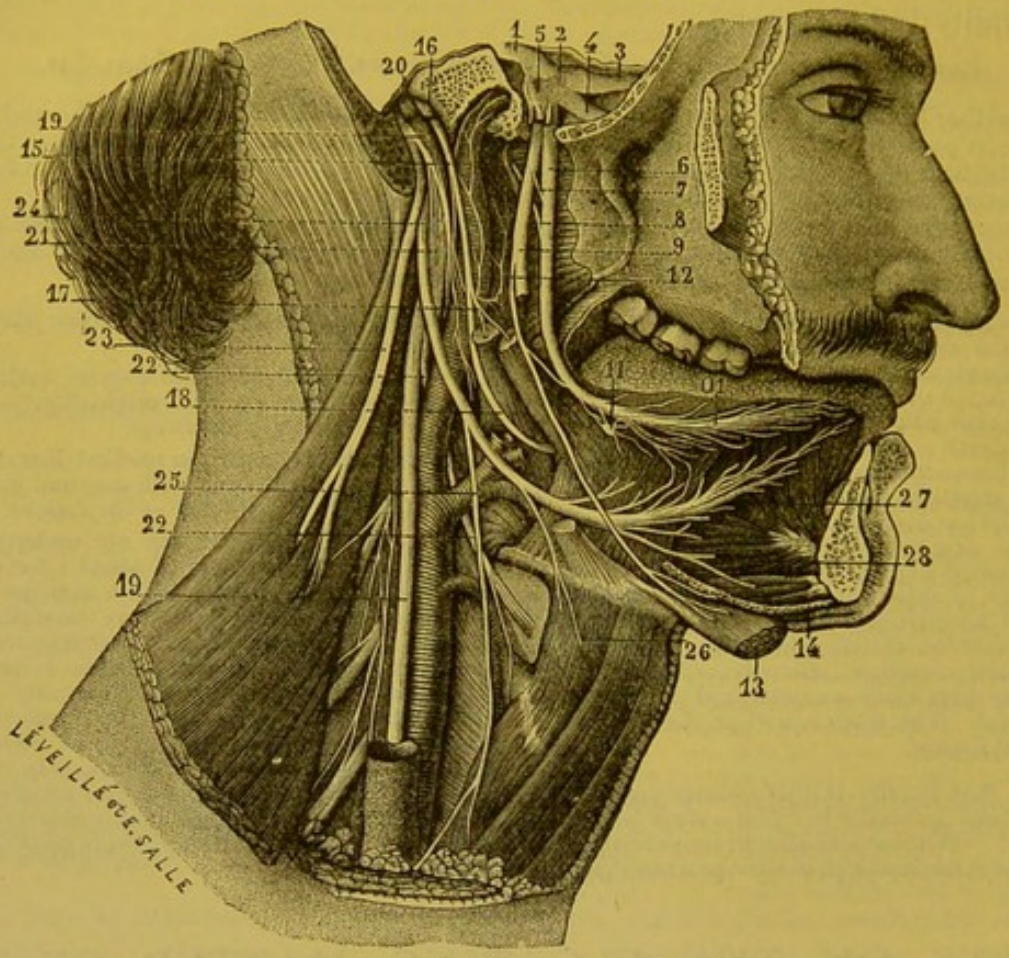

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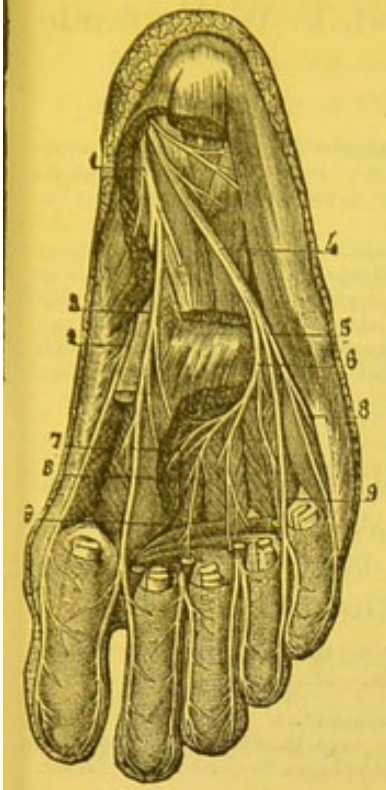

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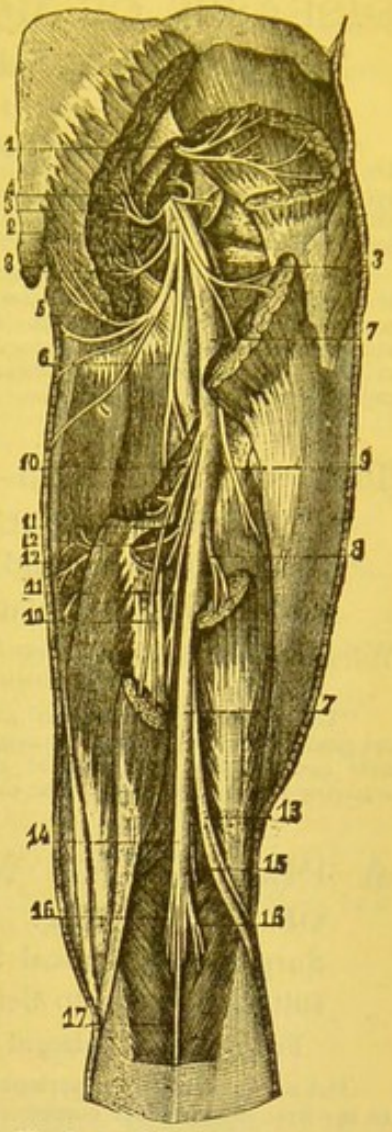

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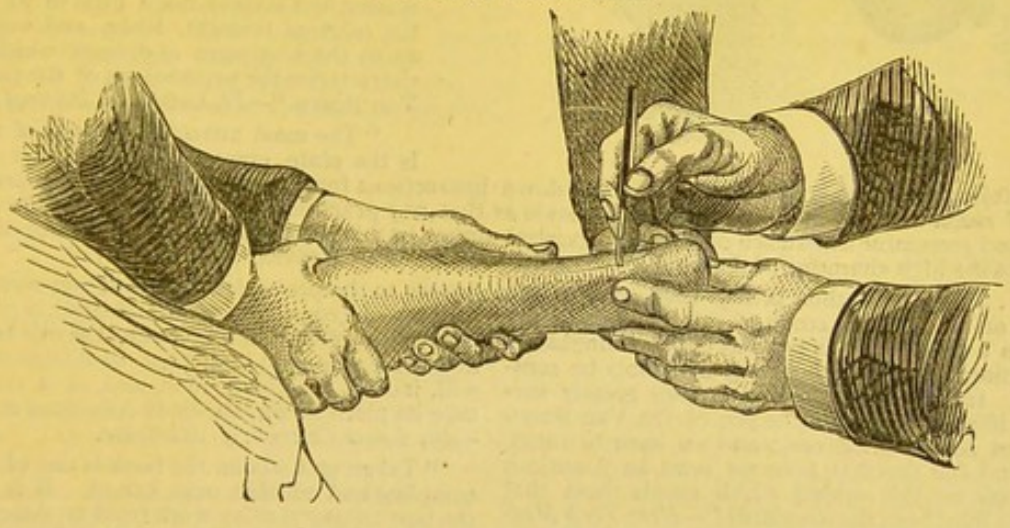

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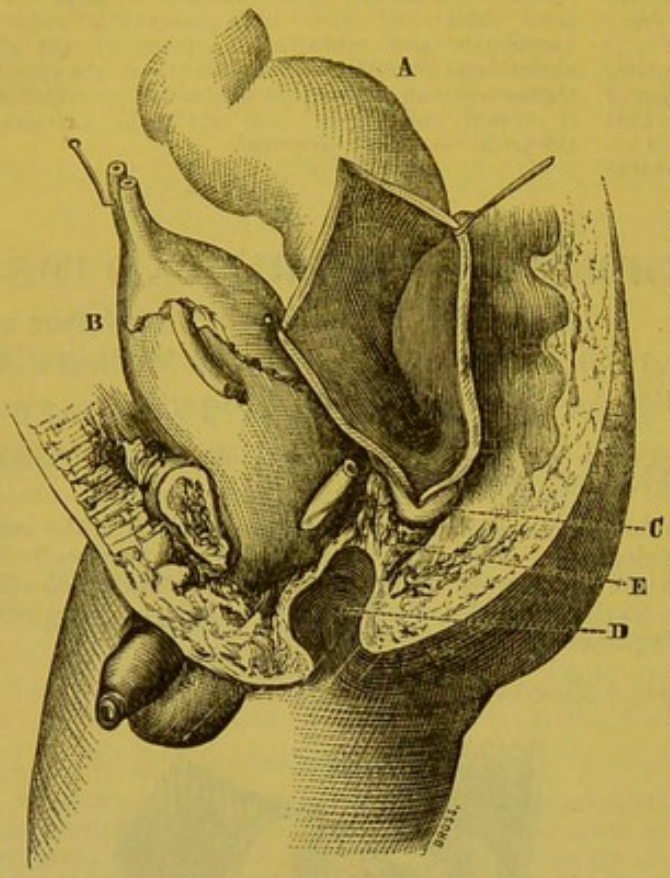

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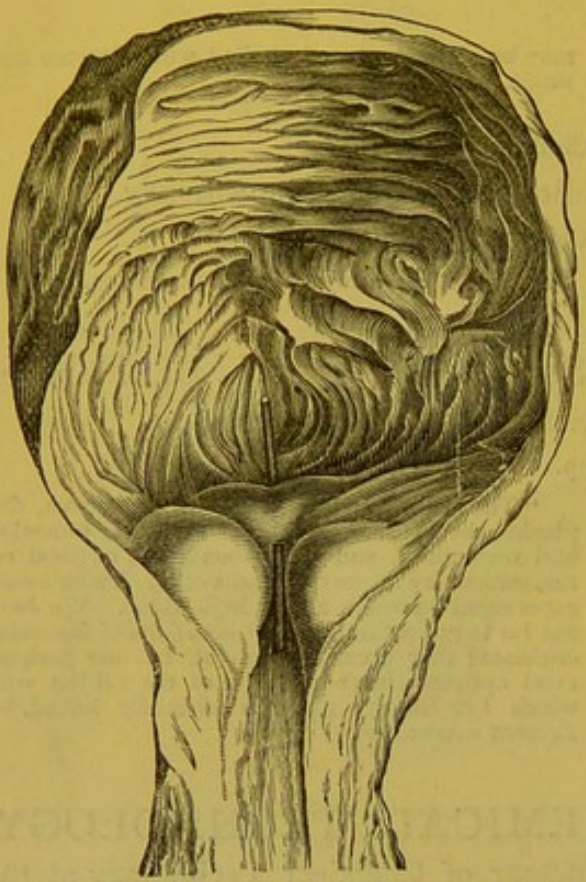

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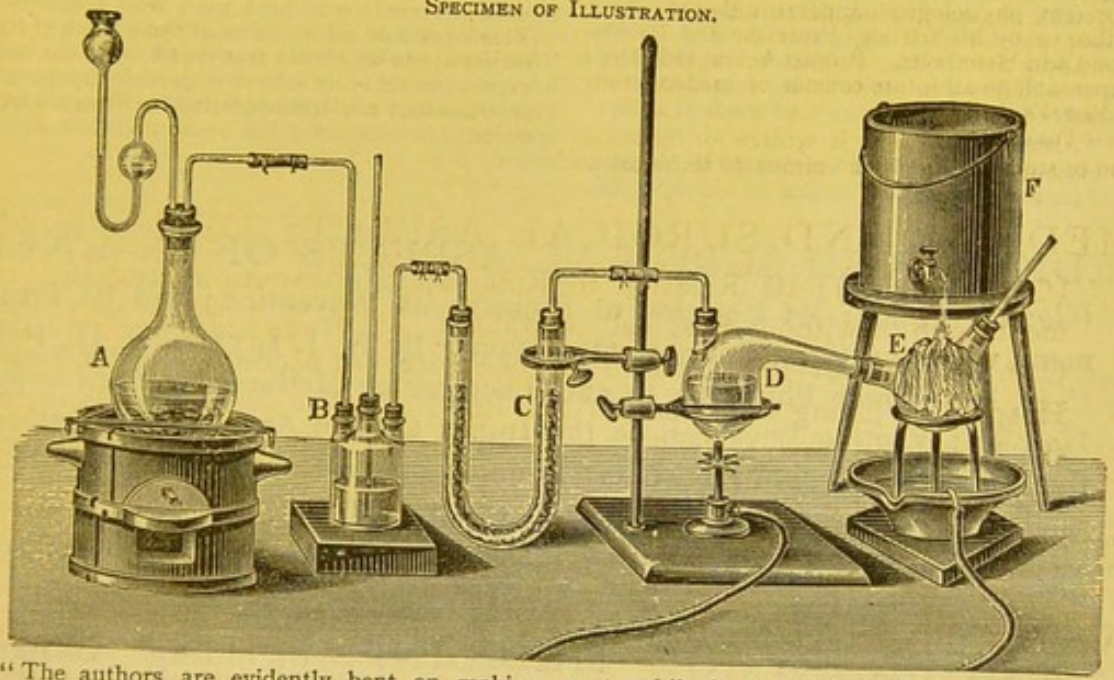

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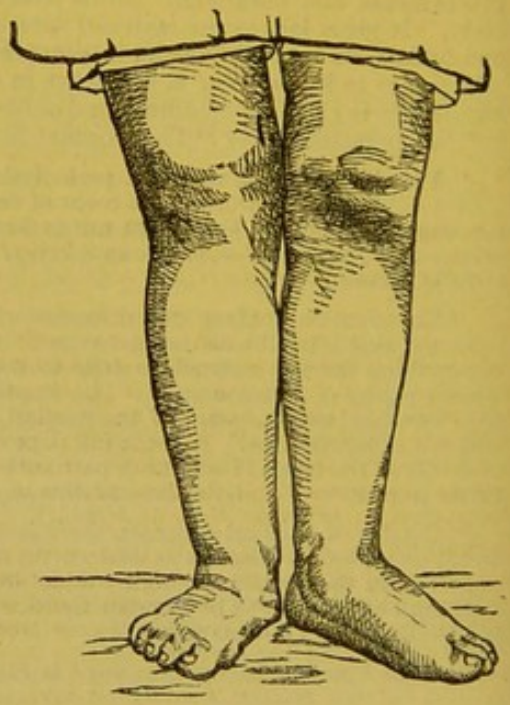

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