

# A TEXT-BOOK OF OBSTETRICS

BY

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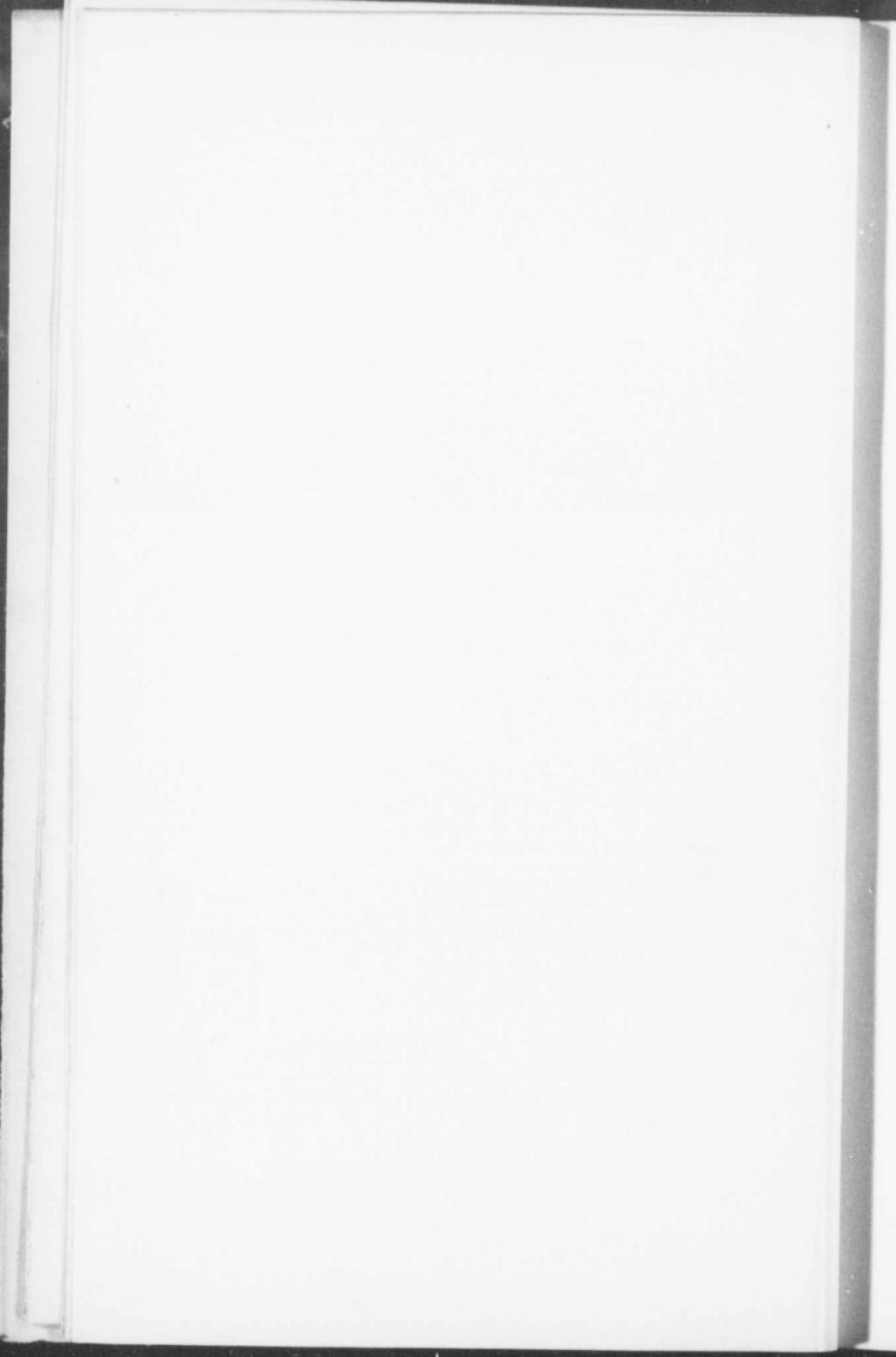
TO

FRANK BILLINGS, M. D.

DEAN OF THE FACULTY OF MEDICINE IN RUSH MEDICAL COLLEGE, UNIVERSITY OF CHICAGO;  
PRESIDENT OF THE AMERICAN MEDICAL ASSOCIATION

IN RECOGNITION OF HIS DISTINGUISHED SERVICES  
AS A PHYSICIAN AND AS A TOKEN  
OF PERSONAL ESTEEM

**This Volume is Dedicated**



## PREFACE.

In writing this volume consideration has been given to the needs both of the scientific student and of the active practitioner.

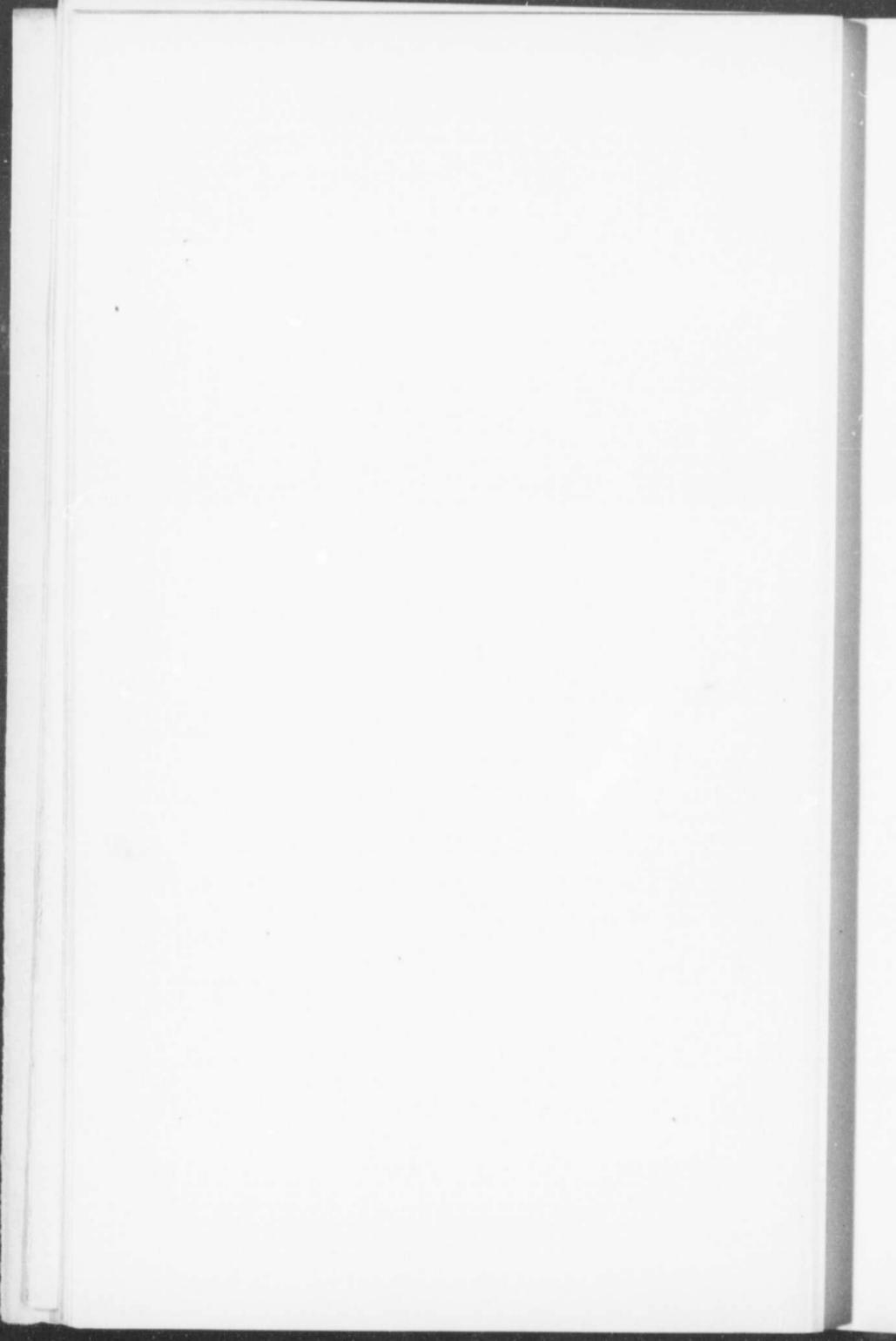
Particular attention is directed to the anatomic changes in pregnancy, labor, and the puerperium, the description being largely based upon studies of frozen sections published in recent years by the author and other workers. Great prominence, also, is given to embryologic, physiologic, and pathologic data which are of importance in relation to obstetrics. Several of these have been investigated in special researches by the author.

The practical aspects of the subject are presented in such a manner as to be of direct assistance to the clinical worker. Emphasis is given to methods of treatment that have been tested by experience.

Great care has been given to the preparation of illustrations, many of which have never appeared in a text-book of obstetrics. In their selection the publishers have exercised marked generosity. Special acknowledgement is due to Dr. Robert L. Dickinson for the admirable series of illustrations taken from the *American Text-Book of Obstetrics*, the drawings for which were originally made for that work under Dr. Dickinson's supervision. To my associates, Drs. Holmes and Pierce, my thanks are due for suggestions and assistance in the reading of proofs; to Dr. C. Wahrer I am indebted for a number of drawings from which illustrations have been made.

J. CLARENCE WEBSTER.

100 STATE ST., CHICAGO,  
October, 1903.



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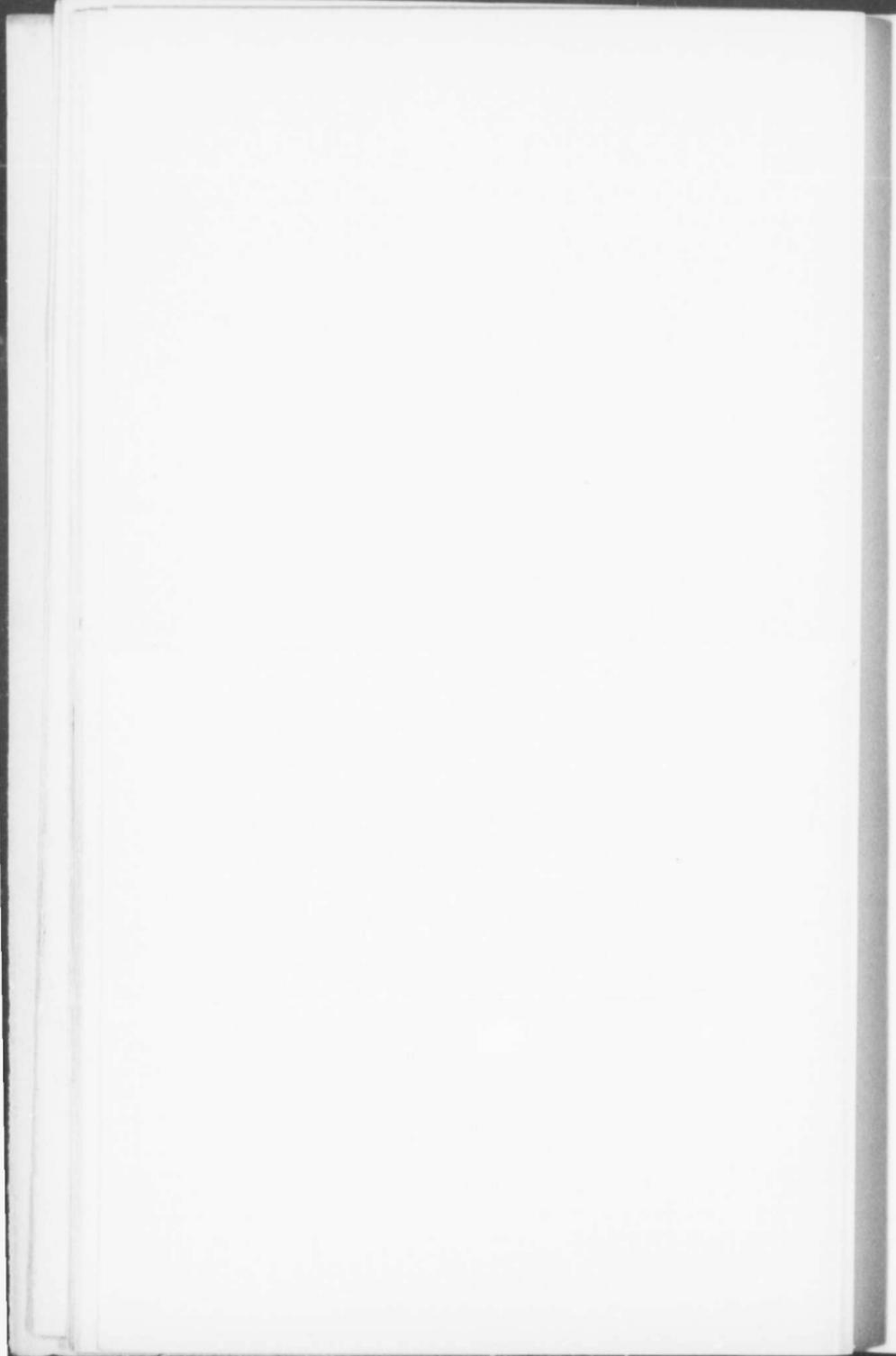
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# PART I.

## PREGNANCY

### CHAPTER I.

#### ANATOMY AND PHYSIOLOGY OF PREGNANCY.

##### CONCEPTION AND GENERATION.

**Male and Female Elements.**—A. **Ovum.**—As it is ready to escape from the ripe Graafian follicle, the ovum measures about 0.2 mm. and has the following structure:

(a) *Deutoplasm (Yolk Protoplasm).*—The main part of the ovum is made up of protoplasm, containing large and small particles (nutritive) with strongly refractile powers.

(b) *Clear Protoplasm (Egg Plasm).*—This is found as a thin layer surrounding the yolk protoplasm, and also as another immediately around the germinal vesicle.

(c) *Germinal Vesicle (Nucleus).*—This body is rounded, and has a distinct enveloping nuclear membrane possessing a double contour. Its diameter measures about  $37\mu$ , on the average. It is situated eccentrically.

(d) *Germinal Spot (Nucleolus).*—This has a somewhat yellow appearance, and according to Nagel is capable of amoeboid movements. After death it breaks up into several particles.

(e) *Paranucleolus.*—One or more may be seen. They are apparently thickenings in the protoplasmic reticulum of the nucleus.

Surrounding the ovum is a very narrow slit, the *perivitelline space*. External to this is a thin, striated, structureless membrane, the *zona pellucida*, measuring about  $14\mu$  in thickness. This is probably derived from the surrounding cells of the discus proligerus.

The cells of the two inner layers of the discus are arranged with their long axes radial to the ovum. The innermost row presents longitudinal striæ, which are apparently continuous with those in the zona pellucida; this layer has been termed by Bischoff the *corona radiata*. The outer cells of the discus are more rounded, and consist of a finely granular protoplasm with large nuclei. The stalk of the discus consists of cells similar to those of the *stratum granulosum*. The latter is composed of two or

more layers of low cylindric cells, forming the inner wall of the follicle. These are probably derived from the original germinal epithelium, though some hold that they are mesodermic in origin. The liquor folliculi is a clear, slightly yellow, glairy fluid, rich in paralbumin. External to the stratum granulosum is the *theca folliculi*, derived from the connective-tissue stroma of the ovary. It consists of an outer layer, the *tunica externa* or *fibrosa*, made up of compressed connective tissue, and an inner, the *tunica interna* or *propria*, more cellular than the outer and rich in capillaries.

The ripe Graafian follicle forms a bulging on the surface of the ovary. Rupture takes place at the most prominent part, the thin covering of ovarian tissue being somewhat degenerated. The cause of rupture is not yet definitely known. As the ovum escapes, surrounded by the zona pellucida, some cells of the discus are probably carried with it. They gradually disappear, and the zona is also lost in cases where conception occurs, before the ovum is well embedded in the uterine mucosa.

**Formation of the Corpus Luteum.**—After escape of the ovum, the Graafian follicle is filled with blood and cells of the stratum granulosum. The rapidly thickened inner layer of the wall of the follicle becomes arranged in a wavy manner, so that the central cavity becomes an irregular stellated slit. It is known as the yellow band, from the presence of numerous yellow particles (lutein cells) in its substance. The blood is gradually absorbed so that the central space is almost obliterated. The lutein cells of the yellow band disappear, and the latter assumes a colloid appearance, known as the *corpus albicans*, in the center of which a few blood-crystals may be found; its size slowly diminishes. Throughout these changes blood-vessels and connective-tissue elements extend from the periphery toward the center of the follicle; as shrinkage of the corpus occurs, sclerosis and hyaline degeneration take place in the vessel-walls.

The terms "true corpus luteum" and "false corpus luteum" should not be used. The former is applied to the condition in pregnancy, the latter to that found in the non-pregnant state. There is practically no difference save as regards duration. When pregnancy occurs, the *corpus luteum* becomes reduced in size only in the course of several months; when pregnancy does not occur, in a few weeks' time. Clark points out that in the former case the vessels are much more congested than in the latter.

**Fate of the Ripened Ova.**—Some are disintegrated and absorbed in the peritoneal cavity, others in the tube and uterus; possibly some reach the vagina; others become fertilized. It has been shown that there is a line of movement on the moist surface of the pelvic peritoneum in each half of the pelvis, the direction being toward the fimbriated end of the tube, the current being

probably due to the movements of the cilia on the fimbriae. It is due to this, probably, that the shed ova move toward the tube. It is not known how long a time is taken in the passage of the ovum to the tube or along the tube to the uterus. In several animals the transit has been observed to last three to five days; in a bitch, eight days. As the fertilized ovum passes along the tube it probably absorbs some fluid from the lumen.

**Maturation or Ripening of the Ovum.**—Each ripe ovum is believed to undergo changes preparatory to fertilization, whether the latter occurs or not. As studied in some of the lower animals they are as follows: The germinal vesicle moves toward the periphery of the ovum, where a small portion splits off, and, surrounded by a little protoplasm, moves outward until it lies on the surface of the ovum under the zona radiata. This extended portion is

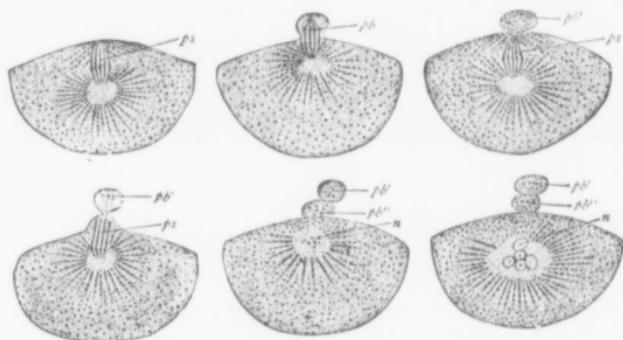


FIG. 1.—Formation of polar bodies in ova of *Asterias glacialis* (Hertwig): *ps*, Polar spindle; *pb*, first polar body; *pb'*, second polar body; *n*, nucleus returning to condition of rest.

termed the *first polar body* or *globule*. The germinal vesicle then moves toward the center of the ovum and advances toward the periphery at another point, a portion again being extruded, known as the *second polar body*. The rest of the vesicle then moves toward the center of the ovum, being thereafter known as the *female pronucleus*. The polar bodies soon after disappear.

**B. Male Element.**—The spermatozoa, essential to the fertilization of the ovum, are contained in the semen of the male, a viscid, opalescent fluid made up of secretions from the testicles, prostate, and Cowper's glands, and containing mainly spermatin, an albuminous material, and several inorganic salts. Under the microscope, besides the spermatozoa, are seen epithelial cells from the genital and urinary canals, and small highly refractile particles—seminal globules, which are probably derived from the nuclei of broken-down cells of the seminiferous tubules. Each spermato-

zoön consists of an ovoid head, the small end being anterior, measuring about  $\frac{1}{60000}$  in. long, a tail  $\frac{1}{5000}$  to  $\frac{1}{4000}$  in. in length, and an intermediate portion shorter than the head. When active

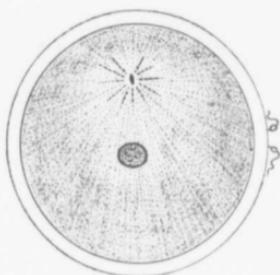


FIG. 2.—Egg of an echinoderm. At one portion of the surface two spermatozoa are seen. Within the ovum are seen the female pronucleus and the male pronucleus. Radiating lines extend from the latter as it approaches the former (Flemming).

the spermatozoa are propelled in a spiral course by lashing movements of the tail. If the semen be kept at body temperature, they continue active for hours. It is by their own motile power that they advance upward along the female genital tract. Here their vitality may be little altered for several days. They have been found in the uterus a week after coitus. Dührssen reports a case in which living spermatozoa were found in one Fallopian tube removed from a woman who had been in the hospital nine days, and who stated that her last coitus had taken place three and a half weeks previous to operation. The time for the passage of

the spermatozoa from the vagina to the fundus uteri or to the pavilion of the tube is not known. It probably varies under dif-

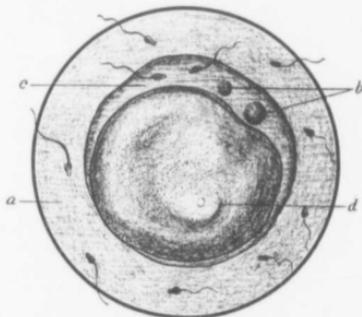


FIG. 3.—Ovum of a bitch fourteen and a half hours after copulation (Kollmann). Several spermatozoa are in the substance of the zona pellucida (*a*). Two polar bodies (*b*) are seen under the zona pellucida, surrounded with clear albuminous fluid (*c*); in the latter two spermatozoa are penetrating. The large rounded central portion of the ovum (*d*) contains the yolk particles.

ferent conditions. Henle has calculated the rate at about 2.7 mm. per minute.

*Place of Fertilization.*—The ovum may meet the spermatozoa

anywhere in its passage from the ovary to the uterine cavity. Some believe that the latter is the most frequent place of union, though most authorities think that it is probably the outer end of the Fallopian tube, as this appears to be a favorite resting-place of the spermatozoa.

*Nature of Fertilization.*—This is unknown in the human female. It has been observed in several invertebrates—*i. e.*, echinoderms, mollusca, ascarides, etc. Among the higher vertebrata various stages have been observed in different forms—*i. e.*, dog, mouse, rabbit, etc.

The spermatozoa penetrate the zona pellucida, though in what numbers is not known in the human subject. Kollmann has counted as many as sixty attempting penetration in the case of a bitch. In some of the lower animals there is an opening in the zona, known as the micropyle, through which the spermatozoön

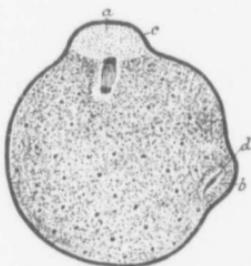


FIG. 4.—Ovum of mouse, showing polar body (*a*) under the zona pellucida (*c*), and below it the rest of the nuclear spindle. At another point (*b*) there is an elevation near the surface, into which a spermatozoön (*d*) has penetrated (Sobotta).

enters. This is wanting in the human ovum. Though many may attempt an entrance, it is probable that only one performs the essential act of fertilization—*i. e.*, blends with the female pronucleus. At the point where this one is about to enter, the protoplasm of the ovum forms a swelling under the zona, known as the receptive prominence. Through this the spermatozoön bores its way, losing its tail, the head becoming the male pronucleus. Around it radial lines appear in the yolk protoplasm. The male and female pronuclei now move toward one another, and blending of the two occurs, followed by a short period in which they cannot be recognized. Soon they reappear as a single mass, henceforth known as the segmentation or cleavage nucleus. Fertilization is now complete.

**Segmentation.**—The early changes in the fertilized ovum have not been studied in the human subject, but they have been carefully investigated in several of the higher vertebrates and in

some invertebrates. In most cases observed the segmentation nucleus undergoes changes of a karyokinetic nature, dividing into two halves, which diverge to opposite ends of the ovum, radial lines appearing in the protoplasm around them. The ovum is then divided into two by an equatorial groove that extends inward from the surface. Each of the cells thus formed divides again into two, and so on until a mass of cells or blastomeres is formed, known as the mulberry mass, muriform body, or morula. This method of segmentation, in which the whole ovum is divided, is termed holoblastic. There are two varieties of holoblastic ova—viz., those in which there is total equal cleavage, and those in which there is total unequal cleavage. The human ovum undoubtedly belongs to the former of these. (In contradistinction to holoblas-



FIG. 5.—*a*, The beginning of segmentation in the mouse's ovum. One portion is slightly larger than the other, though the nuclei appear alike. In the next stage (*b*) the nucleus of the smaller portion undergoes division before that in the other half (Sobotta).

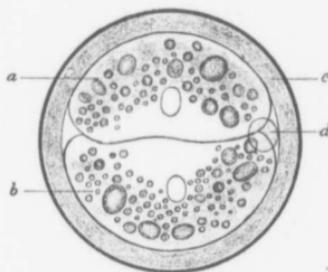
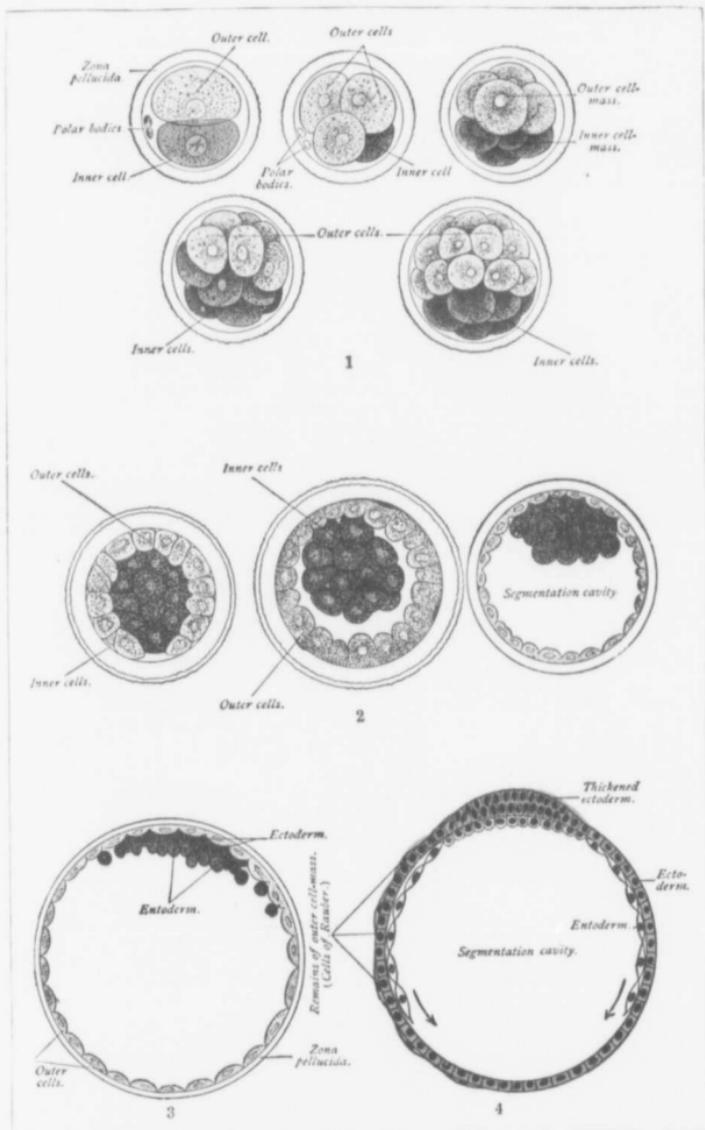


FIG. 6.—First stage of segmentation in the ovum of a field-mouse (Van Beneden). One half (*a*) is slightly smaller than the other (*b*). In the center of each is seen the nucleus, the dark bodies being yolk particles; *c*, zona pellucida; *d*, polar body.

tic segmentation is that termed meroblastic, in which division only of part of the ovum occurs.)

There next appears in the interior of the morula a fissure, known as the cleavage or segmentation cavity. This increases until a considerable space is formed containing an albuminous fluid. This period of development is termed the blastula stage, the ovum being known as the blastodermic vesicle. As observed in the dog and other mammals, the outer wall consists of a single layer of cells (Raubert's) made up of clear protoplasm. Internal to this is a heap of dark granular cells, attached at one part and projecting into the central cavity. The whole vesicle is still within the zona pellucida (which has been sometimes termed the *prochorion*). As increase in size takes place the outer layer gradually thins, the cells becoming difficult to recognize.

PLATE I.



1, 2, 3, Diagrams illustrating the segmentation of the mammalian ovum (Allen Thomson, after van Beneden). 4, Diagram illustrating the relation of the primary layers of the blastoderm, the segmentation-cavity of this stage corresponding with the archenteron of amphioxus (Bonnet).

1872

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The inner cell-mass becomes differentiated into an outer and an inner layer, the early epiblast and hypoblast. The former grows rapidly, extending all around the vesicle under the remains of Rauber's cells; possibly the remains of the latter blend with the epiblastic layer. The hypoblast extends more slowly as an inner lining to the epiblastic layer. This period of development is known as the bilaminar stage of the blastodermic vesicle (corresponding to the gastrula stage in many of the lower forms of animal life).

**Embryonal Area.** — After the differentiation of the epiblast and hypoblast there occurs a thickening of these layers at the point where the original inner cell-mass touched the outer. This thickening, as seen on surface view in the rabbit's ovum, is at first rounded, then oval, and afterward pear-shaped. This is the embryonal area, and it is here that the body of the embryo is developed, the broad portion being the site of its head. At the small or caudal extremity there is a transverse thickening called the terminal ridge. Very soon a longitudinal mark appears in the long axis of the embryonal area, extending over about two-thirds of its length and known as the primitive streak. This appearance is produced by a linear proliferation of cells of the epiblast. (Morphologically this streak corresponds to the closed and drawn-out

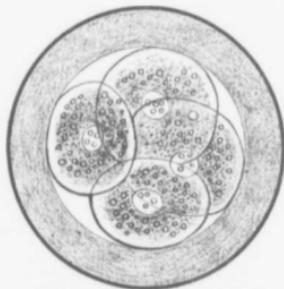


FIG. 7.—Segmentation stage in which the ovum of the field-mouse is divided into four cells (Van Beneden).

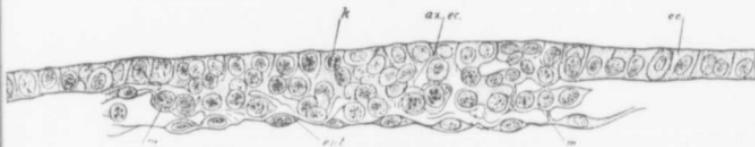


FIG. 8.—Section across the primitive streak of rabbit embryo (Kölliker): *ec.* Ectoderm; *ax. ec.* axial ectoderm undergoing proliferation, as shown by karyokinetic figures ( $\frac{1}{2}$ ); *ent.* entoderm; *m.* mesoderm.

blastospore, the passage which in the gastrula stage of lower animals communicated with the cavity of the vesicle or archenteron. In the human embryonic area the transverse ridge is believed to indicate the point corresponding to the blastospore of lower forms.) On the surface of the streak a long shallow groove appears, known as the primitive groove. The anterior end

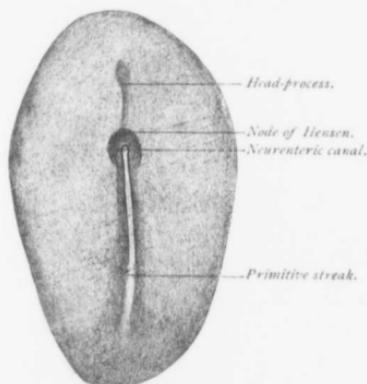


FIG. 9.—Embryonic area of rabbit embryo (Van Beneden). Primitive streak beginning in cell proliferation, known as the "node of Hensen."

of the streak is marked by a kind of knob formed by an accumulation of cells under the surface, known as Hensen's node. Soon

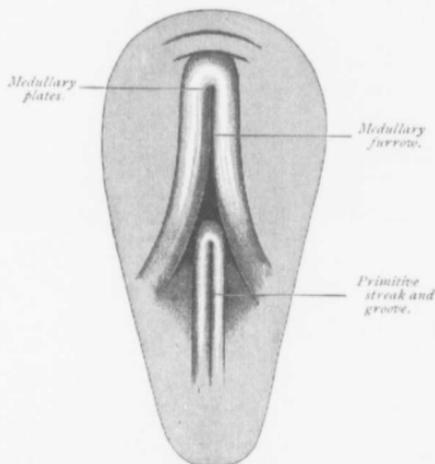


FIG. 10.—Surface view of area pellucida of an eighteen-hour chick embryo (Balfour)

another linear mark develops anterior to the streak and in line with it, termed the head-process of the primitive streak.

**Trilaminar Blastoderm.**—A third layer of cells now de-

velops, the mesoblast. Its origin in the higher vertebrates is not definitely known. In all probability it is formed both from the epiblast and hypoblast layers, appearing first under the anterior end of the primitive streak. After its differentiation as a distinct layer its future growth takes place by the independent proliferation of its own cells. It spreads laterally and posteriorly, and later, from the anterior end of the central mesoblastic layer, two expansions grow forward, curving so that their tips meet in the middle line, enclosing a crescentic space known as the proamnion. Soon after the appearance of the mesoblast the medullary groove appears in front of the primitive streak. It is formed by the development of the medullary folds, two layers of

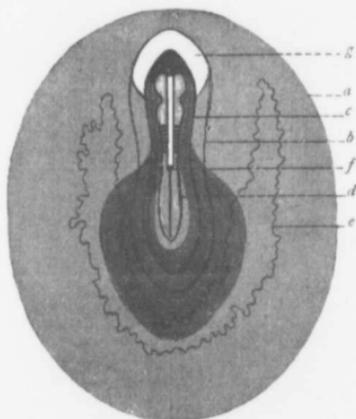


FIG. 11.—Diagrammatic surface view of rabbit's ovum of two hundred and five hours (after Tournoux). The darkly shaded area indicates the extent of the mesoderm: *a*, Peripheral limit of area opaca; *b*, of area pellucida; *c*, of parietal zone; *d*, of stem zone; *f*, Hensen's node; *g*, proamnion.

epiblast that begin in front of the head process and extend backward. These folds curl inward until they coalesce from before backward, forming the neural tube or canal, the original primitive streak being gradually enclosed in the canal.

From this tube the whole future nervous system is developed. While the neural canal is developing a solid column of cells forms under it, derived from the hypoblast. This is the notochord or chorda dorsalis, the axis around which the permanent spinal column is developed. It largely disappears afterward, being represented in postnatal life only by the pulp in the center of the intervertebral disks.

**Extension of the Mesoblast.**—The early mesoblast grad-

ually arranges itself in two paraxial columns, situated one on either side of the middle line, and in two lateral plates extending outward from these. Each of the latter divides into two lamellæ: the outer or somatic mesoblast extends under the ectodermic layer, forming with it the somatopleure; the inner or splanchnic mesoblast extends over the hypoblastic layer, forming with it the splanchnopleure. The space between the somatopleure and the splanchnopleure is the celom, body cavity, or pleuroperitoneal cavity. The mesodermic cells lining this cavity become flattened and endothelial in nature, being often termed the mesothelium.

**Mesoblastic Somites.**—Early after the appearance of the paraxial mesoblastic columns transverse division occurs in them,

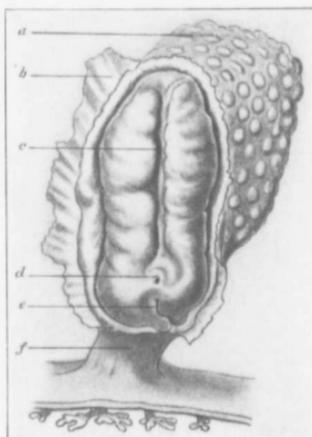


FIG. 12.—Reconstruction of an early stage in development (Graf Spee): *a*, Yolk-sac; *b*, amnion opened up; *c*, medullary groove; *d*, neurenteric canal; *e*, primitive groove; *f*, abdominal stalk, below which is a portion of the chorion.

being first marked at the cephalic end, and afterward appearing in the rest of their extent. The position of these divisions is indicated by transverse parallel lines on the surface of the embryonal area. The segments thus formed are known as the somites, the anterior one being formed before the medullary folds have blended to form the neural canal. This segmentation process is of interest in relation to the future development of the bony and muscular structure of the body and of the genito-urinary apparatus.

**Delimitation of the Embryo.**—During the progress of some of the changes just described, grooves appear on the surface of the embryonic area, one anteriorly, one posteriorly, and one

on each side. These grooves increase in length and meet to form one continuous furrow that runs around the embryonic area. At first the groove is a mere depression in the somatopleure. As it gradually deepens the splanchnopleure becomes depressed under it. This infolding around the embryonic area, toward its inferior surface, causes a gradual constriction of the archenteron, dividing it unequally into two portions. The smaller of these, superficially placed, becomes the intestinal canal of the embryo, while the larger, deeper part remains as the yolk-sac or umbilical vesicle. The constricted passage joining the two becomes the vitelline duct.

It is then evident that that portion of the somatopleure that forms the inner wall of the groove becomes the lateral and ventral body-wall of the embryo, whose delimitation from the embryonic

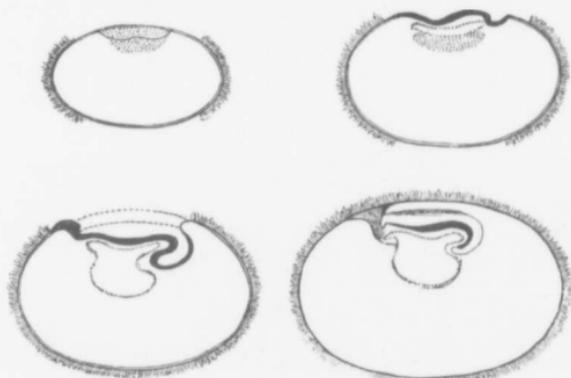


FIG. 13.—Diagrammatic sections representing growth and arrangement of the amnion in the earliest stages of the human embryo (His).

area is thereby brought about. *Pari passu* with these changes the somatopleure forming the outer wall of the groove becomes elevated in a fold known as the fold of the amnion. This is often described in four parts—the head fold, the tail fold, and the lateral folds; in the human ovum, however, there is no tail fold. These rise over the head and back of the embryo as the latter sinks inward upon the umbilical vesicle, the head fold growing toward the caudal end. They blend from before backward so as to form a complete cavity; and after fusing, the two layers of the amniotic fold separate, the inner, forming the true amnion, having epiblast on its inner surface and mesoblast on its outer; the outer layer, often termed the serosa or false amnion, is continuous with the original somatopleure, and with it forms the early or primitive chorionic membrane. It is composed of an outer layer of epiblast

and an inner one of mesoblast. This chorionic membrane is not entirely cut off from the embryo, but is connected with it at its caudal end by a process termed the abdominal stalk (*bauchstiel*), which also serves to join it to the true amnion, the deepening of the early surface groove having resulted in the delimitation of the embryo, so that it is left attached to the surrounding tissues only at its posterior end. The amnion at first envelops only the back and sides of the embryo. Gradually it extends around the latter until it surrounds it as far as the circumference of the abdominal stalk. As development continues, the amniotic cavity enlarges

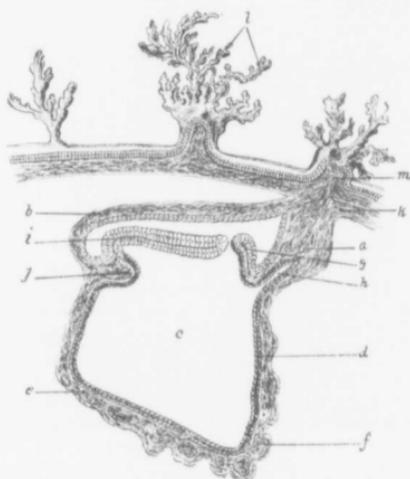


FIG. 14.—Mesial section through an early human ovum (Graf Spee): *a*, Abdominal stalk; *b*, amnion; *c*, yolk-sac; *d*, hypoblast; *e*, mesoblast; *f*, vessels on wall of yolk-sac; *g*, primitive streak; *h*, allantois; *i*, medullary plate; *j*, early heart; *k*, mesoblast of chorion; *l*, early villi; *m*, chorionic mesoblast extending outward into villi.

until it occupies the entire space within the chorion, with the inner surface of which it becomes connected.

**Importance of the Abdominal Stalk.**—This structure is the forerunner of the umbilical cord, connecting the fetus and placenta. It is the pathway along which the vessels of the embryo extend toward the future chorionic villi. The amnion does not form its outer covering, but blends with it at the end farthest from the embryo. Its covering of epiblast is the same as that of the skin of the early embryo. Within the stalk is found at first the yolk-sac and duct, a continuation of the celom, and the allantois about to be described.

The stalk, at first situated at the posterior end of the embryo, gradually changes its position, becoming more centrally placed on the ventral surface, owing to the growth of the tail end of the embryo.

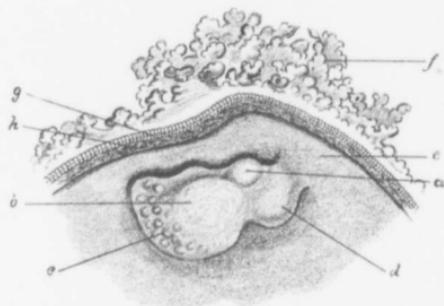


FIG. 15.—Early human ovum (Graf Spee). A portion of the chorionic membrane with the *anlage* of the embryo is seen on its inner surface: *a*, Amnion surrounding *anlage* of embryo; *b*, yolk-sac; *c*, blood-islands in the yolk-sac; *d*, abdominal stalk (*bauchstiel*) connecting embryo and chorion; *e*, chorionic membrane (*serosa*); *f*, early villi of the chorion; *g*, outer or epiblast layer of chorion; *h*, inner or mesoblast layer of chorion.

**Allantois.**—In the human female there is no such development of allantois as is found in some of the lower vertebrates. In the latter it is an outgrowth of the lower gut, which extends into the extra-embryonic celom and spreads out under the false amnion or chorion, performing an important part in the formation of the placenta. In the human ovum it arises from the

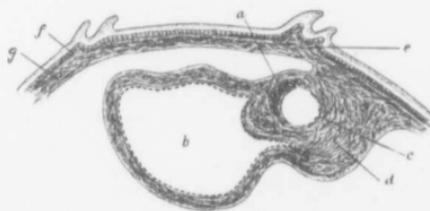


FIG. 16.—Section of early human ovum (Graf Spee): *a*, *Anlage* of embryo; *b*, yolk-sac; *c*, amnion; *d*, abdominal stalk; *e*, chorionic membrane; *f*, epiblast layer of chorion; *g*, mesoblast layer of chorion.

lower end of the intestine and passes into the abdominal stalk, but does not extend outward and spread under the chorion. Along its side the umbilical arteries extend into the stalk on their way to the chorion. The allantois is mainly concerned in the

formation of the bladder. It does not appear to be essential to the vascularization of the chorion, for occasionally complete absence of the bladder may be found along with vascularization of the chorion by vessels derived probably from the omphalomesenteric branches of the aorta of the embryo.

#### PLACENTATION.

##### **Influence of Fertilization on the Uterine Mucosa.**—

As the result of the fertilization of the ovum a genetic reaction takes place, leading to changes in the mucosa of the body of the uterus. That the presence of the ovum within the uterine cavity is not necessary to initiate this reaction is evident from what occurs in ectopic gestation, in which the genetic reaction in the uterus is identical with that which is found in the early stages of uterine pregnancy. In the latter condition, therefore, if the ovum be fertilized in the tube, the reaction may be noted before the ovum reaches the uterine cavity. The mucosa of the body, altered as the result of the genetic reaction, is known as the decidua vera.

**Decidua Vera.**—Before studying the transformed mucosa it is well to recapitulate the following points regarding the normal mucosa of the uterine body as it is found in nulliparæ:

1. Its thickness is not uniform, but varies considerably.
2. The superficial epithelium shows variations in the height, thickness, and shape of the cells, and in the position of their nuclei.
3. The same may be said of the epithelial cells lining the glands; in general these are larger than the surface cells.
4. The interglandular connective tissue is mainly embryonal in nature, consisting of a nucleated protoplasmic reticulum; here and there are found all stages of transformation to the more advanced spindle cells.
5. The connective-tissue cells nearest the surface of the mucosa are arranged for the most part parallel to it. A special layer of these, arranged as a basement membrane under the surface epithelium, can be distinctly seen in many places. Outside the epithelium of the glands the basement membrane is also found.
6. In the superficial portions of the mucosa the capillary junctions of the arteries and veins are the only vessels usually found.
7. The line of junction of the mucosa and the muscular part of the wall is an irregular one. There is no special muscularis mucosæ.

The changes that take place in the formation of the decidua vera are as follows: The mucosa becomes swollen and divided by furrows into a series of flattened or rounded areas of different

sizes. The earliest specimen of which there is record is that described by Peters, of Vienna, in which pregnancy was not advanced more than five or six days. The tissues were edematous and the vessels congested. The surface epithelium was intact, the cells being slightly lower than in the non-pregnant state. Glandular hypertrophy had commenced, the cells being in places somewhat separated from one another and from the gland-wall. Near the ovum there was slight enlargement of some of the connective-tissue cells, and extravasated blood-corpuscles were found



FIG. 17.—Pregnant uterus in second half of first week. The cavity has been laid open, showing the altered condition of the mucosa (H. Peters); *E* marks the site at which the ovum is embedded.

in different places. After the first week more distinct changes are found; the lining epithelium becomes more columnar, in parts appearing more cubical or even flattened, the nuclei becoming rounded or flattened somewhat parallel to the surface of the decidua, the cilia gradually disappearing. Here and there strips of epithelium or individual cells may become detached from the surface. In some parts the cell substance disappears, the nucleus alone being left, and in others the nucleus may be found in the first stages of degeneration. The probable cause of degeneration in the covering epithelium is the rapid growth of the intergland-

ular cellular tissue, causing stretching, flattening, and separation of the superjacent epithelium, which does not take part in the development.

The glands increase in size, but no new ones are formed. In many parts their upper ends become indistinct or obliterated owing to the lateral pressure of the surrounding growing decidual cells. The deeper portions are enlarged in size, so that the spongy nature of the lowest part of the mucosa is more marked than in the non-pregnant state. In many places the spaces show a tendency to be arranged with their long axes parallel to the surface, due to the increasing pressure of the developing ovum. The glandular epithelium becomes greatly altered; in most parts the columnar shape is lost, the cells becoming cubical or somewhat flattened.

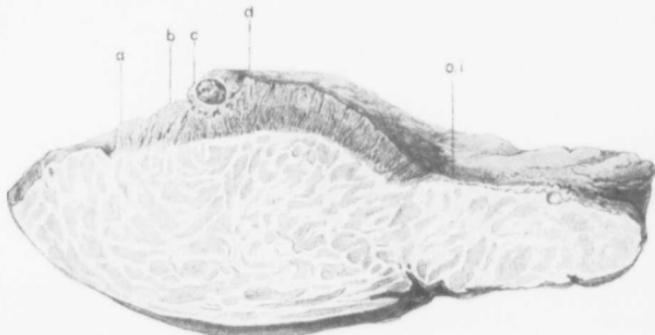


FIG. 18.—Section through posterior wall of uterus with ovum of second week (Leopold). The decidua is 4 mm. thick at fundus (*a*), increases to 6 and 8 mm. (*b, c*) beside ovum, to 9 mm. below it (*d*), and continues about 8 to 6 mm. down to os internum (*e, f*). Beneath the ovum the serotina is only 4 mm. thick. The mucosa of the cervix, beyond *e, f*, is not altered.

They are shed singly or in groups into the lumen, and become greatly degenerated.

The most striking change in the mucosa is the development of the decidual cells, which commences in the outermost layer of the mucosa, the process extending downward toward the spongiosa. In their well-formed condition the decidual cells appear rounded, oval, polygonal, or spindle-shaped (many of these appearances are simply due to the different planes in which the cells are cut). The nuclei are large and somewhat rounded. In most places the cells are connected by broad or slender processes, although sometimes these are wanting. Sometimes the spindle-shaped cells lie in compact bundles, the individual strands appearing to be distinct from one another. Occasionally smaller bundles, torn up by blood-extravasation, may be noted; the processes

connecting many of the cells, whose outlines cannot be defined when they are closely packed, may easily be traced when they are thus separated. Near the surface of the vera the long axes of the cells lie, for the most part, parallel to it. The earliest formation of decidual cells is due to hypertrophy of the connective-tissue elements, both nucleus and cell-substance sharing in the enlargement; the proportion of the latter to the size of the nucleus is much greater than in the non-pregnant state. New cells are also formed during pregnancy, being especially marked in the first five or six months. There is no ground for believing that leukocytes or glandular or surface epithelium of the mucosa share in the formation of the decidual cells.

Marked changes take place in the blood-vessels. In the compact layer enormous dilatation of the capillaries is the chief feature,

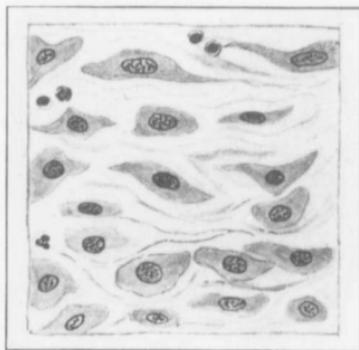


FIG. 19.—Decidual cells from compact layer of vera in sixth week of pregnancy.  $\times 300$ .

there being also some increase in the size of the arterioles and venules communicating with them. Many capillaries, however, do not become much dilated, and may be very little altered. Here and there small extravasations of blood are found among the decidual cells, extending into the lumen of the glands in various places. These changes in the mucosa are well marked during the second month; indeed, the highest stage in progressive development is probably reached by the vera in the early part of this month, though the period is probably not a fixed one, but varies in different cases. By the fourth month the surface epithelium has entirely disappeared. The compacta is slightly thinner than it was in the second month; the cells lining the glands are to a great extent separated from the walls and degenerated. Only in a few places can a section of a gland be found close to or between the muscular bundles with a well-preserved epithelial

lining. Both in the superficial and deep layers of the mucosa very slight evidence of degeneration is found in some of the decidual cells. In some cases the cell-outlines are indistinct, the matrix appearing swollen and staining lightly. Vacuolation of nuclei and cell-substance is found here and there. At the same time, in various places, cell-division is evident. In the spongy layer the interglandular trabeculae are greatly thinned. Some of them are broken across as a result of stretching due to the growth of

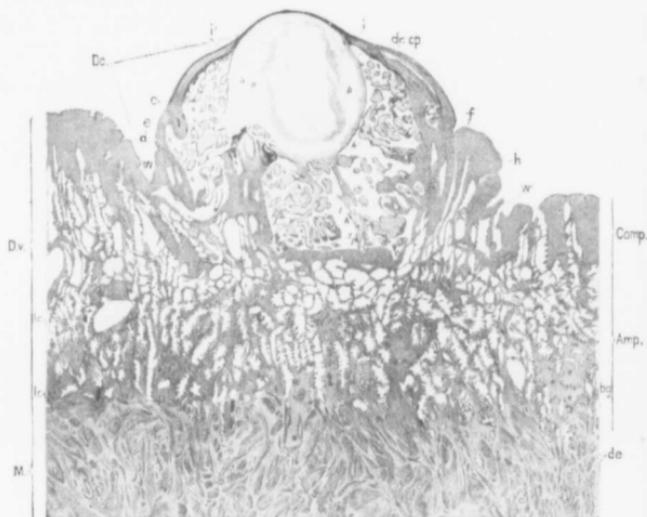


FIG. 20.—Section through ovum of second week, embedded in decidua (low power) (Leopold): *M*, Muscular wall with ends of glands (*de*) in it; *Dv*, decidua vera divided into compact (*Comp.*) and spongy (*Amp.*) layers. The mucosa rises at *ae, w'* around ovum to form the reflexa (or decidua capsularis, *De.*). In this, up to *dr, cp.*, gland spaces are seen; above *i, i'* it consists mainly of fibrin. The ovum *b, b'* is at one point in close relation to a decidual elevation. Between it and the surrounding decidua many villi are seen.

the uterine musculature, associated with a disproportionate rapidity of growth in the decidua. Capillary dilatation is still found in the compacta, but the sinuses are smaller and less numerous than in the second month. Thrombosis is found in several. The intima of several veins and arteries is thickened as a result of proliferation of epithelium or of the connective-tissue elements.

During the succeeding months of pregnancy the vera becomes thinner, especially in the compact layer. Elongation of the gland-

spaces in the spongy layer and their tendency to lie parallel to the surface become more marked. The blood-sinuses have to a very great extent become obliterated. At full time, in some parts, no compact layer worthy of the name can be found. The decidual cells vary greatly in appearance, in many places presenting degeneration, which is found in all degrees, though it is interesting to note that no deeply staining, fibrin-like masses of degenerated decidua are found similar to those in the serotina. Occasionally fibrin masses resulting from old extravasated blood may be seen in the vera.

**Decidua Reflexa.**—For many years the origin of the decidua reflexa in the human female has been the subject of much differ-

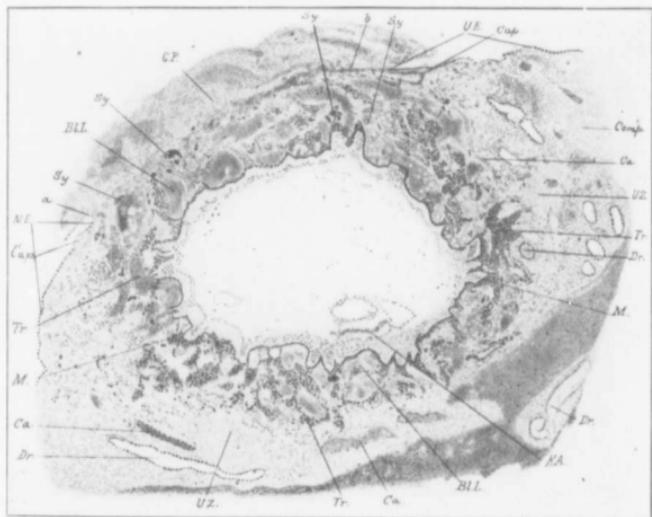


FIG. 21.—Section through ovum embedded in the mucosa. Second half of first week of pregnancy. The largest diameter of the chorionic vesicle is seen (H. Peters); *G.P.*, Blood-clot lying on the outer polar portion of the chorionic vesicle; *a, b*, edges of opening in mucosa through which the ovum has excavated; *U.E.*, uterine epithelium; *Cap.*, decidua reflexa; *Tr.*, trophoblast; *Ca.*, maternal capillary; *Dr.*, gland of uterine mucosa; *B.L.L.*, lacunae in the trophoblast, containing maternal blood; *K.A.*, site of embryo; *Comp.*, decidua compacta; *M.*, fetal mesoblast; *U.Z.*, interglandular tissue of mucosa, in which early decidual cells are found.

ence of opinion; very widely held has been the view that, when the ovum becomes attached to the mucosa, projections of the latter grow up around it, forming a complete investment. More recently several authorities have held that, as the ovum attaches itself to the growing vera, the latter, continuing its development, soon

surrounds and envelops the former, the reflexa being, therefore, merely the superficial part of the vera which has grown above and over the ovum. Hubert Peters's specimen is of the greatest interest in connection with the origin of the reflexa, because it is the earliest stage yet secured. Peters's view as to the origin is as follows: When the young ovum becomes attached to the mucosa it rapidly sinks into the compacta, thereafter continuing to excavate laterally as well as deeply; the overhanging portion of the mucosa forms the reflexa, the gap through which the ovum entered being closed by the reorganization of blood-clot. In his

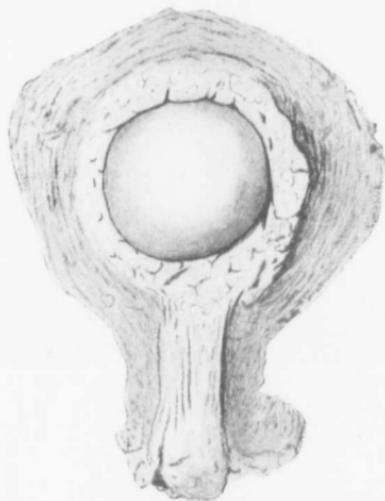


FIG. 22.—Uterus in the fourth week of pregnancy. The anterior wall is removed to show the unopened decidua reflexa. The latter is in close contact with the decidua vera; its transverse diameter is the longest, measuring 2.7 cm.; its vertical and antero-posterior diameters measure about 2.5 cm.

specimen the epithelium on the outer surface was cubical near the base, but flattened toward the outer portion; near the gap several cells were detached and lay in the blood-clot. In the basal portion of the reflexa the glands and interglandular tissue were similar to those of the neighboring serotina. The tissue was edematous, the capillaries being dilated in parts, slight extravasations of blood being present. In later specimens decidual formation is noted in the reflexa. Degeneration takes place in the cells at an early period, being first noticed near the inner surface and in the outer polar portion of the reflexa; indeed, in the latter area very little

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else than fibrin can be found from a very early period of pregnancy.

The innermost layer of the reflexa soon presents an almost continuous layer of fibrin-like material of regular thickness, most marked near the outer pole of the reflexa. This appearance is due to coagulation-necrosis in the decidual tissue, though part of the surface layer may be fibrin derived from blood. No appearance whatever of maternal epithelium can be found at any period on the inner surface of the reflexa. As to the primary determining cause of the necrotic changes in the reflexa it is

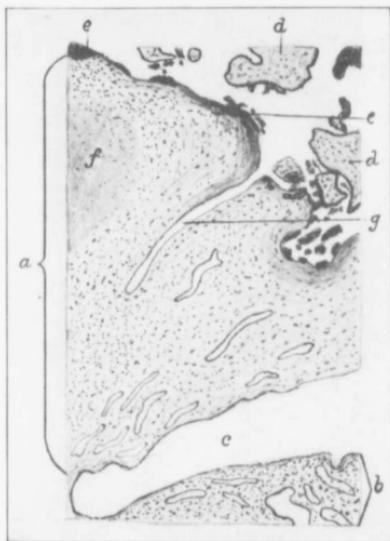


FIG. 23.—Section through reflexa near its base. Sixth week of gestation.  $\times 30$ . *a*, Reflexa; *b*, portion of vera; *c*, space between reflexa and vera; *d*, villi of chorion laeve; *e*, syncytium on surface of reflexa; *f*, fibrinous degeneration; *g*, gland.

impossible to speak with certainty. They are probably mainly due to imperfect blood-supply. At first the reflexa appears to be well vascularized, and the tissue might therefore be supposed to be well nourished. Possibly owing to the increase of decidual cells, the lymph-spaces may be so obliterated as to lead to necrosis at different points, this change being further assisted by the pressure of blood effused in different parts of the reflexa. Possibly, also, the circulation is slowed by the outward pressure of the rapidly growing ovum. It is interesting to inquire as to the relation of

this hyaline or fibrinous degeneration to changes in the attached villi of the chorion laeve. It is held by some that the former is secondary to the latter. Others hold that the relationship is one of association only, both the reflexa and villi degenerating from causes inherent to themselves. It is, however, possible that the degenerated condition of the reflexa is the cause of retrogression in the villi attached to it. As there is no stimulus to increased growth of the latter, owing to the non-active condition of the reflexa, and as the villi are bathed for a short time only with freely circulating maternal blood, they do not functionate for more than a very short period, and slowly degenerate. Apart from the intrinsic degenerative changes in the reflexa, also, must be mentioned the part played by mechanical stretching due to the increase in size of the ovum. As to the function of the decidua reflexa, it seems merely to fix and steady the ovum during its early life, while the placental circulation is being established; it probably also furnishes slight nourishment to the ovum through the chorion laeve, but this is of minor importance and of brief duration.

During the third month the space between the reflexa and vera begins to be obliterated, the layers being in close contact, though not adherent. Hitherto it has been generally taught that the reflexa blends with the vera, and that it more or less forms the inner layer of the latter during the advanced months of pregnancy. The observations of Minot, Fränkel, and myself have cast doubts upon this view. During the fourth month I have found that the reflexa, while in some sections noticeable as a thin, almost completely fibrinous or hyaline layer in contact with the vera, in others is entirely absent, the chorion laeve lying against the vera. At this period there is very little degeneration in the vera, so that it is quite easy to distinguish its tissues from the reflexa. During the remaining months of pregnancy small portions of the reflexa may frequently be distinguished, being recognized as patches of fibrin, in which occasional remains of degenerated villi are found.

**Decidua Serotina.**—The decidua serotina is that part of the vera lying between the muscular layer of the uterine wall and the ovum; to it the latter is attached, and in relation to it the placenta is ordinarily developed. In the earliest stage, therefore, the serotina is identical with the vera, save that its outer layer is altered as a result of the embedding of the ovum. In Peters's early specimen its tissues were edematous and congested, slight extravasation of blood being found in different places. Several capillaries were much dilated, especially near the surface, forming blood-sinuses. Some of these were completely lined with endothelium; in others the latter was more or less stretched and separated from the wall as a result of rapid distention of the vessels. The earliest stage of transformation of connective-tissue

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cells into decidual cells was observed. In some of the glands loosening and degeneration of the epithelium had begun, the lumen being filled with blood in some instances. The outer tissues of the ovum were intimately related to the compact layer, masses of proliferated epiblast—trophoblast extending into it in all directions. At various points maternal blood-sinuses communicated with lacunæ in the trophoblast, the maternal blood circulating through the latter. There was no evidence of transformation of any maternal tissues into syncytium, the latter being derived from changes in the cells lining the trophoblastic lacunæ. In later stages of pregnancy the decidual cells develop as has

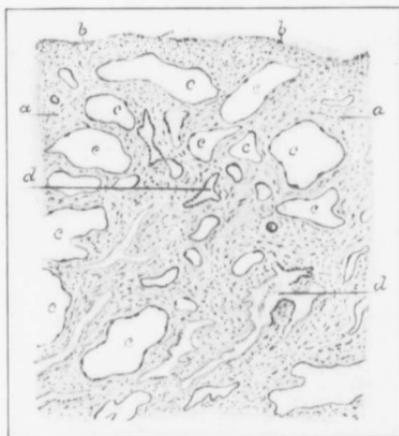


FIG. 24.—Superficial portion of decidua vera. Sixth week of gestation.  $\times 30$ . *a*, Compact decidual tissue; *b*, surface of vera, on which the epithelium is somewhat flattened, degenerated, and separated; *c*, capillaries dilated to form blood-sinuses; *d*, portions of glands, in some of which the lining epithelium is cast off.

been described in connection with the vera, variations being found in them in regard to size, shape, and arrangement. Degenerative changes take place from an early period. By the sixth week the superficial part of the compact layer is occupied by an irregular layer of hyaline or fibrinous material, which stains deeply with eosin. From it processes extend inward, varying considerably in their staining reaction. In this layer many outlines of altered decidual cells may be found.

It is interesting to note that in the vera no such appearance is found save close to the serotina, degeneration taking place in the former much more slowly and to a less marked extent.



FIG. 25.—Portion of spongy layer of serotina. Sixth week of gestation.  $\times 40$ . *a*, Remains of gland-spaces pressed somewhat parallel to the uterine musculature and containing cast-off degenerating glandular epithelium; *b*, decidua tissue of interglandular trabeculae.

As pregnancy advances, after the early weeks the surface of the serotina is often found to be irregular, small projections being

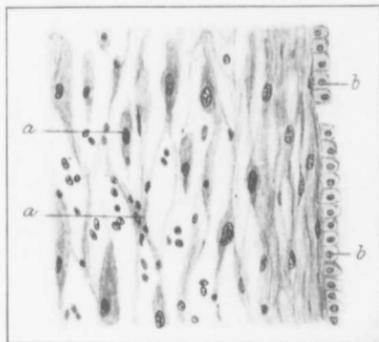


FIG. 26.—Portion of decidua serotina. Fourth month of gestation.  $\times 300$ . *a*, Anastomosing decidua cells; *b*, remains of epithelium lining gland-lumen.

found, varying in height and irregularly distributed. In some cases these are very few and small.

PLATE 2.



Section through wall of pregnant uterus at edge of placenta (near full time):  
*a*, Decidua serotina; *b*, decidua vera; *c*, spongy layer of decidua; *d*, muscular wall; *e*, layer of decidua extending for short distance under chorion at edge of placenta; *f*, circular sinus (so-called) at edge of placenta; *g*, chorionic epithelium; *h*, amnion; *i*, villi of placenta; *j*, maternal blood in intervillous space; *k*, deeply staining fibrinous layer at surface of decidua; *l*, blood-sinus in decidua.

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At the fourth month the average thickness of the serotina is less than it was during the second month, the reduction having occurred both in the compact and spongy layers. Many of the glands are obliterated or compressed, their epithelium being degenerated; in their outer parts near the muscle they are greatly elongated and tend to lie parallel to the latter. Masses of syncytium are irregularly scattered through the whole decidua, being also found in the adjacent parts of the musculature. They are found in the connective tissue, in blood-sinuses, in veins, and occasionally in the lumen of glands. In several places the walls of vessels are surrounded with thick fibrin; in some vessels endothelial proliferation is found. As pregnancy advances further thinning of the serotina takes place, with increasing degeneration of the tissue, though in many parts some undegenerated decidual cells may

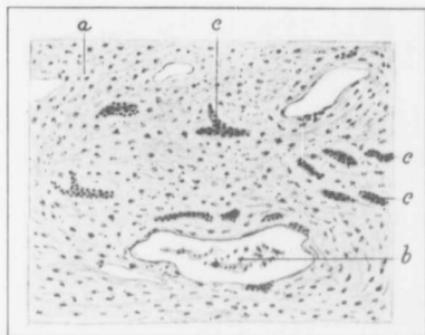


FIG. 27.—Portion of compact layer of serotina. Fourth month of gestation.  $\times 40$ .  
*a*, Decidua serotina; *b*, gland-space; *c*, mass of syncytium among the decidual cells.

continue to be found. Masses of syncytium in the decidua are relatively less abundant than at an earlier period. More marked thickening of the intima is noticed in many of the vessels.

At full time the serotina varies greatly in different portions. At some places it is almost absent, only a thin layer of decidua intervening between the muscular layer and the villi. In a few parts it is entirely wanting, the villi lying against the muscle. These portions must have been thin in the beginning, their disappearance having been due to mechanical stretching as well as to physiologic absorption. Over a large extent its thickness measures only from 0.1 to 1 mm. Here and there narrow and broad hillocks, mostly of low elevation, project from the surface, being rarely higher than 1.5 mm.

The compact and spongy layers vary in appearance in different places; the trabeculae of the latter are narrow and in many places

broken. In the compacta very few traces of glands exist, their epithelium being entirely absent. In the spongy layer the epithelial debris has largely disappeared from the gland-spaces. The decidua presents varied appearances: the superficial portions of the compacta are largely changed into fibrinous material, staining deeply, some parts being dense, others loose and vacuolated. In it cell-outlines may occasionally be distinguished, the nuclei being observed in various stages of degeneration, those areas in which cell-outlines and nuclei are most easily seen staining less deeply than the distinct fibrinous portions. In other parts well-formed decidua cells are seen, those nearest the surface lying more or less parallel to it; they stain with varying intensity. Here and there masses of well-marked branching and anastomosing cells are found with one or more nuclei. In the trabeculae

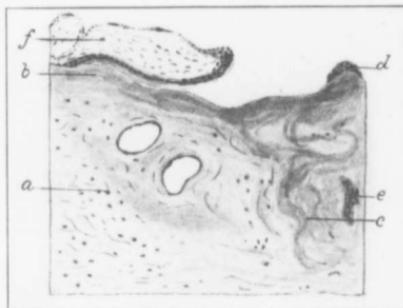


FIG. 28.—Section from full-time pregnant uterus.  $\times 60$ . *a*, Decidual cells of serotina; *b*, fibrinous degeneration in superficial portion of decidua; *c*, fibrinous degeneration in deeper portion of decidua; *d*, syncytium on surface; *e*, syncytial mass in decidua; *f*, villus.

of the spongy layer the cells are not so large as in the compacta, the largest being found near the latter.

The blood-sinuses vary considerably in size, shape, and appearance, many of them are contracted by fibrinous thickening around them, or by endothelial proliferation. In some places the vessels are closed by the pressure of blood-extravasation around them. Masses of syncytium are distributed as has already been described.

**Nature of the Progressive Changes in the Decidua.**—It has been pointed out that the decidua reaches its highest development at some time during the second month. At the end of pregnancy it is diminished in thickness.

*Changes Mechanical in Nature.*—The thinning is partly due to pressure of the uterine contents as well as to the great stretching that takes place in a direction parallel to the surface. These

mechanical alterations are evident from the arrangement of the gland-spaces parallel to the surface as pregnancy advances, from the thinning of the trabeculae of the spongy layer and the tearing across of them during the later months. The general tendency of the decidual cells to lie more or less parallel to the surface should also be noted. The loose arrangement of decidual cells found in various parts may also be caused by the stretching.

In the early months the same influences cause portions of the surface and the glandular epithelium to be cast off.

*Changes Non-mechanical in Nature.*—The degeneration and disappearance of the glandular epithelium is now beyond dispute. The view of those who hold that it is transformed into syncytium is utterly untenable. The degeneration may be mainly mechanical—*i. e.*, the cells may become flattened and separated as the result of the rapid increase and stretching of the interglandular tissue, but it also may be due to the choking of the lymphatics by the decidual proliferation, leading to interference with the nutrition of the epithelium, in the compacta at least. The glandular epithelium of the compact layer always degenerates before that of the spongy layer; the latter is probably mainly affected by the mechanical influences. The most important degeneration in the interglandular tissue is coagulation-necrosis, which gives rise to the hyaline or fibrinous areas so constantly found in the serotina. It is usually found in the reflexa before it appears in the serotina; in the latter it is present by the sixth week. It is chiefly found in the superficial portion of the compacta, although it may extend downward to a varying extent in different places. It frequently marks the outermost limit of the decidua, but occasionally a thin layer of unaltered decidua may be found above it. Though degeneration occurs in the cells of the decidua vera, characteristic deeply staining hyaline areas are not found in it. In seeking for an explanation of the difference between the degree of degeneration in the reflexa and serotina and that in the vera, an important influence may possibly be attributed to the fetal structures in relation to the reflexa and serotina; certainly, in the early appearance of the degeneration, it is generally related to that portion of the decidua to which villi are attached. It is possible, also, that the fibrinous layer on the inner surface of the reflexa may be derived from maternal blood lying between the villi which bathe the surface of the reflexa and serotina in the early weeks. Another factor favoring the degeneration may be that which has already been mentioned in connection with the degeneration of the surface epithelium—compression and obliteration of lymph-spaces as well as of many capillaries that do not dilate to form blood-sinuses, leading to interference with the nutrition of the superficial area of the decidua, especially with that part which forms the reflexa. Owing to the spongy

character of the lower portion of the decidua there is little danger of interference with its nutrition. It is possible, also, that the early rapid formation of the blood-sinuses in the compact layer may increase the pressure on surrounding cells. Fatty degeneration is very rare in the decidua except in pathologic conditions.

*Absorption of Decidua.*—Absorption of degenerated decidual

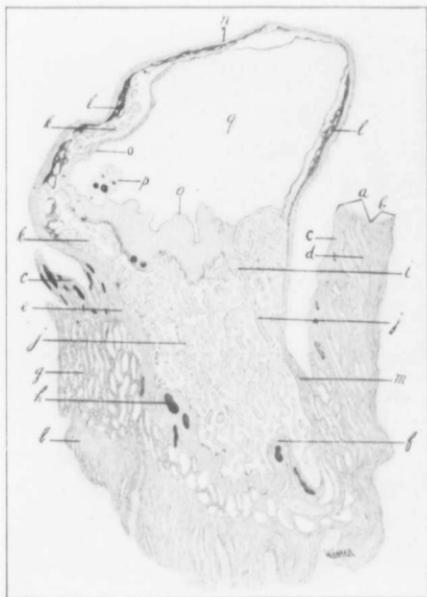


FIG. 20.—Section from uterus in fourth week of pregnancy: *a*, Decidua vera; *b*, portion of uterine musculature; *c*, compact layer of vera; *d*, spongy layer of vera; *e*, compact layer of serotina; *f*, decidual hillock; *g*, spongy layer of serotina; *h*, blood-sinus in serotina; *i*, chorion; *j*, villi of chorion frondosum; *k*, villi of chorion laeve; *l*, fibrin on inner wall of decidua reflexa, in which villi are embedded; *m*, basal portion of reflexa; *n*, outer polar portion of reflexa; *o*, amnion; *p*, umbilical cord; *q*, amniotic cavity.

tissue takes place during pregnancy, at least, after the first two or three months. The removal is brought about either by the maternal blood or lymph or through the agency of leukocytes. Its disappearance may also be partly due to the action of the fetal epiblast. The trophoblastic nature of the latter, first described by Hubrecht in the case of the hedge-hog, has been demonstrated in other mammals, and may be considered as well

established in the human female. But degeneration and absorption are not the only changes that occur in the decidua during pregnancy. New formation of tissue occurs constantly, especially in the early months; and were it not for this it is certain the mechanical stretching, compression, and thinning of the decidua, along with degeneration and absorption, would cause its entire disappearance before the end of pregnancy. Indeed, at full time the serotina, in certain parts, may have disappeared entirely, or almost entirely, because the formative activities of the tissues are unable to counterbalance the influence of the destructive agencies. Throughout pregnancy areas of well-formed active decidual cells may be noted, and these are probably mainly instrumental in making up for the losses that are sustained.

#### **Early Relations between the Ovum and Decidua.—**

Until the publication of Peters's work all statements as to the early relationships between the ovum and decidua were speculative. His sections have added much to our knowledge, and must be briefly noted.

The chorionic vesicle in his specimen was a lenticular mass, measuring 3, 1.5, 1.5 mm. in its three diameters, the longest being parallel to the serotina. It was embedded in the outer part of the compacta save at its outer polar portion, where there was an area 1 mm. in diameter covered only by blood-clot, which closed the gap in that part of the decidua under which the ovum had excavated. No remains of maternal surface epithelium were found under the ovum. All around the vesicle was a marked development of epiblast—the trophoblast—thicker next the serotina than on the outer surface of the vesicle. It was not solid, but consisted of irregular spaces, between which were lacunæ of various sizes, many of which were filled with maternal blood derived from dilated capillaries in the superficial layer of the compacta. Internal to the trophoblast lay a thin layer of fetal mesoblast, which extended for a slight distance outward, at different points, into shallow depressions in the trophoblast. The cells of the latter, distinct from one another, formed several layers, those next the fetal mesoblast being somewhat cubical; those of the outer layers being somewhat rounded in outline. The nuclei were large, round or oval, finely granular, and staining deeply. In the outer portions the cells were more irregular, some of them being vacuolated. In many of the lacunæ of the trophoblast which were occupied by maternal blood the lining consisted of a nucleated protoplasm in which no cell-outlines could be distinguished. The latter was regarded by Peters as the earliest stage in the formation of syncytium, and consisted in a fusion of the trophoblastic cells, brought about partly by the pressure of the blood, partly by the influence of the blood-plasma; broken-down blood-corpuscles seemed to fuse with the cells in some parts.

At different points the outer processes of the trabeculae penetrated maternal blood-sinuses, the communication with the trophoblastic lacunae being undoubtedly established in this way. The trophoblastic strands between the lacunae are to be regarded as the primitive villi, being entirely epiblastic. During the second week the fetal mesoblast begins to penetrate them, forming the connective-tissue core, in which capillaries gradually develop. Many of the strands attached to the decidua give rise to future

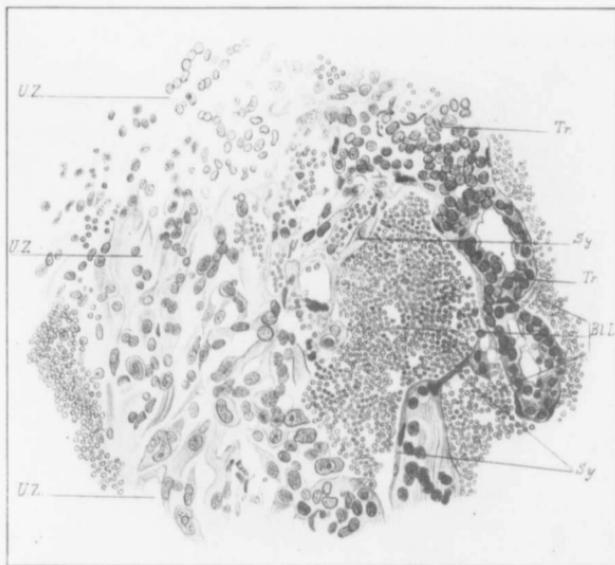
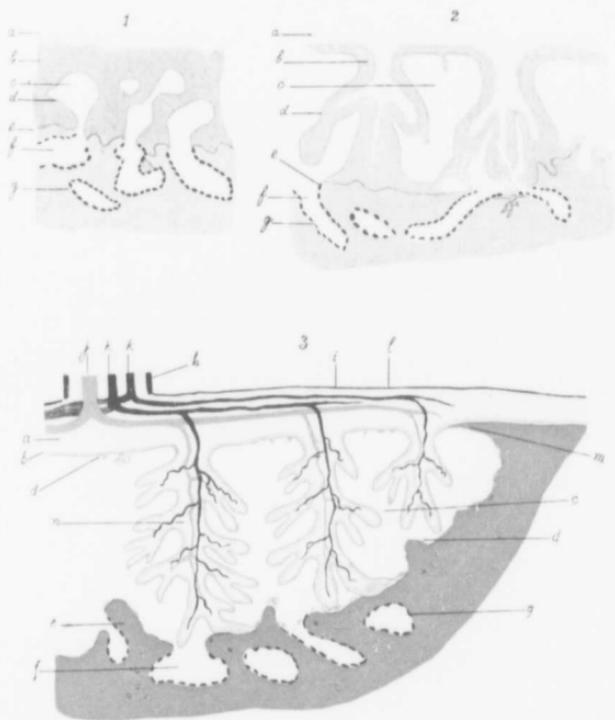


FIG. 30.—Section through outer portion of trophoblast and adjoining decidua. First week of pregnancy (H. Peters): *Tr.*, Trophoblast; *S.y.*, earliest formation of syncytium; *B.L.*, lacunae in the trophoblast filled with maternal blood; *U.Z.*, connective tissue of uterine mucosa, in which early decidual cell-formation is beginning.

permanent villus-stems. New villi very soon begin to develop, the earliest forms being buds of fetal epiblast. The original lacunae in the trophoblast increase in size, forming the permanent intervillous space, in which the maternal blood circulates around the villi. On the surface of the decidua is found a well-marked, irregular layer of plasmoidal, nucleated protoplasm identical with the syncytium found on the outer part of the chorion and villi, and in many places continuous with it. Irregular masses of this syncytium, some of which are reticulated, project from the

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PLATE 3.



Diagrammatic representation of relationship of ovum to decidua: **1**, In latter half of first week; **2**, a few days later; **3**, a few months later, when placenta is well defined; *a*, fetal mesoblast, showing indications of beginning extension into trophoblast stalks in **1**, actual extension in **2** and **3**; *b*, trophoblast, being reduced in **3** and constituting here the layer of Langhans; *c*, trophoblast lacuna in **1**, enlarged in **2** and **3** as an intervillous space; *d*, syncytium, seen in its earliest stage in **1**; *e*, decidua; *f*, maternal blood-sinus; *g*, endothelium lining maternal sinus; *h*, epiblastic covering of cord; *i*, amniotic epiblast; *j*, umbilical vein; *k*, umbilical artery; *l*, amniotic mesoblast; *m*, extension of decidua on under surface of chorion at edge of placenta; *n*, large villus-stem.

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decidual surface into the intervillous spaces, and portions extend as well downward into the substance of the decidua. This syncytium found on the surface of the decidua is derived from the

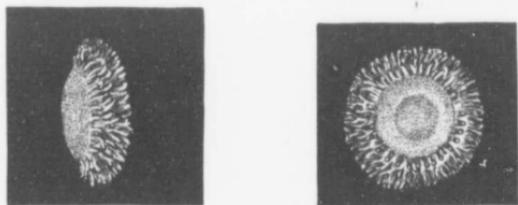


FIG. 31.—Human ovum of about twelve days (Reichert): A, Side view; B, front view. The villi are seen to be limited in distribution, leaving the poles free.

outermost portions of the trophoblast, which are pressed against the decidua as the blood increases in the intervillous spaces. It may, therefore, be regarded as a remnant of the early trophoblastic

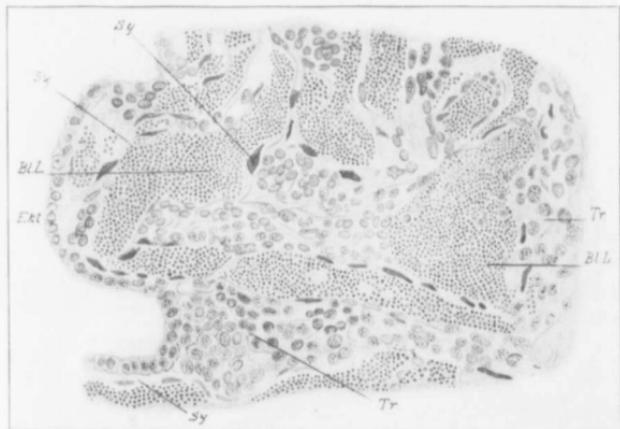


FIG. 32.—Section through the chorionic epiblast layer and part of its trophoblastic extension. First week of pregnancy (H. Peters): *Ekt*, Chorionic epiblast; *Tr*, trophoblast; *Sy*, earliest syncytium; *B.L.*, lacunae in the trophoblast, into which maternal blood has found its way.

connection between the chorionic vesicle and the decidua. As regards the function of the early marked epiblastic proliferation, the following may be suggested:

1. It helps to fix the ovum to the decidua.
2. The trabeculae of the early reticulum are the pathfinders for the future permanent villi.
3. Absorption of nourishment is undoubtedly an important function, and there can be no doubt that the early embedding of the ovum is accompanied by direct absorption of the tissue and fluids of the decidua by means of the fetal epiblast.
4. The trophoblastic extensions also serve to establish a connection between the maternal blood and the fetal tissues by eating through the decidua and walls of the sinuses. As soon as the blood enters the lacunae in the trophoblast nourishment is probably taken from it, though there is as yet no fetal circulation in the early epiblastic stalks.

Throughout pregnancy syncytial remains are found on the decidua and in its substance, extending into sinuses, gland spaces, and veins, even reaching below into the musculature. They are mainly limited to the serotina, being also found to a slight extent in the early reflexa. They are not found in the decidua vera except occasionally immediately adjacent to the serotina, from which syncytial projections may extend outward obliquely into the vera for a short distance. After the obliteration of the reflexa, when the remains of the chorion have come into relationship with the vera, small irregular portions of syncytium may be found on the surface of the latter. That the syncytium is entirely fetal in origin cannot be disputed. If the vera and serotina be compared at the sixth week, before the reflexa is obliterated, not a trace of syncytium is found on or in the vera; whereas, it is abundantly present in the serotina. The view that the syncytium is derived from the uterine epithelium cannot be maintained.

**Chorion.**—The chorion is best described as the outermost covering of the blastodermic vesicle, which enters into direct relationship with the decidua serotina and decidua reflexa. This layer is at first entirely epiblastic, a thin layer of mesoblast, however, very soon developing internal to it. On entering into relationship with the decidua the epiblast increases in thickness, forming the trophoblast, already described, which soon becomes reticulated owing to the development of lacunae in its substance. These lacunae are the earliest stage in the formation of the future intervillous spaces; maternal blood very early enters into them, communication with the maternal sinuses being established by the trophoblastic strands. The trabeculae between the lacunae are to be regarded as the earliest villous formations. Into them projections gradually extend, commencing early in the second week. The transformation of the cells lining the lacunae into syncytium has already been described. The latter gradually increases so as to form a well-marked layer covering the outer part of the entire chorion, the deeper portion being the unaltered epiblastic cells.

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During the second week these layers are well defined, the deep layer consisting of cubical or round cells, lying in close contact with the fetal mesoblast; they possess well-marked outlines, lightly staining cell-substance, and round or oval nuclei. This layer is generally known as the Langhans layer.

The superficial syncytial layer is composed of darkly staining granular protoplasm, nucleated but without distinct cell-outlines. It varies in thickness in different places, the nuclei being massed together at intervals in large numbers; here and there projections extend into the intervillous spaces. The syncytium probably acts as a kind of endothelial lining of the intervillous spaces, and may play some important part in the physiologic interchange which takes place between the fetal and maternal blood during pregnancy. It probably also exercises an influence in preventing coagulation of the maternal blood. The chorionic mesoblast, in its earliest state, is a thin layer containing from two to four thicknesses of cells, which are round, oval, or spindle shaped. Very soon branching is noted in them.

In all early specimens the chorionic villi are mostly unbranched; some are, however, slightly branched. They extend outward at right angles or obliquely from the chorionic surface and run a straight or wavy course. Many variations are found as regards the extent to which the syncytium is developed on them, as well as regards the thickness of the mesoblastic core and the extent to which capillary formation has taken place in them. Some of the villi may be attached to the decidua merely by a stalk of syncytium. The majority become attached by a proliferation of the Langhans layer of epiblast at their ends, forming a thick mass of cells. The syncytial layer on the surface of the mass becomes stretched, thinned, and more or less broken off.

The description of the chorion thus given applies to all parts of it during the early days of gestation. Thereafter it must be described in two portions:

1. The chorion frondosum or placental part.
2. The chorion laeve or non-placental part.

**Placental Part of the Chorion.**—By the second half of the second month the villi have become more numerous and more branched. The branches can be traced in all stages of their development, from solid buds or strands to those which are vacuolated and to those which contain mesoblast. The proliferative activity of the epiblast, which is very marked in the early months, diminishes as pregnancy advances.

In fairly well-formed villi, at the end of the second month, the Langhans layer consists of a single or, in some parts, a double row of cells, whose protoplasm stains more lightly than that of the syncytial layer. The outer or syncytial layer is, on the average, much thicker than the Langhans layer; in many parts the

cells of the latter are more or less separated from one another. Slight degeneration may be noted in the syncytium, indicated by vacuolation, by a tendency to split, and by deeper staining of some parts than of others. Aschoff states that it is normal to find fat in the syncytium. The chorionic mesoblast is more fibrillated than during the earlier weeks, and appears condensed in parts. It contains more spindle-shaped cells, which usually lie parallel to the surface. In the villous stems the mesoblast is most condensed at the periphery and at the outer ends. In the small villi it is quite loose, of the delicate mucoid type. Most of the villi contain capillaries consisting of tubes of small flat endothelial cells, around which the connective tissue is somewhat condensed, though to a varying extent in different places. Among the villi are free pieces of syncytium, irregular in shape and size, and presenting the same appearance as the buds and processes

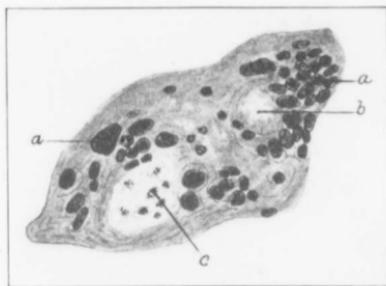


FIG. 33.—Bud of syncytium from intervillous space. Fifth week of gestation.  $\times 350$ . *a*, Deeply staining nuclei of various sizes in undifferentiated matrix; *b*, early stage of vacuolation; *c*, mesoblast penetrating a vacuolated portion.

attached to the villi; they are evidently sections of the latter. The villi are attached indiscriminately to elevations and depressions on the decidua surface. In some cases a pit-like depression may be occupied by a villus, which may thus seem to be compressed by the surrounding decidua tissue. This appearance has often erroneously been interpreted as a boring of the villus into the serotina; while the ends of the villi, by means of their epithelium, undoubtedly do absorb the decidua to a slight extent, there is never any deep extension into the serotina. As pregnancy advances the connective tissue of the chorion and villi becomes denser and more fibrillated; the epithelium gradually thins, the syncytium splitting to a greater extent and undergoing hyaline degeneration and vacuolation. At the end of pregnancy the conditions are as follows: Here and there one or more villi may be embedded in a mass of fibrin, the epithelium of the villi being absent, their con-

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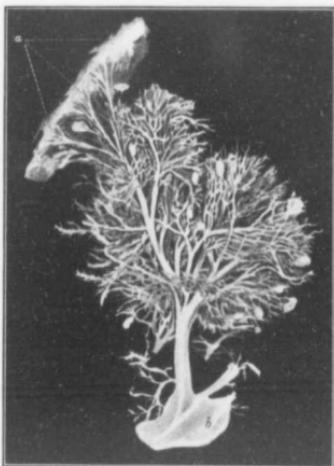


FIG. 34.—Villus-stem and branching villi in the fifth month of gestation (Bumm):  
*a*, Decidua serotina; *b*, chorion.

nective tissue being dense, and their vessels more or less obliterated. The fibrin may be dense and fibrillated or it may have a



FIG. 35.—Villi attached to serotina. Sixth week of gestation.  $\times 90$ . *a*, Serotina;  
*b*, villus-stem; *c*, proliferation of Langhans cells attaching villus-stem to serotina;  
*d*, mass of syncytium in the serotina.

loose, reticulated structure. Scattered through it may be found pieces of epithelium in various stages of degeneration. The villi in general are relatively more attenuated than in early pregnancy. In the large ones the connective tissue is uniformly or irregularly dense, especially around the vessels. There is a relatively large proportion of matrix to cells; many of the latter are shrivelled, lying in spaces. In the small villi the connective tissue is for the most part loose and mucoid. Many of the vessels are diminished in caliber, especially in the larger villi, owing to the thickening of the intima or of the connective tissue around them, or to both of these conditions. Hyaline degeneration may be occasionally found in the vessel-walls. The endothelium may be both proliferated and swollen. The epithelial covering of the villi differs considerably from the condition found in early pregnancy. In many parts



FIG. 36.—Portion of injected villus from a placenta of about five months (Minot).

it consists of a layer containing cubical or flattened nuclei, evidently the remains of the syncytium, no cell-outlines being recognizable; the nuclei may be close together or more or less separated; they are finely granular and stain deeply. In some places the syncytium occurs in masses of various shapes and sizes; in many parts it is degenerated and split up. Occasionally a strip may be separated, resembling an endothelial layer. Here and there the connective-tissue core of the villi is quite bared, being directly bathed by maternal blood in the intervillous space. Very few cells of the Langhans layer are found; they may be somewhat flattened, and are usually separated more or less from one another. In parts the surface epithelium is entirely replaced by a deeply staining fibrinous layer. A few buds of syncytium project from the chorion, and few detached projections are found among the

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villi. In most of the villi attached to the decidua the proliferated cells of the Langhans layer, at their outer ends, have disappeared, so that the connective tissue of the villus is in direct contact with the decidual tissue. Where the latter is in a condition of hyaline degeneration, the line of demarcation may be readily made out; where the degeneration is also present in the villus, it is very difficult to distinguish fetal from maternal tissue. Owing to the thinness of the serotina in parts the attached villi may be very close to the muscular part of the wall. Occasionally the decidua is entirely absent, the villi lying in contact with the muscle.

**Non-placental Part of the Chorion.**—In the earliest specimens of the pregnant uterus no distinction can be established between the villi attached to the serotina and those attached to the reflexa,

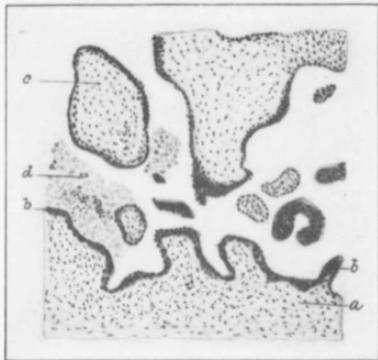


FIG. 37.—Section through part of decidua serotina and placenta. Sixth week of pregnancy.  $\times 60$ . *a*, Compact layer of serotina; *b, b*, layer of syncytium on surface of serotina; *c*, villus; *d*, maternal blood in intervillous spaces.

either in regard to number, size, shape, or minute structure. The description already given of the early placental portion will also serve for that of the non-placental portion. The first change by which a distinction can be established usually begins before the end of the first month of gestation. It is a growth of villi in relation to the serotina more marked than in relation to the reflexa. In the sixth week the chorionic membrane has the same appearance in all parts, the distance between it and the reflexa varying in size in different specimens. Toward the outer polar portion of the reflexa this space diminishes in width, the chorionic membrane lying in closer relationship with the reflexa, being to a great extent in contact with it or separated only by a few villi. The villi vary considerably. Near the serotina they are most numerous and similar to those of the chorion frondosum; further

out they are less branched and possess fewer epithelial buds and are poorly vascularized, some, indeed, containing no capillaries; in many the connective tissue has a hyaline appearance. Near the serotina many villi are attached to the reflexa by marked proliferation of the Langhans layer; elsewhere it is found to a much less extent. By this time, as already has been pointed out, considerable hyaline or fibrinous degeneration may be found in the reflexa, and in some parts the ends of the villi are also degenerated. As pregnancy advances the reflexa thins and gradually disappears, and the chorionic membrane may lie in many places directly in contact with the vera, the line of union varying in different parts, being regular in some areas and uneven in others. The original reflexal villi have degenerated, their superficial epi-

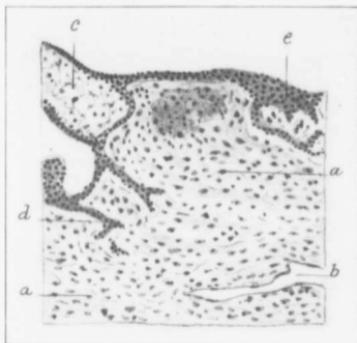


FIG. 38.—Section from sixth-week pregnant uterus.  $\times 80$ . *a*, Compact layer of serotina; *b*, gland; *c*, villus attached to surface of serotina by syncytial layer; *d*, stalk of syncytium extending into serotina; *e*, syncytium on surface of serotina continuous with covering of villus.

thelium having become destroyed, their connective tissue having undergone hyaline degeneration. They become compressed between the chorionic membrane and the decidua; by the sixth month these two tissues are in parts adherent. The chorionic connective tissue is fibrillated, the nuclei being elongated parallel to the surface. The chorionic epithelium which forms the means of attachment to the decidua is usually a well-marked layer, rarely more than two rows of cells in thickness. Occasionally, at this time, portions of the original reflexa which have not disappeared may still be found between the chorionic membrane and the vera. At full time the chorionic connective tissue is generally dense in structure, the epithelial layer being usually distinct and thickest close to the placenta. Many are vacuolated and present other signs of degeneration.

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**Relation of the Vessels of the Mucosa to the Intervillous Circulation.**—It has been clearly demonstrated by Peters's specimen that as the ovum breaks through the surface of the mucosa and becomes embedded in the compacta there may be a small extravasation of maternal blood around the ovum. In his case it formed a clot over the outer polar portion at the site of entrance through the surface mucosa.

Peters supposes that this blood furnishes nourishment to the ovum. Whether this extravasation always occurs can only be settled by the examination of other early specimens. It may only be accidental in Peters's case.

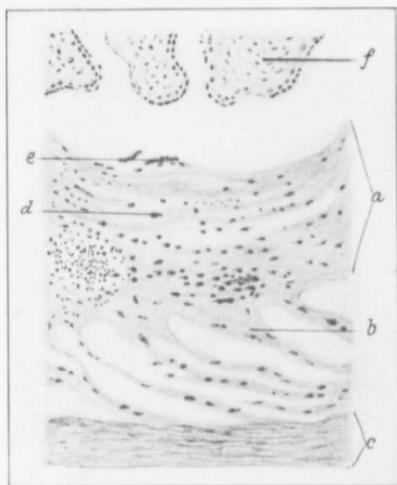


FIG. 39.—Section from full-time gestation.  $\times 80$ . *a*, Compact layer of serotina; *b*, spongy layer; *e*, portion of muscular wall; *d*, decidua cells; *e*, remains of syncytium on surface of decidua; *f*, villi.

His sections very clearly establish, however, what my previous work has led me to conjecture as to the earliest stage in the establishment of a relationship between the chorion and maternal blood. This I have already described in detail. The great multiplication of the chorionic epiblast to form a trophoblast layer is accompanied by the formation of lacunæ in the latter, into which maternal blood finds its way.

That the walls of the maternal sinuses are perforated by the phagocytic action of the trophoblast can scarcely be doubted.

The lacunæ in the trophoblast are the beginnings of the intervillous spaces of the well-formed placenta. Owing to the gradual

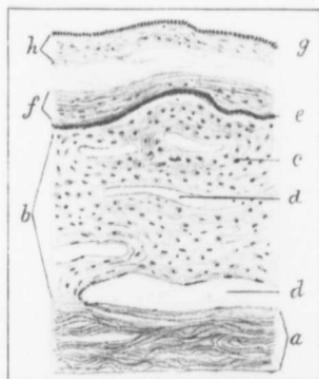


FIG. 40.—Section through inner part of uterine wall in the non-placental area. Sixth month of gestation.  $\times 80$ . *a*, Portion of muscular wall; *h*, decidua vera; *c*, decidua cells; *d*, gland space; *e*, chorionic epithelium; *f*, chorionic connective tissue; *g*, amniotic epithelium; *h*, amniotic connective tissue.

establishment of communication between them, maternal blood very early circulates around the whole chorionic surface of the ovum.

As pregnancy advances this circulation gradually becomes limited to the chorion frondosum, or that part which enters into

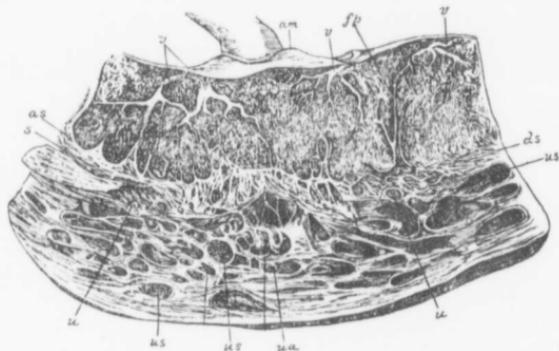


FIG. 41.—Section through uterine wall and attached placenta (Wagner): *u*, Uterine wall rendered spongy by greatly developed uterine sinuses (*us*); *ua*, branches of uterine artery; *ds*, decidua serotina; *s*, line of separation; *fp*, fetal portion of placenta, consisting of a mass of vascular fetal villi (*fv*); *ms*, maternal blood sinuses; *am*, amnion covering free internal surface of placenta.

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the formation of the placenta. Occasionally, however, a small or large portion of the chorion laeve may remain, developing continuously with the frondosum, and the maternal blood may circulate among its villi, which thus form a reflexal placenta.

In the permanent condition the villi are attached mainly by their ends to the surface of the decidua. They do not force their way through the walls of the maternal sinuses so as to hang naked in them, nor do they become covered with an investment of maternal endothelium. These old views must be entirely abandoned. It is very exceptional to find a villus hanging into

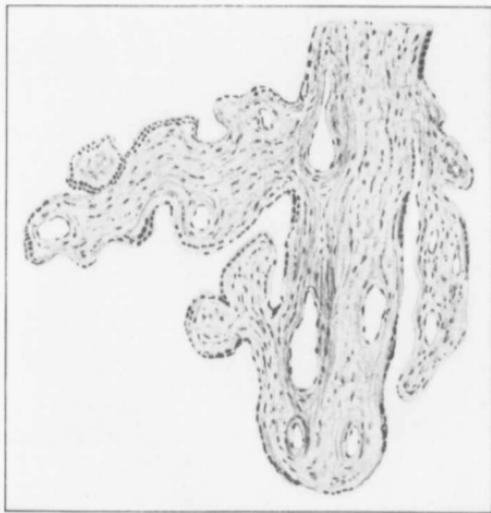


FIG. 42.—Villus-stem from full-time placenta. The epithelium varies in thickness. In parts it is absent. The connective tissue is dense, especially around some of the vessels.  $\times 80$ .

the open mouth of a sinus at the surface of the decidua or attached to its walls.

Neither is there any extension of the endothelium of the maternal sinuses outward, forming a covering for the villi; this old view has been based on an incorrect interpretation of the appearances seen in sections. Recent careful histologic methods have shown that the covering of the villi, long termed "maternal endothelium," is really "fetal epiblast." In advanced pregnancy the latter may be thinned in parts, resembling the former.

The condition of the maternal vessels which communicate with

the intervillous spaces must also be noted. It is very evident that, as the maternal blood circulates among the villi, giving up its oxygen and nourishment to the fetal blood in the villi, there must be openings in the serotina through which the current flows toward the villi, and others through which it flows from the intervillous spaces into the maternal venous system.

Much has been written as to the nature of the serotinal vessels and their relationship to the intervillous space. Attention may be particularly directed to the work of Waldeyer, Turner, and Bumm. It is usually stated that both arteries and veins open into the intervillous spaces. I object to the use of these words, and would substitute "afferent" and "efferent" vessels instead.

There can be no doubt that in normal cases it is rare to find a vessel worthy of the name of artery or vein in the superficial part of the mucosa. They are mainly capillaries, having lost their muscular and elastic coats deeper down. One does find a few small vessels, to which the term "arteriole" may be applied, consisting of a lining of endothelium surrounded by one or two layers of somewhat flattened connective-tissue cells. These conditions are found in the non-pregnant uterus as well as in early pregnancy. Block, who has particularly studied the vessels of the mucosa in eight specimens of pregnant uterus, is of exactly the same opinion as myself on this point.

One of the earliest changes in pregnancy is the dilatation of capillaries in the superficial layers of the decidua, giving rise to large sinuses. The arterioles and venules which communicate with these are also somewhat increased in size. Microscopically it is impossible to distinguish many of these arterioles and venules from one another, and I am at a loss to know how certain observers have so confidently figured vessels in their drawings as one or the other.

Neither can any support be given to those who describe a particular and definite arrangement of the afferent and efferent vessels. Thus, Bumm, in a recent paper, gives a diagram representing the afferent vessels (called "arteries" by him) opening into the intervillous spaces on the sides of the outward prolongations of the decidua (called by him "intercotyledonary septa"), and the efferent vessels (named "veins" by him) opening from the surface of the decidua between these prolongations. His beautifully figured artery coiling on a decidual hillock and sending jets of red paint outward among the villi must be regarded only as a pretty fancy.

No such systematic and orderly arrangement can be found. Afferent as well as efferent vessels open indiscriminately on the decidual surface between the decidual elevations as well as on them, as Farre long ago pointed out; and for the most part the openings occur between those narrow prolongations of the decidua to which the term "septa" has been applied. Kölliker, indeed,

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could find no arterial openings in these septa. They are generally poorly vascularized. Indeed, if the afferent blood alone proceeded from them, the villi would be but poorly nourished.

The vessels by which blood enters and leaves the intervillous spaces are almost entirely the large sinuses—dilated capillaries of the compact layer of the serotina. The opening of communication will direct an afferent or efferent current, probably, according to whether it is nearer the arterial or venous end of the sinus. It is very rare for a small arteriole or venule to open directly into the intervillous space. As to the number of openings in a full-time specimen, we have no accurate information. Attempts have been made to estimate them. According to Waldeyer, they are most numerous in the central portion of the area serotina.

As to the physics of the intervillous circulation, it is very evident that the windings of the small arterial vessels through

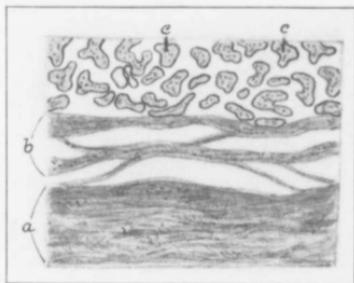


FIG. 43.—Section from full-time pregnant uterus.  $\times 25$ . *a*, Portion of muscular wall; *b*, decidua serotina; *c*, villi.

the muscular part of the uterine wall and the deeper part of the mucosa must be associated with a diminution of the force with which the blood is poured into the intervillous space. The dilatation of capillaries into large sinuses must also assist in diminishing the force of the current. If the arteries were to run a straight course and to open directly into the intervillous spaces without the interposition of blood-sinuses, the jets of blood would probably be a source of danger to the villi, tearing them across or separating them from their attachments.

The condition of the veins in the mucosa is such as to favor the removal of the deoxygenated blood as rapidly as possible; they have not the tortuosity of the arterioles, but run a more direct course.

In conclusion, it may be noted that the intervillous circulation is so conditioned as to be largely independent of sudden changes in the maternal vascular system. It is probably not a swift-flowing,

pulsating stream, but a steady-moving mass of blood. Evidently the least motion will be at the parts most distant from the openings—*i. e.*, the surface of the chorionic membrane. Variations in resistance will be found also next to the decidual surface, according to the number and position of the openings of the maternal sinuses in it.

**Amnion.**—At what period in the human ovum the folds of the extra-embryonic somatopleure develop, giving rise to the amnion, we are uncertain. Peters states that the amniotic cavity was completely closed in his early specimen, being lined with a

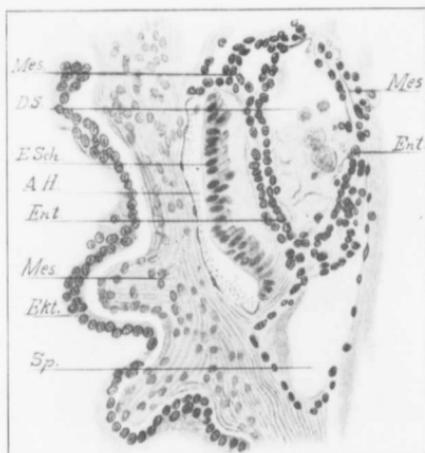


FIG. 44.—Section through embryonic region of ovum. First week of pregnancy (H. Peters): *E.Sch.*, Embryonic epiblast; *Ent.*, embryonic hypoblast; *Mes.*, embryonic mesoblast; *D.S.*, umbilical vesicle; *Ekt.*, chorionic epiblast; *Sp.*, fold in exocoelom; *A.H.*, amniotic cavity lined by a single layer of flattened cells, which are in striking contrast with the layer of cylindrical cells of the embryonic epiblast.

layer of very flattened cells opposite the embryo and with cylindrical cells next to it. Outside was a layer of mesoblast, consisting of several thicknesses of cells.

In Spee's early case of the second week the epiblastic layer consisted of a single layer of flattened cells, the mesoblast consisting of a single layer of cells.

During the third and fourth weeks the epiblastic layer is not unlike an endothelium, so flattened are the cells composing it. The nuclei are round or oval and placed at varying distances from one another. The mesoblastic tissue varies in thickness, being composed of an outer layer very similar in appearance to

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the epiblastic layer and termed the mesothelium, and an inner layer lying next the epiblast, composed of a homogeneous, faintly staining material, finely fibrillated, in which very few cells can be seen.

By the fourth month the epithelial cells have become more numerous and are less flattened than previously, for the most part having a cubical shape; in some parts being columnar. The connective tissue still presents a dense, homogeneous appearance next the epiblast, being looser next the chorionic mesoblast; it is usually connected with the latter by loose strands.

At full time the epithelium is mainly cubical, though in some places it is columnar. On surface view the cells appear irregularly rounded or polygonal in outline. Their edges appear to form irregular projections, which seem to blend, forming bridges between adjacent cells. Stomata have been described among the cells by various authors, but others deny that they exist.

The connective tissue is loosely connected with that of the chorion in most parts, the connecting strands being termed the subamniotic layer by Barbour; here and there firm union exists, so that no distinction between them can be made out.

**Shed Placenta.**—The shed placenta is smaller in area and thicker than it is *in situ* before labor. This is due to the compression of the organ during labor, maternal blood being forced to a large extent out of the intervillous spaces, the volume of fetal blood in the villi also being reduced.

As it appears at the end of the third stage it is best described as discoidal. A considerable range of variations are found as regards its size, shape, color, and consistence.

On the average, in the case of single pregnancies, it is somewhat rounded, and measures crosswise about seven inches. In its central portion the thickness is, on the average, one inch. It usually thins gradually toward the edge. Sometimes the thickness is fairly uniform until near the edge, when it suddenly diminishes. In some cases the thickness varies considerably in different portions. Its outline is often oval, but is sometimes ovoid, reniform, crescentic, or lobed.

One or more detached portions may occasionally be found—"placenta succenturiata." The separated mass may be related to maternal blood, just as is the main part of the placenta. Rarely the detached portion may be as large as that to which the cord is attached, explaining what is sometimes described as a double placenta with a single fetus. In such a condition the cord may end in the membranes joining the two parts of the placenta, its vessels going to each.

Sometimes the villi of the small separated portion are functionless, the mass being termed "placenta spuria."

In some cases the separated portion is derived from an

abnormal development of a circumscribed area of the chorion laeve. Very rarely the placenta may extend ring-like around the uterus, being thus similar to the condition found in some lower mammals. When a gap exists in its substance, owing to scanti-



FIG. 45.—Uterine surface of placenta immediately after delivery (reduced).

ness or absence of villi, the condition is termed "placenta fenestrata."

The consistence of the placenta is variable. It may be quite firm or very soft and plastic. Its weight varies a good deal; ordinarily from twelve to twenty ounces.

The uterine surface varies in appearance. It is usually dark red, but it may be quite pale. Ordinarily it consists of a number

PLATE 4.



Anomalies of the Placenta: 1, Placenta with irregular lobes (Auvard); 2, placenta in two unequal lobes (Auvard); 3, irregular placenta (Auvard); 4, small accessory placenta (Ribemont-Lepage); 5, placenta succenturiata (Ribemont-Lepage); 6, "battledore" placenta, oval (Auvard); 7, placenta with velamentous attachment of cord (Ribemont-Lepage); 8, placenta with two equal lobes (Ribemont-Lepage).

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of irregularly rounded convex areas, with fissures running between them. These areas are generally termed cotyledons. It is, however, very rare that any definite cotyledonary arrangement exists. The fissures are usually shallow, extending only a short distance into the substance of the placenta. Occasionally they may divide half or more of its thickness. They vary greatly in number, and consequently the areas between them vary greatly in size.

This surface is usually said to be rough and shaggy. This is, however, an inaccurate description. A very large portion of it is fairly smooth. As I have already pointed out, in speaking of the separation plane of the ovum, the maternal surface of the shed placenta usually represents a plane passing through the compact layer of the decidua serotina. This is not rough and shaggy. The latter description applies to those areas which represent a plane passing through the spongy layer of the decidua. But ordinarily it is only here and there that this part is torn through. The surface is also shaggy when, as not infrequently happens, the ends of the villi are exposed, no decidual tissue having been removed.

An exact idea of the surface can best be obtained by placing the placenta in a basin of water and examining it with a hand-lens. The distinction between the shaggy and smooth portions can thus easily be made out.

The fetal surface is covered with the amnion, which is smooth and shining. Through it can be seen the chorionic membrane, from the lower surface of which the villi extend. The chorion has a mottled appearance, usually a mixture of purple, gray, and yellow areas, which vary greatly in size, ordinarily, from the thickness of a pin-head to that of a pea; in some cases they are considerably larger.

The amnion may easily be stripped from the surface as far as the insertion of the cord.

The umbilical cord usually enters the fetal surface of the placenta near the center. It may, however, be inserted at any point between the center and the margin. In some cases the cord is inserted into the membranes—the velamentous insertion.

From the cord the branches of the umbilical vein and arteries spread in the superficial part of the chorion under the amnion to all parts of the placenta, being very distinctly recognized. In some cases very few of the vessels stand out prominently on the surface. The veins are beneath the level of the arteries, and are larger in caliber. There are no anastomoses between the branches of either of these sets of vessels outside of the cord. Often the two arteries are connected by a short branch about half an inch above the placental end of the cord. Most of the vessels can be traced in their various divisions until they disappear as fine

branches to supply the villi; sometimes a large branch disappears abruptly, its ramifications not being visible. Great variations are noticed as regards the course of the branches. Minot states that the more eccentric the insertion of the cord the more symmetrically are the vessels distributed; the nearer the center the less their symmetry.

Occasionally remains of the umbilical duct and vesicle may be noticed under the amnion, close to the cord. The former is a minute sac; the latter a thread-like stalk. Very rarely these may be accompanied with unobliterated omphalomesenteric vessels.



FIG. 46.—Placenta at full term, showing superficial distribution of blood-vessels (Minot).

At the edge of the placenta the amnion, chorion, and decidua extend outward, forming the so-called "membranes."

Occasionally the place of transition is not the edge of the placenta, but a ring around the fetal surface of the organ, internal to the edge.

A good idea of the general plan of the placenta may be obtained from the study of transverse sections across it. On the fetal side are the amniotic and chorionic membranes. On the maternal side is a very thin layer of decidua, which may be wanting in places. These meet and are in close apposition at the placental edge; here the decidua may often spread for a short distance on the under surface of the chorionic membrane.

Between the decidua and chorionic layers there is thus a large

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area, forming the main thickness of the placenta. This area is a space which is almost entirely occupied with projections of the chorion, forming the villus-stems and villi, which vary in size, shape, and structure. Many of the large stems are attached to the decidual layer; the great majority of the small villi, however, hang free like the branches of a tree. Surrounding the villi is maternal blood, which gives the dark-red color to the placenta. Ordinarily the intervals between the villi in which the maternal blood is found are termed "intervillous spaces," but it must be clearly understood that these spaces are in free communication. The expression "intervillous space" is, therefore, more accurate. In the angle at the edge of the placenta very few villi may exist in some parts, so that the appearance of a sinus is produced, and, indeed, it has been termed the *circular sinus*. No special name should be given to it, however. It is merely the marginal portion of the intervillous space, and never extends as a direct sinus around the placenta, but is interrupted at irregular intervals by a well-marked development of villi.

Besides the villus-stems and villi sections of buds and irregular masses of syncytium growing from the chorionic membrane and villi are noticed. In many parts, where the free ends have been divided, the appearance is presented of masses lying free in the maternal blood. Here and there several villi closely pressed together are cut across. Some of these are embedded in fibrin, others are not. These are different forms of the *Zellknotten*, which I have previously described. Portions of fibrin are also found on the surface of a number of villi. Besides these structures are noticed elevations of the decidual layer forming the maternal surface, and generally termed decidual septa. They are directed perpendicularly or obliquely toward the fetal surface of the placenta, and are for the most part very short; they rarely extend into the intervillous space for any considerable distance. Sometimes, near the edge of the placenta, they may nearly reach the chorionic membrane.

Villi are attached to them as well as to the general surface of the decidua. Leopold and others consider that these are of great structural importance, and suppose that fixation villi are chiefly attached to them. Extensive study of the placenta proves this view to be wrong. These decidual projections vary greatly in their development, being usually short, and often very scanty. They have no special significance in relation to the attachment of the villi.

Often sections across free ends of such projections may be noticed, giving the appearance of portions of decidual tissue lying free in the maternal blood of the intervillous space. Occasionally such a section may include a number of villi attached to the decidual tissue or closely pressed against it; varying quantities

of fibrin may also be found between or around these villi. Such masses form other varieties of the *Zellknoten*.

The quantity of maternal blood in the intervillous space varies greatly. Where it is small the villi are closely massed together.

Of all the tissues above noted the fetal elements form by far the greater portion. This can be clearly demonstrated if the chorionic vessels be injected with a carmin-gelatin solution through the umbilical arteries, the decidua layer being afterward carefully removed by dissection, and the maternal blood washed out of the intervillous space. When the mass is placed in water the thickness of the placenta is seen to consist of a beautiful frondose arrangement of the injected villi.

In such a preparation the fetal vessels may be distinctly traced. The large veins and arteries ramify in the chorionic membrane, the latter being more branched than the former. They dip down into the villus-stems, dividing mainly dichotomously and extending into their various branches. In the small villi capillaries only are found; in several the latter do not always extend throughout the whole length. In short ones there is usually only a single loop; in larger ones a tortuous arrangement of the vessels, forming a number of loops, between which an anastomosis may exist.

I have already pointed out that the vessels vary in size in different specimens. Ordinarily the capillaries are small, but they may sometimes be dilated, allowing six or more blood-corpuscles to lie side by side. Occasionally a capillary may be small at one point and wide at another.

**Placental Infarcts.**—Very frequently the placenta presents areas of various sizes, shapes, and colors, which are generally termed infarcts. Whitridge Williams has recently classified them as follows:

1. Small whitish or yellowish fibrous-like areas, a few millimeters in thickness, sharply marked off from the surrounding placental tissue.
2. Wedge-shaped or irregularly rounded dull-white areas, of a striated fibrinous appearance.
3. Large portions of placenta showing this change.
4. A yellowish-white rim, varying in width and thickness, extending around the margin of the placenta on the fetal side under the amnion, forming a complete or partial ring. This condition is often termed "*placenta marginata*."

In some cases this ring is situated more than half an inch internal to the edge.

5. Rarely a pinkish or brickdust-colored mass, of small or large size, found mainly near the maternal surface, but sometimes occupying the whole thickness of the placenta. These are known as "*red infarcts*."

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6. Very rarely there are scattered through the placenta red or black areas, of various sizes, consisting of blood surrounded by a fibrous-like substance. These are termed by some "*red infarcts*," by others "apoplexies." Pinard has named the appearance "*placenta truffe*." Williams points out that these are quite distinct in nature from the above-mentioned red infarcts.

Very many views have been advanced as to the nature of these infarcts. Williams has fully tabulated them, but it is beyond the scope of this work to refer to them in detail. It is here only necessary to consider their relationship to the changes normally found in placental growth and development. Do they occur in healthy conditions or are they an indication of maternal or fetal disease? In the present state of our knowledge it is impossible to answer this question accurately.

Williams noticed infarcts measuring at least 1 cm. in diameter in 315 out of 500 placenta. Smaller ones, many just visible to the naked eye, were observed in the great majority of placenta, while microscopic examination revealed early stages of infarct formation in every full-time placenta examined by him.

He regards this condition, in a moderate degree of development, as not pathologic, and exerting no influence upon mother or fetus. It is to be regarded as a sign of senile change in the placenta, as was first suggested by Druitt years ago.

My own observations are in harmony with those of Williams, not only as regards the frequency and significance of infarcts, but as regards their mode of formation.

The chief cause of the process is the thickening of the intima in vessels of various villi, especially in those of medium size. Of less importance in diminishing the lumen of the vessels is thickening of the connective tissue around them. These vascular changes, already fully described by me, have been noted by a number of previous observers, the most prominent of whom was Ackermann.

The first result of obliteration of the lumen, according to Williams, is coagulation-necrosis beneath the syncytium, with subsequent formation of canalized fibrin.

In my description of full-term villi I have pointed out the frequency of fibrinous material on the surface of the villi, with remains of the syncytial layer external to it, or in some parts none whatever.

This fibrin probably results from changes in the Langhans layer of epithelial cells and the underlying stroma. That the Langhans cells do largely undergo this transformation normally, as has been mainly demonstrated by Nitabuch and Eberhardt, my sections clearly show.

The syncytium may undergo the same change, but always later, as is best demonstrated in the formation of the infarct. Its

preservation is probably due to its contact with the maternal blood, from which it may be nourished. As Peters has pointed out, the syncytial layer acts as a kind of endothelium for the intervillous blood, serving an important function in transmitting necessary elements to the fetal blood-stream. It also undoubtedly tends to prevent coagulation, as Peters suggested. When, therefore, the syncytium becomes largely altered in any area the blood tends to coagulate there, and in this way the contribution of maternal blood to the infarct is brought about.

Finally, when several villi are massed together by a fibrinous mass, their entire stroma gradually undergoes hyaline degeneration, so that in well-advanced conditions their outlines are often scarcely to be recognized.

Occasionally infarcts are found in which, along with the villi and fibrin, there is decidual tissue. No doubt, in some cases, large cells have been described as decidual which were those of the Langhans layer, not degenerated; but there can be no doubt that decidual tissue may sometimes form part of these infarct masses. The appearance is produced when the section divides an elevation of the serotina to which are attached villi in which the fibrinous changes have progressed. Sometimes, in these, groups of the Langhans cells may also be seen, for I have already demonstrated the frequency with which these cells are proliferated at the ends of the attachment of villi to the decidua, and the variations found in their disappearance as pregnancy advances.

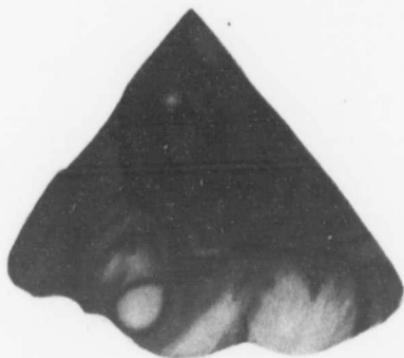
In some cases the infarct masses consist only of degenerating villi bound together without any blood-coagulation around them. These have been recently termed by Eden as "non-fibrinous infarcts." Katschenko was the first to describe this blending of villi.

The red infarct consists of degenerating villi around which the blood has coagulated rapidly, fibrin formation being, therefore, little developed.

Infarct formation is most marked in women with albuminuria. It is found in connection with syphilis and other diseased conditions of the mother, but we cannot speak with any accuracy concerning the relationship.

**Umbilical Cord.**—The origin of the umbilical cord has already been described. (See p. 28.) Its structure varies somewhat at different stages of pregnancy. In the early weeks it is covered with a single layer of cubical cells. By the third month there are two layers. By the fifth month the layers are more numerous and stratified, the superficial cells being flattened like those of the skin. In its development the cord ectoderm corresponds with that of the body, though it is more slowly altered. The mesoderm, in the early weeks, consists of a network of nucleated protoplasm, of which the filaments and meshes vary in

PLATE 5.



A



B



C

Portions of placenta with the so-called "white infarcts." *A.* Uterine surface of part of placenta, showing pale infarcted areas near the margin. *B.* Section through part of placenta near margin, showing pale area extending downward from the chorionic layer near the edge. *C.* Section through part of placenta, showing pale area at margin continuous with the chorionic layer.

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size; some nuclei have no protoplasm around them. By the fourth month the network is simpler, the meshes larger, and the filaments fewer and coarser; connective-tissue fibrils have begun to develop. Elastic fibers develop chiefly in the second half of pregnancy. In the cord, in the early weeks, the following structures are found: Two umbilical arteries; two umbilical veins; part of the allantois; duct of the yolk-sac, carrying the omphalo-

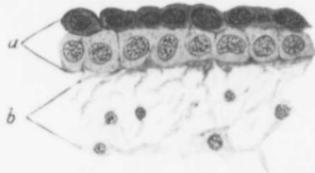


FIG. 47.—Epithelial covering of umbilical cord at end of second month.  $\times$  nearly 550 diameters. *a*, Epithelial cells in two layers; *b*, early connective-tissue core of cord.

mesenteric vessels; extension of the celom or body-cavity in which the omphalic duct lies. In the celom coils of intestines may be found during the second month; sometimes later.

As pregnancy advances the celomic tube, omphalic duct, and allantoic duct gradually become less marked, in the order named. Thus, by the fourth month the first named may be very small, extending only a short distance from the abdominal wall of the

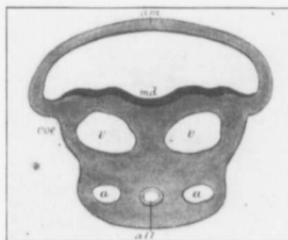


FIG. 48.—Diagrammatic section of the abdominal stalk (*Bauchstiel*) of human embryo. Modified from W. His (after Minot); *am*, Amnion; *md*, medullary groove; *v, v*, umbilical veins; *a, a*, umbilical arteries; *all*, allantois; *coe*, celom.

fetus. The omphalic duct becomes shrivelled and usually obliterated. The allantoic stalk consists of a tube lined by two or three layers of endodermal cells, surrounded by somewhat condensed mesoderm; usually the lumen becomes early obliterated. This structure generally persists to full time as a remnant, which may be detected in the fetal end of the cord. One of the umbilical veins, usually the right, becomes obliterated before the third

month. Many variations are found as regards the changes which take place in these various structures.

At full time the ectoderm consists of several layers of cells, stratified and resembling early skin. The connective tissue of

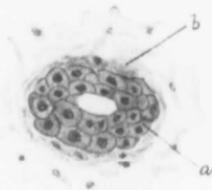


FIG. 49.—Transverse section of allantois from umbilical cord at end of second month of pregnancy.  $\times 325$  diameters. *a*, Epithelial cells of hypoblastic origin; *b*, mesoblast surrounding epithelium.

the cord, in which the vessels and other structures lie, is termed Whartonian jelly, and is mainly embryonic mucoïd tissue; in it well-marked connective-tissue fibrils run in different directions.

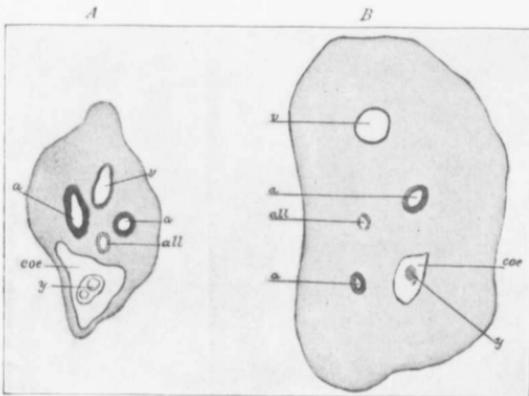


FIG. 50.—Two sections of umbilical cord (after Minot).  $\times 20$  diameters. *A*, At sixty days; *B*, at three months. *v*, Umbilical vein; *a, a*, umbilical arteries; *all*, allantois; *coe*, celom; *y*, yolk-sac.

Elastic fibers are also found. So far as is known no nerves or lymphatic vessels occur in the cord. The spaces of the connective tissue have by some been described as communicating with the amniotic cavity by stomata. The connective tissue varies consid-

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erably in density in different parts. In many cases it is condensed mainly in three portions, which extend from the allantoic duct as septa, between which the umbilical vessels run. Wandering white corpuscles may be found in the connective-tissue spaces.

There are two umbilical arteries and one vein. The arteries have no elastic layers, and a very thin intima. Their walls are mainly muscular. When cut across they contract and project, but do not retract. Their caliber increases from the fetus toward the placenta. The vein is somewhat like the artery, its intima being more distinct; in it are found ring-shaped or semilunar valves, never, however, placed opposite one another. No nerves or vasa vasorum have been found in the walls of the vessels. The latter are described by some as being present in early fetal life. The vessels are related to one another in various ways. Usually the arteries are coiled around the vein, running from right to left, causing a twisted appearance; sometimes they run from left to right; sometimes they run parallel almost the whole length of the cord; rarely the twist is from left to right and from right to left in the same cord. Occasionally the cord is split into two portions, the arteries being in one and the vein in the other. The explanation of the twisted arrangement is not certain. It is undoubtedly beneficial, as it makes the cord stronger and lessens the risk of compression, at the same time steadying and regulating the force of the blood-stream in the cord.

**Relation to the Placenta.**—The placental insertion of the cord is usually eccentric, rarely central or marginal; sometimes it is attached to the membranes, "velamentous insertion." The arteries are often connected by a transverse branch as they pass to the placenta, about half an inch above the latter.

**Relation to the Fetus.**—In early embryonic life the cord is attached near the caudal end. By the time the limbs are formed it is connected just above the pubes. The insertion gradually rises during pregnancy, until at term it is about three-quarters of an inch below the middle of the fetus.

#### ANATOMY OF THE FETUS.

The earliest outlining of the external form of the human embryo takes place about the end of the second week. His described specimens which he believed to be respectively thirteen and fifteen days old. In these the characteristic feature is the dorsal concavity. The embryo is enclosed in the amnion. The caudal end is connected with the primitive chorion by the ventral stalk, which is almost in line with the long axis of the embryo. The umbilical vesicle communicates freely with the wide-open intestinal canal.

*Twenty-first Day.*—The first rudiments of the limbs appear as little buds.

*Twenty-third Day.*—Between the twenty-first and twenty-third days the dorsal concavity changes to a marked convexity, the caudal and cephalic ends overlapping. After this day the convexity is less marked.

*Fourth Week.*—The visceral arches and clefts develop. Communication between the umbilical vesicle and the intestinal tract is reduced to a narrow vitelline duct. A well-marked tail is present by the twenty-fifth day. (His has termed the period of the third and fourth weeks the embryonic stage, and the remainder of pregnancy the fetal stage.)

*Second Month.*—During this month the rate of growth is less

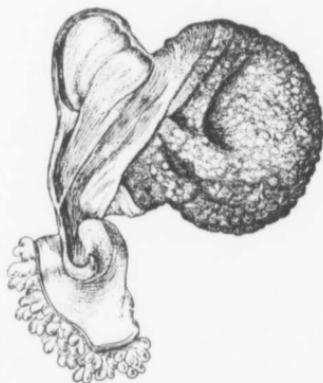


FIG. 51.—Human embryo of about the thirteenth day (His). The caudal pole of the embryo is connected with the blastodermic vesicle by means of the abdominal stalk; the amnion completely encloses the embryo, and the large vitelline sac communicates throughout the greater part of the ventral surface by means of the unclosed gut-tract.

rapid. The convexity of the body diminishes somewhat, the head being gradually raised. The vitelline duct is elongated. Intestines bulge into the umbilical cord. The abdomen is very prominent. The limbs become differentiated into their component parts, the upper being first developed. The external parts of the eye, ear, nose, and mouth become marked. Ossification begins in the lower jaw. In the eighth week the tail disappears and the external genitals develop, without, however, any distinction of sex.

*Third Month.*—Nails appear on fingers and toes. The external genitals begin to show sex character.

*Fourth Month.*—Lanugo, a growth of fine hair, appears on the

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head and other parts. The anus opens. The intestines are contained entirely within the body-cavity. The umbilicus is close to the pubes. The spinal cord extends the whole length of the spinal canal.

*Fifth Month.*—Fetal movements are usually felt by the mother. Heart sounds are perceptible. Eyelids begin to separate. Trace of bile in the intestines.

*Sixth Month.*—Skin wrinkled, dirty red in color, and coated with vernix caseosa. Eyebrows and eyelashes appear.

*Seventh Month.*—Skin is less wrinkled, owing to development of subcutaneous fat. Meconium is found throughout the large

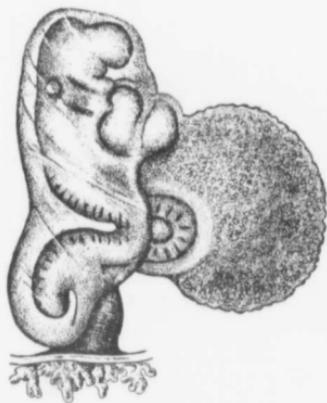


FIG. 52.—Human embryo of about the fifteenth day (His). The embryo is attached to the wall of the blastodermic vesicle by means of the abdominal stalk, and is enclosed within the amnion; the large vitelline sac freely communicates with the still wide-open gut.

intestine. Testes are at internal abdominal rings or in inguinal canals. Nails break through epidermal coverings.

*Eighth Month.*—Bulk of fetus increases proportionately more than length. Skin has brighter flesh color and is less wrinkled. Lanugo begins to disappear.

*Ninth Month.*—Body of fetus well rounded. Lanugo mostly gone. Umbilicus almost in middle of body. End of spinal cord is at level of first lumbar vertebra. The first epiphyseal ossification appears in lower end of femur. Sometimes it develops also in upper epiphyses of humerus and tibia.

**Size of the Fetus.**—The fetus varies in size at corresponding periods of development in different cases. Various tables have

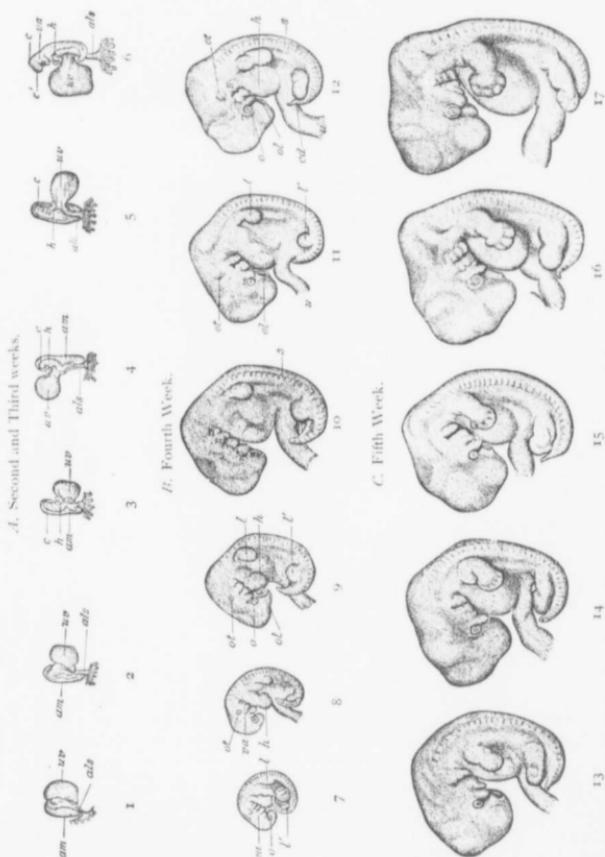


FIG. 53.—Early human embryos, all enlarged about two and a half times (His): 1-4, From twelfth to fifteenth day; 5, 6, from eighteenth to twenty-first day; 7, 8, from twenty-third to twenty-fifth day; 9-12, from twenty-seventh to thirtieth day; 13-17, from thirty-first to thirty-fourth day. *am*, Amnion; *ur*, umbilical or vitelline vesicle; *als*, allantoic or abdominal stalk; *c, c'*, brain vesicles; *h*, heart; *sa*, visceral arches; *o*, optic vesicle; *ot*, otic vesicle; *ol*, olfactory pit; *L, P*, upper and lower extremities; *s*, somites; *u*, caudal process; *u*, primitive umbilical cord.

been drawn up, giving the length and weight at different months. Hasse calculates the length in centimeters as follows:

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| At the end of 1 lunar month | length of fetus is | 1 cm. |
| " " 2 " months              | " " "              | 4 "   |
| " " 3 " "                   | " " "              | 9 "   |
| " " 4 " "                   | " " "              | 16 "  |
| " " 5 " "                   | " " "              | 25 "  |
| " " 6 " "                   | " " "              | 30 "  |
| " " 7 " "                   | " " "              | 35 "  |
| " " 8 " "                   | " " "              | 40 "  |
| " " 9 " "                   | " " "              | 45 "  |
| " " 10 " "                  | " " "              | 50 "  |

The length equals the number of months up to the fifth multiplied by the same figure; after the fifth the number of months multiplied by five. The lengths are a little too large for the early months, though satisfactory for the later ones.

Expressed in inches, the length may be stated as follows:

|                             |                  |                                  |
|-----------------------------|------------------|----------------------------------|
| At the end of 1 lunar month | 0.3 in. (about), | straight line from head to tail. |
| " " 2 " months              | 1 to 1½ in.      |                                  |
| " " 3 " "                   | 3 to 3½ in.      |                                  |
| " " 4 " "                   | 4 to 6½ in.      |                                  |
| " " 5 " "                   | 7 to 10½ in.     |                                  |
| " " 6 " "                   | 11 to 13½ in.    |                                  |
| " " 7 " "                   | 13½ to 15½ in.   |                                  |
| " " 8 " "                   | 15½ to 16½ in.   |                                  |
| " " 9 " "                   | 16½ to 17½ in.   |                                  |
| " " 10 " "                  | 17½ to 18½ in.   |                                  |

**Weight of the Fetus.**—Many variations are found in the weight of the fetus at different periods in various specimens.

|                        |                                   |
|------------------------|-----------------------------------|
| At the end of 2 months | average weight is 4-5 gm.         |
| " " 3 " "              | weight is 5-20 " —average, 11 gm. |
| " " 4 " "              | " 10-120 " — " 57 "               |
| " " 5 " "              | " 75-500 " — " 285 "              |
| " " 6 " "              | " 375-1280 " — " 635 "            |
| " " 7 " "              | " 785-2250 " — " 1218 "           |
| " " 8 " "              | " 1095-2440 " — " 1569 "          |
| " " 9 " "              | " 1500-2905 " — " 1971 "          |
| " " 10 " "             | " 3000-3600 " — " 3200 "          |

The average full-time weight of the single fetus is a little over 7 pounds; the average in the case of males being about 7½, and in the case of females 7 pounds. Full-time infants weighing more than 10 pounds are very rare. Mrs. Bates, the Nova Scotia giantess, bore two children, the first weighing at birth 19 pounds, and the second 23¾ pounds. In the case of multiple pregnancies a fetus may be extremely small, though well developed. Harris has reported one weighing 1 pound. Frequently they may weigh between 2½ and 4 pounds.

The explanation of variations in the size of the full-time fetus cannot be fully given. There are differences according to sex, males being larger than females. Young mothers have, on the average, smaller infants than those who are more mature. Those born

of mothers between thirty and thirty-five are said to be the heaviest. Infants of the same sex weigh more in successive pregnancies, if they are not born too close together. In the case of primiparæ, therefore, the average weight of infants is less than in multiparæ. The weight varies directly with that of the mother. Conditions seriously affecting the health tend to interfere with the

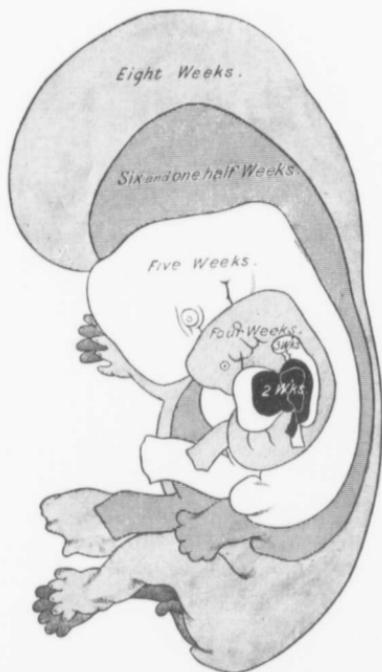


FIG. 54.—Diagram illustrating the outlines of the human fetus at various stages from the end of the second to the end of the eighth week, magnified four times (modified after Mall).

development of the fetus. Some women and families tend to give birth to small children; others have the opposite tendency.

**Some Anatomic Peculiarities of the Fetus at Full Time.—Head.**—The cranium is relatively much larger than the face, the disproportion being more marked than in the adult, and being due to the small development of the face region. The vault

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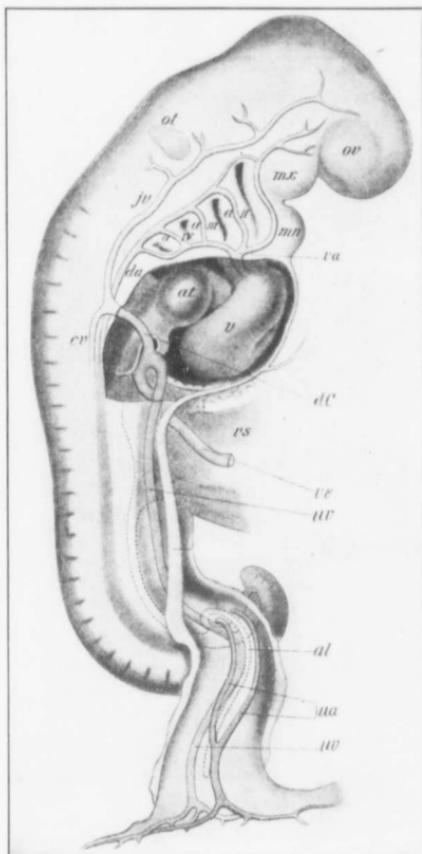


FIG. 55.—Human embryo of about three weeks, showing visceral arches and furrows and their relations to aortic arches (His): *mx, mv*, Maxillary and mandibular processes of first visceral arch; *a I-a IV*, first to fourth aortic arches; *jv, cv*, primitive jugular and cardinal veins; *dC*, duct of Cuvier; *at, v*, atrium and ventricle of primitive heart; *vs*, vitelline sac; *va, da*, ventral and dorsal aortae; *ov, ot*, optic and otic vesicles; *uv, ua*, umbilical veins and arteries; *av*, vitelline vein; *al*, allantois.

and base of the cranium differ considerably in respect to the relationship of their constituent parts, the bones composing the former being thinner and more loosely joined together. The importance

of this difference is seen in labor. When the head is subjected to pressure the vault can be considerably altered in shape, whereas the base remains firm, thus affording protection to the important nerve structures lying upon it. The heads of males are, on the average, larger and more ossified than those of females. (A detailed description of the head is given in connection with the Mechanism of Labor.) (See p. 199.)

**Heart and Blood-vessels.**—The size of the heart is approximately that of the closed fist of the fetus to which it belongs. Its weight is relatively greater than in the adult, but there is practically no difference, relatively, as regards size. The heart is placed more transversely and a little higher than in the adult. In the septum between the right and left auricles is an opening, the *foramen ovale*. In connection with this, in the right auricle, is a fold of the lining, known as the Eustachian valve. A canal, termed the *ductus arteriosus*, joins the pulmonary artery to the aorta. From each hypogastric branch of the internal iliac arteries a vessel known as the umbilical artery extends to the cord through the navel; they are distributed to the villi of the placenta. The umbilical vein, on entering the fetus, is continuous with the *ductus venosus*, which runs on the under surface of the liver to the inferior *vena cava*.

**Thymus.**—The large size of the gland is a striking feature. It lies in the anterior mediastinum, consisting of a right and a left lobe, and sometimes of an intermediate one, as well. Its upper limit is above the suprasternal notch, where it almost reaches the isthmus of the thyroid, its lower level being near the diaphragm. Posteriorly it is in relation to the large vessels connected with the base of the heart, to a considerable part of the pericardium, and to the pleura covering the lungs. By some this gland is regarded as the parent source of the white blood-corpuscles.

**Lungs.**—The lungs are placed at the back of the thorax. They are uniform in color; in texture and consistence somewhat resembling the liver. The surface is marked by slight furrows, faintly indicating lobular division. The anterior and lower borders are thin and sharp. The area of chest-wall in contact with the lungs is relatively very much smaller than in the adult.

**Diaphragm.**—This is relatively higher in its central portion than in adult life.

**Liver.**—This structure is very large, occupying nearly one-half of the abdominal cavity. The left lobe is relatively much larger than in the adult. The longitudinal fissure is very deep, containing the ductus venosus and umbilical vein.

**Stomach.**—The stomach is of small size, and at birth can hold only 1 to 1½ ounces of fluid without being overdistended. At that period it is either empty or contains mucus or liquor amnii. Vernix caseosa and meconium are sometimes found in it.

The viscus lies largely under cover of the left lobe of the liver, the fundus being poorly developed.

**Suprarenal Bodies.**—These structures are about one-third of the size of the kidney, being, therefore, relatively larger than in the adult. Each has the shape of a three-sided pyramid, resting upon the upper end and anterior surface of the kidney.

**Kidneys.**—The relations of the kidneys are not very different from those found in the adult, except that the suprarenal body covers more of its anterior surface. The surface is somewhat lobulated.

**Umbilicus.**—The attachment of the cord to the abdomen is relatively lower than in the adult. It is opposite the junction of the fourth and fifth lumbar vertebrae; whereas in the adult it is opposite the junction of the third and fourth.

**Bladder.**—This viscus is almost entirely an abdominal organ, its position and shape varying according to the amount of urine in it and according to the pressure exerted upon it by other pelvic and abdominal contents. When empty the upper end reaches almost halfway to the umbilicus; when distended it may reach the umbilicus, or even higher. The vesical end of the urethra is situated about opposite the top of the symphysis. In the empty condition the anterior and posterior walls lie in apposition, the cavity being then in a direct line with the urethra in the female. The upper portion is smaller than the lower, the viscus, when moderately distended, having an ovoid shape, the broad end being lowermost. It is only in an overdistended condition that the upper part of the bladder becomes larger than the lower. The anterior wall is attached to the anterior abdominal wall, there being no intervening pouch of peritoneum. The peritoneal reflection takes place 2 to 3 cm. above the symphysis, a short distance below the umbilicus. The vertical length of the cavity, when empty, measures from 2 to 2.5 cm. It rarely contains more than 1 to 1½ drams at the time of birth.

**Urethra.**—In the female it is parallel to the axis of the pelvis, turning slightly forward at the lower end, the external orifice being slightly in front of a line drawn vertically from the symphysis. A No. 10 catheter may usually be passed into the bladder, though it is not necessary to use one as large as this in the newborn child.

**Rectum.**—The rectum is relatively larger and less curved than in the adult. It is almost a straight vertical tube in the erect position of the body. The anus is directed downward and slightly backward, being situated relatively further back than in the adult. It does not lie in a depression between the buttocks, as in the adult, owing to the small development of the gluteal regions.

**Uterus.**—The uterus at full time is partly a pelvic, partly an abdominal, organ. Its position varies according to the pressure

exerted upon it by the bladder and intestines. When these structures are empty probably the larger part of the uterus lies below the level of the brim. The long axis is mainly vertical, a slight degree of anteversion being common. Frequently the fundus may be directed somewhat to the right or left. Sometimes rotation on the long axis is present. Occasionally there is a slight degree of anteflexion at the junction of the body and cervix. Rarely retroversion is met. In one instance I found retroflexion present, though the organ was anteverted. The average length measures about 3 cm. The cervix is much larger than the body, its length being two or three times as great. The folds of the arbor vitæ extend to the fundus. On the vaginal surface of the cervix rugæ are sometimes seen.

**Vagina.**—The vagina runs almost vertically, being nearly parallel with the rectum and urethra. It forms a very obtuse angle with the uterus. In transverse section it is H-shaped, the anterior and posterior walls being in contact in the middle line.

**Fallopian Tubes.**—The Fallopian tubes average 2 to 3 cm. in length, the right being usually a little longer than the left. Each has three to five sinuities. They extend from the uterus outward and slightly backward, many variations being found in their shape and direction.

**Ovaries.**—The ovaries lie somewhat vertically near the uterus, above the plane of the brim, many variations in their position being found.

**External Genitals.**—In the female the labia majora are relatively smaller than in the adult, the labia minora being not so hidden from view as in later life. The labia minora do not blend posteriorly with the labia majora, but are united behind the introitus vaginae by the ridge known as the fourchette.

#### FETAL PHYSIOLOGY.

**Nutrition.**—In the earliest stage after fertilization of the ovum its nutriment is probably derived from the yolk-particles belonging to the original ovum. As it passes downward to the uterus it probably absorbs fluids from the tube-lumen by endosmosis. When trophoblast proliferation occurs in connection with embedding of the ovum in the uterine mucosa, direct absorption from maternal tissues probably takes place. When the omphalomesenteric circulation is established in the wall of the umbilical vesicle<sup>1</sup> a small amount of nourishment may, through them,

<sup>1</sup> The yolk-sac does not serve such an important function in affording a direct food supply among mammals as in the other vertebrata. Yet in several of the former—*i. e.*, insectivora, cheiroptera, rodentia, it is specialized to play an important part. It enlarges and enters into relationship with the diplotrophoblast, forming a temporary connection between the mother and fetus, the vitelline or omphaloidean placenta, the fetus being nourished by the vitelline or omphalomesenteric vessels.

reach the fetus, but this is a very insignificant supply. The chief source of nourishment during pregnancy is the maternal blood circulating in the intervillous spaces, all the materials necessary to the fetus passing through the walls of the villi and entering the fetal vessels within the latter. The nature of this transmission is, as yet, unknown. The liquor amnii may furnish an infinitesimal quantity of nourishment, absorbed after being swallowed. That it is not important is evident from cases in which the fetus is well-nourished, though the liquor amnii be very scanty or the esophagus be imperforate.

**Respiration.**—In the villi the impure fetal blood brought to them by branches of the umbilical arteries is oxygenated and purified, the carbonic acid and other products of tissue waste escaping through the villi into the maternal blood, and by it carried away to the various excretory organs of the mother. The process is, therefore, somewhat similar to that which occurs in the pulmonary circulation of the adult, only in the latter the air in the lung vesicles corresponds to the maternal blood in the intervillous spaces. The fetal blood is rich in oxygen derived from the red blood-corpuscles of the maternal blood; indeed, it seems as if it held a greater quantity than is essential. The difference between the quantities of oxygen in the umbilical vein and arteries is much less than that existing between arterial and venous blood in the child after birth. The spectroscope shows oxyhemoglobin bands.

**Fetal Circulation.**—After the placenta has been well formed and the villi vascularized the circulation in the vessels of the fetus has the following arrangement: The blood in the umbilical vein (in the early stages there are two veins) is that which has been purified in the capillaries of the villi. This vessel, on entering the fetus at the navel, passes along the abdominal wall to the under surface of the liver, giving some small branches to the latter. On reaching the transverse fissure it divides into two parts, the larger of which enters the portal vein. The smaller, known as the ductus venosus, opens into the inferior vena cava. The great mass of the pure blood thus brought from the villi passes through the liver before reaching the auricle of the heart;

Later this placenta is replaced by the allantoic placenta. In the human female it is probable that occasionally, in the case of the symphyoidal monstrosity, the permanent placenta is supplied by the vessels of the umbilical vesicle. In the marsupials there is no true placenta, the umbilical vesicle serving to absorb nourishment from the mother before the fetus is transferred to the marsupium. In the human cord, occasionally, pervious vitelline vessels may be discovered at full time. Ordinarily, however, these vessels and the duct of the umbilical vesicle are early obliterated. Rarely that part of the latter within the fetus remains and is known as Meckel's diverticulum, which may be free, attached to the umbilicus or abdominal wall, or may open on the surface, forming a fistula. The umbilical vesicle may frequently be found as a very small cyst under the amnion, near the insertion of the cord into the placenta.

the rest of the blood passing through the ductus venosus mixes with impure blood in the inferior vena cava returning from the lower portion of the fetus. The stream, therefore, which enters the right auricle consists mainly of purified blood. It passes into the left auricle by way of the foramen ovale, being guided by the Eustachian valve. From the left auricle the blood enters the left ventricle, thence into the aorta, from which it largely passes into the branches supplying the head and upper extremities. It continues down the descending arch of the aorta, where it is joined by impure blood which has passed through the ductus arteriosus from the pulmonary artery. This impure blood is derived from the veins of the head and upper extremities, and enters the right auricle through the superior vena cava; it crosses the stream of pure blood without mixing with it to any extent, and passes through the tricuspid valve into the right ventricle, whence it escapes by the pulmonary artery. As the lungs are functionless there is no need for a pulmonary circulation similar to that which exists in the adult. Only a small quantity goes to these structures to keep up their nutrition. The main current of the blood passes through the ductus arteriosus to join the more purified blood descending through the aorta. It is thus evident that the head and upper extremities are supplied by a much purer blood than the lower part of the body; this arrangement is undoubtedly related to the necessity of supplying the best nourishment for the rapidly developing brain centers. In the last weeks of pregnancy the Eustachian valve often shrinks somewhat, so that more blending of the two blood-currents occurs in the right auricle. In consequence of this mixing the head supply is less pure, while that going to the lower part of the body is less impure as the end of pregnancy approaches. The lower part of the body, as might be expected, grows more rapidly during the last weeks, while the increase in the head and upper extremities shows, relatively, a smaller increase. From the internal iliac division of each iliac branch of the aorta the hypogastric arteries carry blood, largely impure, to the umbilical cord, in which they run as the umbilical arteries, giving rise to the capillary loops in the villi, which carry the blood-stream into branches of the umbilical vein. The nature of the interchange of materials between the circulation of the fetal blood in the villi and that of the maternal blood in the intervillous spaces is not at all well understood.

**Changes after Birth.**—When the cord is divided and respiration has begun, more blood passes through the pulmonary arteries from the right ventricle and less through the ductus arteriosus into the aorta. With the entrance into the left auricle of blood from the pulmonary veins, less enters it from the right auricle through the foramen ovale; and, at the same time, the stream passing from the right auricle into the right ventricle is

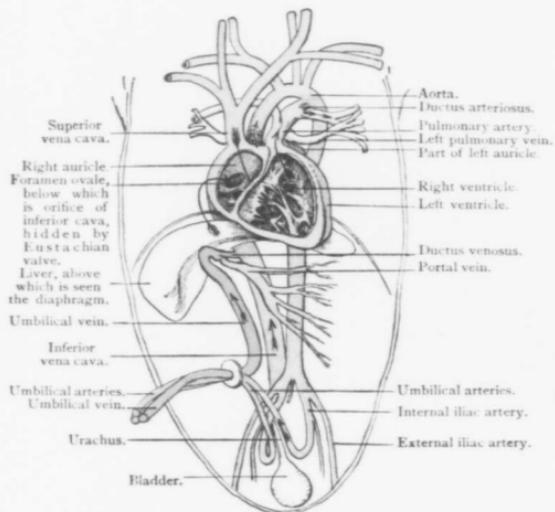


FIG. 1.—Diagram of fetal circulation before birth. The arrows indicate the course of the blood-current; the colors show the character of the blood carried by the different vessels.

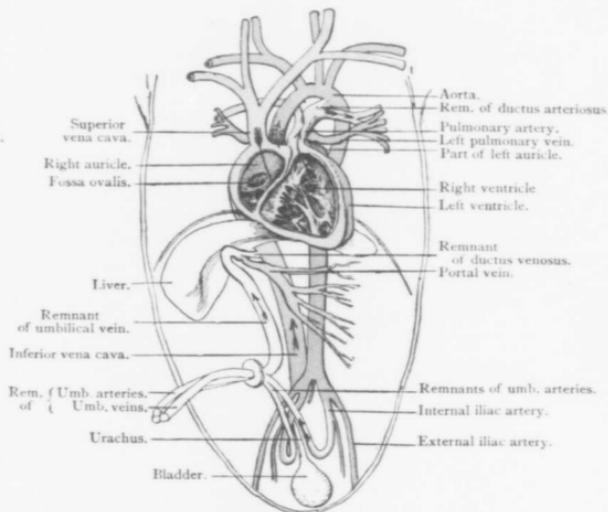


FIG. 2.—Diagram of circulation after birth. The ductus venosus, the foramen ovale, and the ductus arteriosus are now closed and no longer transmit portions of the blood-current.

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larger. By the eighth or tenth day the ductus arteriosus is closed in the great majority of cases; a few weeks after birth it is a fibrous cord, the ligamentum arteriosum. The foramen ovale closes about the end of the first week in most cases, but this may take place earlier or as late as the third week. Rarely it may remain as a small opening for a year or more. Occasionally it is permanently patent, leading to a mixture of arterial and venous blood, which causes blueness of the body, the condition known in infancy as *cyanosis neonatorum*, and in the adult *morbis caruleus*. By the fourth day after birth those portions of the hypogastric arteries which passed from the sides of the bladder to the umbilical cord have shrunk and closed. The umbilical vein and ductus venosus are obliterated by the end of the first week.

During the first year the left ventricle hypertrophies, so that its wall becomes double that of the right in thickness. The wall of the right auricle at birth is thicker than the left, but from the second month to the end of the first year they are equal in thickness; afterward the right increases a little over the left.

**Blood in the Newborn Child.**—The red blood-corpuscles are relatively more numerous than in the adult. Aitken states that the count is greater during the first forty-eight hours, owing to concentration of blood (due to loss of urine, perspiration, fasting, etc.). After the second day there is a fall in the number, until by the tenth day there are less than at birth. Nucleated red cells—normoblasts and megaloblasts—are found at birth and during the first week. Variations in the size and shape of the red cells and deficiency in rouleaux formation are noted. The percentage of hemoglobin is higher at birth than in the adult, but not as high as it is a few days later. The white corpuscles are two or three times as numerous as in the adult. Aitken states that they increase during the first two days, thereafter decreasing, being less numerous than at birth by the tenth day. The lymphocytes are more abundant than the neutrophiles at birth. The latter increase enormously after the first feeding, and gradually decrease afterward. The eosinophiles are usually more numerous than in the adult. The amount of fibrin is small. Nucleon, or phosphocarnic acid, has been found in the fetal blood by Sfameni. The freezing-point of the fetal blood at birth is lower than that of the maternal blood, and its density (1060) is greater, though the former contains slightly more water than the latter. Runge states that fetal blood is richer in salts at the time of birth, especially in undissolved salts. Sfameni gives the average composition of fetal blood as follows:

|                         | Per cent. |
|-------------------------|-----------|
| Water . . . . .         | 78.52     |
| Solids . . . . .        | 21.47     |
| Organic . . . . .       | 20.72     |
| Inorganic . . . . .     | 0.74      |
| Soluble salts . . . . . | 0.62      |
| Insoluble . . . . .     | 0.12      |

Hugouenq states that 50 to 60 per cent. of the total quantity of iron in the fetus is in the blood.

**Heat Production.**—The fetus does not waste much energy in heat production because of the temperature of the surrounding liquor amnii, which is nearly as warm as the fetal blood. There is no loss of heat by radiation or evaporation which requires to be made up. Neither is anything taken into the lungs or stomach which must be warmed.

The temperature of the mouth or rectum of the fetus during labor is very slightly ( $\frac{1}{10}$  to  $\frac{2}{10}$  ° C.) higher than that of the neighboring maternal tissues. It is higher in well-developed infants than in weakly ones. The temperature of the liquor amnii is intermediate between the maternal and fetal. It is, therefore, evident that the fetus produces heat to a certain extent, though fetal oxidation is feeble. In experiments on animals it has been shown that the fetal temperature rises or falls according as the mother gains or loses heat. Preyer thinks that the fetus does not possess a heat-regulating mechanism.

**Alimentary Functions.**—The fetus *in utero* has the power of swallowing. As regards the activity of the glands in the alimentary tract, information is imperfect. There is very scanty elaboration in all the glands connected with the mouth. A slight trace of ptyalin is found in the parotid secretion. In the gastric juice pepsin and rennin are present at the time of birth, many variations in the quantity being found. Ballantyne states that there is enough digestive ferment in the stomach to digest all the albuminous material swallowed in the liquor amnii. Of the pancreatic ferments, trypsin and steapsin or pancreatin are found. The former has been found as early as the fifth month; some have been unable to detect it. They undoubtedly serve an important function in digesting the proteids and fats of milk after birth. Amylopsin, the starch-digesting ferment, is absent. As regards the intestines, Werker has shown that Brunner's glands are relatively more numerous than in the adult state; the significance of this is not known. The large size of the liver is related to an influence in fetal life not well understood. The glycogenic function is probably very important. Bile is found in the intestines as early as the third or fourth month; bile acids and pigments may be demonstrated in it.

Meconium is always found after the fifth month, though it may be present before that time. It is undoubtedly largely made up of bile, for it is never found where bile cannot enter the intestine. It is formed independently of the liquor amnii, for it occurs in conditions which prevent this fluid from entering the bowel. But while bile is the most important constituent, liquor amnii may often be mixed with it; also vernix caseosa, lanugo, and skin epithelium which have been swallowed, intestinal epithelium, leuko-

cytes, and the constituents of mucus. Zweifel's analysis of meconium shows that solids vary from 20 to 27 per cent. of the whole, 1 per cent. consisting of inorganic salts—viz., sodium chlorid, iron oxid, sulphates and phosphates of magnesia and calcium. Altered bile salts, mucin, and bile pigments make up the main part of the organic solid.

Intestinal peristalsis is not active in antenatal life. It is rare to find meconium in the liquor amnii save in cases of asphyxia.

**Renal Function.**—In early fetal life the Wolffian bodies and ducts form an excretory apparatus. They open into the allantois, and in some cases may contain urea, uric acid, chlorids, phosphates, sulphates, etc. It is believed this is an indication of waste connected with tissue metabolism. With regard to renal activity in late fetal life there has been considerable difference of opinion. Fetal urine is undoubtedly frequently found in the liquor amnii, but not in such quantities as to indicate that it is an important constituent. When an imperforate urethra is present in a newborn child, it might be expected that distention of the bladder should always be present if renal activity is marked *in utero*. Occasionally this is found; but, as Joulin has shown, in a large percentage of cases there is no distention. Yet urine is frequently found in the fetal bladder at birth; in breech cases the fetus may urinate during birth; premature infants may have urine in the bladder; methylen-blue administered to the mother may be passed by the newborn child. The fetal urine is pale and of low specific gravity (1010 or less), containing a small quantity of urea (0.15 per cent., according to Helme), abundant uric acid, chlorids, and kreatinin. Frequently albumin is found in it, which Flensburg attributes to the increase in uric acid. Sometimes it contains bilirubin and indican, and certain substances which may be administered to the mother. Gusserow gave benzoate of soda to the mother and found hippuric acid in the urine of the newborn fetus. Schaller's experiments are important in this connection. He administered phloridzin to pregnant women and examined the fetal urine and liquor amnii at various periods. This drug causes sugar in the kidneys, so that an early determination of the renal activity may be made. Schaller's conclusions are:

1. There is no regular secretion and periodic excretion of urine by the fetus, even near the end of pregnancy.
2. Fetal renal activity may be considered to begin usually when the process of labor induces changes in the fetal circulation. But even during labor it is rare that the fetus urinates.
3. The fetal kidneys functionate much more slowly than those of the adult.

It is certain that the kidneys are capable of excreting urine, though the function very often is not exercised until the time of labor. Ballantyne states that it may, like other fetal functions,

be dispensed with if the placenta acts well. With regard to the emptying of the bladder into the amniotic fluid, he says that there is no sufficient proof that this happens constantly or even frequently during intra-uterine life; nor is it probable that normally the liquor amnii is derived mainly from the fetal urine.

**Glycogenic Function.**—Glycogen is found in many tissues of the fetus, even in early pregnancy. Though it is believed to represent stored-up nutritive material, its exact relationship to metabolism is not understood.

**Function of the Nervous System.**—There is no proof that the fetus exhibits purposeful or intelligent action while in the uterus. The gray matter is not well developed, and, probably, fetal movements are altogether reflex. Before birth some parts only of the afferent tract of the brain are myelinated; after birth a rapid extension takes place.

Fetal movements are affected by various maternal conditions and by external stimuli—*i. e.*, application of cold to the abdomen, pressure or friction applied to the abdomen. The Röntgen rays are said to stimulate them; also red light, strong smells, dreams, various drugs, etc. The fetus possesses cutaneous sensibility, pinching of the skin setting up reflex movements.

**Functions of the Placenta.**—In describing the structure of the placenta it has been shown to be entirely an organ of the chorion, consisting of projections of the latter, termed villi, that are attached to the uterine mucosa, and bathed by maternal blood circulating among them.

Comparatively little is known as to the nature of the interchange of materials between the fetal and maternal circulations through the medium of the villi. Reference has already been made to the respiratory process carried on by them during pregnancy. For many years the placenta has been regarded merely as the medium through which nutritive material and oxygen passed from the mother to the fetus, and the effete products of fetal metabolism from fetus to mother; it was considered to be a kind of fine sieve, through which percolation took place, or a diffusion membrane that favored osmosis. It is now almost certain that the transmission of substances between the maternal and fetal blood is not merely a matter of physics. The chorionic epithelium is now believed by many to be a highly differentiated tissue, capable of carrying on complex vital processes, possessing powers of selection, elaboration, and even digestion. Cavazzani and Levi, for example, state that there is no correspondence between the quantity of urea in the maternal and fetal blood, that there is more glucose in the former than in the latter, and that the density of the fetal blood is greater than that of the maternal blood. It appears that there are considerable variations in the transmission of substances through the placenta at different

periods of pregnancy. Thus, in the last three months there is a great increase in the iron, potash, and lime stored up in the fetus. In the early months there is a great predominance of soda over potash. Phosphoric acid in early pregnancy is mainly fixed in the fetus in nuclein or lecithin, and in the late months as lime.

Various materials may be stored in the placenta. Thus, it undoubtedly fixes glycogen. It is thought that albuminoid material is transmitted as soluble peptones, though this is not definitely known. Many drugs introduced into the maternal circulation may enter the fetal blood—*i. e.*, strychnin, ether, iodine, chloroform, quinin, etc. Bureau reports an interesting case of a woman who had taken large doses of morphin for seven years. During her pregnancy she took about fifteen grains daily. When labor took place, he examined the blood in the umbilical cord and found the drug in it. Nicloux has shown that alcohol given to a woman an hour before labor can be found in the umbilical vessels at birth. There has been some question as to the possibility of the passage of maternal leukocytes through the walls of the villi entering the fetal circulation.

Varaldo states that there are more leukocytes in the umbilical vein than in the umbilical arteries, there being, on the average, considerably more per cubic millimeter in the former than in the latter, and that more of them contain iodophilic granules in the former than in the latter. It has, therefore, been concluded by several that leukocytes normally carry substances (possibly nutriment) to the fetal tissues. This has not been proved, however. In maternal leukocythemia there is no corresponding increase in white corpuscles in the fetal blood.

Various maternal diseases are transmitted to the fetus through the placenta.

The placenta acts as a protective barrier against the invasion of the fetus by various poisons. It is more efficacious against some than against others. Porak's experiments on the guinea-pig, for example, show that in this animal copper passes easily, arsenic with difficulty, and mercury not at all, the poisons being stored to a greater or less extent in the placental tissue. With regard to micro-organisms and their toxins little is known. Many microbes are able to pass from mother to fetus, but nothing is known as to the conditions associated with the transit. It does not appear that any placental lesion is necessary. The placenta appears to be more resistant to some organisms than to others. Thus, it is clearly established that tubercle bacilli rarely pass through it; indeed, cases of Lehmann and others prove that though tuberculosis may be started in the placental tissue, the fetus may be free. In this connection, however, it must be noted that sometimes tubercle bacilli may be present in the fetus, though no lesions be present, inoculations of guinea-pigs with portions

of the fetal tissues causing tuberculosis. It seems certain that in the great majority of cases the placenta is the sole route by which micro-organisms and toxins reach the fetus. It is possible that they may pass through the amnion into the amniotic fluid and thence enter the fetus, but this is probably a very rare mode of infection. Charrin and Duclert's experiments on guinea-pigs suggest that the passage of germs through the placenta is helped or retarded by varying conditions of the maternal blood. Thus, they found retardation when the maternal system was saturated with corrosive sublimate. When tuberculin, alcohol, acetate of lead, or lactic acid was present the passage of the germs seemed to be facilitated. Neelov has experimented on pregnant rabbits, and states that non-pathogenic organisms cannot pass from mother to fetus.

The placenta suffices to allow the fetus to grow and thrive in many diseased conditions or malformations incompatible with health or life in the adult. Pathologic conditions affecting the structure and function of the placenta endanger the life of the fetus. In many maternal diseases, doubtless, the fetus is destroyed as the result of changes in the placenta, affecting its structure or function, produced by its resistance to the toxic material in circulation.

The placenta is believed by many to produce an internal secretion, and there has been considerable speculation as to the rôle this may play in influencing fetal metabolism and as a destroyer of toxic agents that might try to pass from the maternal blood to the fetus, but nothing definite is known. The placenta also acts as the great excretory organ for the fetus. Savory long ago produced tetanus in a pregnant cat by injecting strychnin into the fetus *in utero*. The passage of other drugs has been similarly demonstrated by others. Charrin holds that toxins placed in the fetus, either directly or by the spermatozoa of the father, may pass to the mother; this might explain certain cases of immunization in syphilis (Colles's law). By injecting diphtheria toxin into the fetus *in utero* he has killed the mother animal. Guinard and Hochwelker have shown experimentally that the passage of drugs from the fetus to the mother is stopped if the former is killed, and that if the fetus be injected after its death the drug is only found in its tissues. Baron and Castaigne have found that drugs introduced into the amniotic fluid are also transmitted to the maternal tissues, though much less rapidly than when injected into the fetus. If the latter be dead the substances do not pass to the maternal circulation. Attempts have been made to analyze the placental tissue. It is stated to have a neutral reaction and to contain nearly 84 per cent. of water. Most of the matters removed by extraction are albuminous, only a small part being true extractive. In the ashes there is a large quantity of phos-

phorus, an excess of soda over potash, and much lime. Most of the phosphorus-containing matters are easily extracted with water.

**Liquor Amnii.—Character.**—The liquor amnii increases in quantity up to about the seventh month, and afterward decreases somewhat. The amount varies considerably in different cases. It bears no constant relationship to the weight of mother, fetus, cord, or placenta. In an eighth-month pregnant uterus removed from a cadaver, Barbour and Webster found that the space occupied by the liquor amnii measured somewhat less than 26 cubic inches. At term the quantity measures between 1 and 2 pints. In early pregnancy the fluid is usually clear and pale; toward the end it is usually turbid and variously colored—*i. e.*, green, brown, blackish, red, according to its constituents. The specific gravity varies from 1002 to 1028, the average being about 1008. The reaction is slightly alkaline or neutral. It contains less than 2 per cent. of solids, consisting of urea and other extractives, various inorganic salts, a slight trace of albumin, globulin, and, frequently, of sugar. Gillespie has found traces of albumoses, and thinks they may be produced by the action of digestive ferments similar to those found in pleuritic or ascitic effusions. Mucin, cholesterin, kreatin, and kreatinin are occasionally found. The albumin is less at the end than in early pregnancy; the urea slightly more abundant, often being about 4 per cent. at the end of the ninth month. In addition the liquor usually contains lanugo, vernix caseosa, epidermis, meconium, and intestinal epithelium in varying quantities. Veit states that its freezing-point is always higher than that of fetal or maternal blood.

**Sources.**—There is a difference of opinion as to whether the liquor amnii is derived from fetal or maternal sources, or from both. The weight of evidence favors the view that it has a twofold origin. It has long been held that the fetal urine is an important constituent; but it is interesting to note that during the last three months of pregnancy, when the excretion of fetal urine might be expected to increase, the liquor amnii gradually diminishes in quantity. Moreover, the urea in the liquor amnii is smaller than it would be if urine were continually added to it. But the strongest evidence against this view is derived from Schaller's experiments, to which I have already referred. Then, in cases of obstruction of the fetal urinary passage, there is no necessary accompanying deficiency of liquor amnii. It must, indeed, be concluded that the fetal urine contributes but a very small part to the amniotic fluid. By some it is believed that the latter is partly derived from fetal fluid which passes through the skin, though there is no proof that this takes place to any appreciable extent. In many cases, undoubtedly, a small quantity is derived from meconium that passes from the bowel of the

fetus, though this is of very little significance; there may be abundant liquor amnii when the anus is imperforate.

Regarding the influence of the fetal vessels in the cord and placenta in producing the fluid, nothing definite can be said. It cannot be proved that they do not play a part. Neither has there been a satisfactory establishment of the view that the fluid is derived from maternal vessels by a transudation through the membranes, although, in all probability, this does take place to an important degree. The strongest experimental support of this view is that furnished by Haidlen, who administered iodine to a pregnant woman, in whom death of the fetus had taken place; the drug was found in the amniotic fluid.

**Uses.**—The liquor amnii furnishes much protection to the fetus. It insures a constant pressure and temperature during pregnancy and diminishes the risk of injury from without. It allows of free fetal movements, and at the same time saves the maternal tissues from much of the direct impact of fetal movements. In labor, especially during the first stage, it receives directly the pressure due to the uterine contractions and causes its equal distribution, the fetus itself being thereby for a long period protected. When the membranes rupture the escaping amniotic fluid seems to flush out and cleanse the lower genital passage.

According to Ballantyne the liquor amnii forms the chief water supply to the fetus. It is absorbed by the skin, and often swallowed. He also thinks that some nourishment may be derived from it, as Ahlfeld has strongly insisted. It is impossible to prove or disprove the latter statement. Certainly the amount of nourishing material in the fluid is very small.

#### ANATOMIC AND PHYSIOLOGIC CHANGES IN THE MATERNAL SYSTEM.

**Uterus.**—**Shape and Size.**—In the early weeks the pregnant uterus is pear-shaped, the transverse diameter at the fundus being wider than the anteroposterior diameter. The body of the uterus is not infrequently asymmetrical. (See p. 124.) During the second, third, and fourth months the corpus uteri becomes somewhat spherical. In the later months of pregnancy the pyriform shape is again assumed. Webster has described a stage that appears to be intermediate. In the cadaver of a woman, about five months pregnant, studied by frozen sections, he found a uterus in which the body was neither spherical nor pyriform as in the last months of pregnancy. Its longest diameter was the vertical one, and the transverse and anteroposterior diameters of the lower part of the body were greater than those of the upper part. It was, indeed, somewhat pear-shaped, but with *the large end lowermost*. This specimen seems to indicate that the uterus, as found at the midterm of pregnancy, represents mainly the

lower half of the body of the uterus as found at the end of pregnancy, the upper portion of the full-term uterus being mainly an upward expansion of the fundus of the organ, developing during the second half of pregnancy. This intermediate stage the author has frequently demonstrated on the living subject. Whether or not it is present in every case cannot be stated.

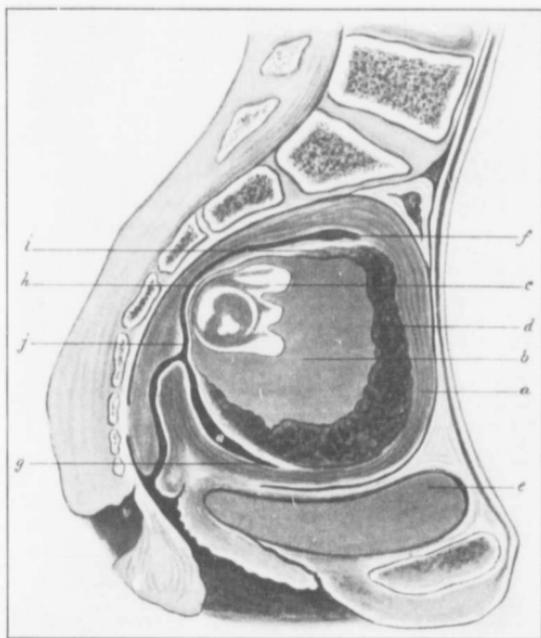


FIG. 56.—Vertical mesial section of pelvis from a woman who died of pernicious vomiting at the end of the third month of pregnancy. A considerable portion of the decidua reflexa is covered by the placenta, which extends, in the anterior part of the uterus, as low as the os internum: *a*, Uterine wall, to which the serotinal placenta is attached; *b*, amniotic cavity; *c*, fetus; *d*, serotinal placenta; *e*, urine in bladder; *f*, space between decidua vera and decidua reflexa; *g*, junction of reflexa and serotina on anterior wall of uterus; *h*, decidua reflexa free from placenta; *i*, placenta developed on posterior part of decidua reflexa, somewhat degenerated in its thinnest portion; *j*, os internum.

The shape of the uterus varies considerably according to the relationships that exist between it and surrounding structures. Throughout pregnancy it is variously moulded, both by hard and soft structures. This is best demonstrated by studying the body after it has been frozen. Sections show that, in the second half

of pregnancy, it is moulded by the brim of the pelvis, the bodies of the vertebrae, by distended intestines, etc. It may also be

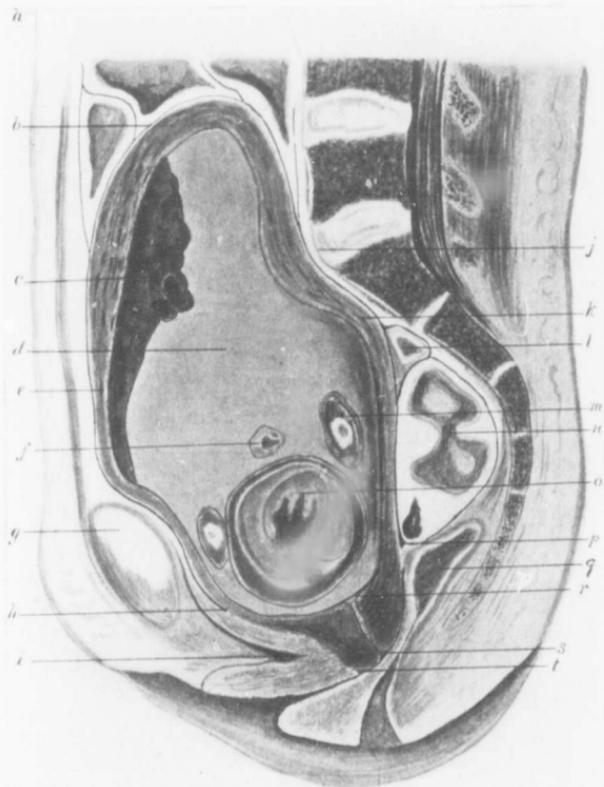


FIG. 57.—Vertical mesial section. Right half. Beginning of fifth month of pregnancy (reduced): *a*, Level of umbilicus; *b*, fundus uteri; *c*, placenta; *d*, liquor amnii; *e*, venous sinus; *f*, cord; *g*, symphysis; *h*, uterovesical pouch; *i*, bladder; *j*, promontory; *k*, transition in thickness of uterine wall; *l*, rectum; *m*, arm of fetus; *n*, dermoid tumor of right ovary; *o*, fetal heart; *p*, pouch of Douglas; *q*, rectum; *r*, os internum; *s*, os externum; *t*, anterior fornix.

moulded by portions of the fetus that press against it from within. In a thin woman, during active movements of the fetus,

the contour of the uterine wall may often be seen to change frequently.

**Measurements.**—In studying the measurements of the uterus it must be remembered that there are normal variations, such as are found in other organs of the body. Then, those due to alterations in shape produced by surrounding structures must be taken into account.

The diameters can be most accurately measured in the frozen cadaver, not in the living subject, in whom the outer surface of the pregnant organ is so hard to define. In the early part of the fourth month Webster found the vertical diameter from the os internum to the outside of the fundus to be  $3\frac{1}{2}$  in. In the beginning of the fifth month he found it to be 6 in. In Barbour and Webster's eighth-month specimen it measured about 9 in. At full time the vertical diameter, as measured in frozen sections of Braune's, Waldeyer's, and Barbour's, varies from about  $9\frac{1}{2}$  to 10 in. The widest anteroposterior diameter measures  $5\frac{1}{2}$  to 6 in.; the greatest transverse diameter between  $8\frac{1}{2}$  and 9 in.; the greatest anteroposterior circumference 24 to  $26\frac{1}{2}$  in.

**Position.**—Variations are found in the position of the pregnant uterus just as in the case of the non-pregnant organ. These may be congenital or may be due to acquired causes. Thus, the uterus may be symmetrically placed, its long vertical axis being in the middle line of the body; this is more common in primiparae. Frequently the whole organ is placed nearer one side of the pelvis than of the other. In many cases the long axis is oblique to that of the body. This is most marked where deviation is caused by old inflammatory conditions, tumors, distention of the bladder or intestine. Webster has recently investigated a specimen in which marked obliquity and elevation of the sixth-month pregnant uterus were caused by an accumulation of urine in the bladder, mainly in one half of the pelvis. Of all the deviations found, that of the fundus toward the right is the most frequent; this is in correspondence with what is found in the non-pregnant state.

It is often stated that in the early weeks of pregnancy the uterus, as a whole, sinks down in the pelvis. That the enlarging body, in the erect posture, rests on a greater area of the bladder and presses more heavily upon it is certain, but there is no satisfactory proof that the cervix is appreciably lowered if the woman be healthy and uninjured. It must be remembered that in normal nulliparae there are variations in the situation of the uterus in the pelvis, and also that it lies at a lower level in women who have born a number of children. Though the difficulty of establishing accurate topographic relationships by clinical means is great, it may readily be granted that, owing to the softening of the tissues of the pelvic floor and the increasing weight of the uterus,

there may be a very slight descent of the organ, as a whole, in the first three months.

The normal anteversion and ante flexion tend to become more pronounced during the early weeks; as the uterus grows upward into the abdomen these characteristics become less marked. During the late weeks there may be slight descent of the organ, as a whole; but more noticeable is the tendency to increased anteversion, the fundus falling downward and forward. The most marked changes



FIG. 58.—Vertical mesial section of a multipara who died in the eighth month of pregnancy. The fetus and liquor amnii have been removed.

in the position of the fundus are found in multiparæ with a relaxed abdominal wall, especially if there be marked separation of the recti. When the latter diastasis exists in an extreme degree the uterus may fall forward and bulge between the muscles when the patient is erect.

It is frequently stated that the uterus rotates on its long axis as it grows in pregnancy, the movement being either toward the right or left; most frequently in the former direction, so that the

left border is moved forward in the pelvis. In special investigations made to determine the accuracy of this view, Webster has shown that there is no proof that rotation characterizes the growth of the gravid uterus.

Rotation, undoubtedly, is occasionally found, but we cannot speak with certainty regarding the frequency of its occurrence.



FIG. 50.—Vertical mesial section of a multipara who died of tuberculosis in the eighth month of pregnancy. The body was frozen (Barbour and Webster): *a*, Venous sinuses; *b*, placenta; *c*, umbilical cord; *d*, vertebrae of fetus; *e*, uterovesical reflection of peritoneum; *f*, symphysis pubis; *g*, bladder; *h*, vagina; *i*, liquor amnii; *j*, head of child; *k*, umbilical cord; *l*, left lower leg; *m*, promontory of sacrum; *n*, cervix; *o*, pouch of Douglas; *p*, rectum.

Clinically it is impossible, save very rarely, to estimate it. The outlines of the soft and easily moulded uterine bag cannot be defined, nor can the landmarks necessary to the exact determination of rotation be made out. No doubt, in some cases, conditions described as rotation have been really only the moulding of the uterus on the fetus by the examining hand or against surrounding structures. Again, rotation has been described where

it has not been true or inherent, but only accidental, due to displacement by distended bowel or bladder, or to that caused by old adhesions or cicatrices.

In many cases the rotation found in pregnancy is only the continuance of the condition that was present in the non-pregnant state. We know that rotation is frequently present in the normal nullipara, and it is not surprising that it is also found in pregnancy.

Some authors have insisted that rotation exerts an important influence in modifying the position of the fetus. Such a statement is entirely speculative and is incompatible with our present knowledge of the anatomy of pregnancy.

**Volume.**—Webster measured the surface area of the wall

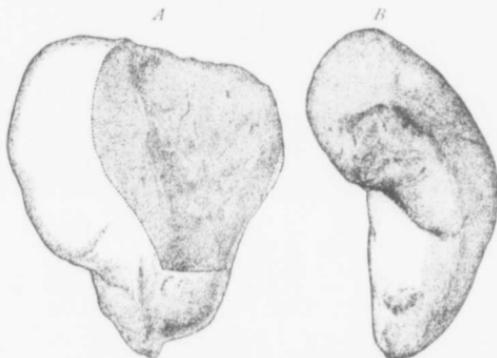


FIG. 60.—Cast of the amniotic cavity in the eighth month of pregnancy. The body was frozen (Barbour and Webster): *A*, Anterior surface; *B*, right lateral surface. The shaded area in (*A*) is the placental area; the bend on the posterior wall in (*B*) corresponds to the projection of the sacral promontory.

of the amniotic cavity of the uterus in the beginning of the fifth month of pregnancy and found it to be 65 sq. in. The cubic contents measured 610 c.c. In Barbour and Webster's eighth-month case the area of the wall was 147 sq. in., and the capacity of the amniotic cavity about 158 cu. in. At full term, according to Barbour, the area of the wall is about 200 sq. in. Krause calculates that the uterine cavity at this period is 519 times greater than in the virgin state.

**Weight.**—The empty full-time uterus weighs from 24 to 28 oz. In the nullipara it weighs about 1 oz., and in the multipara about  $1\frac{1}{2}$  oz.

**Divisions of the Uterine Wall.**—In the pregnant uterus three parts are ordinarily considered—cervix, lower uterine segment,

upper uterine segment. The latter two parts together make up the body of the uterus. This subdivision is not made in describing the non-pregnant uterus.

The distinction between the three parts is best made out when sections of the frozen cadaver are made. To the naked eye the difference between the upper and lower segments is merely one of thickness. A well-marked illustration is found in Webster's section of a fifth-month pregnancy. There has been much discussion in recent years as to the nature and relationships of the various divisions, especially of the lower uterine segment and cervix. The following description is based upon anatomic investigations: The *cervix* becomes softened and congested during pregnancy, being slightly enlarged in its transverse diameters during the early months. It changes very little during pregnancy. There is no anatomic shortening. Descriptions of shortening based on clinical examination are entirely unreliable; it is easy to err, so soft and compressible is the cervix in many cases. Frozen sections have established the fact that, taking individual variations into consideration, the cervix is nearly as large at the end as at the beginning of pregnancy. Barbour gives the following table of measurements:



FIG. 61.—Cervix at end of pregnancy (Waldeyer).

| Month.                      | Number of cases. | Average length of cervix. |
|-----------------------------|------------------|---------------------------|
| Fourth . . . . .            | 5                | 4.6 cm.                   |
| Fifth . . . . .             | 5                | 4.3 "                     |
| Sixth and Seventh . . . . . | 10               | 4.0 "                     |
| Eighth . . . . .            | 3                | 4.5 "                     |
| Ninth . . . . .             | 4                | 3.5 "                     |
| Tenth . . . . .             | 12               | 3.0 "                     |

The slight shortening of the late weeks is not a true inherent change in the tissues of the cervix, but a mechanical alteration, largely due to the weight of the growing uterine body pressing the softened cervix downward against the subjacent tissues. In many cases, also, another factor is present—viz., widening of the cervical canal in the late weeks. In primiparæ this is usually marked only in the lower part of the canal immediately before labor; in multiparæ some weeks beforehand; frequently the whole canal widens so that the presenting part of the fetus may be felt through the os internum. It is very evident that such relaxation of the cervix and widening of the canal must be accompanied with slight diminution of the vertical diameter. The explanation of cervical dilatation and of the variations found in many

cases of advanced pregnancy are unknown. It has been suggested that the painless uterine contractions cause it. As well-marked degrees are found in multiparae, an important factor is undoubtedly the weakened structure of the cervix. The weight of the uterine contents in the erect posture may mechanically exercise some influence. But an important factor is the increased serous infiltration of the cervical tissues during the last weeks, due to increased congestion of the vessels accompanying the interference with the circulation caused by the sinking of the uterus.

The old view that the cervix is shortened in pregnancy because it is taken up into the lower part of the body must be abandoned. There is no such process. The lower uterine segment belongs entirely to the body and the cervix contributes nothing to it. On section the wall of the cervix has a felted texture, the spaces between the bundles of tissue being larger than in the non-pregnant state. Indeed, any increase in thickness may alone be accounted for by the increased fluid in these spaces. It is easily distinguished from the lower uterine segment, because the latter has much less white and elastic connective tissue and a greater proportion of muscle, which is arranged in a series of plates parallel to the long axis of the wall. The transition between the two arrangements is fairly sharp and distinct. The cervical glands are considerably enlarged and secrete abundant mucus; the latter forms a large plug that fills the canal. There is no sharp transition between the cervical mucosa and that lining the lower uterine segment, as is the case in the non-pregnant uterus. The relation of the membranes is no guide, for while they may often be adherent down to the upper end of the cervix, they are frequently loosely attached or quite free above it for some distance.

Many variations are found in the distribution of the decidual cells in the mucosa above the cervix. Here they are often scanty or degenerated in the late months. Usually these are not found in the cervical mucosa, whose connective-tissue cells are small and numerous, but occasionally a few decidual cells may be found below the level of the os internum.

**Body-wall.**—The differentiation of the lower from the upper uterine segment is not constantly or definitely marked. Sections of frozen cadavers show that many variations are found. It is not known when the differentiation begins. Sections of the frozen body made in early pregnancy show that during the first three months the wall is not thinner above the cervix than elsewhere. Webster's fourth-month specimen shows a slight difference both anteriorly and posteriorly; Waldeyer's later fourth-month specimen has a thin wall posteriorly as high as the fundus, whereas the whole anterior wall is thicker near the cervix than at a higher level. In Webster's fifth-month case there is a well-marked

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differentiation into upper and lower segments, much better marked than in most published cases.

In the second half of pregnancy differentiation is much more frequently noticed, but there are many variations. Thus, in a full-time uterus described by Bayer the lower uterine segment measured  $3\frac{1}{8}$  in., and in another  $3\frac{1}{8}$  in.; in 2 cases of Hofmeier's it

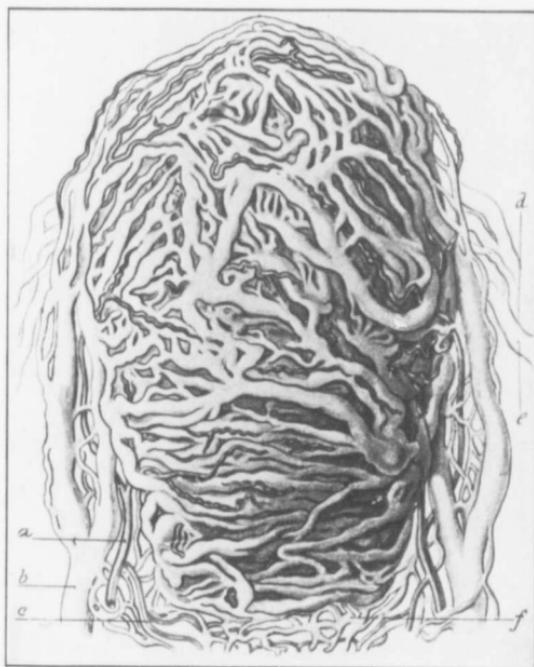


FIG. 62.—Injected veins and arteries of pregnant uterus (from a preparation by Hyrtl) (Heitzmann): *a*, Uterine artery; *b*, uterine vein; *c*, vaginal branches of uterine artery; *d*, ovarian artery; *e*, ovarian vein; *f*, vaginal plexus.

was about  $2\frac{3}{4}$  in. In 2 eighth-month specimens I found the differentiation so slight that it was impossible to make any accurate measurements.

In most full-time cases the lower part of the anterior wall of the body is somewhat thinned, varying in different cases. In Braune's, Waldeyer's, and Braune and Zweifel's specimens it is about one-third the thickness of the upper uterine segment.

Posteriorly the corresponding part of the wall is not thinned, being as thick or thicker than the upper uterine segment.

In some the peritoneum is loosely attached over the lower segment of the anterior uterine wall, being firmly united to it above. This relationship is not always present, many variations being found at different periods of pregnancy. A more constant



FIG. 63.—Vertical mesial section of a woman who died in the sixth month of pregnancy. The uterus was much displaced upward and to the left as a result of the distention of the bladder by a considerable quantity of urine. The irregular outline of the uterine wall is mainly due to manipulations of the body before freezing; *a*, Symphysis pubis; *b*, promontory; *c*, uterine wall; *d*, fetus; *e*, amniotic fluid; *f*, cavity of bladder containing urine; *g*, vagina; *h*, rectum.

characteristic of the lower segment is the arrangement of the muscular tissue into a series of easily separable plates, lying in the long axis of the uterus. This peculiarity may exist although the lower segment may not differ in thickness from the upper segment. The extent to which it may be found varies; in the advanced months it is usually between 1 and 3 in. Close to the cervix the plates spread out and blend with the felted texture of

the cervix. The relationship of the mucosa lining the lower segment to that of the cervix I have already described.

As to the nature of the lower segment there can be no doubt that it is the lower part of the uterine body, being in no degree derived from the cervix. As found at the end of pregnancy it represents that which forms almost the whole uterus at the fourth month; the increase in the organ after this period taking place mainly in its upper portion. The thinning of the lower segment is doubtless related, as Barbour has suggested, to the pressure of the uterine contents, variations being probably mainly due to the consistence of the segment and to the amount of pressure. In the erect posture the contents press more directly upon the ante-

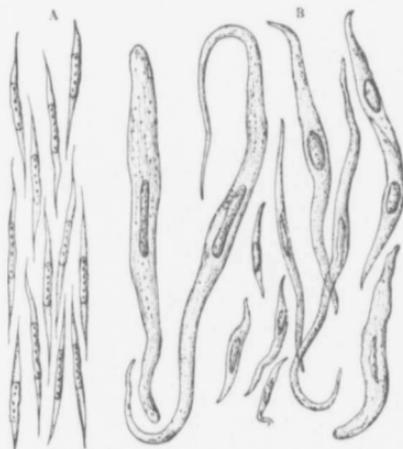


FIG. 64.—A, Isolated muscle elements of the non-pregnant uterus; B, cells from the organ shortly after delivery (Sappey).

rior than upon the posterior wall; this may explain why the former is more frequently thinned than the latter. As to the upper uterine segment, it must be noted that it is not usually of uniform thickness, that part to which the placenta is attached being thinner than the rest. The statement that a large sinus usually marks the junction of the lower and upper segments is not correct. There is no definite or constant line of demarcation between the segments in pregnancy.

**Changes in the Musculature.**—The physiologic changes in the musculature of the body consist in a hypertrophy of pre-existing fibers; they increase fifty to eighty times in length and two to three times in thickness. New fibers are also developed

from embryonic cells which are present in the non-pregnant uterus. The largest fibers may be as large as  $\frac{1}{50}$  in. in length.

The arrangement of the muscular bundles is complicated. They may be divided into three sets:

1. A thin outer layer, covering the uterus anteriorly and posteriorly, consisting of longitudinal and transverse bands which extend into the various uterine ligaments.
2. A thick middle layer, forming the main thickness of the uterine wall, made up of irregular bands of fibers.
3. A very thin inner layer, whose fibers run transversely; it forms concentric bands around the inner end of the Fallopian tubes and os internum, the latter being very strong.

In the lower uterine segment very little of the arrangement of the middle layer is found. In the cervix the musculature is an irregular, felted mass. A concentric band may often be traced around the os externum.

**Blood-vessels.**—The arteries become increased in length and thickness and are more tortuous during pregnancy. During the late months diminution of the lumen is frequently observed, due to a thickening of the intima or outer part of the wall.

The veins also increase greatly. Their walls are very thin, being supported by the surrounding uterine musculature. Thickening of the wall is also found in different vessels toward the end of pregnancy, and thrombosis is often noted. There is also great increase in the lymphatics and nerves of the uterus. The ganglia near the cervix become enlarged, and the nervous irritability of the whole uterus is intensified.

**Pelvic Floor.**—During pregnancy there is considerable softening of the tissues of the floor, accompanying an increased quantity of blood circulating through them. This is of importance in facilitating the stretching of tissues occasioned by parturition. As regards the disposition of the floor as a whole, the chief change in pregnancy is that caused by the increased intra-abdominal pressure.

Measurements made upon the frozen cadaver show that the floor is somewhat bulged downward during the second half of pregnancy. This is evident from the increased pelvic-floor projection as well as the skin distance from the coccyx to the symphysis. The base of the bladder, urethral orifice, cervix, and bottom of the uterovesical pouch are lower than in the nulliparous condition. Considerable variations are found in normal cases, due to individual peculiarities of shape, to different degrees of relaxation in the tissues, and to differences in intra-abdominal pressure. Thus, in a primipara during the last weeks of gestation the cervix is usually at a lower level than in a multipara. This is due to the greater resistance of the abdominal parietes to the upward development of the uterus in the former. The bladder is usually

entirely within the pelvis when empty, and is found at different levels. As it becomes distended it may rise above the brim, but as pregnancy advances upward expansion is relatively less marked than lateral expansion, which may be equal on each side of the middle line, or greater on one side than on the other. Throughout a considerable period of pregnancy the uterus is elevated by the well-filled bladder. In a sixth-month specimen studied by Webster, such displacement of the uterus is well shown. The more pregnancy is advanced the less the uterus is disturbed, and the bladder is forced to distend more transversely. When the viscus is distended with urine its upper surface is concave, as a result of the pressure of the anterior uterine wall.

**Pelvic Peritoneum.**—It has been widely taught that the entire peritoneum in pregnancy is elevated by the upward growth of the uterus. Recent investigations of frozen cadavers, in which undisturbed relationships can be studied, prove that this teaching is only partially true. They show clearly that the peritoneum

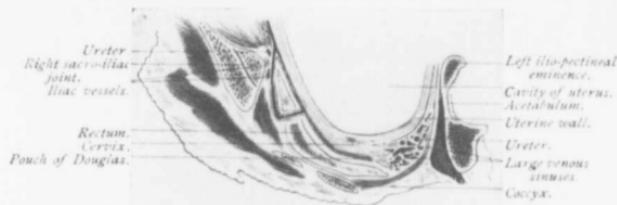


FIG. 65.—Vertical oblique section of pelvis of eighth-month pregnancy. The fetus has been removed from the uterus (Barbour and Webster).

covering the uterus increases along with its musculature, and that the stripping of the peritoneum from the posterior part of the upper surface of the bladder occurs with no uniformity or regularity. This stripping is generally attributed to elevation by the growing uterus, but as the growth changes in the organ during the second half of pregnancy affect chiefly its upper part, it is difficult to understand how they can affect the peritoneal relations of the anterior and posterior pouches. It seems, rather, that the bladder is stripped away from the peritoneum by the sinking of the pelvic floor, though the former may be the explanation in some cases. Owing to the very delicate loose connective tissue joining the bladder and peritoneum, the latter does not follow the posterior part of the former in its downward descent. Usually the bulging of the floor is most marked near the end of pregnancy. Waldeyer's and Braune's sections show a great part of the bladder uncovered. In Barbour and Webster's eighth-month case, where the bladder is not so low, there is scarcely any strip-

ping of the peritoneum. The variations that are found are probably also due to the different degrees to which the peritoneum is folded in the uterovesical pouch. The extent of the stripping must depend upon the amount of unfolding that takes place.

As regards the pouch of Douglas, there is no elevation of its central portion throughout the whole of pregnancy.

The lateral relationships of the pelvic peritoneum have been chiefly studied by Polk and Barbour. They have shown that the base of the broad ligament is considerably elevated by the expanding uterus, a large area on each side being thus uncovered. In Barbour and Webster's eighth-month specimen the anterior



FIG. 66.—Full-time pregnancy. Reconstruction from frozen sections. Right occipito-anterior position (Braune).

layer of the ligament descended below the brim as far as the center of the acetabulum. When the uterus was pulled gently away from the bone at the brim level the layers of each ligament were  $1\frac{1}{2}$  in. apart, although, in the undisturbed condition of parts, they were so disposed as almost to meet, being folded upon the cellular tissue between.

In a full-time case in which labor had just begun the highest lateral point of attachment of the broad ligament was on the right side, where it was  $\frac{1}{2}$  in. below the middle of the iliac crest; on the left side  $\frac{3}{4}$  in. lower. The lowest point on both sides was about the level of the center of the acetabulum, the layers being

$\frac{5}{8}$  in. apart on the right side and 1 in. on the left. The uterosacral ligaments extended from near the brim posteriorly downward and forward, to be attached to the uterus  $1\frac{1}{2}$  in. below the level of their posterior ends. The round ligaments increase greatly in length; at full time they extend from the uterus downward and inward almost vertically, curving forward at their lower ends toward the internal abdominal rings. Where they turn forward they may often make a sharp bend, each ligament being folded on itself. The round ligaments are not tense in pregnancy unless the uterus is so displaced upward as to stretch them somewhat.

The **Fallopian tubes** at full time are found in different positions. Their outer ends are generally packed between the uterus and the upper part of the iliac fossæ. The ovaries also vary in their relationships. Like the tubes, they are capable of a considerable range of movement, owing to the mobility of the upper parts of the broad ligament, and they may thus vary in position within certain limits, apart from movements of the pregnant uterus.

**Relationships of the Uterus.**—The pregnant uterus is plastic, being readily moulded by structures firmer than itself with which it comes in contact. Normally, in the advanced stages, it shows the indentation of the vertebral bodies and posterior half of the pelvic brim. The bowel, tense with gas or feces, easily makes an impression upon it.

The more tense the abdominal wall the less room there is for expansion of the uterus, which consequently is pressed more backward against the spine. In a primipara, therefore, the pressure is always greater than in a multipara. Where the abdominal wall is lax the fundus is directed somewhat forward when the woman is in the erect posture. When there is marked separation of the recti muscles this is found in a marked degree.

In the first three months of pregnancy the uterus lies entirely within the pelvic cavity. As it rises upward the anterior wall comes into direct contact with the anterior abdominal wall, the intestines being elevated; at full time they are in contact up to a varying distance above the umbilicus. Above this they are separated by intestines; usually the latter dip very slightly below the level of the fundus in front of the uterus. They lie mainly between the fundus and the liver, and between the posterior abdominal and uterine walls on each side of the spine for a short distance only below the fundus. Occasionally, in conditions producing marked tympanites, the bowels may descend in front of the uterus; or they may exist there throughout gestation, as the result of old adhesions. Sometimes the omentum alone may lie between the uterus and abdominal wall below the level of the navel, even in advanced gestation, though ordinarily it lies in the region of the fundus.

The highest point of the diaphragm is elevated from 1 to 2 in. at full term; in a case of Barbour's it was opposite the cartilage joining the eighth and ninth dorsal vertebrae. The liver, therefore, is considerably elevated. In the pelvis, besides the rectum, a loop of sigmoid flexure may be found in the pouch of Douglas. Very rarely a coil of the ileum may be found there.

As regards the relationship of the ureters, it is generally believed that they are so protected by their position in the declivity on each side of the spine that the uterus does not press directly upon them. Frozen sections, however, prove that the pregnant uterus may mould itself closely against the pelvic brim and sides of the vertebral bodies, and it is not unlikely that this exercises some pressure upon the ureters, especially if the uterus be very large, the pelvis be small, or the abdominal walls be very tense. When the presenting part sinks in the pelvis there is likely to be some increase in pressure. (See p. 314.)

At full time the position of the fundus varies according to the size of the uterus. It is frequently found at the level of the lower margin of the first lumbar vertebra. In the erect posture, if the abdominal wall be lax, it reaches a somewhat lower level. In a primipara it is probably, on the average, lower than in a multipara.

The distance from the top of the symphysis to the fundus, measured with calipers, ranges, on the average, from  $9\frac{1}{2}$  to 11 in. when the woman is in the dorsal position. In the erect posture, if the long axis of the uterus falls in line with that of the pelvic inlet, the measurement is diminished. In a primipara described by Braune and Zweifel it measured  $8\frac{1}{2}$  in.

The method of measuring the elevation of the uterus in reference to the umbilicus should be abandoned on account of the variability of the latter point. For clinical purposes it is best to measure the distance above the symphysis; and it should be remembered that the outline of the uterus can be accurately determined only during a period of hardening.

**Relation of the Placenta.**—The placenta is most frequently situated entirely in the upper uterine segment, occasionally partly in the upper and partly in the lower segments, rarely entirely in the lower. From a study of 1000 cases Caruso states that it is most frequently attached to the anterior wall, occasionally to the posterior wall, seldom to the right side, very rarely to the left side. A complete fundal insertion is also very infrequent. Its most frequent site is probably the right upper portion of the anterior uterine wall. Bayer and Leopold state that when the placenta is situated anteriorly the Fallopian tubes are parallel to the long axis of the uterus; when it is attached to the posterior wall they converge anteriorly. Palm, in describing the relationship between the placental site and the uterine attachment of the tubes and round ligaments, states:

1. When the placenta is on the lower part of the posterior wall the uterus is symmetrical, the tubes and round ligaments being attached high, somewhat near one another, and at the same level.

2. When the placenta is on the lower part of the anterior wall the uterus is symmetrical, but the tubes and round ligaments are attached wide apart and laterally.

3. When it is posterior and high the uterus is symmetrical and rounded, the tubes and round ligaments being attached lower and nearer one another on the anterior wall.

4. When it is anterior and high the uterus is symmetrical and rounded, the tubes and ligaments being widely separated and attached laterally.

5. When it is situated on one side, near the fundus, the uterus is asymmetrical, one corner being more prominent and higher, the attachments of the tubes and round ligaments being wide apart at the sides and high.

That part of the wall to which the placenta is attached is usually thinner than the neighboring portion. The placental area varies in different cases. On the average it may be said to measure about one-fifth of the total inner surface of the uterus at full time.

**Intra-uterine Pressure.**—Milne Murray has pointed out that there is a positive intra-uterine pressure during pregnancy, and that it is greater than the extra-uterine pressure, though the difference may be very small. It is impossible, therefore, that the uterine wall can in normal cases be flaccid. If flaccidity is ever found in a post-mortem specimen, it is caused by some change, such as the escape of some fluid from the uterus.

**Circulatory System.—Blood.**—The total quantity of blood in the body is increased, accompanying the requirements of the increased vascular area in the uterus. It is relatively more watery than in the non-pregnant state. There is less serum-albumin, more extractive matter and fibrin. The increase in fibrin elements is especially formed during the last three or four months, and is due, according to Nasse, to the breaking up of leukocytes, which are relatively and actually greater than before pregnancy. Willcocks has shown that the red corpuscles are somewhat multiplied, but are relatively less abundant than in the non-pregnant state. There is, therefore, a relative diminution of hemoglobin, although each red corpuscle has its normal amount or slightly more than normal.

Ascoli and Edra state that no hyperleukocytosis appears in the blood of the pregnant woman until just before the expulsion of the child. Hibbard and White, from observations made in the Boston Lying-in Hospital, state that leukocytosis is found in more than 75 per cent. of women in labor, being best marked and more

frequent in primiparæ; the highest counts are found the more advanced the labor; the leukocytosis is due to an increase in the polynuclear cells. Elder and Hutchinson, in 11 cases at term, found an average of 14,522, the counts varying from 8000 to 25,000. Cabot states that most primiparæ show a moderate increase of all varieties of leukocytes during pregnancy, the average count being 13,000. In the last weeks there is a rise, the count varying from 16,000 to 18,000. He found an increase in about 50 per cent. of multiparæ. He thinks that all varieties of the leukocytes are multiplied. Henderson found an increase in all cases, the lowest counts being in multiparæ, though in them the number never fell below 10,600. In 38 cases at the time of labor he found the average to be 21,365; the lowest count being 10,600, the highest 36,600. He found that the leukocytosis was smaller with a male *in utero* than with a female. In weak and ill-nourished women the leukocytes are much diminished. Pray regards the leukocytosis as partly due to the increased action of pelvic lymph glands, and partly to toxemia due to the increased metabolism.

**Heart.**—According to Blot the weight of the heart increases one-fifth in pregnancy; Löhlein states that it is not quite as much. This is due to muscular hypertrophy accompanying increased work, which mainly affects the left half, especially the left ventricle; its wall thickens about 25 per cent. There is also slight hypertrophy of the right half, for, as Charpentier has pointed out, there is greater tension in the pulmonary circulation, and this necessitates more work on the part of that side. There is, in addition, some dilatation of both sides of the heart. The hypertrophy remains for a considerable time during the lactation period, but gradually diminishes. There is little, if any, permanent enlargement, and it is very doubtful if healthy multiparæ have, on the average, larger hearts than nulliparæ. Murmurs often develop in the cardiac area in advanced gestation; they usually disappear within the first two or three weeks of the puerperium. Löhlein found them in 68 per cent. of cases; Fritsch in 78 per cent. They are usually soft or blowing systolic murmurs heard at the base or apex.

Stengel and Stanton state that the outward displacement of the apex in advanced pregnancy is due to upward displacement of the diaphragm from pressure. They state that the murmurs are due to overaction of the right heart and to distention of the conus arteriosus.

The pulse rate is not usually altered. It is stated by some that it is increased; by others that it is diminished. Jarissenne states that in pregnancy the pulse rate does not vary from the horizontal to the erect posture. (This was pointed out by Graves in connection with cardiac hypertrophy generally).

Duroziez states that after delivery the heart remains enlarged, save when the woman does not suckle; in the latter circumstance it diminishes in size rapidly.

**Digestion and Metabolism.**—In the early months the appetite is often capricious; nausea and vomiting being very common, especially during the second and third months. In the late months digestion is usually more active and the appetite keener; during this period there is a great tendency to constipation.

The woman increases in weight apart from the growing uterus and ovum. There is usually a gain of 10 to 15 pounds during pregnancy, the gain being most marked during the last two months. In some cases the increase is much less than 10 pounds; in others considerably greater than 15. The increment exists mainly as adipose tissue, which is most noticeable in connection with the mammæ, hips, and abdominal wall. It is also found in the omentum and elsewhere. This accumulation represents material to be used in supplying nourishment to the future child.

Winckel estimates the average gain in weight in pregnancy, from all causes, as 1770 gr.; of this 1000 belong to the ovum, 150 to the increased genital organs, 620 to the rest of the body.

**Skin.**—The activity of the sweat and sebaceous glands is heightened. The hair often improves in quality, and, if it has been previously falling out, ceases usually to do so. Pigmentation develops in various parts—*i. e.*, middle line of abdomen, areolæ of mammæ, axillæ, external genitals, etc. It is thought by some that this may be associated with a temporary enlargement of the suprarenal bodies. The discoloration does not entirely disappear after delivery, traces of it being found in different parts. Wychgel, working with Veit, states that in the skin there is an excess of free iron, and Veit believes this is due to the dissolving action of the fetal syncytium on the maternal blood, the hemoglobin being set free from the red corpuscles.

**Respiration.**—In advanced gestation respiration becomes almost entirely thoracic. There is no diminution in the size of the thoracic cavity even though the diaphragm is somewhat elevated, because of the increased basal diameters. Dohrn shows that this is more marked in the transverse than in the antero-posterior diameter. The amount of carbonic acid gas expired is considerably greater than in the non-pregnant state.

**Temperature.**—It is believed that the body temperature is slightly elevated in pregnancy. Winckel states that on the average the increase amounts to 2° or 3° C. Gruher noted it in 96 cases, and found the average morning temperature to be 37.46° C., and the average evening temperature 37.36° to 37.32° C.

**Locomotion.**—As the abdomen becomes more prominent the woman alters the position of her body in order to adjust the

center of gravity. If she is tall she walks with the shoulders thrown well back; if short she throws back the whole body.

**Urinary System.**—The kidneys probably become slightly enlarged during pregnancy. The urine is increased in quantity; the specific gravity is lower, being about 1014; the urea excreted is normal. These changes are directly associated with the increased maternal circulation and arterial tension. Sugar is found in a number of cases, not a true glycosuria, but a lactosuria due to the milk-sugar in the blood, derived from the breasts. This is more frequently found after delivery. Peptones are occasionally found, being thought by many to indicate death of the fetus, though there is no proof whatever of this. They are more frequently found after labor, where they are probably due to changes in the involuting uterus. R. Costa states that acetonuria cannot be regarded as a sign of fetal death. He has found it in normal pregnancy, chiefly near full term, and states that it increases during labor, especially if prolonged; in the puerperium it diminishes, remaining, however, greater than in gestation for at least six days. Merletti states that in the last three months of pregnancy bile is found in the urine in double and treble the amount found in the non-pregnant state. He has noted also an increase following death of the fetus. Wychgel states that there is an excess of free iron in the urine of pregnant women as compared with that of non-pregnant women, and, with Veit, thinks that it may be due to the hemolytic action of the fetal syncytium on the maternal red blood corpuscles. (The appearance of albumin will be considered in the section dealing with the Pathology of Pregnancy).

**Frequency of Micturition.**—As a result of the pressure of the uterus on the bladder during the first three months of pregnancy, frequent urination is often noticed. Many variations are found as regards the duration of this disturbance. Sometimes it may last only a few days; generally several weeks. Occasionally it is entirely absent. Usually it disappears as the uterus rises into the abdomen, but it may sometimes persist. This symptom is most marked in women who have suffered from prolapse of the pelvic floor. In the last month of pregnancy frequent micturition is again often noticed. This is due to the sinking of the uterus that takes place during this period.

**Reflex and Electric Excitability.**—Tridondani states that in pregnant women the superficial reflexes are diminished, with the exception of the abdominal one, which is a little increased in primiparæ. The deep and tendon reflexes are much increased, especially the patellar. The pharyngeal and pupil reflexes are weakened, the latter showing a condition resembling the Argyll-Robertson phenomenon. He also states that the electric excitability is diminished. All of these changes are more marked in primiparæ than in multiparæ, and late in pregnancy rather

than early. There is a return to normal about ten days after labor.

**Glandular Changes.**—The thyroid enlarges, causing increased fullness of the neck. This hypertrophy, no doubt, is related to the altered metabolism that characterizes the pregnant state. It seems to be well established that the internal secretion, iodothylin, exercises an antitoxic or medicinal effect upon the toxic products of proteid metabolism. The spleen, liver, and suprarenals are also enlarged.

## CHAPTER II.

### BACTERIOLOGY OF THE VAGINA IN PREGNANCY.

THERE has been much difference of opinion as to the normal condition of the vagina during pregnancy, but the causes of their differences have been recently fairly well elucidated, and at the present time it may be accepted as proved that the genital canal tends to be maintained in a state of asepticity by natural means. Gönner first definitely stated this in 1887. He examined 31 women and found no pathogenic organisms in the vagina, but only various germs which would not grow on the ordinary culture media. He, therefore, maintained that prophylactic vaginal douches were unnecessary, and that autoinfection of a woman could not occur. Döderlein, in the same year, made a series of examinations and announced that pathogenic organisms were frequently present, from which cultures could be obtained, and he opposed Gönner, urging the use of prophylactic douches.

Winter, in 1886, Staffeck, Burgubum and Witte, in 1890, came to conclusions somewhat similar to those of Döderlein. Döderlein, in 1892, made a further series of examinations in 195 pregnant women, and stated that he found two distinct types of secretion. One of these, termed normal, was a white, thickish, crumbly material, acid in reaction, containing epithelial cells, occasional yeast cells, and many thick bacilli. The other secretion, termed abnormal, was more fluid and pus-like, less acid in reaction, often being neutral or alkaline, containing many leukocytes, epithelial cells, and all varieties of bacteria, especially cocci and short bacilli. Cultures from the normal secretion were almost always sterile. Those from the abnormal secretion showed positive results, various pathogenic organisms being found, streptococci in 10 per cent. of cases. He obtained the normal secretion in 55.3 per cent. of his cases, and the abnormal in 44.6 per cent. As a result of his work he modified his original view, stating that in

those women with the abnormal secretion autoinfection might occur, and that in them prophylactic douches should be employed.

Whitridge Williams, in 1893, examined 15 cases, and found Döderlein's normal secretion in 5 and the abnormal secretion in 10. Cultures of pathogenic organisms were obtained, streptococci being found in 20 per cent. of all the cases.

Krönig, in 1894, studied 100 cases, examining the vaginal secretion of pregnant women in all conditions, normal and pathologic, and did not find septic organisms, nor any which would grow aerobically on ordinary media at body temperature, save in a few instances gonococci and yeast organisms. He, therefore, expressed the view that the vagina of every pregnant woman not recently contaminated by digital or instrumental examination or coitus is aseptic. In 221 cases he found Döderlein's normal secretion in 117; the abnormal in 104. Of the former, 30.8 per cent. had an abnormal puerperal history, and 29.8 per cent. of the latter.

In 1894 Döderlein challenged the soundness of Krönig's views. Krönig thereupon carried out a series of interesting experiments on pregnant women, to determine the bactericidal action of the vaginal secretion. Cultures of the bacillus pyocyaneus were introduced into the vagina. They were destroyed in all cases after a number of hours, varying in different instances, the average being 20 hours. They were destroyed most rapidly where the vaginal secretion contained cultures of Döderlein's long vaginal non-pathogenic bacilli; less rapidly in those containing short rods and cocci. All pathogenic staphylococci introduced were destroyed within twenty hours; streptococci within six hours. He concluded that the vagina becomes aseptic, at most, within two or three days after foreign material is introduced into it. He also stated that antiseptic douches weakened or destroyed the natural antiseptic action of the secretion.

Menge, in 1894, confirmed Krönig's views, showing that the natural antiseptic action exists in the non-pregnant state, though not so strongly as in pregnancy. In 1897 Krönig, having investigated an additional large number of cases, emphasized his previous statements. He maintained that the work of those who had found pathogenic organisms in the vagina had been faulty; that these organisms had been introduced from the vulva as the result of careless technic. His own method was so devised as to make contamination impossible.

Whitridge Williams in 1898 made a new series of observations based upon Krönig's method of examination, and as a result corroborated the views expressed by Krönig and Menge, reversing his earlier opinions, which had been based upon faulty technic. He showed that the ordinary methods employed in obtaining

the vaginal secretion are likely to introduce organisms from the vulva, which is rich in pathogenic and other microbes. His conclusion was that there is nothing to indicate that the vaginal secretion, whether of the normal or abnormal nature described by Döderlein, contains pyogenic cocci which can cause puerperal infection. As regards saprophytes, our knowledge is comparatively scanty. Gonner states that there are none in the vaginal secretion, either aerobic or anaerobic. It is not impossible that some of the non-pathogenic germs which ordinarily exist in the vagina may occasionally act as saprophytes, but there is no proof of this as yet.

In view of the above-mentioned results, it is evident that in the great majority of cases prophylactic douching in pregnancy is unnecessary. Neither is it necessary after labor if the woman be not exposed to contamination by those who attend her during parturition.

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### CHAPTER III.

#### DIAGNOSIS OF UTERINE PREGNANCY.

THE diagnosis of pregnancy is often easy, but in a considerable proportion of cases it is such a difficult matter that the most experienced physician may easily fall into error. The most careful consideration should be given to the two-fold foundation upon which the diagnosis is established—viz., the data furnished by the woman regarding herself, and those obtained through the physician's physical examination. The most important of these are the latter, and in cases of difficulty should be held in far more serious consideration than the former. Women's histories are often misleading, from stupidity, nervousness, inaccuracy of observation, or from a wilful desire to deceive; too great caution cannot be exercised in interpreting them. Care must be taken also not to lay too much stress upon one or other symptom or sign. There are many variations in the development of the phenomena of pregnancy, and it is important that the deviations from the normal be continually remembered.

#### SIGNS AND SYMPTOMS.

**Altered Menstrual Function.**—In the great majority of cases menstruation ceases after conception and does not appear during the course of pregnancy. The non-appearance of menstruation in a healthy adult woman whose periods have previously been regular must always justify the suspicion of pregnancy,

particularly if she is known to have subjected herself to sexual intercourse. In some cases after conception a discharge of blood may take place from the uterus at times corresponding to menstruation, even when the relationships of ovum and decidua are normal. Most frequently this occurs only once, probably in the cases in which conception took place immediately before an expected period. The discharge is usually derived from the decidua vera (sometimes from the reflexa), and escapes through the cervix from the space between the vera and reflexa. Rarely there is a monthly discharge on more than one occasion. The duration and quantity of blood are usually much less than normal. Records have been made of a few cases in which periodic bleedings have occurred throughout pregnancy.

When pregnancy takes place in one-half of a bicornute or septate uterus, such escapes of blood from the other half have been frequently noted. In many instances in which discharges of blood are noted some pathologic condition exists—*i. e.*, uterine polypi, inflammation, malignant disease, placenta prævia, etc. In cases of gestation outside the uterine cavity, discharges of blood from the uterus, occurring in great variations as regards frequency, duration and quantity, are common. It is, therefore, evident that errors in diagnosis may arise if it be not remembered that pregnancy may be accompanied occasionally by discharges of blood from the uterus. As a diagnostic sign the menstrual phenomena fail, also, when pregnancy occurs during a period of amenorrhea, due to normal or pathologic conditions. This must be remembered in connection with its occurrence in early life, before menstruation has ever been established; in the skipping-time often associated with the establishment of puberty; during lactation and the irregular intervals of the menopause. In some cases the menstrual type is very irregular, though the woman be healthy, leading to a simulation of a missed menstruation. Often the amenorrhea is due to some local or general disturbance of the system.

**Nausea and Vomiting.**—In a large number of cases nausea and vomiting occur in the first half of pregnancy, apart from any recognizable pathologic change. They are generally regarded as being reflexly caused by the growing uterus, though at the present time they are believed by many to be manifestations of pregnancy toxemia. The disturbances begin usually during the second month and rarely last beyond the end of the fourth month. They may sometimes develop during the first month, may extend beyond the twelfth week, occasionally lasting until the end of pregnancy. In rare cases they may develop during the last weeks.

Many variations are found in the manifestations of these disorders. Often the woman feels nauseated immediately on rising from bed in the morning. This is frequently accompanied by the

vomiting of a small or large quantity of acid, glairy mucus. In many cases the woman has no more trouble throughout the day. In some cases vomiting occurs immediately or one or two hours after the first food taken. Some women are troubled several times a day. In some vomiting may be brought on by any exertion, excitement, or agitation. Rarely the disturbance occurs only at night, when the woman goes to bed. Generally the attack is followed by a feeling of complete relief, but in some cases by distress; its duration varies considerably. Salivation often accompanies the nausea, being in some cases very marked. Sometimes ptyalism is more troublesome than the nausea. Rarely vomiting is followed by diarrhea. In most cases women do not suffer as regards their general health, but occasionally they get worn, thin, and anemic. (Pernicious vomiting is described on page 301.) The importance of nausea and vomiting alone as an indication of pregnancy is not great, since many diseased conditions produce them. Their occurrence as reflex disturbances in various pelvic disorders must be remembered.

**Altered Nervous State.**—In some cases no change can be noted in the nervous equilibrium. Often there is increased emotional susceptibility, and exhibitions of peevishness, fretfulness, irritability, and unreasonableness. Sometimes there is more or less depression of spirits. Occasionally there is increased buoyancy and mental activity. Sometimes greater sluggishness of mind and enfeeblement of memory are noted. There may be a change in the woman's esthetic and moral senses. She may become careless, slovenly, dirty; she may deviate into dishonesty, untruthfulness, and sometimes lasciviousness. Her appetite occasionally becomes strangely altered. She may try to eat substances which are not used for food—*i. e.*, plaster, paper, etc., or may desire abnormal quantities of such articles as salt, pepper, vinegar, or may crave for foods which are out of season. Sometimes the perversion of appetite is of a very distressing nature.

**Quickening.**—This term is applied to the woman's appreciation of the fetal movements. Generally the sensation is experienced between the sixteenth and eighteenth weeks, rarely earlier, occasionally at a later date. Ordinarily the earliest movements are compared to a feeble fluttering. Sometimes a woman never feels movements throughout pregnancy or only toward the end. The movements may often be increased by long fasting, by palpation of the abdomen, or by application of cold to it. Normally women feel quickening at about the same time in successive pregnancies. Too much prominence must not be given to this symptom in diagnosing pregnancy. A married woman who has had children is not often deceived, but others may be. Movements of gas in the bowel, changes in the position of tumors, contractions in the muscles of the abdominal wall, may simulate fetal

movements. Occasionally pregnant women describe a sensation in the early weeks that is entirely imaginary. So, also, non-pregnant women who have exposed themselves to the risk of impregnation may imagine that they feel movements of a fetus.

**Mammary Changes.**—Enlargement of the breasts usually takes place, being first appreciable toward the end of the second month. This is due to hypertrophy and hyperplasy of the gland tissues, recognizable by an increased firmness and by an uneven, knotty character. The change is generally first distinguished at the periphery of the breast. In some cases the enlargement is very marked; in others scarcely any increase may be made out during the whole of pregnancy. Between these extremes many variations are found.

In many women mammary increase is partly due to deposit of fat around the glandular lobules and under the skin, this development being most marked during the last three months. The greater the subcutaneous deposit the less distinctly can the lobules of breast tissue be palpated. As a result of the stretching of the skin caused by breast hypertrophy the *cutis vera* becomes thinned in different parts, giving rise to the surface appearance known as "striae." These are similar to those found in the abdomen. They may be faintly or strongly marked, or in some cases entirely wanting. They occur around the edge or on the breast surface. Old striae are white; recent ones vary from a pale pink to a deep rosy hue. In some women the whole breast feels full and firm; in others there is more or less relaxation. Palpation may cause some women to complain of pain or soreness in the breasts. Apart from palpation, many describe a feeling of fulness, tingling, or sensitiveness, especially in the early months.

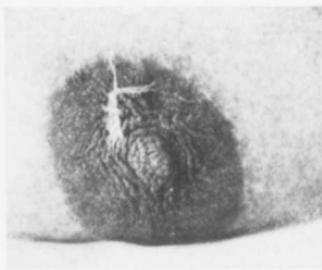
**Veins.**—The veins are larger, and in most cases are seen as blue lines under the skin, sometimes forming distinct elevations.

**Areola.**—The areola becomes darker in color, usually in the second month, the most marked change occurring in brunets, in whom it is dark brown. The lighter the woman's complexion the less pigmented is the areola. In some blonds it may appear pale rose-colored, scarcely any change from the non-pregnant state being appreciable. Elevation of the areola is noticeable in some cases, giving rise occasionally to the appearance of a miniature breast. It often appears wrinkled, due to contraction of bands of subcutaneous muscle. Irritation of the surface, or mental influences, bring about an areolar puckering, which is usually accompanied by some forward projection of the nipple. Scattered over the areola are small nodules known as Montgomery's tubercles, varying in number from two or three to twenty. They are enlarged sebaceous follicles. Their secretion moistens the skin and may sometimes be very abundant. Occasionally these prominences may be entirely wanting.

PLATE 7.



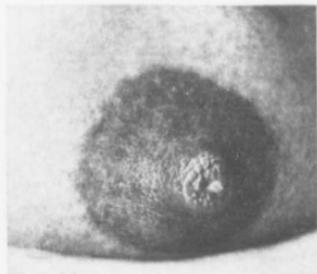
Montgomery's follicles (F), largely developed.



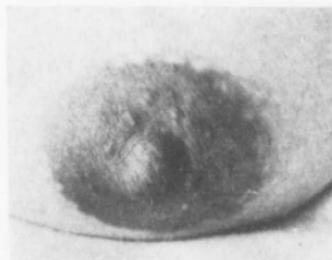
Erectility of nipple and primary areola.



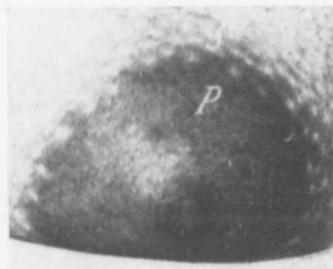
Veins coursing over the breast and primary areola, with irregular pigmentation (in a blonde).



Milk, with faint secondary areola (in a brunette).



Secondary areola of usual size (in a brunette).



Secondary areola, prominently marked (S), with wide primary (P) areola (in a brunette).

Mammary signs of pregnancy in their order (two-thirds life size).

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External to the uniformly darkened areola above described, known as the "primary areola," there appears about mid-term a patchy pigmentation known as the "secondary areola." It consists of small, round, pale spots surrounded by darkened skin; in the center of each spot is the opening of a sebaceous gland. This appearance is usually found in brunets, rarely in blonds; it may extend over a small or large area.

During the third month and thereafter colostrum may be squeezed from the nipple, and appears as a clear pale or yellow fluid in the early months; later it usually becomes opaque. In some instances it may be found earlier than the third month; in others only toward the end of pregnancy; rarely it cannot be obtained at all. In cases where it is abundant it may ooze from the nipples and then dry and form a scale. The nipples usually become larger and more prominent in pregnancy, but sometimes little or no change is visible. In cases where there is depression of a nipple the condition may be more marked as the surrounding tissue increases in size.

**Value of the Mammary Signs in the Diagnosis of Pregnancy.**—In a woman who has never before conceived the various signs above described are, alone, suggestive of pregnancy. In a multipara, in whose breast there are usually striae and permanent darkening of the areola, they are much less suggestive. There is a greater probability of pregnancy if there be a history of cessation of menstruation and morning sickness. However, in some instances such a combination may occur apart from gestation. Any or all of these breast changes may occur reflexly from various pelvic and abdominal disturbances—*i. e.*, tumors, displacements, chronic inflammation; or they may occur in connection with a disturbed imagination or other neuroses. In the various forms of spurious pregnancy they are usually present. It is very rare that in these states the mammary signs are so pronounced as in a typical pregnancy. In ectopic gestation they are usually less marked than in uterine cases. If desirous of examining the breasts of an unmarried girl in whom pregnancy is suspected, it is well to make the pretence of listening to the heart and lungs in order to distract her attention.

**Abdominal Signs.—Pigmentation.**—In the fourth month a pigmented line begins to be noticed, extending mesially from the pubes toward the ensiform cartilage. In blonds it is faintly marked; in brunets pronounced. Ordinarily its width varies from  $\frac{1}{8}$  to  $\frac{1}{4}$  inch; sometimes it is greater than this. In some cases it is much more distinct below than above the navel. In dark women pigmentation may also be very evident in the striae and in the region of the mons veneris.

**Striae** develop during the second half of pregnancy, especially in the last two months. They are termed "striae gravidarum" or

"lineæ albicantes." They are stretched and thinned portions of the connective tissue of the cutis vera. Recent ones are pale pink, rosy, or purplish; old striæ are white and scar-like. They are irregular in shape and size and vary greatly in number in different cases. They are most abundant in the lower half of the abdomen and around the navel, and may often be found on the thighs and buttocks. In the region of the umbilicus the long axis of the striæ are often arranged somewhat concentrically. Occasionally no striæ are produced at all by the distention of pregnancy. But this is found only in about 5 or 6 per cent. of cases. Sometimes careful search may reveal faint traces of striæ where they are thought not to exist. It must be remembered that these striæ are not characteristic of pregnancy, but may be produced by skin-stretching due to other causes—*i. e.*, adiposity, ascites, abdominal tumors.

**Separation of the recti**, due to stretching of the linea alba, is very frequently found in slight degrees in primiparæ in advanced pregnancy. In multiparæ it is usually more marked. It may be found only near the navel or above and below it. In thin women it may be sometimes recognized as a depression of the skin between the edges of the recti. Generally it can best be made out by placing the hand on the abdomen as the woman brings the recti into action. The uterus is very distinctly palpated through the affected area. In extreme cases the recti may be separated several inches, so that in the erect position the anterior wall of the uterus bulges between them when the woman stands erect. The umbilicus tends to become everted as the abdomen increases, so that by the sixth month its deepest portion is about level with the skin surface; thereafter it usually forms a local convexity. In dark women it is surrounded by a ring of pigment, continuous with the linea nigra.

The **size and shape of the abdomen** vary at different periods in different conditions of the woman and of the uterine contents. During the first three months of pregnancy, while the uterus is within the pelvis, it is held by some authorities that the lower abdominal region is slightly diminished in its anteroposterior diameter owing to some sinking of the pelvic floor. This statement is of no clinical importance, for the eye cannot distinguish any such change. Bulging of the lower abdominal wall may first be noticed in the fourth month; thereafter it progressively increases. In general it may be said that the bulging is mesial and symmetrical. Many variations from this condition are to be noted. Asymmetry is most frequently observed in multiparæ. In primiparæ whose abdominal walls are firm and unstretched the abdominal enlargement is usually uniform; this is most likely to be the case when the woman is fat. Asymmetry is most often due to projections outward of fetal parts, but it may be due to deviations of the

uterus as a whole; sometimes it is due to pathologic conditions—*i. e.*, tumors and other swellings. The shape may change in a short time in some cases owing to fetal movements, these being often visible on inspection. Ordinarily it is stated that at the sixth month the fundus reaches the umbilicus, and near the end of the eighth, the ensiform. This is inaccurate. The navel varies in its position and should not be taken as a landmark. The ensiform is often never reached at all by the fundus. The variations in the size of the abdomen in different cases are mainly related to the size of the fetus and quantity of liquor amnii, and



FIG. 67.—Locating cephalic prominence by palpation with both hands. The hand sinks deeper in the pelvis at the side on which the occiput lies (Leopold).

to the laxity of the abdominal walls. *Ceteris paribus*, the swelling is less prominent in primiparæ than in multiparæ. In women with contracted pelvic brim there is more prominence of the abdomen, since the uterus and fetus cannot sink within the pelvis. Its size is also increased when there are pathologic swellings in the abdomen.

It is often noticed that during the last month of pregnancy the fundus sinks somewhat. In primiparæ this is generally due to the sinking of the uterus vertically as a whole (clinically this is described as a sinking of the fetal head within the true pelvis).

In multiparae the lower position of the fundus is mainly due to descent of the latter forward and downward as a result of increased weakening of the anterior abdominal wall; the distance varies greatly in different cases. The reason of the sinking of the uterus as a whole in primiparae is the strength and resistance of the abdominal wall; as the uterus increases it is forced in the direction of least resistance—*i. e.*, downward. In multiparae it is rare to find the fetal head within the pelvis at full term, whereas in primiparae it is the rule. The head may be prevented from

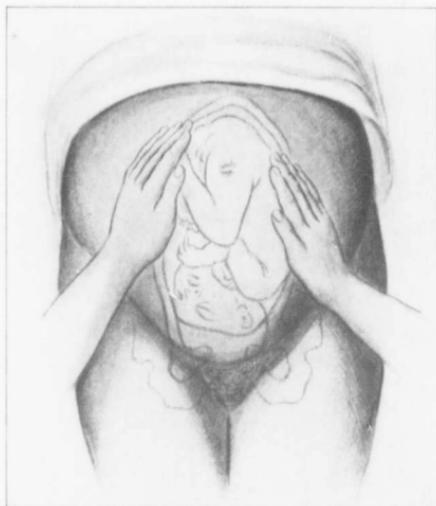


FIG. 68.—Examination of upper fetal pole, showing relation of examining hands to fetal parts (Leopold).

entering the pelvis in primiparae by various factors—*i. e.*, contracted pelvis, large head, tumors, and by the attachment of the placenta to the lower uterine segment. The uterus may first be palpated through the abdomen in pregnancy in the fourth month, when the fundus and part of the anterior wall can be felt. Thereafter an increasing area comes into relation with the abdominal wall.

The consistence of the uterine tumor varies from time to time. In its softened and relaxed condition it resembles a bag incompletely filled with water, its outline being difficult to define. In this state the fingers may usually indent the wall so that the fetus may be palpated. That part of the uterus to which the pla-

centa is attached is less elastic and more boggy than the rest of the wall. In the hardened condition of the uterus the outline may easily be distinguished and the fingers usually cannot feel the fetal parts; this change is due to contractions of the uterine musculature not sufficient to cause pain. They occur at intervals varying from five to ten minutes and last from one-half to four or five minutes. They are involuntary and independent of external stimuli, though they may be induced by palpation, cold or heat applied to the abdomen. This variation in consistence is *one of the most important signs* of pregnancy. It may also be found in the rare condition of the uterus distended with blood, sometimes in a soft myoma, or in a greatly distended bladder. The round ligaments may sometimes be palpated in pregnancy; most frequently, however, in labor. They can best be felt in thin-walled multiparæ by passing the fingers from the flanks downward and forward. The higher the fundus the more distinct are the ridges formed by them. When the uterus is rotated, that one which is most anterior is usually most prominent. The elevated ovary and tube may sometimes be palpated, especially on one side, if moved anteriorly by rotation of the uterus.

Fetal parts can rarely be palpated through the abdomen satisfactorily before the sixth month. In the late months, if there be not excessive liquor amnii, if the abdominal wall be thin and relaxed and the uterus soft, various parts of the fetus may be felt—*i. e.*, breech, head, trunk, limbs. When fetal movements take place the hand may usually feel them. In the fifth month they are not very distinct, being compared to a throb. Later they are recognized as a gliding of the body, head or breech under the hand, as a series of thrusts when the limbs strike outward, or as combinations of these when movements are very vigorous. Often they may be started or made more noticeable by the application of cold or by deep palpation. Frequently no movements may be felt during a period of several hours or even days; their absence, therefore, does not mean a dead child or negative pregnancy. Movements may be simulated by contractions in the abdominal muscles or by the passage of gas through the intestines.

On percussion of the abdomen in pregnancy a dull note is obtained over that portion of the wall of the uterus which is in direct contact with the anterior wall of the uterus. Above this the note is resonant where the intestines come into relation with the fundus. Very rarely the intestines may descend low in front of the uterus, leading to altered percussion-findings.

**Fetal Heart.**—The fetal heart sounds become audible usually between the eighteenth and twentieth weeks, when they may often be heard through a stethoscope applied near the fundus of the uterus. Rarely they may be distinguished three or four weeks

earlier. In the late months it is heard when the back of the fetus is within reach of the stethoscope; in head presentations below the level of the umbilicus; in breech presentations above. The sound is compared to the distant ticking of a watch under a pillow. The rate averages about 130 per minute, the ordinary range of variation being between 120 and 150. Naegele found the minimum rate to be 90, and the maximum 180 in 600 cases. It is usually about twice the maternal heart beat.

Variations may be noted from time to time in the same fetus. Frankenhäuser believed that sex could be determined by the rate, males having a slow heart and females a rapid one. This is a very unreliable sign, for although the rate varies inversely with the size of the fetus, a large female could not be diagnosed from a small male. The causes of all variations are not well known. The rate is increased by active movements and by elevation of maternal temperature. It slows in the early stages of fetal asphyxiation and increases toward the end of the process. In labor it rises as the pain begins, and slows toward the period of maximum intensity, when the heart may sometimes momentarily cease. Interference with the cord slows the heart and makes the sounds weaker. The heart may be inaudible or faint in a healthy fetus when its back is turned toward the back of the mother, in hydramnios, when the abdominal wall is thick, when the placenta is situated anteriorly, or when the sound is masked by the noise of gas in the maternal intestines, by the uterine souffle, or by sounds in the examiner's ear. Failure to hear the heart, even on successive occasions, is not alone conclusive of death of the fetus. When the fetus is very feeble its heart may be heard with difficulty. Ordinarily a rate lower than 120 must be regarded as dangerous, especially if irregular. Several simulations of the fetal heart sounds must be remembered. Thus, the ear may mistake maternal pulsations for them. In ordinary circumstances the error may be detected by placing a finger on the mother's radial pulse and noting its rate. If the latter be very much quickened from excitement, fever, prolonged labor, or loss of blood, it may be difficult to distinguish maternal from fetal sounds.

**Uterine Souffle.**—This term is applied to a soft blowing murmur, synchronous with the maternal pulse, heard in the lower abdominal region. According to Depaul it first develops after the tenth week. It is usually best heard about the seventh month, and is rarely ever absent. It is most distinct over the broad ligaments close to the uterus, being often more distinct on one side than on the other. It may frequently be heard also over a portion of the uterine wall, especially when the placenta is situated anteriorly. The sound is caused by the flow of blood through enlarged arteries in the broad ligament and is not due to

pressure of the stethoscope. Pressure may make it disappear. In some cases a thrill is felt by the hand placed on the abdomen. Kiwisch states that sometimes a souffle may be caused by the epigastric arteries. The uterine souffle may often be intensified by placing the woman in the genupectoral posture. It may be heard after the death of the fetus, and often after delivery. Sometimes it is faint, at other times well marked; it is most evident in anemic women. It gradually disappears in the puerperium. A similar souffle may be heard in some cases of ectopic pregnancy, and in conditions of enlarged uterus not associated with pregnancy—*i. e.*, fibromyoma. Herman and Champneys state that the souffle of pregnancy is higher in pitch than that of uterine tumors.

**Funic Souffle.**—This term, first used by Kennedy in 1833, is applied to a murmur heard through the uterine wall, synchronous with the fetal heart beat; it is rarely obtained. It is believed to be produced by pressure of the stethoscope on the umbilical cord when the latter rests against the fetus close to the uterus. Frankenhäuser states that it is caused by winding of the cord around parts of the fetus, by knots in the cord, and by prolapse of the cord. In some cases the souffle is not derived from the cord, but is produced by the fetal heart valves and transmitted through the uterine wall; thus it may be caused by fetal cardiac disease or by various temporary conditions.

**Fetal Shock.**—This term is applied to the sounds produced by movements of the fetus as heard by the examiner's ear. Contractions of fetal muscles begin about the tenth week. The sounds produced by movements of the limbs or body cannot be heard before the fourteenth or fifteenth week, when they resemble a faint thud or irregular tapping. In cases where the abdominal wall is thick or the liquor amnii abundant the sounds may not be distinguished at this early date. Movements of gas and liquid in the intestine may be mistaken for them; very rarely the bubbling of gas due to decomposition in the liquor amnii.

**Uterine Signs.**—The various signs presented by the uterus on abdominal examination after the fourth month of pregnancy have already been described. In the early months also important points are to be noted. On inspection the cervix is seen to have a purplish hue. This varies in intensity and in the time of commencement; ordinarily it is faintly marked early in the second month. On bimanual examination the cervix feels softer than in the non-pregnant state. This is usually first recognized early in the second month, the softening appearing to be superficial. As pregnancy advances more of the thickness of the cervix is affected. In cases in which there has been marked induration of the cervix as a result of old inflammation there may be very little

change in consistence. As a rule, the softening proceeds slowly until the sixth month; afterward it advances more rapidly.

As a result of these changes the cervix becomes less easily definable toward the end of gestation, and to the examining fingers may seem to be shortened. (See p. 98.) During the last few weeks the canal of the cervix is usually patulous. In primiparæ this is true of the lower portion; in multiparæ often of the whole extent. In the former the os internum remains small; in the latter it is frequently so patulous as to admit a finger-tip. In the diagnosis of pregnancy too much importance must not be paid to the condition of the cervix in the early months. In the late weeks a very soft and somewhat patulous state is strongly suggestive of pregnancy.

The body of the uterus in the early months of pregnancy becomes characteristically altered. It enlarges and becomes somewhat globular. It varies in consistence, being at one time soft and difficult to outline, at another doughy and boggy, and when contractions are present in the musculature hard and non-elastic. In the first two or three weeks these changes are recognized with much greater difficulty than in later weeks, so that in the earliest stage it is rarely possible to diagnose pregnancy absolutely from the bimanual examination alone. After the early part of the second month the increase in size of the body is generally felt as a bulging through the anterior fornix; this, of course, is absent when the uterus is retroverted or retroposed. On abdomino-vaginal or abdomino-rectal examination the wall of the uterus close to the cervix is usually so soft and compressible that the opposed fingers appear almost to meet. This is known as Hegar's sign; in a small percentage of cases it is not well marked or only partially. It is best obtained during the second and third months. Braun-Fernwald has emphasized the importance of asymmetry of the uterus as distinguished by bimanual examination. This sign is undoubtedly frequently present, one half of the body appearing to be larger and softer than the other; a longitudinal depression may also be felt between the two portions. This condition may often be detected by the end of the first month. The explanation of this sign is undoubtedly the development of the ovum, in such cases, more in one half of the uterine cavity than in the other. In describing the anatomy of the uterus I have stated that between the globular condition of the body in the fourth month and the pyriform shape of the late months there is an intermediate stage, when the fundus begins to enlarge at the beginning of the fifth month. At this time, on careful examination, the commencing upward elevation of the fundus may be distinguished if the conditions be favorable to easy palpation. This stage is, however, a very short one, as the fundal enlargement soon broadens.

**Ballotement** is the movement of the fetus or parts of the fetus in the amniotic fluid, by the fingers applied to the abdominal or vaginal wall. The whole fetus may be thus moved by external manipulations, especially in the fourth and fifth months. Afterward, usually only some part of the fetus—*i. e.*, head, breech, limb, may be moved. During the ninth month, when the liquor amnii is relatively diminished, it is not easy to obtain ballotement. The movements are obtained when the woman lies on her back or side. The fetal part may sometimes be pushed from one hand to the other; or it may be moved by a sudden jerk of the fingers, returning against them. When the fetus is very large or the uterus greatly distended by hydramnios or twin pregnancy ballotement is rarely obtained. Ballotement may be simulated by palpation movements of a wandering spleen, kidney, liver, or of a pedunculated cystic or solid tumor in the abdomen.

Internal ballotement is obtained by pressing one or two fingers against the anterior vaginal wall, giving a sudden movement to that part of the fetus lying against the anterior uterine wall. The fetus rises, and may or may not settle down again in its former position. This sign is best obtained during the fifth and six months. It is absent in the early months, when the fetus is very small, and in the advanced months, when the liquor amnii is diminished in quantity. To examine the patient most satisfactorily she should be placed in a sitting or half-sitting posture. Ballotement may be simulated by palpation of pelvic tumors, especially if complicated with fluid accumulations, kidney prolapsed into pelvis, stone or tumor in the bladder, and by marked pulsation in the fornix vaginae.

**Vaginal Signs.**—By the end of the first month slight darkening of the vaginal walls is often noticed, due to increased congestion of the tissues. In many cases this change begins at later periods. Chadwick states that it is noticed in 80 per cent. of women by the end of the third month. As pregnancy advances the color of the walls becomes deep violet, changing more to blue in the late months. These changes were first described by Jacquemin. In a few cases there may be few color changes. The wall becomes softer as pregnancy advances, and pulsation of arteries may be felt distinctly by the examining finger, especially near the fornix. The vulva also becomes softer and darker in color and is more freely moistened than in the non-pregnant state.

#### DIFFERENTIAL DIAGNOSIS OF PREGNANCY.

**In Early Pregnancy.—Metritis.**—A uterus enlarged by chronic inflammation may be mistaken for pregnancy, especially if menstruation has been irregular or if one or more periods have been missed. The metritic uterus does not vary in consistence

like the pregnant uterus, nor is there any softening above the cervix. In cases of doubt it is necessary to wait several weeks in order to determine whether or not the progressive increase in the size of the uterus, characteristic of pregnancy, takes place.

**Myoma.**—An interstitial submucous fibroid may simulate the pregnant uterus, especially if the fibroid be soft. There is, however, usually no amenorrhœa. There may have been a history of previous abortions or of sterility. In doubtful cases examination must be made at intervals of a few weeks in order to determine the rate of growth. The pregnant uterus grows much more rapidly than a fibroid. Sometimes an early pregnant uterus may bleed and simulate a fibroid. Marked hemorrhage is especially found when there is a placenta prævia or when there is a threatened abortion from any cause.

In early pregnancy asymmetry of the uterus is occasionally noted when the ovum develops near one Fallopian tube, especially in cases of a slightly marked bicornute condition. For a short while the uterus may be thought to be a fibroid, a fibroid and pregnancy, or an ectopic gestation may be suspected. (See p. 325.)

**Enlarged Ovary or Tube.**—An ovarian cystoma or an enlarged ovary containing any kind of fluid, or a distended tube, if adherent to the uterus or pressed closely against it, may be mistaken for a pregnant uterus. This is especially apt to be the case if the uterus is retroverted and the swelling is situated in front and adherent to the uterus. The alternate hardening and relaxation of the latter are wanting in the mass, and progressive increase in size as rapid as that of the pregnant uterus is rarely found. Menstruation is not likely to be absent.

**Ectopic Gestation.**—Various forms of ectopic pregnancy are apt to be mistaken for uterine pregnancy. (See p. 416.)

**Distended Bladder.**—A bladder more or less distended with urine may simulate the pregnant uterus. If, however, a high rectal examination be made the uterus is found displaced backward. In all doubtful cases the bladder should be catheterized.

**Hematometra.**—A uterus distended by blood may closely simulate pregnancy. As the condition is caused by atresia in or below the cervix, its nature should easily be established. When there is atresia of one half of a septate uterus the condition may be more puzzling and requires the most thorough study.

**In Advanced Pregnancy.—Obesity.**—A fat abdominal wall, especially if protuberant or associated with separation of the recti muscles and enteroptosis, may sometimes simulate the enlargement of pregnancy, especially if there be amenorrhœa. Some degree of resonance may be obtained on percussion. The chief signs of gestation—*i. e.*, fetal heart, fetal movements, fetal parts,

ballottement, are absent. The cervix is not soft and the vagina not discolored.

**Flatulent Distention of the Abdomen.**—This condition is similarly distinguished from the enlargement of pregnancy. (See Pseudocycosis, p. 138.)

**Ascites.**—Distention of the abdomen by free ascitic fluid, unaccompanied by new growths, is very rarely mistaken for pregnancy. The characteristic signs of ascites are not found in the latter condition. They are as follows: bulging and dulness in the flanks, resonance in the upper middle portion of the belly as the patient lies on her back, change in the area of dulness as the patient moves her position. When, however, ascites is accompanied with new growths—*i. e.*, fibroids, ovarian tumors, or with tuberculous masses of bowel or omentum, the latter may be mistaken for fetal parts and ballottement may be obtained. If there be amenorrhea the simulation of pregnancy may be marked. There are, however, no active movements, no fetal heart sounds, and no variations in the sac containing the fluid. The simulation of pregnancy is intensified if the ascitic fluid be loculated, especially if mesially placed.

**Uterine Tumors.**—A large solid fibroid, especially a soft myoma, may closely resemble the pregnant uterus. A souffle may be present, the vagina and cervix may be congested and darkened, and the consistence of the tumor may vary. Sometimes a submucous fibroid may be felt inside a patulous cervix and may be mistaken for the head or breech of the fetus. There is usually, however, no amenorrhea, but rather menorrhagia or metrorrhagia. But, above all, the chief signs of pregnancy—*viz.*, those related to the fetus, are absent.

When the tumor is partially cystic the resemblance to the pregnant uterus may be very close. When several fibroids are present, irregular in shape and pedunculated, they may be mistaken for the fetal parts and ballottement may be simulated, especially if ascites be present. Sometimes in such cases the patient may feel the tumors move when she changes her position, and she may regard them as active fetal movements. When uterine fibroids are associated with pregnancy the condition may be mistaken even after the most careful examination. Most frequently the pregnancy is overlooked.

**Ovarian Tumors.**—A large ovarian cystoma may simulate the enlarged pregnant uterus, especially when it lies mesially and when the uterus is so displaced as not to be felt bimanually. The wall does not undergo alternate hardening and relaxation, a souffle is very rarely heard, and no fetal heart sounds are present. Occasionally projecting secondary cysts may simulate fetal parts, but there is rarely a simulation of ballottement. Menstruation is not usually absent, or if it is there is usually a history of gradual dis-

appearance and anemia. Sometimes, however, the tumors may be found in a period of amenorrhœa associated with the menopause.

Malignant tumors of the ovary may also simulate pregnancy. The author once saw a young girl with an abdominal swelling in whom there were many secondary signs of pregnancy. The swelling closely resembled a pregnant uterus, though no fetal signs were found. She had never menstruated. On abdominal section the mass was found to be a soft sarcoma of the ovary. Malignant ovarian growths accompanied by ascites may simulate pregnancy, as described above.

**Parovarian Cyst.**—When such a cyst is large, occupying the lower abdominal region, it may also be mistaken for a pregnant uterus, especially if the uterus may be so displaced as not to be palpated. Its wall is very thin and does not vary in consistence, and fluctuation may usually be readily obtained. Fetal signs are entirely wanting and menstruation is rarely absent.

**Other Abdominal Tumors.**—A hydatid cyst may, like an ovarian cyst, simulate the pregnant uterus, especially if it develop in the pelvis and enter into close relationship with the uterus. Malignant omental and mesenteric growths are rarely mistaken for the pregnant uterus. If ascites be present there may be a simulation, the growths being mistaken for fetal parts. An enlarged spleen may descend into the pelvis and may sometimes be mistaken for pregnancy. As a rule, the signs and symptoms associated with the enlargement, and the extension of the swelling under the ribs on the left side, suffice to establish its nature.

**Ectopic Gestation.**—Various forms of advanced ectopic pregnancy may simulate uterine gestation. (See p. 416.)

In all the above-mentioned conditions that may simulate uterine pregnancy, few or many of the normal signs and symptoms of gestation may be present—*i. e.*, mammary changes, nausea, pigmentation, discoloration of the vagina, an enlargement, sometimes progressive and rapid, etc. In some instances ballottement may be felt. Sometimes the mother may state that she feels movements. In all cases systematic investigation and thorough physical examination are essential. Abdominal palpation and the rectovaginal abdominal bimanual should always be employed. In every case of doubt the patient should be studied under anesthesia. When there is no urgency, and in the majority of cases there is none, repeated examination at intervals of a few weeks may be necessary. Very rarely is an exploratory incision required in order to establish the diagnosis. This should be done when it is felt that the patient may be endangered by allowing the condition which is confounded with pregnancy to continue, especially if it should prove to be of such a nature as to require treatment by abdominal section.

## CHAPTER IV.

## LENGTH OF GESTATION; CALCULATION OF THE DURATION OF PREGNANCY.

**Length of Gestation.**—The average duration of pregnancy is ordinarily considered to be 280 days, 40 weeks, 9 calendar months, or 10 lunar months. It is impossible to be accurate in any given case, because the exact time of conception is not known. There are no symptoms by which this process is made known either to the mother or to the physician. Conception may closely succeed insemination or may not follow it for several days. Active spermatozoa may live in the Fallopian tubes for three weeks. We are ignorant, moreover, regarding the place of fertilization of the ovum in any given case, and, if fertilized in the tube, do not know how long it may take to reach the uterine mucosa. It seems undoubted there are considerable variations in the normal length of pregnancy, the reasons being not understood. In some women it may be habitually longer or shorter than the average. It is believed by some that the duration of pregnancy is apt to be short at the beginning and the end of the reproductive era and longer in the mid-period. It is also stated to be shorter in single than in married women.

Issmer states that the duration of pregnancy increases with each child up to the ninth, after which there is a decrease. He also says that the average is a little greater in strong women than in those who are weak. Some authorities hold that it is greater in women who rest a great deal during pregnancy than in those who work.

In the domestic animals observations seem to show that the length of pregnancy has a normal range of variations. Thus, Tessier found it to be in mares 311 to 394 days; in cows 241 to 308 days. Various calculations have been made as to the occurrence of labor after a single coitus. The average varies. Matthews Duncan found it to be 275 days in 46 cases; Lowenhardt 272.2 in 578 cases; Ahlfeld 271 in 425 cases, the difference between the longest and shortest being 99 days. Hecker found the average to be 273.5 days, the difference between the longest and shortest being 63 days.

**Viability of the Fetus.**—The earliest period at which the fetus is viable—*i. e.*, may survive, is not definitely known. Many instances are recorded in which the exact ages of fetuses which have lived are given, but the figures must be regarded as only approximately accurate, since the exact age cannot be estimated either by maternal or fetal data. The consensus of medical

opinion favors the view that a fetus born before the one hundred and fiftieth day cannot be viable, and that it is not likely to live in the majority of cases if born before the latter part of the seventh lunar month.

In the case of labors during the last month of pregnancy, mistakes are doubtless often made in diagnosing as short and normal those pregnancies that are really premature from abnormal (but often unknown) causes. Careful study of the fetus may help in deciding the true nature of such cases, but owing to the variations in the size and development of the fetus it is not possible to form an accurate conclusion.

The law with regard to children born before the full term varies in different countries. In France and Italy one born within 180 days after marriage can be repudiated by the husband if there has been no intercourse between him and his wife before marriage. In Scotland a birth 6 months after marriage is considered legal. In England and America no limit is fixed.

**Protracted Gestation.**—Many cases of prolonged pregnancy have been recorded, most of which have been calculated from a single coitus or from death or absence of the husband. Sir J. Y. Simpson published an account of four cases in which labor occurred respectively 336, 332, 319, and 324 days after the cessation of menstruation. Puppe has reported a case in which the duration of pregnancy was estimated at 348 days. These and other similar statistics are open to the criticism that the calculations based upon menstrual data or the time of coitus may be quite fallacious.

In a number of cases in which pregnancy was believed to be protracted the fetus was above the average weight, but whether this is always found is not known. It is difficult to form conclusions from the size of the child, because normally it may vary considerably. Some authorities have reported cases in which at the expected time of confinement ineffective labor pains have come on and passed away, the actual delivery taking place a month later. Of course, in these instances error may have been made in the calculation, and the threatening of labor may have taken place not at term but a month beforehand. It cannot be denied, however, that a true "missed labor" may sometimes occur.

The law regarding protracted pregnancy varies in different countries. In France legitimacy cannot be contested until 300 days have passed after death of the husband or the last opportunity for coitus. The law is the same in Austria. In Prussia it is 301 days. In England and America there is no fixed date. In one State in the latter country there has been a legal decision in favor of 317 days. In England a child born 304 days after separation of the parents has been held as legitimate.

**Calculation of the Probable Date of Delivery.**—Various

methods are employed to calculate the time of labor, all of which are apt to be fallacious and inaccurate.

**Cessation of Menstruation.**—Some authorities have been accustomed to estimate the probable date of labor by counting from the end of the last menstrual period. Thus, Matthews Duncan, having noted that the average interval between the cessation of menstruation and labor was 278 days, adopted the following method: "Find the day on which the female ceased to menstruate, or the first day of being what she calls 'well.' Take that day nine months forward as 275, unless February is included, in which case it is taken as 273 days. To this add 3 days in the former case, or 5 if February is in the count, to make up 278. This two hundred and seventy-eighth day should then be fixed on as the middle of the fortnight in which the confinement is likely to occur, by which means allowance is made for the average variation either of excess or deficiency." Naegele's method, the one most commonly employed, consists in fixing a date 280 days from the first day of the last menstruation. One may count 9 months ahead or go back 3 months and add the number of days necessary to make the total of 280 days. For 7 months in the year 7 days (in leap years after February 6 days) are added. In February 4 days, in December and January 5 days, and in April and September 6 days only are necessary.

Lowenhardt bases his method upon the view that pregnancy corresponds to 10 menstrual intervals of 28 days each. He states that variations in the duration of pregnancy depend upon the length of the interval, and to estimate the expected labor he multiplies the interval by 10. Thus, the ordinary interval is 28, and this multiplied by 10 amounts to 280. These methods are not accurate. When they were introduced it was believed that ovulation always occurred at menstruation. Now we know that an ovum may escape from the ovary at any time during or between menstruation. It is also known that conception may occur immediately after the last menstruation or just before the period that should next take place. Moreover, it is certain that one or more menstrual discharges may sometimes occur after conception has taken place. Consequently errors may result from calculations based on the menstrual data, amounting to a few days or 3 or 4 weeks. Lowenhardt's method is most unreliable.

In many cases menstrual data are of no avail—*i. e.*, when conception occurs before menstruation has begun, in the dodging periods of puberty and the menopause, in conditions of amenorrhœa due to various causes, in cases in which the menstrual function is irregular. When discharges of blood, menstrual or pathologic, escape from the uterus after conception has taken place the calculation is likely to be fallacious.

**Coitus.**—Reference has already been made to the calculation

of the duration of pregnancy by counting from a single coitus, and the fallacies have been mentioned.

**Quickening.**—Calculations based on the time of quickening are very fallacious. The time varies considerably in different cases (see p. 115), though on the average it may be said to occur about mid-term.

**Size of the Uterus.**—The size of the uterus at different periods of pregnancy has already been described. (See page 93.) In ordinary practice it is usual to estimate the period of pregnancy by determining the relationship between the fundus of the uterus and the pelvic brim, and between the fundus and the umbilicus. These methods are only approximately accurate. The navel varies considerably in position and should not be regarded as a fixed point, especially in multiparae. Then there are variations in the position of the fundus, due to the tonicity of the abdominal wall, the amount of liquor amnii, the size and number of fetuses, the relationship of different viscera, pathologic conditions, etc.

**Mensuration of the Fetus.**—Measurement of the fetal ellipsoid is made to determine the stage of pregnancy in the later months. Ahlfeld has pointed out that the full length of the fetus is about double the head to breech measurement in the normal attitude of flexion. To obtain this measurement it is necessary to use calipers, placing one pole on the abdomen, against the upper end of the fetal mass, and the other in the cervix, care being taken to make the fetus lie vertically. As such a procedure may be inconvenient, the method has been adopted of measuring from the top of the pubes to the upper end of the fetal pole, since this is about the same. In advanced gestation the measurement is said to correspond to the number of lunar months passed.

This method gives only approximately accurate results. The size of the fetus varies considerably. Thus, at full time it may measure from  $17\frac{1}{2}$  to  $19\frac{1}{2}$  in. in length. Sutugin gives the following measurements:

| Lunar month.      | Length of fetal ellipsoid. |
|-------------------|----------------------------|
| Seventh . . . . . | 7.6 in.                    |
| Eighth . . . . .  | 8.3 in.                    |
| Ninth . . . . .   | 9.2 in.                    |
| Tenth . . . . .   | 9.7 in.                    |

## CHAPTER V.

## MULTIPLE PREGNANCY.

**Twins.**—Statistics as to multiple pregnancies, furnished by different European and American countries, vary. On the average twin gestation may be said to occur about once in every 80 or 90 pregnancies.

**Causes.**—The explanation of twin conception is probably to be explained by atavism, a reversion to an arrangement found in the lower mammals. Such a view is strengthened by the occasional occurrence of a multiple gestation both in the tube and uterus. In the great majority of cases it occurs in the uterine cavity.

The condition appears to be more common in some districts than in others. Thus, in Ireland it is more frequently found than in England or Scotland. It is often a hereditary peculiarity, being transmitted through the males or females, sometimes in successive generations, sometimes at intervals. Twins are commonest in primiparæ, especially in those who are elderly. Sir Arthur Mitchell has pointed out their frequent occurrence in families which produce idiots, imbeciles, and those with deformities—*i. e.*, spina bifida, club-foot, etc.

**Varieties.**—Twins are binovular or uniovular.

1. *Binovular.*—These arise from the fertilization and development of two ova. They may be derived from one ovary, each being in an independent Graafian follicle; they may be contained in one Graafian follicle; or each ovum may come from a separate ovary. They may both develop in the normal uterus, one in each horn of a bicornute uterus, both in one Fallopian tube, one in each tube, or one in the uterus and one in a tube. In the present description reference will be made only to the cases in which both develop in the normal uterus.

Binovular twins are about six times as frequent as the uniovular variety, and are to be regarded as more normal than the latter. They may occur at any period of the reproductive life. The children are often carried to term and born healthy. Their combined average weight is greater than in the case of uniovular twins. Their sex may be the same, but often it is different. Rumpe has shown that in 101 cases of binovular twins, both children were males in 31 and females in 16; while in 54 each sex was represented.

*Relationship in Fetal and Maternal Structures.*—Each ovum is usually covered in the early stages of development with its own reflexa. It is also believed that both may sometimes develop

under a common reflexa. In advanced gestations it is not possible to decide regarding the early reflexal relationships. Each ovum develops a separate chorion. These may remain distinct throughout pregnancy, or blending of adjacent portions may occur, the joined part disappearing, so that a common chorionic sac may be formed. There is also at first a separate amniotic cavity for each embryo. Very rarely there may be a disappearance of the contiguous portions of the sacs, giving rise to one amniotic cavity. In such a case evidence of the double origin may be found on careful search. Each fetus has a distinct placenta. These may sometimes be so close together as to make it appear as if there is only one large single placenta. The independence of the two parts is shown in the absence of any anastomosis between the fetal vessels. Anomalous insertions of the cord and *placenta succenturiata* are not infrequent in twin cases.

2. *Uniovular*.—Uniovular twins arise from one ovum. In some cases two blastodermic areas are formed, each of which develops; in others there may be a single blastodermic area, which divides, each forming a fetus. Uniovular twins are to be considered as decidedly abnormal. They are born prematurely much more frequently than the binovular variety, and if they reach full term are apt to be weak and ill developed. Abnormality of one fetus is very common in uniovular twin pregnancy, hydramnios being usually found with it. Uniovular twins are always of the same sex. Their frequency is believed to be about 15 to 20 per cent. of all twin cases.

*Relationship of Fetal and Maternal Structures*.—In the case of uniovular twins there is always one reflexa and one chorion. There may be a single amnion or each fetus may have its own amniotic sac. Ahlfeld says that the former condition is found only in 8 per cent. of cases. The placenta is single and generally large. The umbilical cords may enter it separately or united. Usually an anastomosis can be made out between the two sets of fetal vessels under the amniotic covering of the placenta.

**Course and Complications**.—Twins often show disparity as regards size, development, and vitality. The difference may be slightly or strongly marked. The explanation is not fully understood, though one important factor is the nature of the blood supply to each fetus; it is not, however, always possible to state wherein the nutritional difference exists. One fetus may sometimes be nourished by a much larger chorionic area than the other after the degeneration of the chorion laeve. There may be a difference in some cases in the nature of the vascularization of the maternal decidua related to each chorion frondosum. Degenerative changes may be more marked in the villi connected with one fetus than in those belonging to the other. Structural

peculiarities in the embryo may also partly explain differences in growth and development. There may be a faulty development in one cord. In the case of uniovular twins the anastomosis of the fetal vessels may be such as to favor one fetus more than the other.

In some instances the less fortunate fetus perishes, and if it lies in its own amniotic sac it may be expelled from the uterus, the other fetus developing to full time; in some cases its death may be followed by expulsion of the entire uterine contents. Frequently neither of these results is found, as the dead fetus may remain in the uterus and form with its own placenta and membranes a mole, or it may be pushed and flattened by the pressure of the ovum which continues to develop so as to form the so-called *fetus papyraceus*. Very rarely one of a pair of twins contained in a single amniotic cavity may be thus changed, the other continuing to develop. Death of the fetus is much more common in the case of uniovular than in the case of binovular twins. Occasionally one of a pair of uniovular twins develops in a peculiar relationship to the other as a result of the nature of the anastomosis between the fetal vessels. The better-developed embryo has the stronger circulation, which, through the anastomosis, interferes with the circulation connected with the weaker embryo, which it gradually uses to a great extent for itself. The heart of the weaker embryo gradually atrophies as a result of this arrangement. The upper part of its body does not develop, but becomes a shapeless mass. The lower part of the body may develop so that the legs are recognizable, since its nourishment continues because of the circulation of blood through its umbilical vessels. The embryo thus altered is known as the *acardiac monster*; it is a mere appendage to the healthy fetus.

Very rarely, when twins are alive and unequally developed, one may be expelled from the uterus some weeks before the other, which continues to develop. This probably only happens when the amniotic cavities are distinct, especially in the case of a malformation of the uterus marked by its division into halves. Premature complete emptying of the uterus is believed to occur in more than 60 per cent. of twin cases.

Hydramnios is often found in twin gestations, and hydatidiform degeneration of the chorion is not infrequent. Placental infarcts of various sizes are common. Faulty conditions of an umbilical cord may be present. Sometimes the cords of twins in one amniotic sac become knotted or twisted and may thus lead to their death. Fetal malformations may be found especially in the case of uniovular twins. Eclampsia, albuminuria, and edema of the suprapubic cutaneous tissue and of the lower limbs are frequent. At full time the fetuses are unusually equal in size, the average weight being  $9\frac{1}{2}$  pounds, the weight of each varying from

3 to 7 pounds. In about 65 per cent. of cases twins are of the same sex, these being all the uniovular and some of the binovular. In slightly more than 50 per cent. of the cases in which the sex is the same the twins are male; in a little less than 50 per cent. they are females.

**Diagnosis.**—The diagnosis is often uncertain, and may not be established until labor occurs. In pregnancy twins may be suspected from unusual size of the uterus. This has no positive value, however, since it may be due to a large fetus, excessive liquor amnii, or a tumor. A large uterus without excessive amniotic fluid, in which there is limited mobility of the fetus and an unusual number of projecting fetal parts, is strongly suggestive of twin gestation. The information to be derived from palpation and auscultation is most important. Sometimes a sulcus may be felt in the uterine wall between the two fetuses. This is often absent and may be due to other causes. The outlining of two distinct fetal heads or two backs is an important sign. Ahlfeld states that if two fetal poles are found more than  $11\frac{1}{4}$  in. apart in advanced pregnancy, there is a strong probability of the presence of twins. The detection of two fetal heart sounds in different positions, especially if they differ in rhythm, is conclusive. Of course, different heart sounds may never be heard in some twin pregnancies, even where both fetuses are alive, owing to their disposition; or only one may be heard, because of the death of one fetus.

**Disposition of the Twins.**—At full time many variations are found in the disposition of the twins. In 899 cases of labor tabulated by Kleinwachter and 203 by Reuss the presentation was as follows: Both heads in 49 per cent.; head and breech in 31 per cent.; both breeches in 8 per cent.; head and breech in 6.18 per cent.; breech and transverse in 4.14 per cent.; both transverse in 0.35 per cent. The transverse presentations were generally secondary to sudden emptying of the amniotic fluid or birth of the first fetus, the uterus being large and relaxed.

**Triplets.**—Triplets are said to occur in the proportion of 1 in 6000 to 10,000 pregnancies. They may develop from three ova; two may develop from one and one from another; or it is believed that the three may arise from one ovum. Walla has reported a case of premature labor in which there was a common placenta and chorion and three separate amniotic sacs. There is, therefore, a difference as regards the relationships of placenta and membranes. Sometimes one or two of the fetuses may die during pregnancy, each becoming a *fetus papyraceus*.

**Quadruplets and quintuplets** are very rare.

**Superfecundation.**—This is defined as the fecundation at or near the same time of two separate ova by two separate acts of coitus. This appears to be established by the case of a woman who

had intercourse with a white man and a black man near the same time, afterward giving birth to a white and a black child. Similar instances have been noted in the lower animals. Thus, a mare covered by a stallion and by an ass has been known to give birth to a horse and a mule at one labor. Superfecundation probably accounts for a number of binovular pregnancies.

**Superfetation.**—This is described as the fertilization of two ova at different periods, one occurring some time after the other has already developed to a certain extent. Those who believe this possible quote the following in proof—viz., the delivery of two fetuses at different degrees of development; the delivery of a mature child, followed after some months by one equally mature. Those who do not believe in superfetation say that the former of these occurrences may only be a twin conception, one ovum being more developed than the other; in the second instance the condition may be that of a double pregnancy in a septate or bicornuate uterus. An interesting case of this nature is as described by Ross, of Brighton, England.<sup>1</sup> A woman had a miscarriage of twins on July 16, 1870, and on October 31 was delivered of a well-developed child. In this case there was a complete double uterus.

The occurrence of superfetation in a single uterus has been thought possible for many centuries. The Romans had laws prescribing the laws of succession in such cases. To prove it beyond doubt is very difficult, and such an instance as that described by Tyler Smith, at first sight, appears difficult of any other explanation. A primipara miscarried at the end of the fifth month, and a few hours later discharged a well-formed ovum of about one month. Menstruation had occurred regularly during the pregnancy. The uterus appeared to be normal. It is possible in such a case that the uterus is single so far as regards its outer contour, but divided by a septum internally. Such a condition is practically the same as the bicornuate uterus. It is frequently stated that superfetation is impossible because ovulation ceases in pregnancy. While this is usually the case, there are exceptional instances in which ova are shed. It is also said that ova cannot reach the uterine cavity on account of the closure of the uterine end of the Fallopian tube by the development of the decidua. There is no proof that these ends become so occluded as not to allow an ovum to enter the space between the vera and reflexa, at least in the early months. Great variations are found as regards the time of obliteration of this space. It has also been stated that the thick mucous plug in the cervical canal prevents the spermatozoa from passing up. It is likely, however, that they may penetrate mucus in the pregnant as in the non-pregnant state.

<sup>1</sup> *Lancet*, 1871, vol. ii., p. 188.

## CHAPTER VI.

**PSEUDOCYESIS (FALSE OR SPURIOUS PREGNANCY).**

THIS is the condition in which a woman believes herself to be pregnant, though no conception has occurred. It may be found at any period of the reproductive life, though it is probably most frequent near the climacteric; it is not infrequent in unmarried women who have had illicit intercourse and fear that they have been impregnated, or in young married women who are very anxious to conceive. In many cases there is a disturbed mental state, various neuroses being manifested. Sometimes the delusion may be fixed and retained for years. Occasionally marked mental disorders may develop. In many instances the simulation of pregnancy may be most marked, various signs and symptoms being present—*i. e.*, cessation of menstruation, morning sickness, changes in the breasts, swelling of the abdomen, movements, etc. In every case careful examination should be carried out under anaesthesia, and it is often advisable to do this in consultation, in order to give satisfactory assurance to the woman as to her condition. In a number of instances pelvic or abdominal diseases may be found—*i. e.*, new growths, displacements, inflammatory swellings. These may be large enough to cause abdominal enlargement. Sometimes the latter is merely due to adiposity; sometimes to relaxed parietes with enteroptosis. Ascites may be the cause of enlargement in some cases. Occasionally irregular action of the abdominal muscles leads to the appearance of a swelling; frequently it is due to gaseous distention of the intestines. Occasionally a woman with the delusion of pregnancy may have a spurious labor when she believes herself to be at full term. An interesting historic case of this nature was that of Bloody Mary, Queen of England.

## CHAPTER VII.

**HYGIENE AND MANAGEMENT OF PREGNANCY.**

**Care of the Alimentary Tract.**—During pregnancy the diet should be simple, nutritious, and regular. Heavy breakfasts, late suppers, excessive indulgence in tea, coffee, alcoholics, indigestible and rich food, should be avoided. In many cases women are satisfied with the ordinary articles of diet. Often, however, there is marked capriciousness, and it may be difficult to satisfy their peculiar fancies and conform to a normal dietary. It is advisable that the quantity of nitrogenous matter in the shape of

red meats should be strictly regulated. Indeed, it is well, as a rule, that the latter should not be taken more than once daily. Fruit, vegetables, and liquids, especially milk, should be freely allowed. During the early months, when nausea exists, it may be necessary to select the articles of food with great care, and occasionally such preparations as koumiss, peptonized food, plasmon, beef juices, etc., can alone be digested. In many cases the nausea is manifested only in the early morning, the woman being afterward able to take ordinary meals.

When the morning sickness is very troublesome various measures may be adopted. A cup of cocoa, chocolate, coffee, tea, or beef tea may be given before the woman leaves her bed. Sometimes a small Seidlitz powder given before rising will control the nausea. Occasionally a small dose of *vin. ipecac.* (℥v., in a wine-glassful of water), sipped three or four times at intervals of ten minutes, may be beneficial. Often the nausea is accompanied with heartburn and acid eructations. In this condition sodium bicarbonate or light magnesia is valuable; sometimes a large dose of the latter at bedtime acts satisfactorily. When there is no constipation a mixture of milk and lime water is often satisfactory.

When there is constipation an attempt should be made to change the habit by attention to the dietary—*i. e.*, diminishing bread, meat, and fluids and allowing plenty of fruit and vegetables. Sometimes a glassful of pure water or of salt water at bedtime or before breakfast suffices. Well-salted beef tea or chicken tea at bedtime may also be used for the same purpose. When dietetic measures fail, laxatives may be used—*i. e.*, pulv. glycyrr. co., mineral waters (Hunyadi János), cascara sagrada, maltine with cascara, sodium phosphate, etc. Strong purgatives should not be used save when other agents fail. Enemata should not be used as a routine. Occasionally they may be used when the lower bowel is loaded and the woman feels uncomfortable. For this purpose one or two cupfuls of warm Castile soapsuds or of warm water containing a little salt may be used. In cases where the nausea is very bad and the patient's strength is reduced, it is necessary to use such measures as lavage of the stomach, stimulation by champagne or brandy, rectal feeding.

Prochownick urges that in women who are very fat the abdominal muscles are apt to be thin and the uterine musculature weak in labor. He advises, therefore, that such should be dieted, so as to reduce the obesity, massage and exercises being adopted to improve the muscular tone. Women reduced by diseases—*i. e.*, chlorosis, by previous numerous labors, overwork, bad hygienic conditions, etc., should be dieted with great care, so as to improve their health. Frequently a few weeks' rest in bed is advisable,

light massage being given during this period. In those who have previously been unable to nurse Prochownik recommends plenty of carbohydrates in addition to the ordinary quantities of the other constituents, along with gentle massage of the breasts, the latter being carried out during the six weeks before labor.

**Exercise.**—Moderate regular exercise is valuable. The woman should walk in the open air, though not to such an extent as to fatigue herself. In warm weather she should as well sit outdoors as much as possible or drive. Moderate cycling is allowable in the early months. Horseback-riding, driving over rough roads, heavy lifting, straining, hard work, must be avoided. The rooms in which she lives should be well ventilated both night and day. Long standing on the feet should be avoided. Long railway journeys are not, as a rule, advisable. A valuable exercise for pregnant women may be obtained by the use of light wooden dumb-bells, or by the movement of a light weight suspended over a pulley. In some cases regular daily massage of the limbs is advisable as an adjunct to other exercises; it is very beneficial, and occasionally may be the only exercise permissible.

**Rest.**—The nightly sleep should be regular and undisturbed. It is often advisable to supplement this by a nap of an hour or two in the morning before the midday meal. At any rate, it is advisable, especially during the second half of gestation, that the woman should lie for an hour or more during the day on a flat sofa or bed. If she is troubled with a feeling of weight and dragging in the abdomen, or of weakness, pains, or cramps in the limbs, great relief is usually given by rest for an hour or more on a straight, inclined plane, the pelvis being twelve or eighteen inches higher than the head. Sometimes the discomfort most quickly disappears if the genupectoral posture is adopted for a short time.

**Clothing.**—The clothing should not constrict the chest or abdomen and corsets should be abandoned. The skirts should be suspended directly from the shoulders or from a loose waist; they should not be tied in the ordinary way around the abdomen nor allowed to drag down the latter. If the breasts are large and heavy they may be prevented from dragging by a well-adjusted supporter. Whenever the abdominal wall is lax, the linea alba stretched, and the recti abdominis muscles separated, a well-fitting elastic abdominal binder should be worn when the woman is not lying down. It should extend from the pubes to midway between the umbilicus and the ensiform cartilage. It may be kept from slipping up by rubber bands which pass around the thighs. If these cannot be worn with comfort, garters passing from the stockings to the lower edge of the binder along the front of the thighs suffice to keep it in position. Constricting garters must not be worn on the limbs. The stockings may be suspended from the

abdominal binder if the latter be worn, or a special form may be worn which passes around the hip.

**Bathing.**—Daily bathing of the body is advisable. The water should not be too hot or too cold; a temperature of 75° F. is satisfactory. The bath may be taken at bedtime or in the morning, the skin being well rubbed.

**Care of the Breasts.**—The breasts and nipples must be kept clean; water and bland soap or borax (5j to a pint) usually serve for this purpose. The clothes should be arranged so as not to press against the nipples. When the latter are small or retracted they may be drawn out once daily during the last two or three months of pregnancy, clean fingers or a breast pump being used. Hardening agents, such as alcohol, should not be employed. It is more rational to keep the nipples supple, and for this purpose lanolin or cocoa butter may sometimes be used. If the colostrum is abundant and oozes from the nipples in the late months, care must be taken to place absorbent cotton over them and to prevent them from becoming covered with the dried material.

**Care of the Genitalia.**—Vaginal douches are not necessary in pregnancy except when they are required in the treatment of some pathologic condition. Some women are in the habit of washing out the vagina with a pint of warm water and experience increased comfort. The employment of antiseptic douches in pregnancy, as a prophylactic measure, is in the great majority of cases unnecessary. As a result of the researches that have been made concerning the bacteriology of the vagina (see p. 111), it is established that there is a normal bactericidal influence exerted in the genital canal tending to produce continued asepticity, and that this influence may be considerably weakened by the chemical action of many antiseptics.

It is only when there is a local acute or chronic infective or venereal process on the vulva, vagina, or cervix that antiseptics are necessary to check the pathologic process and to destroy the chances of a fresh infection during or after confinement. Sexual intercourse is generally regulated by the inclinations of husband and wife, rarely by medical considerations. So many variations are found as regards this habit that it is impossible to state what should be the limit of its performance. From the medical standpoint it is reasonable to advise moderation, especially when the woman has suffered from previous abortions, and abstinence during the last month or two of pregnancy. It is wise also to abstain in the early months at the times corresponding to the menstrual period. If the husband shows evidence of uncured venereal disease, coitus should be prohibited during a much longer period.

**Urinalysis.**—A regular monthly examination of the woman's

urine should be made during the first seven months of pregnancy, and afterward once a week or fortnight. The total amount passed in twenty-four hours should be noted at intervals. The quantitative estimation of urea is very important. Careful qualitative and microscopic investigations are also necessary.

**Psychic State.**—The variations in the mental condition of a pregnant woman have already been described. It is necessary that she be tenderly and tactfully cared for and managed by her husband and friends. Much allowance must often be made for her peculiarities. She should be protected from worry, shock, and anxieties. Her environment should give quietness, cheerfulness, and freedom from excitement.

**Avoidance of Contact with Disease.**—The pregnant woman should be protected from the risk of contracting the infectious and contagious diseases, both for her own sake and that of the fetus. During the last weeks she must be particularly careful in this respect.

**Obstetric Examination.**—After the midterm of pregnancy the physician should at times carefully examine the abdomen and pelvis externally, and once or twice should make a thorough bimanual examination. The knowledge thus gained may often prove of the greatest value in deciding the course to be followed in the future care of the patient. In private practice there is widespread neglect to carry out systematic physical examination in pregnancy, and the resulting misfortunes are consequently numerous. The investigation is made to determine: 1, Whether or not pregnancy exists; 2, the period of pregnancy; 3, the number of fetuses in utero; 4, the attitude, presentation and position, size and general condition of the fetus; 5, the existence of abnormal or pathologic changes in fetal or maternal tissues; 6, the size and shape of the pelvis; 7, the probable time of confinement; 8, the prognosis in the case.

Special stress must be laid on the importance of obtaining information, as much as possible, by means of abdominal palpation, a method which has been greatly neglected in the past. Experience thus gained during pregnancy makes it more easy for the practitioner to reduce to a minimum the employment of vaginal examination in labor, a great desideratum from the standpoint of aseptic technic. To Pinard is perhaps due the chief credit for developing the method of palpation in a systematic manner in recent times. Mundé, Leopold, Müllerheim, Warden, MacLennan, and others have devoted considerable attention to it. In carrying out palpation the patient should lie on her back, with her lower limbs extended and slightly abducted and her arms placed alongside her body. The bladder should have been recently emptied. The examiner's hands should be warm. The examination should be systematic. Leopold advises beginning with the fundus and

moving down toward the cervix. Pinard recommends examining the lower portion first and the fundus last. Usually it is advisable in the very beginning to move the hands over the abdomen simply to accustom the patient to the feeling. Then the condition of the abdominal muscles, the position, outline, size, consistence, etc., of the uterus may be determined. An endeavor may also be made to map out the placental site, round ligaments, and ovaries. The practitioner may then stand alongside the patient, facing her pelvis, and may place a hand on each side of the uterus close to the pelvic brim. The latter should be palpated as far as possible backward from the symphysis. The abdominal wall should then be pressed inward and downward in order to determine the presenting part of the fetus and its relation to the pelvis. If the former has engaged well in the pelvis the inlet is felt thus occupied by a firm, rounded mass, which in pregnancy is almost certain to be the head, presenting by the vertex. Before labor the trunk, breech, or face is practically never within the pelvic cavity. If the presenting part be at the brim the fingers may be able to palpate it to a large extent and to raise it from the brim. It may thus be possible to state whether it is a head, breech, or shoulder. If it be a head, careful palpation should be made to determine its size, mobility, exact position, etc. When neither fetal pole lies in relation to the brim the fingers of both hands may usually determine the absence, and may be approximated more or less toward the middle line. Sometimes the resistance or thickness of the abdominal wall makes it difficult to palpate the portion of the fetus in the lower part of the uterus. Similar trouble may sometimes be caused by an anterior placenta prævia, distention of the bladder, tenderness due to various inflammatory conditions. When the fetus is premature it may be impossible to distinguish the head from the breech; also when the skull is macerated. A tumor of the uterus or neighboring parts may interfere with palpation. The middle portion and fundus of the uterus should then be palpated to determine the body of the fetus, its limbs, and upper pole. When the breech is at the fundus, it is felt to be an irregular mass with less uniform consistence than that which characterizes the fetal head. Often portions of the limbs are felt near it; they are usually not felt when the fetal back lies directly anterior. In the great majority of full-time cases the breech lies in the right half of the fundus. When the head is situated at the fundus the groove of the neck should be sought. The head may also frequently be made to move somewhat apart from the body. This is not the case with the breech. When the back is palpated it feels firm and smooth. Rarely the umbilical cord may be palpated between the back of the fetus and the anterior uterine wall. The fetal limbs are usually most accessible in dorsoposterior positions. The feet are usually most in evidence; they respond more

markedly than the upper limbs to stimulation of the fetus. The many other conditions which may be determined by abdominal palpation are described elsewhere throughout this work.

The examination in pregnancy should include careful study of the bony pelvis and genital passage. The pelvis of every primipara should be carefully measured. This is also necessary in multiparae if there be anything in the previous obstetric history to suggest pelvic abnormalities. The method of carrying out this examination is given later. (See Chapter on Pelvic Deformities.)

## PART II. LABOR.

### CHAPTER I.

#### CLASSIFICATION AND CLINICAL PHENOMENA OF NORMAL LABOR.

##### COMPARATIVE.

LABOR is more difficult and serious in the human female than in other animals. This is due to several causes, chief of which is the peculiarity of the human pelvis as it is modified for the requirements of the erect posture. In all mammals below man the pelvic cavity is practically uncurved. There is no projecting sacral promontory, and the conjugate diameter is greater than the transverse at all levels. As the diameters do not change, there is no necessity for such movements of the fetal head as are found in human labor. The pubic symphysis is relatively lower, so that the conjugate of the inlet is relatively increased. The caudal end of the spine is very movable, so that resistance is diminished at the outlet. In the lower mammals the pelvic ligaments and articulations relax markedly in pregnancy, as a rule. The structures of the pelvic floor are relatively weaker than in man and are more easily canalized. There is less tendency to lacerations and to tedious labors. The fetal head is relatively small and somewhat conical, and is usually so attached to the spine that the small end is anterior. Malpresentations, tumors, and fetal complications are rare. The placenta is much more easily shed among the great majority of animals than in the human female. There is no tendency to hemorrhage or sepsis. Psychical and emotional conditions exercise little or no influence. It is interesting to note that domestication is accompanied by increased difficulties in the labor of animals. Town-kept and stall-fed horses and cattle more frequently need help than those living on the plains. Among the more primitive and barbarian races of mankind parturition is less complicated than among the civilized. Though the pelvis is relatively smaller among them, the fetal head is smaller and more conical. The more artificial and luxurious women become, the greater is the percentage of abnormal parturition.

## CLASSIFICATION OF LABORS.

It is best to describe labors under the following divisions:

1. **Natural**, those in which the cephalic end of the fetus presents at the brim of the pelvis.
2. **Preternatural**, those in which the breech or other parts of the body present. They may divide into breech and transverse cases.
3. **Anomalous** or **complex**, those in which there is risk owing to fetal or maternal complications.

Natural labors may be subdivided into:

- (a) **Normal**, those in which the vertex presents and labor is finished without interference within twenty-four hours.
- (b) **Morbid**, those in which vertex cases are delayed or in which the brow or face presents. These are prolonged labors and often demand artificial delivery.

It is very evident that this classification is imperfect, but the same criticism applies to all that have been introduced into obstetric literature. One that would satisfy the canons of logic would be too unwieldy for practical purposes. The one chosen is simple and may serve as a working-basis for the student.

## CLINICAL PHENOMENA OF NORMAL LABOR.

The phenomena of labor are ordinarily studied in three parts:  
Stage I.—Canalization or dilatation of the cervix and lower uterine segment.

Stage II.—Expulsion of the fetus.

Stage III.—Separation and expulsion of the placenta and membranes.

It is difficult to state the exact time of the commencement of labor. Clinically it is usually referred to the first appreciation of the pains of uterine contractions by the mother. This is incorrect if we define the first stage as that in which dilatation or canalization of the cervix and lower uterine segment is brought about, for in many cases some degree of dilatation may be developed though no pains whatever are felt. Moreover, some degree of dilatation may take place in certain cases during the last days or weeks of pregnancy, the mother being quite unconscious of the change. For practical purposes the division of the phenomena into these three groups is satisfactory. Before considering them in detail, it is well to recapitulate the changes that are usually noted prior to the characteristic signs and symptoms of labor. These are variously termed "premonitions," "premonitory" or "precuratory" signs and symptoms.

During the last weeks of pregnancy, the exact period varying in different cases, the soft parts of the pelvis become more softened and relaxed. In primiparæ the head usually descends into

the pelvis; in multiparæ it lies above the brim, though the fundus generally sinks slightly downward and forward. It is probably this increased downward pressure that causes increased congestion, and consequent softening of the pelvic tissues, by transudation of serum into them. It is also a common cause of frequency of micturition, hemorrhoids, and difficulty of walking during the last weeks; occasionally edema of the lower extremities is produced. The sinking of the uterus is usually associated with easier breathing and with improved gastro-intestinal functions. I have already referred to the variations in the size of the cervical canal that may be found during the last weeks. (See p. 97.) Women, especially multiparæ, often complain of dragging and aching in the pelvis, chiefly in the evening hours. These have been termed *dolores presagientes*. The phenomena of actual labor are as follows:

#### FIRST STAGE.

**Uterine Contractions.**—The painless contractions of pregnancy become stronger, and in the great majority of cases cause the woman pain. For this reason the term "true pains" is used as synonymous with "contractions." The woman becomes more restless and likes to sit down, bend forward, or to press on her sacrum. The pain is felt first in the sacral region, gradually moving around toward the pubes. They begin slowly, increase in intensity, and gradually pass off. At first the intervals may be as much as half an hour, afterward becoming shorter. It may show considerable variations. The pains are involuntary and the woman tends to complain or cry out, not holding her breath (as in the second stage). The suffering varies in different cases. Differences are largely dependent upon the nervous temperament of the woman, though they are also related to variations in the physical factors. The essential suffering is due, first, to the contraction of the uterine muscle, being of the nature of the pain caused by tetanic contractions or cramps in other hollow viscera—*i. e.*, intestine, bladder; and secondly, to the stretching of the cervix and lower uterine segment.

During the pains the uterus grows hard and erects itself, the fundus moving forward from the spine. The maternal heart is quickened and that of the fetus slowed. On vaginal examination during a pain the cervical canal is stretched. The true pains of labor must be distinguished from "false pains." These vary in nature and quality. They may be short and sharp, long and continuous, or irregular. As a rule, they are marked by irregularity. They are mostly abdominal, rarely beginning in the sacral region and moving around to the region of the pubes. They may be caused by cramps in the abdominal wall, intestine, or distended bladder; to old inflammatory areas within the abdominal and

pelvic cavities. They are frequent in cases in which there is marked bowel irregularity and in conditions of overfatigue. Some authors believe that they may be produced by irregular contractions of portions of the uterine wall. False pains may be mistaken for true pains. It is usually said that they may be distinguished by the absence of stretching of the cervical canal during the pains, but this is a very unsatisfactory test, since in the very beginning of labor true uterine contractions may not cause any change in the cervix appreciable by the finger. One important test is the condition of the uterine body during the pain. If there is no genuine contraction, it will not become hard when the pain is felt. This is not always reliable, however, since palpation may be unsatisfactory on account of the woman's nervousness, sensitiveness, or thickness of the abdominal wall. If the cause be contraction of part of the uterus, partial hardening may be felt.

**Dilatation of the Cervix.**—With the recurrence of uterine contractions dilatation of the cervix gradually takes place. The

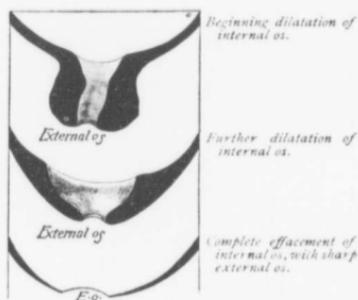


FIG. 69.—Diagram showing the sensation to the examining finger of widening and effacement of the internal os during dilatation of the cervix, and the knife-like edge of the external os (one-half natural size).

process goes on from above downward. If a finger be inserted into the cervical canal, the bag of membranes is felt to grow tense and to press downward firmly against the cervix and adjacent part of the lower uterine segment during a pain, becoming relaxed when the pain passes off. The last portion to be canalized is the lower end of the cervix, which is felt as a thin ring, becoming larger as the first stage advances. In many multiparæ the ring may be irregular in thickness and asymmetric in shape as a result of old laceration and inflammation. With the increase in size of the canal a larger area of membranes is felt. Very often the mucous discharge is tinged with blood during dilatation, the blood coming from the area from which the membranes become

separated. This is often termed "the show." The rate of dilatation varies greatly. As a rule, it is much longer in primiparæ than in multiparæ. It is more rapid in the late than in the earlier stages. When fully canalized the diameter of the os externum should measure at least four inches. Reflex vomiting may occasionally be noticed toward the end of dilatation.

**Formation of the Bag of Membranes.**—As the uterus contracts the force is distributed at right angles to the liquor amnii. The cervix and lower uterine segment playing practically a passive part, and the cervical canal being a point of weakness in the containing wall of the amniotic fluid, it is easy to understand why the lower pole of the amniotic sac should be forced downward. As the lower segment is stretched the membranes separate around the os internum as a result of the disproportion brought

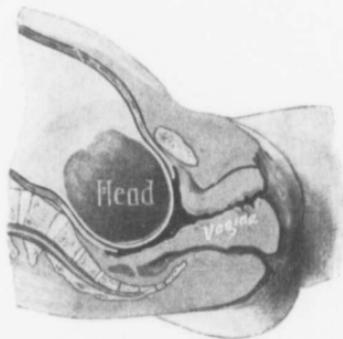


FIG. 70.—Form of membranes during dilatation, watch-glass (Varnier): the presenting part is large and fills the cervix (one-sixth natural size).

about between the membranes and uterine wall. As labor proceeds the area of separation extends upward nearly as high as the retraction ridge. The loosened membranes are known as the "bag of waters" or "bag of membranes." It contains liquor amnii, above which is the fetal head. It forms a hydrostatic dilator when the force of uterine contractions is transmitted through it. It is composed of amnion, chorion, and decidua, the first being the toughest and most important element; the central portion is often composed entirely of the amnion, the chorion and decidua having become separated from it. The bag may roughly be compared to a saucer, being symmetrically rounded. Between pains it is lax and the fetal head may easily be felt above it. During pains it bulges down and becomes very tense; in this condition it may not be possible to palpate the head. In abnormal

cases the bag of membranes may pouch through the cervix somewhat sausage-shaped; in this state it is practically useless as a dilator. In other cases the membranes do not separate from the uterine wall, and thereby cause delay in labor.

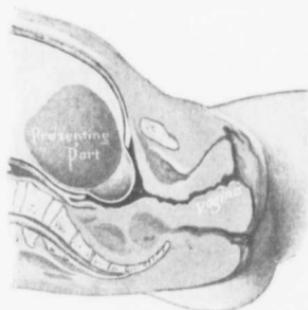


FIG. 71.—Form of membranes with less efficient filling of cervix and pelvis, and larger quantity of forewaters (modified from Varnier).

**Rupture of the Membranes.**—This occurs at various times in different cases. Generally it is noticed a little before dilatation of the cervix is complete; sometimes at the end of dilatation. In abnormal cases rupture may occur prematurely or after dilatation

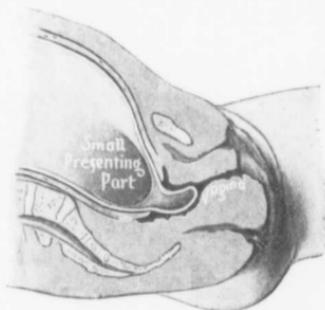


FIG. 72.—Glove-finger form where the presenting part is small (modified from Varnier).

is complete. When the membranes are very tough and do not rupture after dilatation, labor is delayed. Rarely they may not rupture, but may become greatly stretched over the advancing child, being born intact. The rupture is usually central, but it

may be lateral; in the latter form the rent sometimes extends around the bag, so that the latter is born fitting over the head, and known popularly as a "caul." Sometimes a lateral tear occurs prematurely, leading to the slow escape of liquor amnii, a condition sometimes puzzling to the physician. With the rupture there is the escape of a quantity of liquor amnii. The head then comes in contact with the wall of the canal, acting as a plug, whereby the rest of the liquor amnii is prevented from escaping.

Rupture of the membranes must not be described as determining the end of the first stage. It is frequently coincident with the completion of dilatation, but it may take place at other times. The end of this stage is best described as the completion of canalization, with rupture of the membranes. A patient's statement regarding rupture is not always reliable; the dribbling of

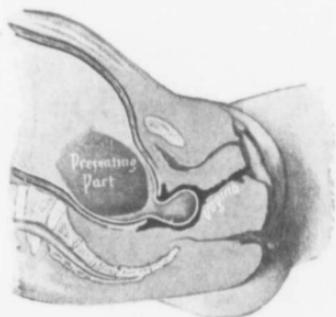


FIG. 73.—Pear-shaped pouch seen with some cases of macerated fetus (modified from Varnier).

urine may be mistaken for it. Rarely there is an accumulation of fluid between the amnion and chorion, which may burst and be regarded as a true rupture.

**Accessory Powers.**—It is generally taught that the accessory muscles are not brought into activity during the first stage of labor. While they play no part in dilating the cervix and ought to be inactive, it is frequently observed that they are employed by the patient toward the latter part of the stage. The patient may frequently control them if she be encouraged, but often she cannot do so.

#### SECOND STAGE.

**Expulsion of the Fetus.**—**Character of the Pains.**—After dilatation of the cervix and escape of the liquor amnii there is sometimes a pause of several minutes, in which the patient may enjoy a little rest or fall into a doze; usually, however, the pains soon

return. They differ in character from those of the first stage. The patient tends to hold her breath and refrain from crying out as she did previously. As the uterine contraction becomes painful she closes the glottis, fixes the diaphragm, and brings into action the abdominal and other accessory muscles that increase intra-abdominal pressure, the viscera being forced downward. This so-called "bearing-down" action is involuntary in character and may often be noticed during unconsciousness; it may, however, be intensified by voluntary effort on the part of the woman. Indeed, she often desires to hold firmly to something with her hands, pressing downward with her feet, thus fixing the thorax and pelvis so that she strains as in the act of defecation. Among many primitive peoples the woman sits or squats in the very position employed during the latter act. In civilized countries she usually lies in bed during this stage, grasping the bedclothes or a cloth tied to the head of the bed, and pressing against an artificial support with the feet, her knees being drawn up. As the pain passes off she frequently cries out. The uterine contractions usually become more severe and more prolonged as the second stage advances; they may become more frequent, especially toward the end. Great variations are found in these conditions in different cases.

**Effect of the Pains on the Maternal System.**—Arterial pressure is increased during the pains. The pulse rate rises until the acme of a pain and then slows. The increase may be largely due to fear, suffering, or nervousness. The respirations become slower during a pain. Urinary excretion is increased as a result of increased blood-pressure. Some authorities state that the temperature rises; others deny this. It is not strange that elevation should take place from marked nervous disturbance, especially in difficult and painful labors.

**Advance of the Head.**—In primiparæ, at the beginning of the second stage in normal cases, the head is usually well within the upper part of the pelvic cavity; in multiparæ the vertex is at or just below the brim level. During the pains the head advances little by little, the rate varying in different cases. On vaginal examination it is found to recede between them. The occipital end gradually rotates, so that when the vulva is reached the posterior fontanel is in the middle line. As the head advances the pubic segment is elevated and compressed behind the symphysis; the sacral segment is bulged downward, so that the perineum is stretched in all directions; its anteroposterior length may amount to 3 or 4 in. At the same time the anus is dilated so that the anterior rectal wall is exposed; it is often D-shaped, the flat side of the letter being toward the vagina. The anteroposterior diameter of the dilated anus may be an inch or even more.

The labia majora and minora are flattened out. The head re-

mains a variable time at the pelvic floor, alternately advancing during the pains and retreating between them, as a result of the recoil of the sacral segment. At this time the swelling of the scalp over the posterior fontanel—the caput succedaneum—becomes more developed, being most marked when the head remains long in this position. As the head descends the fundus uteri sinks, rising again as the head recedes. When definite advance through the vulva takes place the back of the head appears under the pubes, followed by successive portions, the sinciput passing over the perineum, followed by the face. This is usually the most

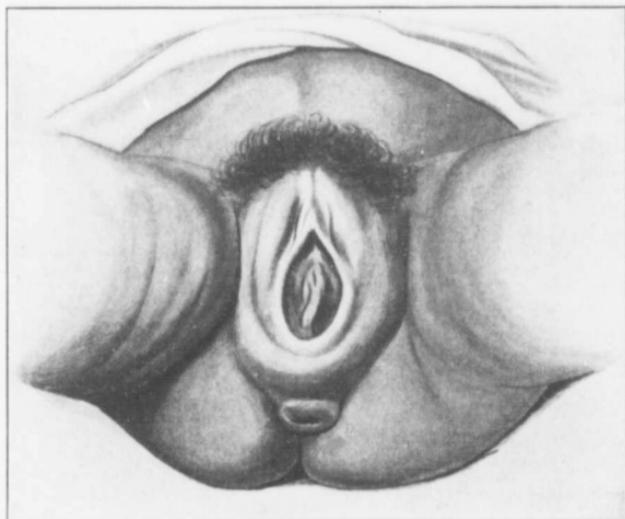


FIG. 74.—Beginning of bulging of perineum by the head, which is visible through the vulvar opening (Bumm).

painful period, the action of the accessory muscles being generally vigorous and for a time entirely beyond the woman's control. In primiparæ the hymen and fourchette are torn, and often part of the perineum; in multiparæ there may be some laceration, but often there is none. The head becomes cyanosed during a pain or continuously; if the latter, it must be regarded as an indication that the cord is compressed or that the circulation through the placenta is seriously interfered with by abnormal pressure on it or by separation of part of it.

Immediately after the birth of the head, or succeeding a short interval, pains return. The head is noticed to rotate so that the

occiput turns to one side—usually that in relation to which it was placed in the uterus. The shoulders are next born, their long diameter being anteroposterior, and afterward the body. Then there is a gush of bloody amniotic fluid. Usually there is no sign of blood until the child is born unless there be laceration of the cervix, lower uterine segment, or vagina. The amount of blood mixed with the liquor amnii varies. It is usually due to some laceration, but may occasionally be due to separation of the placenta.

It is interesting to note the relationship of the fundus and

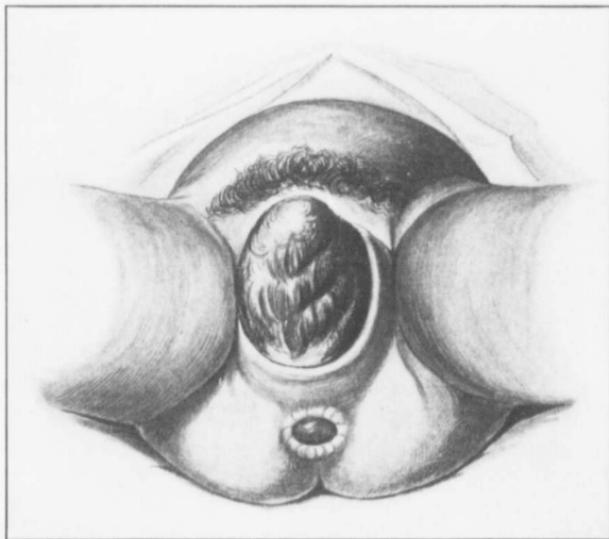


FIG. 75.—Emergence of head from vulva. The caput succedaneum is well shown, and also dilatation of the anus (Bumm).

upper uterine segment during the second stage. The latter becomes elongated in its anteroposterior and shortened in its transverse diameter. The fundus is as high as it was during the first stage, or even a little higher, until the head has begun to escape from the vulva. These changes are to be associated with the retraction of the upper uterine segment, the diminution of the uterine contents as a result of the escape of most of the liquor amnii after rupture of the membranes, and the gradual extension of the body and lower extremities of the fetus.

## THIRD STAGE.

**Separation and Delivery of the Placenta.**—After the birth of the child, accompanied by some liquor amnii, the mother often has a feeling of relief and is inclined to rest quietly. Sometimes she may complain of being faint, though the loss of blood may be small. In some cases there may be a chill of a purely nervous character.

The body of the uterus is easily felt through the abdominal wall, the fundus being at or a little above the level of the umbilicus; it is of firm consistence, though not hard, as during a period of contraction, and may be indented easily with the finger. Ordinarily it is flattened somewhat anteroposteriorly and may lie symmetrically or obliquely. After an interval that varies from a few minutes to a quarter of an hour or more uterine contractions return, causing the woman pains. The body of the uterus becomes very hard and slightly reduced in size. There may be a series of these pains before the placenta is born, some blood escaping at the same time. In the great majority of cases it presents edgewise; occasionally by its fetal surface. Its expulsion from the vagina is due to straining efforts that the woman makes. These may be partly involuntary; sometimes they are absent and the placenta remains undelivered in the vagina. Or her efforts may be unable to expel it while she lies in bed.

In some instances there is no interval whatever between the birth of the child and the expulsion of the placenta, one following upon the other. It is important that the retracted uterus, before separation of the placenta, should be carefully distinguished from the condition in which the placenta lies in the lower uterine segment, cervix, and upper part of the vagina. In the latter case the fundus may stand as high or even higher, riding upon the placental mass; the upper segment is smaller and harder. Sometimes in this state it may relax and fill with blood, so that the outline of the organ may not be palpable. The birth of the placenta is followed by increased retraction and contraction of the uterus, so that the fundus sinks, the largest part of the organ being below the pelvic brim.

**Duration of Labor.**—It is customary to regard twenty-four hours as the limit for normal labors, but this is rather long. Spiegelberg found in 506 cases the average for primiparæ to be 17 hours and for multiparæ 12 hours. Hecker found it, in primiparæ over thirty, 21.1 hours; Ahlfeld, in 82 women over thirty-two, 27.6 hours. The first stage is the longest, but it is very difficult in many cases to estimate its duration, because dilatation may begin before pains are felt by the woman, and because it is impossible to determine accurately when this stage is completed. In multiparæ it may average about  $7\frac{1}{2}$  hours. The second stage in multiparæ lasts about  $1\frac{1}{2}$  hours. The third stage averages from 10 to 25 minutes.

## CHAPTER II.

## ANATOMY AND PHYSIOLOGY OF NORMAL LABOR.

## FIRST AND SECOND STAGES.

## THE SOFT PARTS.

**Form and Dimensions of the Uterus.**—During the greater part of the first stage the position and size of the main portion of the uterine body are not much altered. The exami-

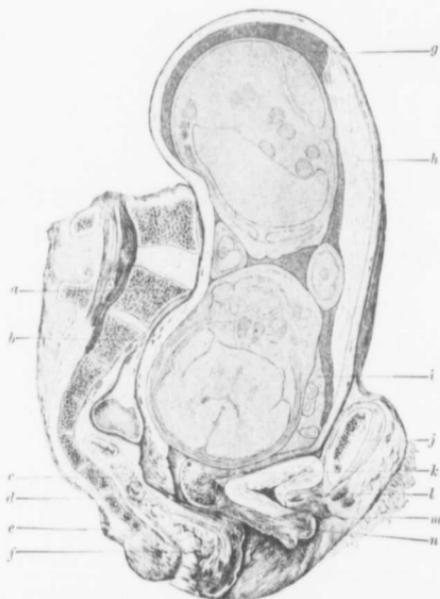


FIG. 76.—Vertical mesial section of a multipara, who died of tuberculosis early in the first stage of labor at full time. The body was frozen (Barbour and Webster): *a*, Promontory; *b*, venous sinuses; *c*, cervix; *d*, pouch of Douglas; *e*, tip of coccyx; *f*, rectum; *g*, liquor amni; *h*, placenta; *i*, left hand; *j*, symphysis pubis; *k*, uterovesical reflection of peritoneum; *l*, bladder; *m*, urethral orifice; *n*, vagina.

nation of frozen sections reveals variations in the height of the fundus, but these are due to various factors—*i. e.*, individual differences in the size of the uterus, variations in the inclination of the pubes, the position in which the body is frozen, the presence

or absence of contraction in the musculature. The influence of primiparity or multiparity is also of some importance. In Pestalozza's first-stage case, a sextipara, the fundus was opposite the first lumbar vertebra, being 11 in. above the pubes; in Pinard and Varnier's, a primipara, it was opposite the junction of the first and second lumbar vertebrae,  $9\frac{1}{2}$  in. above the pubes; in Tibone's, a bipara,  $9\frac{1}{2}$  in. above the pubes; in Schroeder's, a quadripara, in which the uterus lay in the axis of the brim, 8 in. above the pubes.

These figures may be compared with measurements made in

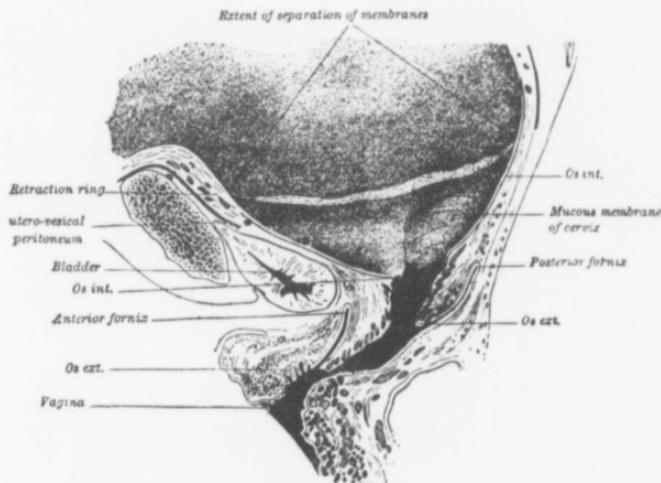


FIG. 77.—Portion of vertical mesial section of Schroeder's first stage of labor case. The head of the fetus and liquor amnii have been removed, and the bag of membranes so far cut away as to show their line of attachment. Note the dilatation of the cervix, the more advanced taking-up of its posterior wall, the thinning of the lower segment anteriorly below the retraction ring, the extent of separation of the membranes, and the bladder not drawn up (from Barbour's *Anatomy of Labor*).

full-time cases. In Braune's and Waldeyer's cases, both multiparae, where the long axis of the uterus lay parallel to the spinal column, the fundus was on a level with the disk between the first and second lumbar vertebrae, 10 in. above the pubes; in Braune and Zweifel's case, a primipara, 11 in. above it. The changes in the first stage do not appear, therefore, to alter the position of the fundus. It is undoubtedly lowered when the anterior abdominal wall is very lax, so that the uterus can fall forward when the woman stands erect. During a strong pain the fundus moves forward and sinks somewhat, the body becoming more globular



FIG. 78.—Transverse section of body of uterus in the first stage of labor (Barbour); *a*, Spinal column of fetus; *b*, fourth lumbar vertebra; *c*, left ureter; *d*, uterus; *e*, left leg of fetus; *f*, placenta; *g*, uterine sinuses.

than in the intervals between the pains; in a case of Barbour's, a sextipara, first stage, the vertical mesial circumference was 28 in.,

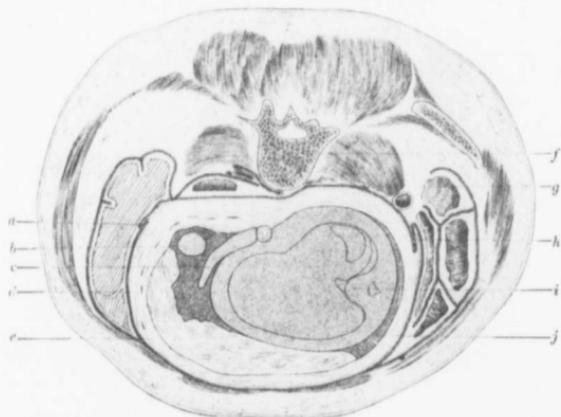


FIG. 79.—Transverse section of body of uterus in the second stage of labor (compare with Fig. 78) (Barbour and Webster); *a*, Right broad ligament; *b*, umbilical cord; *c*, sinus of wall; *d*, wall of uterus; *f*, fourth lumbar vertebra; *g*, left ureter; *h*, left broad ligament; *i*, spinal column of fetus; *j*, liquor amnii.

the widest horizontal 24.2 in., the coronal 26 in. During contraction the uterus is scarcely moulded by the spine and other struct-

ures; between contractions moulding readily occurs. It shows the same variations in position as are found in pregnancy—*i. e.*, it may be slightly lateriverted or rotated.

In the second stage the shape of the uterus becomes altered. Following the diminution of the uterine contents (in Barbour and Webster's second-stage case the amount of liquor amnii in the uterus amounted to 19 cu. in.; in their eighth-month pregnancy it was 26 cu. in.) as a result of rupture of the membranes, the uterine body retracts and becomes less globular, its transverse diameter in particular becoming lessened (I refer to cephalic and

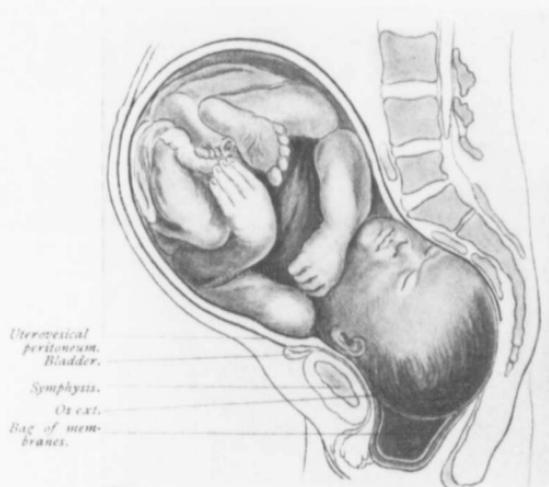


FIG. 80.—Second stage of labor. Reconstruction from frozen sections. Death probably occurred during a uterine contraction. The case is abnormal in regard to the membranes. They are unruptured and bulge downward as a bag as far as the vulva (Braune).

breech presentations). As the head of the fetus descends toward the perineum the fundus does not sink, as might be expected, but either remains stationary or rises. In Barbour and Webster's case (the only normal second-stage specimen yet described) the head of the fetus bulges the perineum and the fundus lies  $9\frac{1}{2}$  in. above the pubes, or opposite the first lumbar vertebra. This position of the fundus is explained by the undoing of the flexed attitude of the child during the progress of labor, leading to its elongation.

In Braune's and Chiari's specimens, in which the second stage is not at all as far advanced, the fundus is at the junction of the

second and third lumbar vertebrae. In the former the long axis of the body is in line with that of the pelvic brim; in the latter it is parallel with the spinal column. The globular shape of the body in Braune's case suggests strongly that death occurred during a period of contraction. In both of these specimens there is the abnormality of unruptured membranes, a condition that necessarily somewhat interferes with the normal change in the shape of the uterus.

During the second stage, in a period of contraction, as the ute-

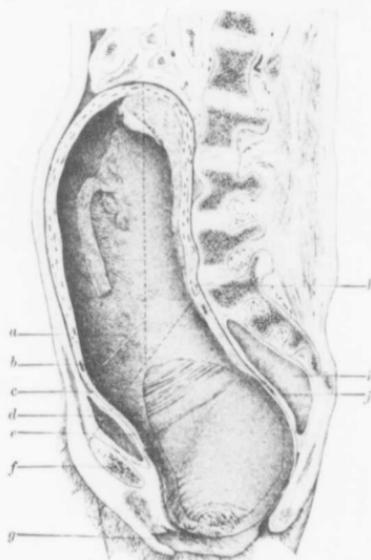


FIG. 81.—Vertical mesial section of a woman who died in the second stage of labor. The fetus and liquor amnii are removed. The case is abnormal as regards the membranes that were unruptured (see Fig. 80) (Chiari): *a*, Limit of separation of membranes; *b*, retraction ring; *c*, utero-vesical peritoneum; *d*, bladder; *e*, os externum; *f*, symphysis pubis; *g*, vulva; *h*, promontory of sacrum; *i*, rectum; *j*, pouch of Douglas.

rine body hardens and moves forward the fundus temporarily sinks somewhat, rising again when the pain has passed. Permanent descent of the fundus only takes place when the head begins to escape from the vulva. As the fetus is born the uterine body retracts so as to embrace the placenta, as is shown in Pestalozza's specimens.

**Differentiation of the Wall of the Uterus.**—As labor

proceeds a marked differentiation of the wall of the uterus above the cervix into upper and lower segments is gradually brought about. During the first stage, as is shown by frozen sections, this change occurs with considerable variability in different cases. In Barbour and Webster's early first-stage case the anterior part of the wall for 2 in. above the cervix is the thinnest portion; the

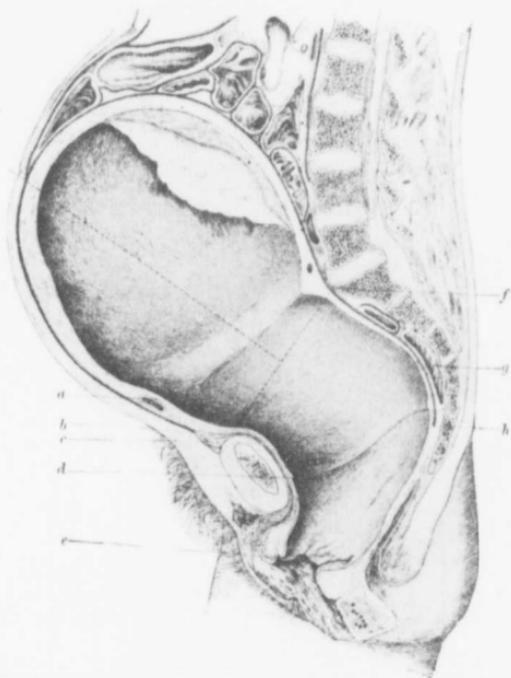


FIG. 82.—Vertical mesial section of woman who died in the second stage of labor during a pain. The fetus and liquor amni are removed. The case is abnormal as regards the membranes which were unruptured (see Fig. 80) (Braune): *a*, Retraction ring; *b*, uterovesical peritoneum; *c*, fundus of bladder; *d*, os externum; *e*, vulva; *f*, promontory of sacrum; *g*, rectum; *h*, pouch of Douglas.

corresponding part of the posterior wall is somewhat thicker, being equal to the thickness of that part of the wall to which the placenta is attached.

In Winter's early case the wall above the cervix, in front and behind, measures 4 mm. in thickness for a short distance, gradually passing into the thicker wall above. In Pestalozza's early case

the wall measures 2 mm. above the cervix, gradually thickening above. In Schroeder's more advanced first-stage specimen the anterior wall above the cervix is 2 mm. thick for a distance of 5.5 cm., beyond which the thickness is four times as great; posteriorly it is 2.8 mm. for a distance of 3.5 cm., then becoming 5 mm. thick.

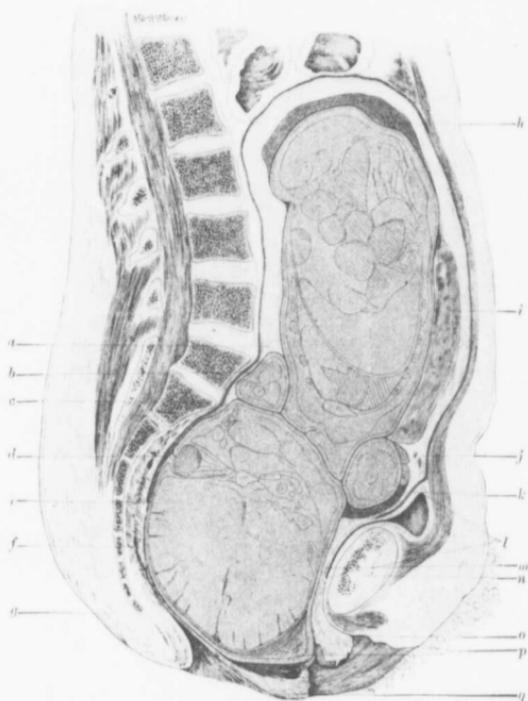


FIG. 83.—Vertical mesial section of a primipara who fatally poisoned herself in the advanced second stage of labor. The body was frozen. The phenomena of labor were normal (Barbour and Webster): *a*, Retraction ring; *b*, lower uterine segment; *c*, promontory; *d*, os externum; *e*, pouch of Douglas; *f*, rectum; *g*, coccyx; *h*, liquor amnii; *i*, placenta; *j*, retraction ring; *k*, lower uterine segment; *l*, bladder; *m*, os externum; *n*, symphysis pubis; *o*, urethral orifice; *p*, caput succedaneum; *q*, perineum.

In this case the transition is so abrupt as to have been termed a "contraction ring" by Schroeder, being about 9.7 cm. above the os internum in front and 9 cm. behind. In the other cases mentioned no such ring can be demonstrated.

In von Saexinger's first-stage case, in which labor began one

month before term, the wall above the cervix is thinner than the part higher up, the posterior being slightly thicker than the anterior. There is a gradual transition between the upper and lower segments. In Winter's first-stage eighth-month case a somewhat similar condition was found. In Lusk's eighth-month case the transition between the upper and lower segments was marked by

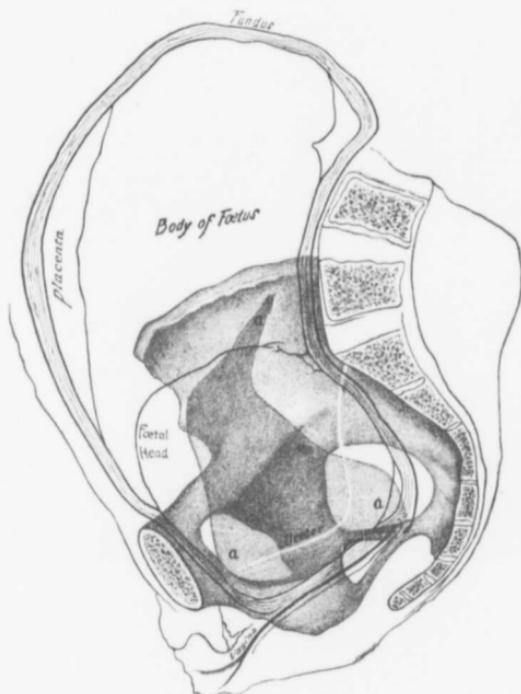


FIG. 84.—Cervix compressed between head and pelvic floor at beginning of labor in a sextipara. (One-third natural size.) (Harbour.) The cervix extends from the tuberosity up to the right-hand *a*; the vagina is shown, and also the ureter and the base of the broad ligament; the area on the side not covered with peritoneum being the shaded space (*a, a, a*).

a ridge (in this case there was probably premature escape of the waters).

The most marked differentiation between the upper and lower segments becomes evident in normal cases during the second stage, and is marked by a sudden transition in the thickness of the wall. The upper segment, while varying in thickness, is generally

much thicker than the lower segment, which may also vary. The lower edge of the upper segment usually projects as a ridge, which has been variously denominated. This ridge varies somewhat in thickness, contour, and position in different cases. It is generally termed "contraction ring" or "retraction ring." In Braune's second-stage case it is 4.2 in. from the os externum and 6.6 in. from the fundus; in Chiari's 2.2 in. from the os externum and 7.7 in. from the fundus. This difference is probably due to the fact that in the former the upper uterine segment is contracting and pulling on the lower segment, while the head is high, stretching it; while in Chiari's the latter has descended low in the pelvis. In Barbour and Webster's second-stage case the ridge is very distinctly marked; above it the thickness of the upper segment varies, being greatest posteriorly ( $\frac{1}{2}$  in.), less at the fundus ( $\frac{7}{16}$  in.), and least where the placenta is attached ( $\frac{1}{4}$  in.). The lower segment averages  $\frac{1}{10}$  in. in thickness. The distance from the os externum to the retraction ring is  $2\frac{1}{2}$  in. anteriorly and  $3\frac{1}{4}$  in. posteriorly, following the curvature of the wall. This difference is due to greater stretching of the lower segment behind than in front, and also to a similar variation in the stretching and thinning of the cervix. The inner surface of the segment below the membranes, which were somewhat separated, has a raw appearance.

**Cervix in Labor.**—Ordinarily the canalization of the cervix takes place from above downward. In primiparæ especially it can generally be made out that the lowest portion in the region of the os externum is the last to begin to dilate. The sections show that the cervix is unequally thinned, the posterior lip being usually elongated more rapidly than the anterior. In the most extreme degree of dilatation the cervical canal has a diameter of four or more inches; its wall has about the same thickness as the lower uterine segment, from which it cannot be distinguished by the naked eye, as the prominence of the wall at the internal os is entirely obliterated. The region of the os externum is easily recognized by the persistence of the fornix vaginae as a narrow slit. In Barbour and Webster's case the latter was  $\frac{1}{4}$  in. deep; the vaginal portion of the cervix was scarcely  $\frac{1}{8}$  in. thick, but it was of sufficiently firm consistence to cause a furrow on the head of the fetus. The inner surface of the dilated cervix was rough and shaggy.

The delimitation of the level of the os internum in the second stage of labor has been a much disputed question. Braune, in his case published in 1872, figured it at the level of the retraction ring. He acknowledged afterward that this was done without any microscopic examination of the tissues. He was evidently in error, placing it too high. Bandl, in his paper in 1876 dealing with rupture of the uterus, also wrongly thought that the lower uterine segment was the thinned upper part of the cervix, the level of the os internum being the ridge afterward known as "Bandl's ring." Chiari published his case in 1878, and from microscopic examination of the wall fixed the upper limit of the cervix above the os externum,

1.2 in. anteriorly and 1 in. posteriorly. Barbour and Webster have made a very careful microscopic study of the walls in their case, and have shown that the cervix does not reach as high as the retraction ring, but is separated by a thin segment derived from the supracerical portion of the

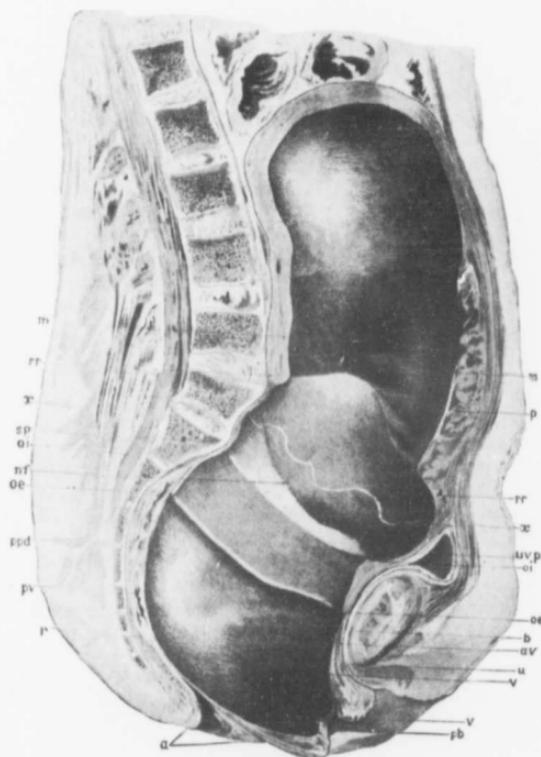


FIG. 85.—Vertical mesial section of Barbour and Webster's second stage of labor case. The fetus and liquor amnii have been removed: *m*, Amniotic surface; the membranes are attached as far down as the wavy line *x*, between the os internum (*oi*) and the retraction ring (*rr*); *p*, placenta; *sp*, promontory of sacrum; *uvp*, uterovesical pouch of peritoneum; *ppd*, pouch of Douglas; *nf*, ridge corresponding to neck of fetus; *oe*, os externum; *b*, bladder-wall compressed behind pubes; *u*, urethra; *av*, *pv*, anterior and posterior vaginal walls; *r*, rectum; *a*, stretched anus; *fb*, stretched perineum.

uterine wall. In their specimen the membranes were firmly attached as low as the retraction ring, below which they were separated. Below the separated edge fragments of membranes were attached in places to the wall. Still lower, remnants of cervical glands could be traced as far as

the os externum. Between the remnants of membranes and those of cervical glands lay *the region of the os internum*—about 1.7 in. above the os externum anteriorly and 1.3 in. posteriorly. Owing to stretching, bruising,

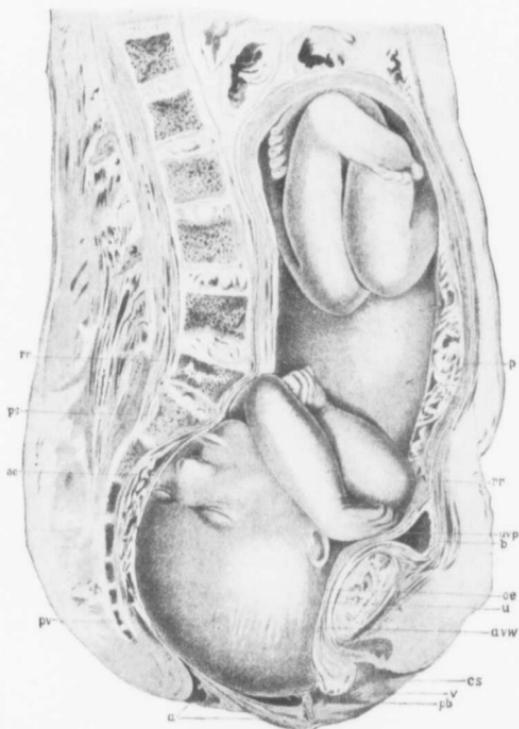


FIG. 86.—Barbour and Webster's second stage of labor case. Reconstruction from frozen sections. In this case labor is farther advanced than in Braune's and Chari's specimens (Figs. 80, 90) and the membranes have ruptured. The flexion of the head on the chest is less than in pregnancy. (See Fig. 112.) The head is at the vulva. It is not completely rotated. The body of the fetus has not rotated, the back being toward the mother's left side (from Barbour's *Atlas of the Anatomy of Labor*): *p*, Placenta; *pr*, retraction ring; *ps*, sacral promontory; *avp*, antero-vesical reflection of peritoneum; *b*, bladder; *u*, urethra; *ae*, os externum; *avw*, anterior wall of vagina; *pv*, posterior vaginal wall; *cs*, caput succedaneum; *v*, vulva; *a*, stretched anus; *pb*, stretched perineum.

and laceration the surface epithelium was considerably destroyed and the glands much separated; it was, therefore, impossible to trace the expanded os internum with absolute accuracy as a definite line. It could only be approximately placed.

Zweifel, in his recent study of a case of placenta prævia, in which turning had been carried out, wrongly describes the cervix as being elongated to 3.8 in. in front and 3 in. posteriorly, fixing the upper limit at the retraction ring. He claimed that Braune was right in his original statement. It is interesting to note that Leopold, in a very similar case, describes the length of the cervix as 1 in.

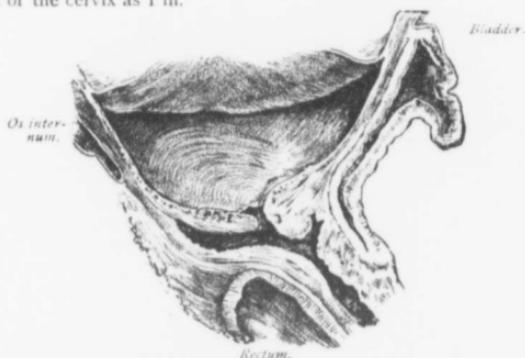


FIG. 87.—Cervix of five and a half months' primipara in dilatation period, with marked irregularity in progress of dilatation of posterior and anterior lips, the posterior being nearly flattened (Winter; frozen section, five-eighths natural size).

The great mass of anatomic evidence undoubtedly goes to show that during labor the vertical measurement of the cervix is normally lengthened not more than about half an inch. The wall of the cervix and lower segment, while enormously stretched and



FIG. 88.—Dilating cervix of eighth-month primipara, with pronounced thinning of posterior lip (Winter; frozen section, two-thirds natural size).

thinned in the second stage of labor, does not entirely lose its power of altering its shape by retraction, for Barbour and Webster's specimen shows thickenings corresponding to depressions on the fetus.

During the first stage, though the cervix is thinned and dilated, so that the os internum is moved away from the os externum, it does not become elevated in the pelvis until dilatation is well advanced. In the second stage both the os externum and the os internum are higher than at the beginning of labor, the elevation of the former being much more marked anteriorly than posteriorly. In Braune's case the distance of the os externum below the brim anteriorly measured  $1\frac{1}{2}$  in., and posteriorly  $3\frac{3}{4}$  in.; in Chiari's, 1 in. in front,  $2\frac{1}{4}$  in. behind; in Barbour and Webster's,

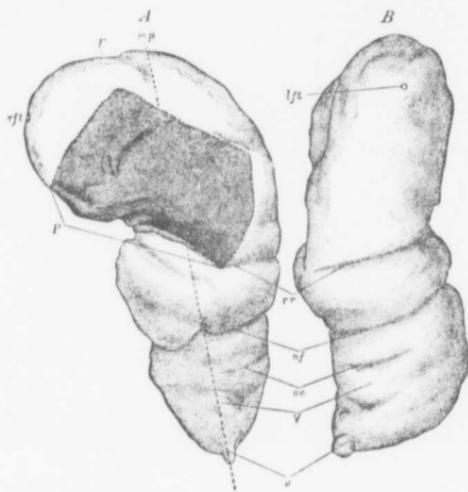


FIG. 32.—Cast of uterine cavity and vagina after removal of fetus and liquor amni in the advanced second stage of labor (Barbour and Webster): *A*, Anterior surface; *B*, left lateral surface. *m.p.*, Mesial plane of body, corresponding to section in Fig. 53; *F*, fundus uteri; *rft*, *lft*, right and left inner ends of Fallopian tubes; *P*, placental area; *rr*, furrow caused by retraction ridge; *nf*, furrow corresponding to depression of neck of fetus; *oe*, os externum; *V*, vagina; *v*, vulva.

$1\frac{1}{4}$  in. in front,  $1\frac{3}{4}$  in. behind. The lower level occupied by the posterior lip of the cervix is due to the greater thinning and stretching of the cervix and lower uterine segment posteriorly.

**Vagina.**—The softened vaginal wall becomes stretched from above downward as labor progresses. The process begins in the first stage, when the bag of waters is forced downward during the dilatation of the cervix. After the waters escape the head of the fetus acts directly on the vaginal walls. In an advanced second-stage case—*i. e.*, Barbour and Webster's, the dilatation is so great that the distance of the anterior from the posterior wall in the

pelvic cavity reaches 4 in.; the wall becomes greatly thinned, especially posteriorly. In Barbour and Webster's case its thickness measured only  $\frac{1}{3}$  in.

The posterior wall becomes stretched in a vertical direction, the anterior wall being scarcely affected in this way. This is most evident when the head is low down, bulging the perineum. Thus, in Barbour and Webster's case the length of the posterior wall from vulva to os externum measured 7 in., the anterior wall being only 2 in. In this specimen a considerable proportion of the elongation belongs to that part of the wall in relation to the perineum, which is much thinned and stretched from above downward. In Braune's specimen, where the head is not so low, the

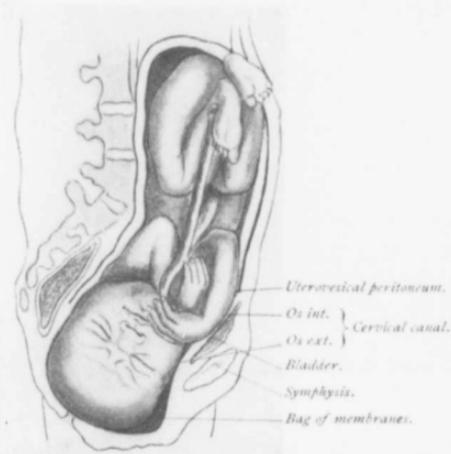


FIG. 90.—Advanced second stage of labor. Reconstruction from frozen sections. The case is abnormal as regards the membranes. They are unruptured and bulge slightly below the head (Chiari).

posterior wall measures 5.5 in. in length and the anterior 2.2 in. In Chiari's, where the head has reached the sacral segment of the pelvic floor but has not begun to bulge it, the posterior wall measures 5 in. and the anterior 2.3 in.

**Pelvic Floor Projection.**—In the first stage there is no change; in the second stage there is a slight increase until the head is actually being born, when it becomes greater. The increase before this act is much less than is generally taught, the explanation being the driving downward and backward of the coccyx and the elevation of the pubic segment of the floor. If

the bag of membranes persists in the second stage, there may be some premature bulging of the floor. The skin distance from coccyx to symphysis increases as the sacral segment is pushed downward.



FIG. 91.—Cast of fetus removed while frozen from case of primipara who died in advanced second stage of labor (Barbour and Webster); *a*, Slight furrow caused by cervix at os externum; *b*, caput succedaneum at vulvar orifice; *c*, groove caused by retraction ridge. The dotted area on the head indicates the position of the anterior fontanel. The length of the fetus from vertex to breech is 13 in.; the flexion of the body and of the head on the chest being less than in pregnancy. The head is partly rotated.

in the pelvic floor during labor have given rise to differences of opinion. A study of the abundant anatomic sections at our disposal should settle all important matters in dispute.

**Bladder and Urethra.**—The urethral orifice normally during labor moves posterior to the plane occupied by it during pregnancy and is slightly elevated. A long-persisting bag of membranes interferes with this change. The junction of the urethra and bladder in the early part of the first stage is scarcely moved from the position occupied by it during pregnancy, but toward the latter part and in the second stage is somewhat elevated. In pregnancy it is placed between  $2\frac{1}{2}$  and 3 in. below the brim. In the advanced second stage (Barbour and Webster) it lies  $1\frac{3}{4}$  in. below.

The bladder itself is variously disposed in the different sections. It has been noted that in pregnancy, in the empty condition, it is almost always found entirely within the true pelvis, only occasionally a small portion rising above the symphysis. In the first stage of labor the same position is found. In the second stage, while the main portion lies below the brim, a small portion is usually found above.

In Barbour and Webster's second-stage case a small pyramidal portion of the bladder reached  $1\frac{1}{4}$  in. above the brim; the lowest level was  $\frac{2}{3}$  in. above the lower edge of the symphysis; its transverse measurement, as it lay compressed against the pubes, was  $4\frac{3}{4}$  in.

**Analysis of Movements in the Pelvic Floor during Labor.**—The changes

have given rise to differences of opinion. A study of the abundant anatomic sections at our disposal should settle all important matters in dispute.

With regard to the pubic segment, it might be supposed (as has been described by some) that, as a result of the forcing down of the uterine contents by labor pains, it would be made to descend. This certainly would be the case were there no restraining force at work from an early stage of labor—viz., the upward traction exercised by the retracting and contracting upper uterine segment on the lower segment and cervix through the attachment of the latter to the bladder and vagina. This upward traction is, however, from the first also counteracted by the thinning of the lower uterine segment and cervix, so that it barely serves during the early part of the first stage to keep the pubic segment in its preparturient position.

There are three factors in operation :

1. The upward traction caused by the retracting and contracting upper uterine segment.
2. The downward pressure of the uterine contents.
3. The thinning of the lower uterine segment and cervix.

For a time in the first stage these factors are so balanced that the pubic segment is scarcely altered. With the advance of this stage the upward traction of the uterus becomes stronger and the downward pressure of the uterine contents on the pubic segment weaker, and gradual elevation of the segment takes place.

As we follow its movement during the second stage its elevation continues, because sections show :

1. That the junction of the urethra and bladder is then higher in the pelvis.
2. That the urethral orifice is higher.
3. That the thickness of the tissue between the lower margin of the pubes and vagina is diminished.
4. That the os externum is higher anteriorly.

Though for a time in the early part of the first stage there is no actual elevation of the pubic segment, the uterovesical pouch of peritoneum tends to be raised as the result of stripping of the peritoneum from the posterior part of the upper surface of the bladder, due to upward traction of the uterus.

Whereas in late pregnancy the os internum and the uterovesical pouch are the same distance below the brim, in the first-stage sections the latter is at a higher level. This difference must be accounted for by the fact that the thinning and elongation of the lower uterine segment are chiefly marked just above the cervix. In the second stage the uterovesical pouch is raised above the brim (it may be as much as one inch).

The pouch of Douglas is not materially altered during labor. In Barbour and Webster's second-stage case the uterosacral ligaments extended from the uterus about an inch above the os externum, backward and slightly downward to the sacrum. Laterally the pelvic peritoneum is somewhat raised, especially anteriorly. The broad ligaments are compressed between the uterus and surrounding structures.

As labor advances, the upward traction of the uterus becoming stronger, the cervix is gradually elevated, and with it that part of the bladder attached to it. Then the upper posterior part of the

bladder is made to slide upward and forward, and the base in its turn, with the rest of the posterior part of the pubic segment, moves in the same direction. This process goes on until the bladder lies behind and partly above the pubes, its cavity then appearing on vertical mesial section as a slit directly continuous with the urethra, parallel to the pubes and to the cervix, which lies close behind it. The pubic segment might, therefore, be described as moving in the arc of a circle whose center is the attachment to the lower part of the pubes of the anterior true ligaments of the bladder (anterior visceral layer of the pelvic fascia); the lower and anterior portion of the segment is very little raised, the posterior part to a considerable extent.

Accompanying the uterine traction are two other factors that help to move the pubic segment upward and forward—viz., the stiffening and forward movement of the uterine wall during the pains, and the compression by the head after it has descended through the dilated cervix into the pelvic cavity. As the latter advances the resistance of the sacral segment tends to press it still more strongly against the pubes.

As has already been pointed out, only a small part of the bladder rises above the brim. In Braune's second-stage case its highest point is  $\frac{3}{4}$  in. above; in Chiari's 1 in.; and in Barbour and Webster's  $1\frac{1}{4}$  in. In the latter labor is further advanced than in the other cases, in which it is to be noted that the bag of membranes is unusually persistent. It is probable that such a condition of the membranes interferes somewhat with the normal elevation of the pubic segment. It does not appear that the urethra is at all elongated during labor. Hart has shown that it becomes somewhat dilated as a result of stretching of the vaginal wall during the second stage.

**Tissues Outside of the Genital Passage.**—As the fetus descends into the pelvic cavity the paracervical and paravaginal tissues are greatly stretched and pressed toward the bony walls. In Barbour and Webster's case the posterior vaginal wall is  $\frac{1}{2}$  in. from the middle of the sacrum and  $\frac{3}{8}$  in. from its lower end.

Although the vagina and cervix are greatly thinned in advanced labor, the risk of laceration in them is greatly lessened by the elastic support given them by the tissues packed between them and the pelvic wall.

Hart has pointed out that (apart from the perineal region) the upper part of the posterior vaginal wall is the weakest and most apt to be torn in labor. It ruptures less frequently than the cervix and lower uterine segment. The compression of the empty rectum shows how any distention of it will interfere with the roominess of the pelvic cavity.

In the advanced second stage the tissues of the sacral segment are driven downward, the coccyx being bent backward, the anus

and perineal body being pushed downward and forward as the head advances toward the outlet. As Hart has pointed out, that part of the sacral segment in front and inclusive of the anterior rectal wall is elongated and driven forward more markedly than the postanal portion, the anus being opened up so as usually to assume a D-shape, the straight side being anterior. In a number of measurements Hart found the average anteroposterior diameter to be about 1 in., the greatest transverse being about  $1\frac{1}{4}$  in. The former diameter is greatest while the head first bulges the perineum; the latter when it is passing. There are occasional deviations from the above-described shape.

The modification of the bony canal by the soft structures has

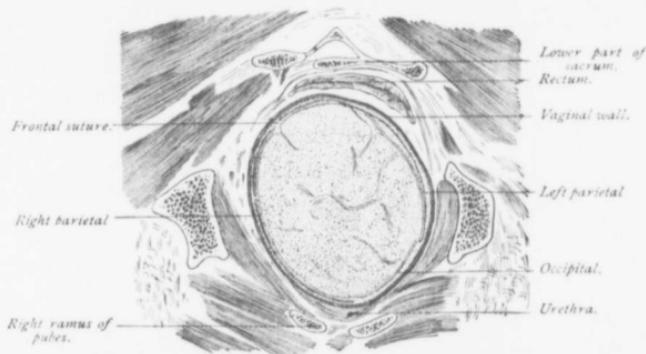


FIG. 92.—Transverse section of the pelvis in the second stage of labor. Note the somewhat oval shape of the genital canal and the moulding of the head (Barbour and Webster).

been well demonstrated by frozen sections. At the brim the transverse diameter is shortened by the psoasiliacus muscles. When the thighs are extended and the muscles tense they interfere with the brim space more than when the thighs are flexed and the muscles relaxed. The blood-vessels that cross the brim exercise a very slight influence in shortening the diameters. When the fetus is very large or the bony pelvis undersized the pressure upon them may be very marked.

The rectum usually crosses the brim on the left side, and so causes a shortening of the left oblique diameter. Frequently a fold of the sigmoid flexure may descend into the pelvis, helping further to interfere with its roominess. The bladder compressed behind the pubes causes a shortening of the conjugate. In the second stage of labor the brim diameters are further diminished by the thickness of the uterine wall. The exact amount of interference caused by the soft tissues cannot be definitely stated. They

are capable of compression, and variations occur. From a study of frozen sections it seems that the conjugate of the brim is ordinarily lessened about half an inch.

The bony cavity is diminished by a variety of structures. The rectum, below the brim, may be on the left side, but often may cross to the right before descending. The compressed bladder shortens the conjugate. The walls of the cervix and bladder and the loose connective tissue connected with them shorten all the diameters. The pyriformis, obturator internus, and levator ani muscles interfere with the roominess of the cavity, especially laterally. This interference is increased by the resistance of the visceral layers of the pelvic fascia to the advancing fetus.

Barbour and Webster's section of the pelvis during the second stage shows how markedly the bony cavity is altered, so that the shape of the genital passage on transverse section is oval, the long diameter being anteroposterior, and even this is shorter than the corresponding bony conjugate by  $\frac{3}{4}$  inch.

#### PHYSIOLOGY.

**Causes of the Onset of Normal Labor.**—The determining cause of the commencement of labor is not known. The following views have been advanced:

1. Increasing irritability of the uterus, the normal contractions that occur during pregnancy becoming more pronounced.
2. Stimulation of the nerve centers related to the uterus. Brown-Séquard believed that this was due to increased  $\text{CO}_2$  in the blood. Others think that it is caused by chemical substances.
3. Changes in the decidua, especially diminution in the caliber of the maternal vessels by thickening of their walls, thrombosis, or the constriction of surrounding connective tissue.
4. Increasing tension on the uterine wall.
5. Diminished resistance in the lower part of the uterus owing to softening of the cervix.
6. Increased movements of an enlarged fetus.
7. Habit and heredity.
8. Menstrual periodicity. Tyler Smith advanced the view that pregnancy was normally interrupted at the time corresponding to the tenth menstrual epoch.
9. Exciting causes—*i. e.*, exercise, emotion, etc.

These views are entirely speculative. Several factors may be concerned. The uterus is probably more irritable toward the end of pregnancy owing to its increasing size, the weight of the fetus, the influence of substances circulating in the blood acting on central and peripheral nerve structures and even on the uterine musculature; the quantity of  $\text{CO}_2$  in the blood is probably increased. There are well-marked changes in many of the vessels

of the decidua, the flow of blood through them being more or less altered. The cervix usually becomes very soft and dilatable. Whether the influence of the tenth missed menstrual period is important is uncertain. Tyler Smith believed that the supposed pelvic congestion and general disturbance played a part in determining the onset of labor at this time. Certainly in early pregnancy we know that abortion frequently occurs at the time corresponding to a menstrual epoch.

**The Uterus during Labor.**—*Historic.*—Until the middle of the seventeenth century the uterus was believed to be inactive during labor, the fetus being thought to deliver itself by its own efforts. It was Harvey who first described uterine contractions, having noticed them in a parturient bitch. In 1857 Calliburces removed the uterus of a parturient animal and observed that uterine activity continued so as to expel the fetus.

Spiegelberg, in 1858, experimented on the uterus *in situ* and found that compression of the aorta caused uterine contractions.

Kehrer, in 1863, studied artificial production of peristaltic movements by heat. Körner, in 1864, noted movements when all nerves leading to it were divided and when the uterus was irritated. Reimann, in 1869, noticed that an excised uterus placed in a chamber at blood temperature underwent rhythmic peristalsis, which was checked by a rise or fall of temperature.

Schlesinger, in 1874, after division of the cervical spinal cord of a bitch, noticed that stimulation of the sciatic nerve produced uterine contractions.

Runge, in 1878, experimented on the uterus *in situ* on the living animal, testing the reaction to hot and cold water.

Rein, in 1880, published a series of observations to the effect that the severance of the uterus from its cerebrospinal or sympathetic nerve connections does not interfere with conception, pregnancy, or labor. He stated that the cervical ganglia were of no importance as automatic uterine centers.

Frommel, in 1882, first registered uterine movements graphically. He described spontaneous rhythmic contractions in the virginal, pregnant, parturient, and puerperal uterus of the rabbit, and confirmed Rein's statement that the movements are independent of an extra-uterine center.

Jacob, in 1884, confirmed and enlarged upon Frommel's observations. He found that rapid loss of blood abolishes uterine contractions; that large doses of curara, morphia, and chloral slowed contractions, chloral also diminishing their intensity; strychnin strengthening contractions. A uterus separated from the body under favorable conditions retains for a long time the power of contracting. Intermittent electric stimulation strengthens contraction and causes new ones; strong interrupted currents interfere with them. Electric stimulation of the medulla has no perceptible influence on them in normal conditions; after division of the cord at the first dorsal vertebra, or between the first and second cervical vertebrae, electric stimulation of the medulla inhibits contractions. Electric stimulation of the spinal cord after separation from the medulla strengthens contractions or starts new ones; stimulation of the lumbar region is most effective. Electric stimulation of the central end of the divided sciatic nerves when the medulla and spinal cord are intact has no particular effect on uterine contractions; if the medulla be separated from the cord such stimulation strengthens contractions. Jacob clearly proved that an excitatory center for

uterine movements exists in the lumbar cord, an inhibitory center in the medulla oblongata. His experiments also show that the rabbit's uterus is influenced by induced electricity differently from the lymph heart and blood heart of frogs, which are of striped muscle, acting rhythmically.

Goltz divided the spinal cord of a bitch at the first lumbar vertebra. Later she went into heat, became pregnant, and gave birth to two pups, one of which was dead; the other she suckled.

Helme, in 1891, carried out a series of experiments on the virginal, pregnant, and puerperal uterus of the sheep, and observed that in all these conditions it exhibited regular and rhythmical contractions, which continued after removal from the body if artificial circulation were kept up; the movements being, therefore, independent of all extra-uterine nerve centers. He proved that they are not due to any rhythmic contraction and relaxation of the vessel walls, but either to an inherent rhythmic function of the muscle cells themselves, or to the influence of nerve ganglia in the uterus acting on the muscle cells through non-medullated nerves.

He analyzed the contraction curve and found it to consist of three parts:

1. The contraction.
2. The maintenance of contraction.
3. The relaxation.

These movements were strongest and most prolonged during early pregnancy; weaker in the puerperium and in the multiparous uterus; weakest in the virginal state. During contraction the uterus was relatively anemic, due to compression of vessels. This is different from the condition in striped muscle, in which during contraction hyperemia exists.

Relaxation after contraction was shown not to be due to refilling of the blood vessels, because it was noticed in an excised organ when there was no circulation. Helme believed relaxation to be due either to elastic reaction of the muscular fibers or to active contraction in another plane. The arrest of the arterial supply caused immediate contractions of the uterus, followed by a weakening and cessation. Clamping of the veins caused a slowing, then irregularity, weakening, and cessation. The circulation of venous blood caused increased strength and rapidity, followed by gradual cessation. Mechanical irritation caused marked contractions.

The physiology of the uterus in the human female is not as well known as it is in various animals which have been subjected to experimentation. The periodic contractions of pregnancy have already been described. The causes determining the onset of the marked contractions that initiate the phenomena of labor in normal cases are not known. They take place entirely involuntarily, though they may be inhibited more or less by mental conditions, especially during the first stage. They may continue in various states of coma or anesthesia. Irritation of the nipples may often stimulate them reflexly. Direct massage of the uterus through the abdominal wall increases them.

While in many of the lower animals with bicornute uterus the contractions occur as peristaltic waves that pass from the outer ends of the cornua toward the vagina, in the human subject no such peristalsis takes place, or if it does it is too rapid to be traced. The hardening of the uterus appears rather to take place in all parts of the active segment at the same time, there being at first

a period of increasing intensity, then one in which there is maintenance of the most marked contraction; afterward relaxation gradually takes place. These phases vary greatly in different stages of labor. The contractions increase in duration and intensity as labor advances, though with many variations in different cases. Intermittency of contractions safeguards the life of the fetus. Continued activity would so interfere with the circulation as to endanger the normal respiratory processes in the placenta. After the escape of the liquor amnii these risks would be increased. During well-marked pains the body of the uterus stiffens and moves forward somewhat. It has been stated that rotation on the long axis takes place, but there is no proof of this. (In the sheep Helme has observed coiling of the outer ends of the cornua and a movement toward one another during contractions.)

The relationship of the uterus to the cerebrospinal and sympathetic nervous systems has been already noted. Experiments on animals have strongly suggested the existence of an excitatory center in the lumbar region. The work of Schlesinger and others shows that stimulation of nerves connected with the lumbar region can reflexly bring about uterine contractions, and it is possible that irritation of the vagina, cervix, or even of the body of the uterus, may act in this way. Lusk, Jacquemart, and others have reported cases in which the cord has been destroyed above the lumbar region, labor taking place naturally afterward. The influence of the brain on the lumbar center is probably one of an inhibitory nature, which ordinarily is little marked in comparison with the involuntary activity of the uterus.

Mirabeau has recently studied a case of labor in which the mother suffered from advanced tabes dorsalis. There was absence of the patellar reflex, unconscious micturition and defecation, and complete paralysis of the lower extremities; sensory impulses were absent as high as the bladder and rectum, and presumably as high as the uterus. Labor was very easy, the pains being strong; they were not felt by the woman; indeed, the cry of the infant was the first intimation she had that the child was born. From this case Mirabeau concluded that the uterine activity was due to a motor center in itself, labor continuing though the nerve arc between the uterus and lumbar region of the cord was destroyed.

The sympathetic ganglia in the uterus are probably also able to induce rhythmic contractions. Cases in which contractions occur after the death of a woman are probably those in which the ganglia determine the activity. Experiments on animals show clearly that rhythmic contractions may take place in the uterus separated from the body if it be kept in favorable conditions. It is believed by many that irritation of the uterus, producing contractions, may act through these ganglia, but it is also possible that such stimulation may act directly on the muscular tissue.

Whether the lumbar center or the uterine ganglia play the most important part in inducing and continuing labor is not known. Probably the increased activity of the uterus as labor progresses is due to increased stimulation of nerves as a result of the stretching of tissues in the cervix and lower uterine segment; and, after escape of the liquor amnii, to pressure of the firm fetus against these structures. Various attempts have been made to estimate the amount of force exerted by the uterus during contractions and the amount necessary to rupture the membranes, but with no very satisfactory results.

How much of the uterine wall undergoes contractions at the beginning of labor is not definitely known, but it is probable that all above the cervix is active. As the first stage of labor advances, the lower uterine segment, becoming stretched, thinned, and pressed upon by the bag of membranes and fetus, probably loses its contractile power to a considerable extent. During the second stage—*i. e.*, when there is complete canalization of the cervix and lower uterine segment, the latter continues to be practically passive so far as contractions are concerned. The active contracting portion is the upper uterine segment, which in the second stage is distinctly thicker than the lower segment, the transition from one to the other being abrupt, the lower edge of the upper segment forming a distinct ridge.

I have already shown that this ridge—variously known as Bandl's ring, retraction ring, contraction ring—does not represent the upper limit of the cervix as was first believed, but rather the junction of the upper and lower segments of the uterine body. Bandl believed it to be developed in obstructed labor, first describing it in a case of ruptured uterus, and he regarded it as placed at the upper limit of the thinned-out cervix. Now it is known that it occurs in all labors, though it may vary as regards the degree of its development. It was termed "contraction ring" by Schroeder, who regarded it as the lower limit of the active contracting part of the uterine wall. While it undoubtedly does mark the lower boundary of the contracting zone, it is not to be regarded as due to the contractions, for it is present when contractions are absent—*i. e.*, between uterine pains. Lusk suggested the name "retraction ring" as more satisfactorily explaining its formation. He pointed out that it is really the lower margin of that part of the uterine body that undergoes the change termed retraction—*viz.*, increasing thickness of the wall, accompanied by diminution of area, a process that is persistent during labor and is to be distinguished from the temporary change caused by contraction. Barbour is a strong advocate of Lusk's terminology, but has suggested that "rim" or "edge" would be better than "ring," since its true nature would thus be suggested.

**Nature of Retraction.**—There is considerable uncertainty

as to the nature of uterine retraction. Some have held that it is of the nature of an elastic recoil in the musculature, but very little importance can be attached to this factor, for the elasticity of the muscle is very slight, and there is little true elastic tissue in the wall outside of the cervix. Matthews Duncan's suggestion that "the elasticity of the peritoneal covering is probably the chief element in the elasticity of the uterus generally" cannot be supported. There seems to be little doubt that the thickening of the wall termed retraction mainly results from physiologic activity in the muscle fibers that cannot be considered independently of

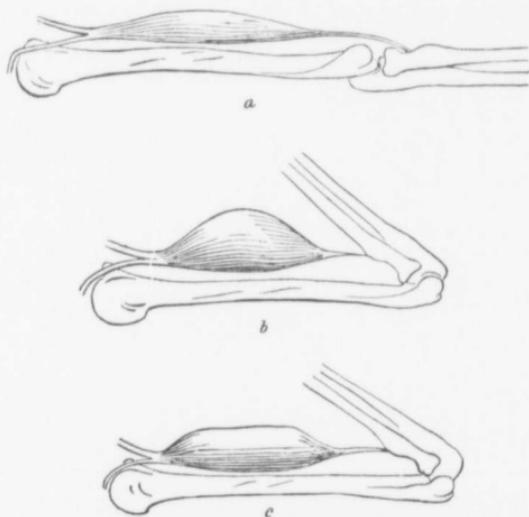


FIG. 93.—Diagrams illustrating different conditions of muscle: *a*, Biceps extended to fullest extent; *b*, biceps in active full contraction; *c*, biceps in passive full relaxation (retraction) (Horrocks).

uterine contractions. Matthews Duncan and others have held that retraction is a distinct and separate function, and that it may go on without contractions. Most hold, however, that retraction is dependent upon contraction, being in fact a condition of permanent shortening of the muscle after the active contraction has passed off. Helme, in experimenting on the uterus of the sheep, noted that after each contraction the relaxation period was not complete—*i. e.*, there was a certain maintenance of contraction, the individual muscle fibers not quite returning to their precontracted state.

Horrocks has recently elaborated this view. He points out

that there has been confusion in the description of muscle in various states, especially as regards the term relaxation. It is necessary to distinguish between a relaxed shortened muscle and one that is lengthened and relaxed. In all probability no muscular fiber, if disconnected from its usual attachment, is capable of returning to its former lengthened condition. Horrocks instances the experiment of stimulating a detached frog's muscle placed on

mercury. Extreme shortening, thickening, and hardening is produced; if the stimulus be withdrawn the muscle relaxes but remains shortened, though less spheroidal. Similarly, when the biceps of one's arm is markedly contracted the muscle becomes short, thick, rounded, and hard. If in this state the forearm be supported by the other hand, so that the hardening of active contraction disappears, a relaxed condition of the muscle is produced, in which the belly is still short and thick though much less marked than during active contraction. This state of relaxation and shortening is retraction. It is complete when it occurs after the muscle has been previously shortened by

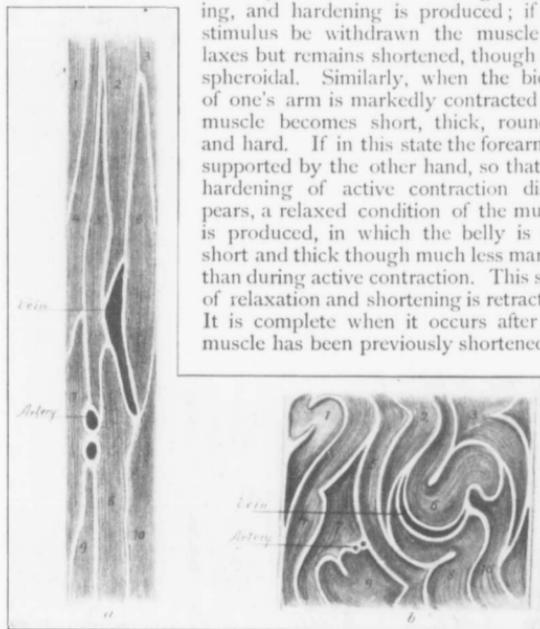


FIG. 94.—Diagram illustrating the change in the arrangement of the muscular bundles produced by labor (Bumm): *a*, Condition during pregnancy; *b*, condition after delivery.

active contraction as much as possible; partial when it follows only a partial contraction of the muscle. It is of importance to note that these same degrees of retraction may be produced without previous active contraction. Thus, if from a state of complete extension the forearm be lifted toward the shoulder by the other hand, without any voluntary contraction of the biceps, the muscle shortens and thickens somewhat though remaining relaxed, and

corresponds exactly to the condition in which, after active contraction sufficient to raise the forearm to a similar position, relaxation occurred. The uterine muscular fibers, like all others in the body in a condition of health, possess a certain tone and tendency to shorten. In the majority of cases this is counteracted by the action of opposing muscles, by the recoil of elastic tissues, the weight of structures, etc. The pregnant uterus being a hollow muscle filled with fluid is subjected continually to a certain degree of hydrostatic resistance, which acts equally everywhere at right angles to the containing wall. This resistance is increased during the painless contractions that occur at varying intervals throughout pregnancy, and it prevents the uterus from remaining retracted—*i. e.*, shortened in the interval of relaxation.

When labor begins the hydrostatic pressure, being increased during the stronger contractions, gradually causes canalization of the lower uterine segment and cervix. As a result of this increasing weakness in the lower part of the uterine sac there is a growing tendency toward the alteration of the upper segment of the uterus by retraction—*i. e.*, the relaxing musculature remains a little shortened. In the great majority of cases this change is not appreciable so long as the membranes are firm and unbroken, for being elastic their retraction after each pain helps to make up for the diminishing support of the lower part of the uterus. Normally toward the end of the first stage, after the lower portion of the membranes has been repeatedly stretched and thinned, the beginning of retraction in the upper uterine segment may usually be noted. In abnormal cases, in which the membranes rupture prematurely or are pouched downward through the cervix on account of their thinness, the area of hydrostatic resistance in the uterus is lessened and retraction of its musculature follows. Normally no retraction ridge is developed during the first stage; if it be found at this time, it is probably to be associated with premature escape of the liquor amnii (as in W. C. Lusk's case). The ridge may, however, be developed, though there be long delay in rupture of the bag of membranes, after the second stage has commenced, because the descent of the bag and fetus into the pelvis allows marked retraction of the uterine body to take place. (See Braune's second-stage case.)

When the membranes rupture normally the characteristic retraction-changes in the uterus begin to be clearly marked. As the contractions follow and the child descends retraction continues; it is mainly marked in the upper segment. The result of the process during that part of the second stage in which the fetus descends to the perineum is a diminution in the upper uterine segment, more marked circularly than longitudinally, the wall becoming thickened. (As has been pointed out, the height of the fundus is not lowered during this part of labor.) The process is

simply one in which there is a rearrangement of the bundles of muscular and other tissues in the uterine wall as the latter accommodates itself to the diminished bulk of its contents. That part of the upper segment on which the placenta is situated undergoes the least retraction, probably because it forms a mechanical obstruction to a reduction in size caused by its attachment. The lower segment and cervix show no uniform retraction because their tissues are continually stretched by the fetus. Their tissue may, however, retract when they come into relation with an indentation on the fetus—*i. e.*, that between the shoulder and neck; in such a relation the wall thickens and fits into the space. (See Barbour and Webster's second-stage case.)

A comparison of different frozen sections shows that there are variations in the thickness of the upper uterine segment caused by retraction in labor. In each case the thinnest portion is that to which the placenta is attached. Irregularities in the contour of the rest of the wall during the second stage are due to unequal retraction, depending upon variations in the relationship of the wall to the fetus. During the second stage there is much less liquor amnii in the uterus than during the first stage; it mainly accumulates in the fundal region, though it tends to fill gaps caused by irregularities in the fetus. In some parts these irregularities are filled by corresponding bulgings of the retracting uterine wall (well shown in Barbour and Webster's second-stage specimen). The position and thickness of the retraction ridge also vary in different cases, but the explanation of the variations is not always certain. The more prolonged the second stage the higher it tends to be placed. In cases of badly obstructed labor, due to such conditions as fetal hydrocephalus, impacted transverse presentations, the ridge may be markedly elevated as the result of excessive retraction.

Its development is undoubtedly affected by the position of the placenta. It probably does not form in that part of the wall to which the placenta is attached unless the latter becomes separated. In Barbour and Webster's second-stage specimen the retraction ridge followed the outline of the lower edge of the placenta and was moulded upon it.

The most marked retraction in the uterus follows the birth of the child, and may often take place without any accompanying hardness such as is due to marked contractions. This is particularly exhibited in the upper uterine segment, but is also found in varying degrees in the lower segment and cervix. This is well shown in Pestalozza's sections of the beginning of the third stage. At this time, also, that part to which the placenta is attached is least retracted. (See p. 216.) Similarly, in cases of Cæsarean section where the operation is carried out before labor has begun, incision of the uterus and removal of its contents are usually fol-

lowed by immediate retraction of the uterine wall, which becomes markedly thickened, without any accompanying hardness, such as is caused by active contractions. The latter, of course, may afterward take place.

Again, as Webster's sections demonstrate, immediately after the placenta and membranes are delivered further retraction characterizes the whole uterine wall, being most marked in the upper segment, less in the cervix, and still less in the lower segment. Within twenty-four hours the latter undergoes such retraction as to be obliterated. The part that changes most slowly is that immediately above the cervix—viz., that which was most stretched and thinned in labor.

**Mechanism of the Canalization of the Cervix and Lower Uterine Segment.**—The following factors are concerned in this process:

1. The most important is the pressure of the bag of waters. This bag is formed of the membranes that become gradually separated from the inferior part of the lower uterine segment, because this part is passive, or relatively so, as compared with the upper active portion of the uterus; it contains the liquor amnii that lies below the presenting part of the fetus. The membranes are elastic and stretch somewhat under pressure. The liquor amnii transmits the force of uterine contractions equally in all directions, and, as the least resistant part of the containing wall is the cervix and lower uterine segment, gradual increase in the canal of the cervix is brought about. The dilating force becomes greater as dilatation advances, for the hydrostatic pressure increases with the area of surface against which it is directed. The os internum is gradually obliterated and is merged in the lower uterine segment, so that henceforth the obstructing ring is the os externum. In cases in which there is premature rupture of the membranes, labor is delayed because canalization is slow. The presenting part of the fetus then comes directly into contact with the cervix and lower segment, and is a much less satisfactory dilator than the bag of waters.

In such cases a *caput succedaneum* usually forms, and this improves its dilating power.

2. **Relaxation of the Tissues of the Cervix.**—The increased softening of the cervix that is usually noted previous to labor, and which in *multiparæ* is often associated with slight dilatation of the canal, becomes intensified when labor begins, as a result of serous infiltration of the tissues. This is due to the increased hyperemia of the cervix during the uterine contractions. The softening thus produced greatly facilitates dilatation. In cases of *placenta prævia*, where there is excessive vascularization of the lower uterine segment, the tissues are more infiltrated than in normal cases and dilatation is more easily accomplished. The vagina becomes

softened and relaxed in a similar manner and usually dilates slightly before the bag of membranes or fetus reaches it.

There is also a special physiologic relationship between the upper uterine segment and the cervix, termed the law of polarity, whereby when the upper part contracts the cervix relaxes. The lower uterine segment also shares in their relaxation. In some cases of labor this law is not observed, abnormal hardness of the cervix, due to contractions of the circular muscular fibers in it, occurring regularly or irregularly during the pains.

3. **The Upward Traction Exercised by the Retracting and Contracting Upper Portion of the Uterus.**—This is an unimportant factor in producing dilatation, and probably is mainly efficient in the latter part of the process. Sections show that the position of the cervix is scarcely altered during the greater part of the first stage, the upward traction being counteracted by the thinning and stretching of the lower uterine segment. Later in labor the upward traction does cause some elevation, owing mainly to the increase of retraction in the upper segment. The fundus cannot sink until the head begins to pass over the perineum, because the breech of the fetus remains at about the same level, as a result of the undoing of its flexed attitude. The upper end of the fetus (with the fundal liquor amnii) offers a constant *point d'appui* over which the upper segment contracts and retracts. Contraction of the longitudinal muscular bundles in the lower uterine segment, described by some as a factor in dilating the cervix, is probably of very slight importance.

4. The weight of the uterine contents may help slightly in dilating the cervix if the woman sits or walks about during the first stage; but it is not an important factor.

#### BONY PELVIS.

An exact knowledge of the bony canal is necessary to the student of obstetrics. The detailed account of its constituent elements, its evolution, its function in protecting the viscera and in transmitting the weight of the trunk are to be found in anatomic works. Here consideration need only be given to the pelvis as a whole, as furnishing a bony passage through which the fetus passes. The bony pelvis is described obstetrically as consisting of two parts—false and true.

The false pelvis is that part that lies above the true brim, being made up of the iliac wings and the lower lumbar vertebræ. The iliac fossæ in the normal pelvis are sometimes compared to shallow saucers. In the erect posture their inner surface looks forward and inward. The pelvic brim is formed by the upper margin of the pubic bones, the iliopectineal lines, and the upper anterior edge of the sacrum. The plane bounded by this line is an irregular one, consisting of a mesial elevated portion extending from

the top of the symphysis to the sacral promontory, and of two lateral parts sloping down toward the rest of the brim. The



FIG. 95.—Female pelvis seen from the front (one-third natural size).

highest part of the plane is the middle of the promontory, which is about an inch above the lateral and anterior levels of the brim.

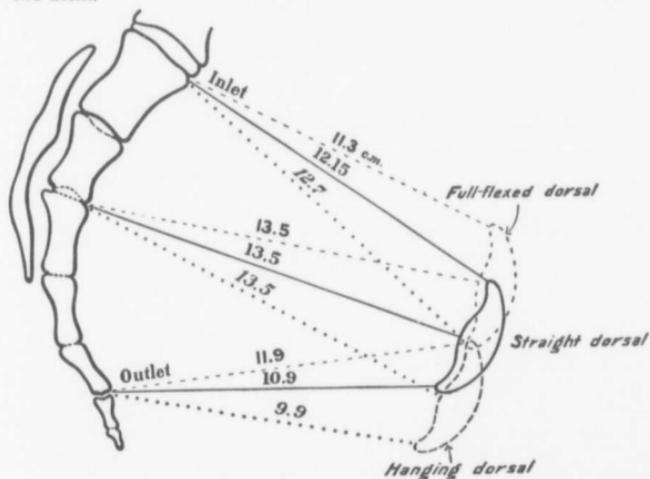


FIG. 96.—Pulling down of symphysis and longer vera in hanging dorsal posture (Küttner).

The shape of the brim in the adult female may be roughly compared to the heart on a playing-card, somewhat modified. Normally the anteroposterior measurement, or conjugate, is the shorter, the transverse being the longer. The true pelvis is that part below the brim. The shortest vertical portion of its wall is straight, and is formed by the bodies of the pubic bones. Laterally the wall is composed of the ischial bones and the pubic rami; it slopes inward somewhat from the brim toward the lower edge of the ischial tuberosity. Posteriorly is the long, curved sacrum and coccyx, the former being concave anteriorly, both vertically and transversely. The whole canal may, therefore, be roughly compared to a section of a curved cylinder, of which the bony wall is very deficient anteriorly.

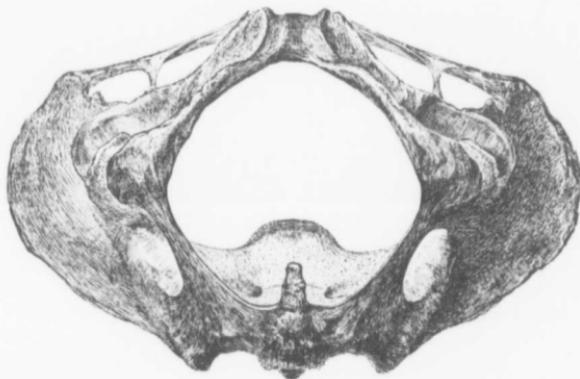


FIG. 97.—Female pelvis, viewed from below, with ligaments (one-third natural size).

On each side the bony wall is incomplete. Between the pubes and the ischium is the obturator foramen, bridged over by a fibrous membrane that is capable of being bulged slightly outward. Between the ischium, sacrum, and coccyx are the strong great and small sacrosacral ligaments. Ordinarily the coccyx is capable of being moved forward and backward with the soft parts.

**Outlet.**—The outlet of the pelvic cavity is lozenge-shaped, the lower margin of the symphysis being in front, the tip of the coccyx behind, and an ischial tuberosity on each side. While anatomically the tip of the coccyx is undoubtedly the postero-inferior mesial limit of the bony outlet, for obstetric purposes the lower end of the sacrum may be so regarded, since ordinarily in labor the coccyx, together with the soft tissues of the sacral seg-

ment, is pushed back by the advancing fetus. The anterior boundaries are formed by the lower margins of the subpubic arch, the posterior by the sacrosciatic ligaments, the ischial tuberosities being on a lower plane than the rest of the outlet. The transverse diameter, measured between the tuberosities, is nearly an inch shorter than the transverse diameter of the brim, and the conjugate (with

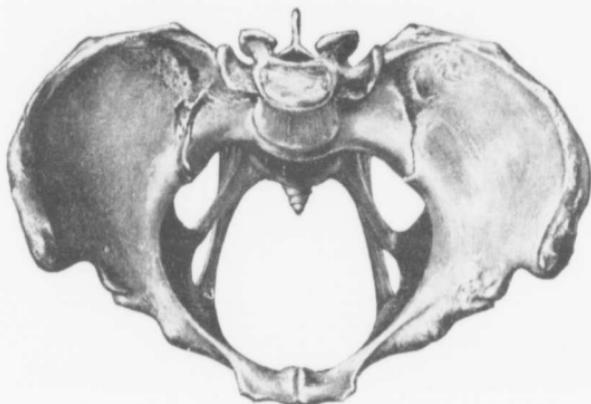


FIG. 93.—Female pelvis viewed in axis of brim.

the coccyx bent back as in labor) nearly an inch larger than that of the brim.

**Inclination of the Pelvis.**—The position of the promontory varies according to the structural peculiarity of the pelvis and according to the posture. If a series of bodies be studied in the erect posture, many variations may be noted. The angle that the anteroposterior diameter of the brim makes with the horizon is generally stated to be about 55 degrees; but as Barbour has shown, it may vary from 35 to 65 degrees, and this variation is entirely independent of the length of the anteroposterior diameter. The height of the promontory above a horizontal plane at the level of the top of the symphysis varies from 2.6 to 5 in., the average being 3.8 inches; this horizontal plane cuts the second coccygeal vertebra, as a rule. A perpendicular from the promontory intersects the horizontal plane at a point 2.4 to 4 in. from the top of the symphysis, the average being 2.8 in. The long axis of the upper part of the sacrum and that of the symphysis are generally regarded as being nearly parallel. According to Meyer, the inclination of the pelvis also depends upon the tension of the iliofemoral ligaments, diminution of inclination occurring when they are relaxed—*i. e.*, when the thighs are moderately separated

and slightly rotated inward; increase taking place on closing the knees, rotating the thighs outward, separating them widely, or markedly rotating them inward. He believes that in the erect posture the center of gravity of the trunk passes posterior to the middle of the acetabula, so that there is a tendency to backward rotation of the pelvis, which is prevented by the iliofemoral ligaments.

**Axis of the Pelvic Cavity.**—The axis is an imaginary curved line, situated midway between the bony walls of the cavity. It is shown in the accompanying illustration (Fig. 99),

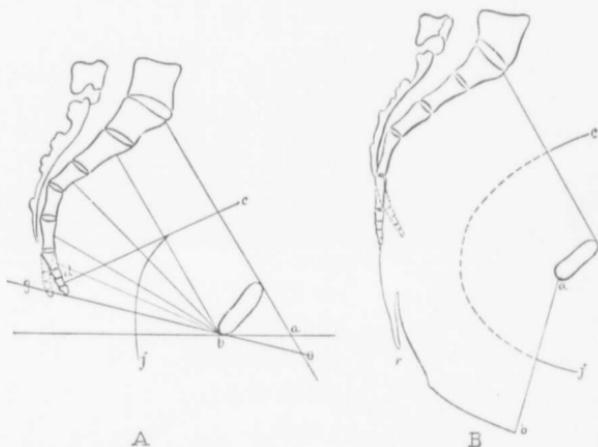


FIG. 99.—Diagram of pelvic curve. *A*. In the bony pelvis: *cd*, axis of inlet; *ab*, horizontal plane; *eg*, anatomic conjugate of outlet; *cf*, axis of pelvis or curve of Carus. *B*. In the pelvis with the soft parts as in advanced labor: *cf*, axis of pelvis; *r*, anus; *ab*, line drawn from symphysis to anterior margin of perineum.

which represents a vertical mesial section of the pelvis, in which is drawn the brim conjugate and a series of anteroposterior diameters from the lower margin of the symphysis to the sacrum and coccyx, the uppermost of which is parallel to the conjugate of the brim. By joining the middle points of these lines the axis of the pelvis is obtained. If the upper part of the axis, which is at right angles to the brim, be extended downward in a straight line, it usually passes through the lower part of the coccyx, whether this be bent back or not. If the axis of the outlet be prolonged upward, it passes through the upper part of the first sacral vertebra, unless the coccyx be bent back, when it cuts the

lower part of this vertebra; variations are found according to the height of the promontory and the curve of the sacrum and coccyx. It is usually taught that this axis represents the direction taken by the head of the fetus during birth. Generally speaking this is true, but it must be remembered that the bony cavity is modified by the soft tissues, and that the axis of the passage along which the head moves (the true obstetric axis) must be somewhat different from the axis of the bony canal. The chief difference exists at the outlet, where, in the living woman, the axis is anterior to that of the bony pelvis, owing to the resistant sacral segment lying in front of the coccyx.

**Measurements of the Bony Pelvis.**—The adult pelvis presents a considerable range of variations in size and shape



FIG. 100.—Effect of different inclinations of pubis upon relationship between true and diagonal conjugate diameters (Ribemont-Dessaignes).

within the limits of the normal. The measurements are, therefore, found to vary somewhat, the following figures approximately representing the average lengths found.

**In the False Pelvis.**—The interspinous or interspinal diameter, measured between the ends of the anterosuperior iliac spines, varies from  $9\frac{1}{4}$  to 10 in. (23.5 to 25.5 cm.). The intercrystal diameter is the greatest distance between the summits of the iliac crests, and varies from  $10\frac{1}{4}$  to 11 in. (26 to 28 cm.). In normal pelvis there is usually a fairly constant ratio between the above diameters—viz., a difference of about 1 in. (2.5 cm.) on the average. Marked deviations from this ratio are found in many abnormal pelvis.

The external oblique diameters are measured respectively between the posterosuperior iliac spine of one side and the antero-

superior iliac spine of the opposite. They are termed "right" and "left" according to the posterior spine. The average length

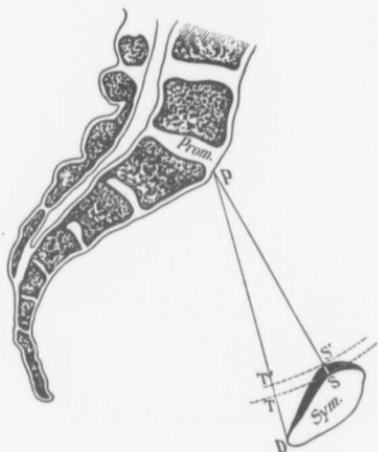


FIG. 101.—Effect of different thicknesses of symphysis upon relationship between true and diagonal conjugate diameters (Ribemont-Dessaignes).

is  $8\frac{3}{4}$  in. (22 cm.). A slight difference between these may be found in normal cases; it is marked in certain pelvic abnormalities.

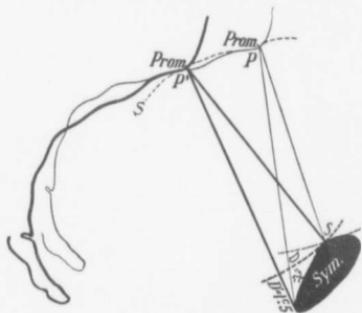


FIG. 102.—Effect of different heights of promontory upon relationship between true and diagonal conjugate diameters (Ribemont-Dessaignes).

**In the True Pelvis.**—(a) *Brim.*—The anatomic conjugate of the brim is the distance between the middle of the promontory

and the top of the symphysis. It is an important measurement, but mainly used as a landmark in anatomic descriptions. It

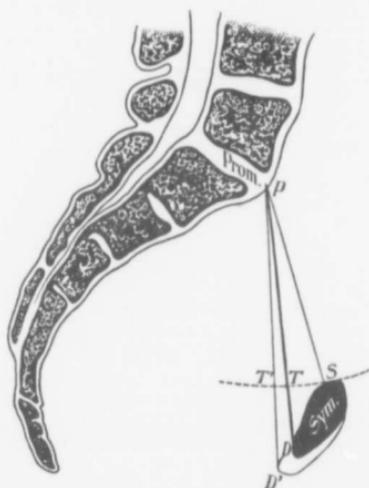


FIG. 103.—Effect of different heights of symphysis upon relationship between true and diagonal conjugate diameters (Ribemont-Dessaignes).

averages about  $4\frac{3}{5}$  in. (12 cm.). The conjugata vera—true, obstetric, or available conjugate—represents the available antero-

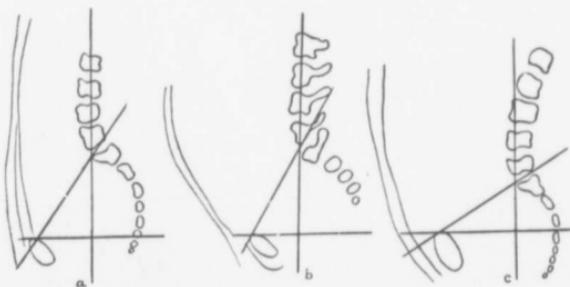


FIG. 104.—*a*, Average elevation of promontory in a series of frozen sections of cadavera; *b*, specimen with an unusually high set of promontory; *c*, specimen with an unusually low set of promontory (after Barbour).

posterior space at the brim for the passage of the fetus. It is measured from the middle of the promontory to the nearest point

of the symphysis, situated slightly behind and below its upper margin. It averages about  $4\frac{3}{8}$  in. (11 cm.), and is, therefore, about  $\frac{3}{10}$  in. less than the anatomic conjugate.

The diagonal conjugate, measured from the subpubic ligament to the middle of the promontory, is  $\frac{1}{2}$  to  $\frac{3}{8}$  in. greater than the true conjugate in normal pelvis. Variations in the relationships of these conjugates are mainly due to differences in the height of

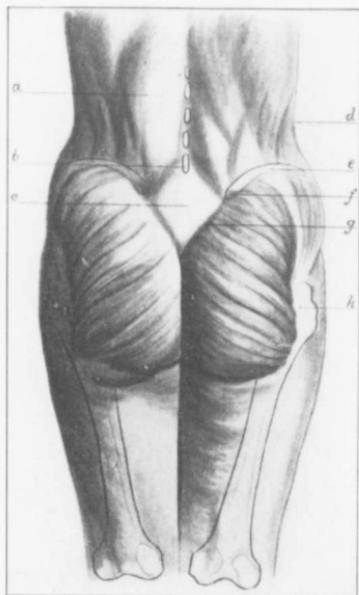


FIG. 105.—View of posterior aspect of normal woman—partly diagrammatic (Bumm): *a*, Prominence of lumbar muscles; *b*, spine of fifth lumbar vertebra; *c*, Michaelis's lozenge; *d*, waist; *e*, iliac crest; *f*, posterosuperior iliac spine; *g*, line of attachment of gluteal muscles; *h*, trochanter.

the symphysis, the position of the promontory, and the angle between the vertical axis of the symphysis and the conjugata vera.

When the vertical height of the symphysis is more than  $1\frac{1}{2}$  in., slightly more than  $\frac{1}{2}$  in. should be deducted from the diagonal conjugate in estimating the vera. In flat pelvis, where the height of the symphysis is greater than normal, and the angle between its axis and the true conjugate is also greater, the difference between the diameters is greater than normal.

In the majority of cases a conjugata diagonalis less than  $4\frac{1}{2}$  in. (11.5 cm.) indicates anteroposterior pelvic contraction.

The transverse diameter is the greatest distance between the iliopectineal lines, and measures about  $5\frac{1}{4}$  in. (13.5 cm.). The relationship between the true and the transverse conjugates is fairly constant in normal pelvis, the latter being nearly an inch longer than the former. The transverse diameter is, on the average, half the length of the intercrystal (Sandstein).

The oblique diameters are measured respectively from each sacro-iliac joint to the iliopectineal eminence of the opposite side. In America, Great Britain, and Germany they are termed right and left according to the sacro-iliac joints; in France according to the iliopectineal eminences. The average length of each is

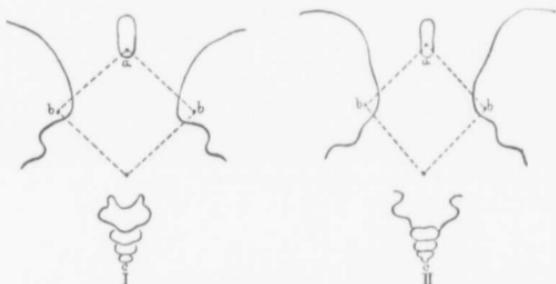


FIG. 106.—Outline diagram showing lozenge of Michaelis: I, In the female; II, in the male. *a*, Last lumbar spine; *b*, posterior superior iliac spine; *c*, coccyx.

nearly 5 in. (12.6 cm.); usually the right is slightly longer than the left.

(*b*) *Cavity*.—The anteroposterior, transverse, and oblique diameters of that part of the cavity that is bounded in front by the symphysis are nearly equal. The level at which these diameters are taken may be considered as passing through the upper edge of the third sacral vertebra and the middle of the symphysis. The anteroposterior and transverse diameters measure about 5 in. (12.6 cm.). There are no fixed points between which to draw the obliques, and they need, therefore, not be specially considered. The vertical measurements of the cavity in front (the height of the symphysis pubis) is  $1\frac{1}{2}$  in. (3.8 cm.); laterally, from the brim to the lower margin of the ischial tuberosity, it is  $3\frac{1}{2}$  in. (8.9 cm.); posteriorly the vertical distance from the brim to the tip of the coccyx is about  $4\frac{1}{4}$  in. (10.8 cm.), to the tip of the sacrum  $3\frac{3}{4}$  in. (9.5 cm.). The vertical measurement of the sacrum and coccyx, following its curve, is about 5 in. (12.7 cm.).

(*c*) *Outlet*.—The anteroposterior or conjugate diameters are the

sacropubic, drawn from the lower margin of the symphysis to the lower end of the sacrum, measuring about  $4\frac{3}{4}$  in. (12 cm.), and the pubococcygeal, from the lower edge of the symphysis to the tip of the coccyx. The latter diameter measures in the dried pelvis about  $3\frac{1}{2}$  in. (8.9 cm.); in labor the coccyx may be bent back so much that the conjugate becomes  $4\frac{3}{4}$  in.

The transverse diameter is drawn between the inner borders of the ischial tuberosities, and measures  $4\frac{3}{8}$  in. (11 cm.).

Oblique diameters need not be described, as there are no fixed points between which they can be drawn.

The distance between the ischial spines is  $4\frac{1}{2}$  in. (10.5 cm.).

**The Pelvis in Relation to Surface Markings.**—The ordinary surface markings of the pelvis are described in anatomic works. Special attention must be given to the back of the pelvic region. Here, in well-developed normal females, a lozenge-shaped area may be noticed. The lateral angles are marked by dimples, about 5 cm. from the middle line, situated over the postero-superior iliac spines. The upper angle is formed by the spine of the fifth lumbar vertebra; the lower is situated over the lower part of the sacrum, near the coccyx, where the gluteal muscles approximate. The boundaries of the upper half of the lozenge are formed by muscles of each half of the back; those of the lower half by the edges of the glutei muscles. The area is well shown in many classic statues. Michaelis was the first obstetrician who called attention to it. The shape varies somewhat in different conditions. In the normal woman the vertical and transverse diameters are almost equal. When the pelvis or sacrum is narrow the lozenge is narrowed transversely. In the male the transverse diameter is shorter than in the female, the lateral angles of the lozenge being consequently larger.

**Physics of the Pelvis of the Adult during Life.**—The amount of movement at the joints of the pelvis during life is very slight. It is increased during pregnancy, owing to the increase in the synovial fluid and to the softening that occurs in the cartilages and ligaments during that period. Occasionally a slight up-and-down movement of the pubic bones at the symphysis may be detected, especially in multiparæ, if a digital examination be made while the woman walks.

The weight of the body is transmitted through the sacrum, which is attached to the ossa innominata at the sacro-iliac joints, where it is slung by various ligaments, especially by the strong posterior sacro-iliac ligaments, which extend from the posterior iliac spines to the posterolateral surface of the sacrum. The old view that the sacrum is related to the pelvis as the keystone of an arch is incorrect. It is more like an inverted keystone, since it is broader toward the pelvic cavity than toward its outer surface. Owing to firm ligamentous attachments, the movement of the

sacrum at the sacro-iliac joints is very slight; but, as Zaglass first pointed out, a slight amount of rotation on an imaginary

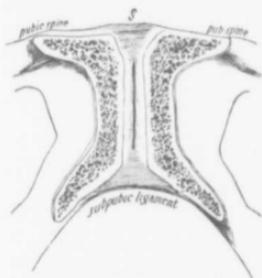


FIG. 107.—Frontal section through symphysis pubis, exposing interpubic cleft (Farabeuf).

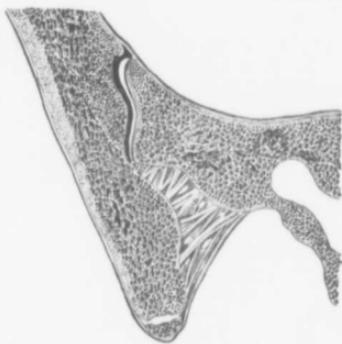


FIG. 108.—Section through the left sacro-iliac articulation (Luschka).

transverse axis may occur. Thus, the promontory may approach or move away from the pubes, the lower end of the sacrum being

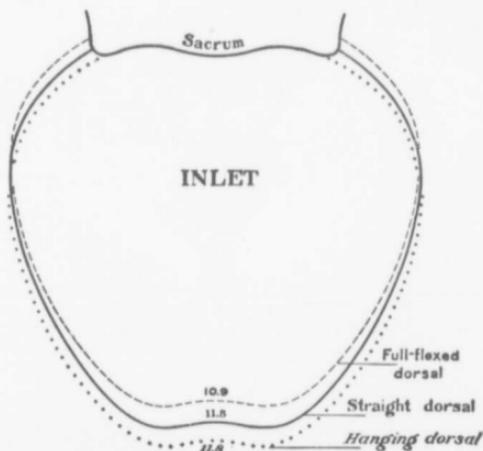


FIG. 109.—The inlet in the three postures—smallest in full-flexed dorsal, longest in hanging dorsal (Küttner).

correspondingly moved backward or forward. Matthews Duncan estimated that a change in the length of the brim conjugate,

amounting to  $\frac{1}{3}$  in., might thus be made. During defecation, as the body is bent to the front, the promontory is tilted forward. Before the head has entered the brim in labor it is important that the body should not be doubled up in any way, in order that there may be no diminution of the conjugate.

In 1889 Walcher showed that the greatest possible increase in the available brim conjugate might be obtained by overextending the body—*i. e.*, by placing the body in the dorsal position on a table, the thighs being allowed to hang over the edge so that the feet do not touch the floor. The distance from promontory to symphysis in this position is  $\frac{1}{4}$  or  $\frac{1}{3}$  in. greater than when the thighs are well flexed over the abdomen.

There are corresponding changes in the position of the lower end of the sacrum, more marked because it is farther from the transverse axis through the sacro-iliac joints than the promontory. The sacropubic conjugate of the outlet is, therefore, greatest when the thighs are well flexed on the belly; in this position also the ischial tuberosities are slightly pushed apart owing to the influence of the wedge-shaped sacrum.

**Male and Female Pelves Compared.**—In the adult female the bones are smoother, the projections being less de-

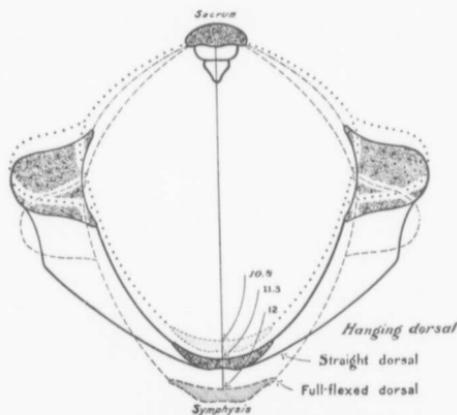


FIG. 110.—The outlet in the three postures—longest in the full-flexed dorsal (Küttner).

veloped than in the male; they are of higher build and weigh less. The height of the pelvis is less, and the breadth and capacity of the true pelvis greater; the sacrum is wider and more concave and the coccyx more movable; the promontory projects more in-

ward; the anteroposterior and transverse diameters of the brim are greater; the subpubic angle is larger. It is generally stated

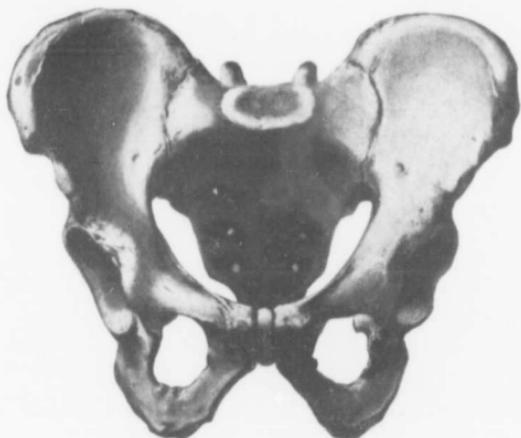


FIG. 111.—Male pelvis seen from the front.

that the subpubic angle measures 90 to 100 degrees in the female, and in the male 75 to 80 degrees. These figures are probably too

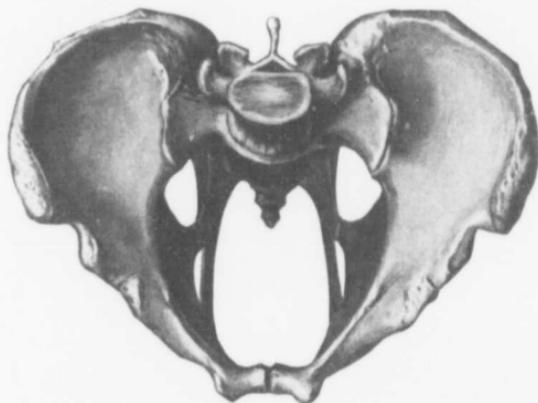


FIG. 112.—Male pelvis viewed in the axis of the brim.

high. Verneau places the average in the female at 74 degrees, and in the male at 60. In the female the tuberosities of the ischium

are wider apart; the great trochanters are more separated. In the male the bones are thick and rough; the brim somewhat triangular; the sacrum long and narrow; the cavity funnel-shaped; the subpubic angle narrow; the outlet small.

The relationship of the pelvis to the shoulders must be noted. It has long been believed that in man the transverse diameter of the shoulders is greater than that of the hips, while in woman the latter is larger. Duval and others have shown that in the Caucasian race, while the statement is true as regards the male, it is not as regards the female. In the latter the two diameters are nearly equal. An interesting comparison of the hips of American men and women has been made by Sargent. He found that between the ages of seventeen and twenty woman's hips, though relatively 4 in. larger, are absolutely smaller than man's; at the age of twenty the girth of the hips is  $\frac{1}{2}$  in. smaller in women than in men; but when measured in men and women of the same height, the girth averages 6 in. more in women than in men. With reference to the spine, it is to be noted that the lumbar curve is more marked in women, and that the lumbar region is relatively larger than in men. For a long time it was held that sexual distinctions become marked in the pelvis only at puberty. In recent years they have been demonstrated at a much earlier period. Romiti showed that at birth the female pelvis is more shallow, has more curved ilia, and a wider subpubic angle than the male. Jürgens made a comparison between birth and the age of five and noted the greater size of the female pelvis, especially in the transverse measurements. Fehling demonstrated differences at the very beginning of ossification. Professor Thomson, of Oxford, has made an elaborate study of the fetus from the fourth month of intra-uterine life, and has shown the exact nature of the differences that exist, and has traced the relative changes from the fetal to adult life.

**Racial Differences in Pelves.**—The highest development of the female pelvis and the most marked differentiation from the male pelvis is found in the Caucasian race. In the lower races there is, as a rule, a less capacious pelvis and more resemblance to that of the male. In them a frequent peculiarity is relative increase of the conjugate of the brim as compared with the transverse. Thus, in native Australian women the brim is nearly circular; in Bush women the conjugate is longer than the transverse. In the lower races the sacrum is long, narrow, and not much curved, the condition that exists in the apes. The broadest and most curved sacrum is found in the Caucasian female. (It is interesting to note that along with the evolution of the pelvis there has been a corresponding increase in the size of the fetal head.)

## THE PASSENGER.

In the first stage of labor, nominally, it is not the fetus, but the bag of membranes with its contained fluid that demands attention. The latter consists of amnion and chorion, with remains of decidua tissue on its lower surface. Often it consists only of amnion in its central area, the chorion, which is not as tough as the amnion, having been ruptured and forced aside. In the second stage of labor the fetus is the moving body which is studied in relation to the genital tract. In the third stage it is the placenta and membranes.

**Fetus at Full Time, Obstetrically Considered.**—The chief consideration must be given to the fetal head, because it is the part that offers the most difficulty in the process of labor; it is the largest and most solid portion of the fetus; it is the presenting part in about 96 per cent. of all confinements; abnormalities in its size, shape, position, and ossification lead to increased risk in labor.

**Fetal Head.**—The obstetrician regards the head as made of a cranial and a facial portion.

The cranium is considered in two parts—the vault and the base. The former is composed of the two halves of the frontal, the two parietals, and that part of the occipital bone that lies above the foramen magnum; on each side is the squamous part of the temporal bone. The vertex is that part of the cranium between the coronal and lambdoidal sutures, extending laterally as far as the parietal eminences. The sinciput is the portion lying between the face and the coronal suture. The occiput is that part behind the lambdoidal suture. The base is made up of the basi-occipital, the sphenoid, the ethmoid, and the petrous portions of the temporal bones.

The bones of the vault are thinner than those of the base, more loosely joined, and consequently more plastic. In labor the vault is moulded in adaptation to the pressure exerted upon it at various parts of the genital passages by the soft and hard tissues of the pelvis. There are many variations in the degree of plasticity found at full time, depending upon the amount of ossification in the bones and the looseness of the sutures. The firmness of the basal bones is a guarantee of protection for the important brain structures lying upon them, external pressure not moulding them to any appreciable extent.

The *sutures* of the vault are the membranous junctions between the bones. The most important are the sagittal, frontal,<sup>1</sup> coronal, and lambdoidal. The fibrocartilaginous junction of the supra- and basi-occipital must be noted; it allows the supra-occipital to be bent inward somewhat upon the basi-occipital when the head is

<sup>1</sup> Some authorities do not distinguish a frontal apart from the sagittal suture, including the former in the latter.

moulded in labor. Budin has laid special stress on its importance in this connection.

The *fontanels* are certain membranous areas in the vault, at the junction of various of its component bones. Of these, two deserve the main attention—the anterior and posterior. The *anterior fontanel* or bregma is placed at the junction of the sagittal, coronal, and frontal sutures. It varies in size and shape in different cases. It is usually lozenge-shaped or kite-shaped, the sharpest angle being anterior. Ballantyne has found the average anteroposterior measurement to be 2.7 cm.; the average width between the lateral angles being 2 cm. Rarely this fontanel may be much smaller or much larger, the head being of normal size. In hydrocephalus it may be very large. The *posterior* or *occipital fontanel* is at the junction of the sagittal and lambdoidal sutures. Often it is a mere triradiate cleft between the bones, no distinct space being appreciable. In other cases, when ossification is less advanced, there may be a small triangular space. Ballantyne has found its average anteroposterior length to be 8 mm. In labor, while the head is compressed, the space may not be recognizable owing to the forcing together of the bones.

The *temporal fontanel* on each side of the head, at the junction of the temporal, parietal, and occipital bones, is of little obstetric importance; occasionally it may be mistaken for the posterior fontanel. The so-called *false fontanels* are deficiencies in ossification in the main thickness of the bones or along the lines of sutures. Abnormalities in the fontanels and sutures may occasionally be produced by the development of separate small masses of bone, known as Wormian bones.

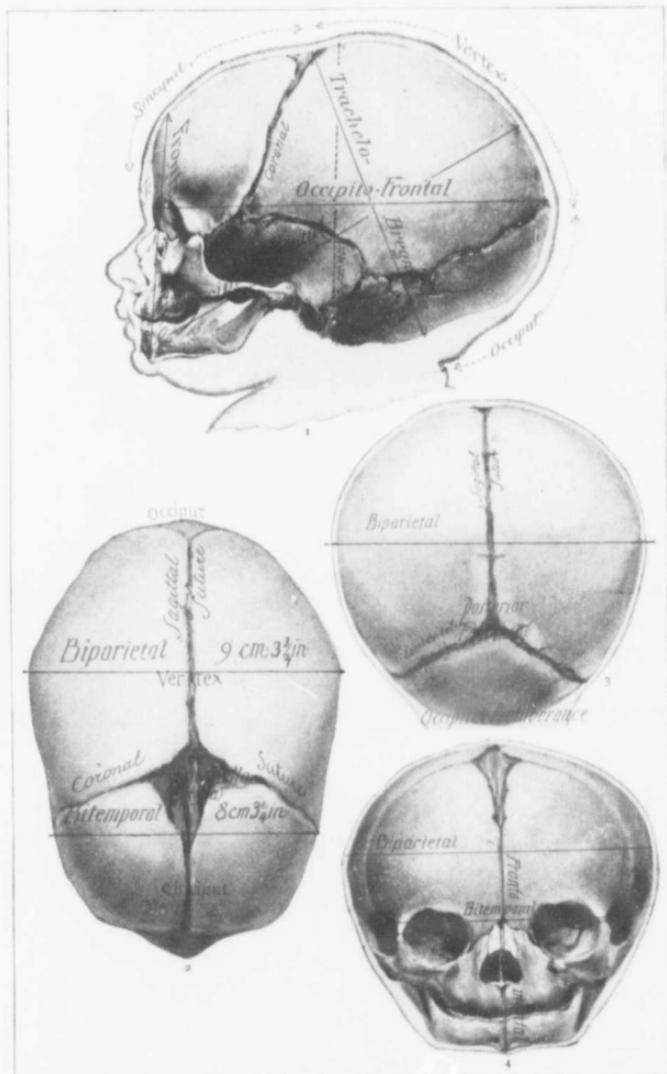
*Protuberances or Eminences.*—The following are to be noted: The *glabella*, or root of the nose; the *frontal eminence*, on each side of the forehead; the *parietal eminence*, on each side of the cranium; the *occipital protuberance*, or inion.

*Measurements.*—The following anteroposterior diameters are important: Occipitomental (o. m.), from the tip of the supra-occipital bone to the middle point of the chin.

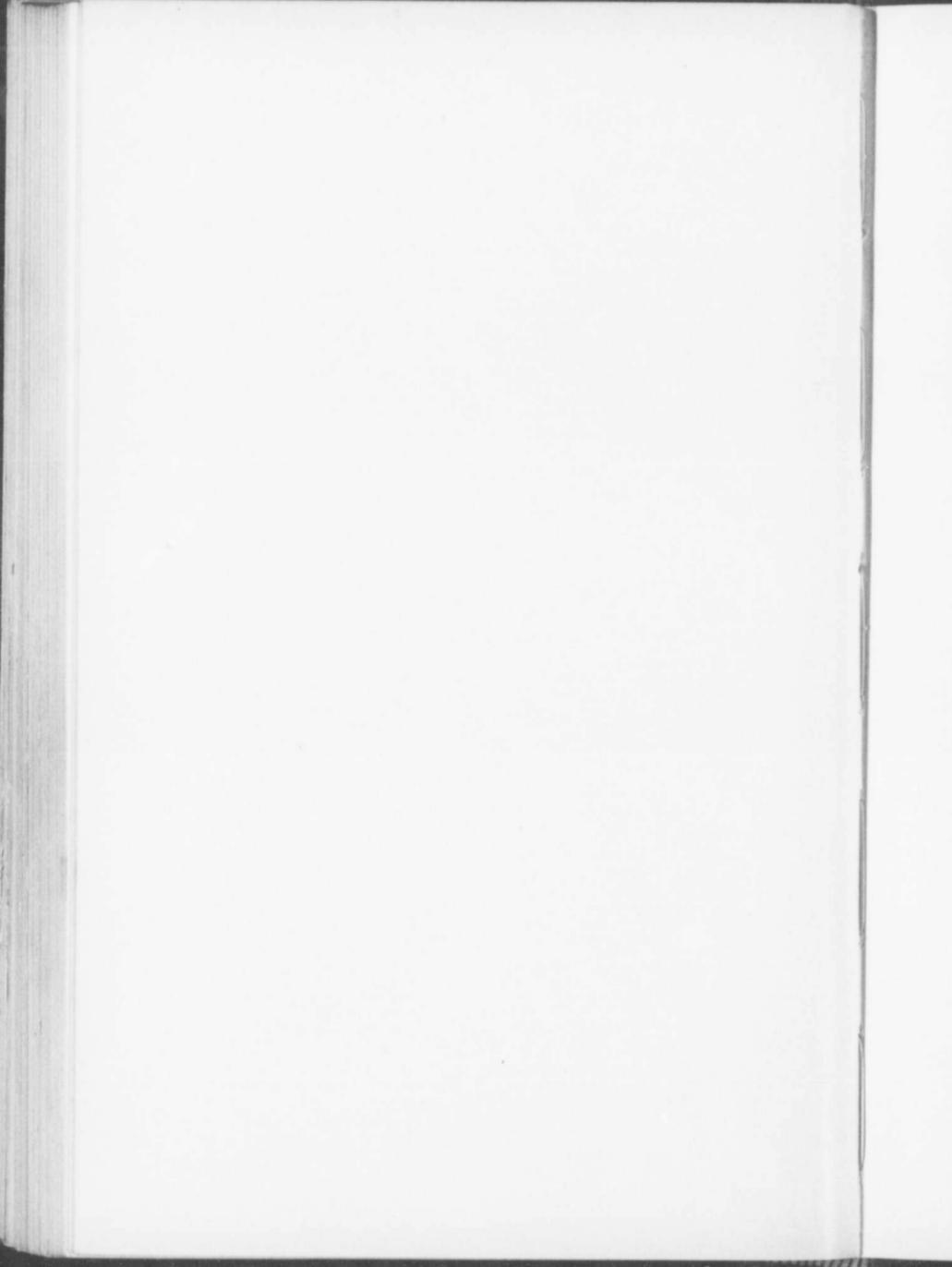
Occipitofrontal (o. f.), from the occipital protuberance to the glabella.

Suboccipitobregmatic, from the junction of the neck and occiput to the center of the bregma; on the dried skull the lower end of this diameter may be measured from a point midway between the foramen magnum and the occipital protuberance. (Some authorities place the upper end at the anterior angle of the bregma; others at the posterior angle. My own view is that a more constant point is the exact intersection of the sagittal and coronal sutures.) It is evident that if a series of suboccipitobregmatic diameters be drawn, they diminish in length from before backward. A suboccipitofrontal diameter is described by some

PLATE 8.



Fetal skull seen (1) from the side, (2) from above, (3) from behind, and (4) from in front, showing sutures, fontanelles, and diameters (Dickinson).



extending from the junction of the occiput and neck to the top of the forehead.

Budin has described another anteroposterior diameter, which he has termed the *supra-occipitontal* or *maximum diameter*. It is drawn from the tip of the chin to the most distant point of the sagittal suture, situated a short distance above the posterior fontanel. This diameter is longer than the occipitontal, the difference being more marked after labor than before.

The *transverse diameters* are as follows: Biparietal (bi-p), from one parietal eminence to the other; bitemporal (bi-t), between the lower ends of the coronal sutures; bimastoid (bi-m), between the mastoid processes.

The *vertical diameters* are rather vaguely defined. The *fronto-mental* extends from the top of the forehead to the lower margin of the chin; the *cervicolaryngeo-* or *trachelobregmatic*, from the center of the anterior fontanel to the junction of the chin and neck, near the larynx.

*Circumferences* of the head are measured in relation to the maximum, the occipitontal, occipitofrontal, and suboccipitobregmatic diameters.

The measurements vary considerably in any series of heads that may be examined. Some variations are, of course, merely to be associated with individual differences in size; others, with the condition of the skulls at the time of examination—*i. e.*, whether unmoulded or moulded by labor; whether dried and bony or unaltered and covered with the soft tissues.

Most statistics are based upon studies made after birth; comparatively few from measurements of unmoulded heads, as obtained by Cæsarean section or postmortem examination. The following figures may be taken as approximating to the average. They refer to the skull covered by the soft parts.

|   |          |                     |
|---|----------|---------------------|
| Occipitontal diameter . . . . .         | 12.5 cm. | 4 $\frac{1}{2}$ in. |
| Occipitofrontal " . . . . .             | 11.5 "   | 4 $\frac{1}{2}$ "   |
| Maximum " . . . . .                     | 13. "    | 5 $\frac{1}{8}$ "   |
| Suboccipitobregmatic diameter . . . . . | 10.3 "   | 4 $\frac{1}{8}$ "   |
| Suboccipitofrontal " . . . . .          | 11. "    | 4 $\frac{1}{4}$ "   |
| Biparietal " . . . . .                  | 10. "    | 3 $\frac{1}{2}$ "   |
| Bitemporal " . . . . .                  | 8.7 "    | 3 $\frac{1}{4}$ "   |
| Bimastoid " . . . . .                   | 7. "     | 2 $\frac{1}{2}$ "   |
| Fronto-mental " . . . . .               | 9. "     | 3 $\frac{1}{2}$ "   |
| Trachelobregmatic " . . . . .           | 9.5 "    | 3 $\frac{3}{8}$ "   |
| Occipitontal circumference . . . . .    | 35.5 "   | 14 "                |
| Suboccipitobregmatic " . . . . .        | 30. "    | 11 $\frac{3}{8}$ "  |
| Occipitofrontal " . . . . .             | 34. "    | 13 $\frac{1}{2}$ "  |
| Maximum " . . . . .                     | 36.5 "   | 14 $\frac{1}{2}$ "  |

When the dried fetal skull is measured these figures are smaller. The changes produced by moulding in labor vary according to the presentation and position of the child and the

peculiarity of the mechanism. They will be described in connection with the various forms of labor.

**Mobility of the Head on the Trunk.**—The head is capable of an extensive degree of movement owing to the plasticity of the joints and tissues in the neck. It may with safety be bent almost to a right angle on any side. Tarnier has stated that the head may be bent backward without injury until the face looks almost directly backward. Such mobility of the tissues diminishes the risks to the fetus in many cases of abnormal and artificial delivery.

**Trunk.**—The trunk is not ordinarily such an important factor in relation to labor as is the head. Its tissues are more plastic and compressible. The bisacromial diameter measures about 12 cm. ( $4\frac{3}{4}$  in.), but may be shortened 2 or 3 cm. by pressure. The anteroposterior chest diameter in the upper part is 8.5 cm. ( $3\frac{3}{4}$  in.). The chest circumference averages 31 cm. ( $12\frac{1}{4}$  in.). The bitrochanteric diameter is 9 cm. ( $3\frac{1}{2}$  in.). The anteroposterior pelvic measurement is 5.5 cm. ( $2\frac{1}{8}$  in.); when the thighs are flexed on the abdomen this is nearly double. The circumference of the pelvis is about 26.6 cm. ( $10\frac{1}{2}$  in.); with one thigh flexed on the abdomen it is about 30.5 cm. (12 in.); with both thighs flexed 33 cm. (13 in.). All these measurements may be reduced by compression.

SUMMARY OF THE STAGES AND FACTORS CONCERNED IN LABOR.

|                      |  |
|----------------------|--|
| <i>First Stage.</i>  | { Powers—Uterus.   |
|                      | { Passages—Lower uterine segment and cervix.<br>{ Passenger—Bag of membranes and forewaters. |
| <i>Second Stage.</i> | { Powers—Uterus and accessory muscles.   |
|                      | { Passages—Genital tract and cavity of pelvis.<br>{ Passenger—The fetus.                     |
| <i>Third Stage.</i>  | { Powers—Uterus and accessory muscles.   |
|                      | { Passages—Lower uterine segment, cervix, and vagina.<br>{ Passenger—Placenta and membranes. |

**Attitude, Presentation, and Position of the Fetus at the beginning of Labor.**—**Attitude.**—The attitude or posture of the fetus may be described as the relationship of its head, trunk, and limbs to one another. Normally this may be expressed by the term "flexion." The fetal mass presents an ovoid shape. The head is flexed toward the chest, the arms are folded on the latter, the thighs are flexed on the abdomen and the legs on the thighs. Many variations are found. Thus, both the upper and lower extremities may be placed at different levels and differently arranged. One leg or both may not be flexed on the thighs, but may be extended up over the body. The face does not always look straight downward, but may be turned slightly to one or the other side. The study of frozen sections has shown that the head is usually inclined toward one shoulder, whether there be a vertex

or a breech presentation. These variations are generally produced by movements of the fetus, but in some cases coiling of the cord influences the disposition of the limbs.

**Presentation.**—This term is ordinarily used to imply a relationship between the long axis of the uterus and that of the fetal ovoid, as well as to indicate that part which is in the axis of the parturient canal. In times past various views have been held as regards normal presentation. Thus, many have thought that the



FIG. 113.—Fetus from a case of advanced pregnancy. The inclination of the head toward one shoulder is shown.



FIG. 114.—Attitude of the fetus *in utero*. A specimen from an eighth-month pregnancy (Barbour and Webster).

anterior fontanel normally presented. Roederer believed it to be the occiput; Naegele taught that it was the parietal region of the head that was anteriorly placed.

At the present day it is generally taught that in normal cases—*i. e.*, about 96 per cent. of all labors, the long axis of the fetal ovoid is parallel with that of the uterus, the head being lowermost, the vertex being the presenting part. Further, it is held that the sagittal suture of the head crosses the axis of the pelvis, the occipitofrontal plane being parallel with the plane of the brim.

These statements are based upon clinical examination, a method of inquiry that is not thoroughly reliable in the determination of anatomic relationships. With the fingers it is very difficult to make out exactly how the presenting part is placed in relation to

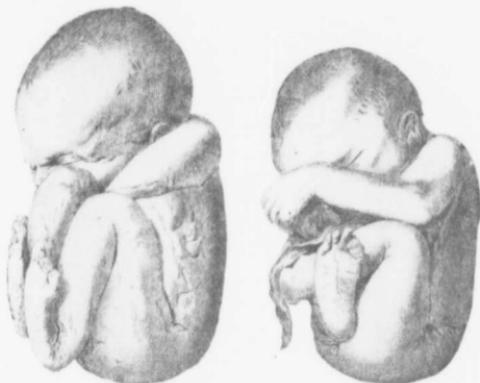


FIG. 115.—Attitude of the fetus *in utero*. Each of these is a full-term specimen (Barbour).

the brim, because the area that is palpated is comparatively small. It is impossible, for example, in the living woman to place the finger in the exact axis of the pelvic cavity and to determine always accurately the relation of the sagittal suture to it.

| CASE.                         | Period.    | Distance of vertex below brim. | Proportion of posterior half of head lying within conjugate of brim. |
|-------------------------------|------------|--------------------------------|--|
| Braune and Zweifel . . . . .  | Primipara. | 9 months. 2.5 in.              | 3.87 in. out of 7 in.  |
| Pinard and Varnier . . . . .  | "          | 7½ " 2.25 "                    | 4 " 6 in.  |
| " " " " . . . . .             | Bipara.    | 8 " 2.4 "                      | 5.75 " 7 in.   |
| Barbour . . . . .             | Sextipara. | First stage. 2.75 "            | 3.50 " 7.75 in.  |
| Winter . . . . .              | Bipara.    | " 2.75 "                       | 3.84 " 7.1 in.   |
| Säxinger . . . . .            | Primipara. | " 2.25 "                       | 2.12 " 6.04 in.  |
| Barbour and Webster . . . . . | Multipara. | " 2.75 "                       | 3.8 " 7.25 in.   |
| Pestalozza . . . . .          | Sextipara. | " 2.50 "                       | 4 " 7 in.  |
| Leopold . . . . .             | Primipara. | " 1.62 "                       | 2 " 4.75 in.   |

It is only by fixing the parts *in situ* and examining them undisturbed that the truth can be ascertained. In recent years this has been done by the freezing method, and it has been clearly demonstrated in a number of cases that the occipitofrontal is not exactly parallel with the plane of the brim, and that the center of the vertex and the sagittal suture are not in the axis of the inlet.

The sagittal suture is either anterior or posterior to the axis, usually in front, and a larger part of one parietal bone is at a lower level than of the other. Barbour has emphasized this peculiarity, and has drawn up a table of measurements made in different cases of frozen sections (see page 204).

In 6 out of 9 cases more of the posterior half of the head than of the anterior lay below the plane of the upper part of the pelvic cavity.

De Seigneux, from a clinical study of 80 consecutive cases, states that three varieties of presentation are to be regarded as normal—viz: (*a*) Anterior parietal in 22.5 per cent.; (*b*) posterior parietal in 53.75 per cent.; (*c*) vertex or synclitic in 23.75 per cent.

He believes that the dimensions of the pelvis have little to do with the presentation. In his series the pelves were normal except 4 in group *a* (1 justominor and 3 rickety flat), 5 in group *b* (2 rickety flat, 2 justominor, 1 non-rickety flat), and 1 justominor in group *c*.

He thinks that presentation is mainly determined by the inclination of the uterine axis to the plane of the pelvic brim. Thus, posterior parietal presentations are more common in primiparæ because, owing to the tenseness of the abdominal wall, the uterus is held back against the spine, while anterior (Nægele) presentations are more common in multiparæ with lax abdominal wall and anteverted uterus. Pelvic contraction acts indirectly only by favoring anteversion, which condition is aggravated by laxity of the abdominal wall.

Barnes, Galabin, Fritsch, and many others also hold that obliquity is not to be regarded as an abnormality. Schatz agrees with this view, but states that it is most marked when the pelvis is flat.

In multiparæ, at the onset of labor, the presenting portion of the head is at or a little above the brim level; occasionally it is found partly below. In primiparæ, in normal conditions, it is within the pelvic cavity. The plane of the head that is related to the planes of the upper part of the pelvic cavity varies in different cases. Often, especially in multiparæ, it is the occipitofrontal. In many cases, in which the head is subjected to unusual surrounding resistance, the occiput is somewhat lower, the plane being more suboccipitofrontal.

**Position.**—This is the relation of the presenting part to the pelvis of the mother. In vertex presentations, at the beginning of labor, when the pelvis is normal, this relationship is such that the anteroposterior diameter of the head is more or less in line with an oblique diameter of the pelvis. This is often termed the Solayres obliquity. It is evident, therefore, that the head may occupy any one of four positions. These are usually demonstrated in terms of the occiput, which may lie to the front and left or to the front and right of the middle line, to the back and right or to the back and left of the middle line. Some authors regard the

brim as divided into four quadrants by the intersection of the conjugate and transverse diameters, and describe the occiput as lying in one or other of these quadrants.

There are no fixed points in the pelvis toward which the occiput is directed. Generally it is stated that when it is anterior it is opposite the iliopectineal eminence, and when posterior opposite the sacro-iliac joint. There are, however, many deviations. Occasionally, indeed, the anteroposterior may correspond more nearly to the transverse than to the oblique diameter of the pelvis. The four positions described may be named as follows: Occipitolaeva anterior (O. L. A.), occipitodextra posterior (O. D. P.), occipitodextra anterior (O. D. A.), occipitolaeva posterior (O. L. P.).

As regards the relative frequency of these, the following statistics are given:

| Position. | Naegele. | Naegele, Jr. | Simpson and Barry. | Dubois. | Murphy. | Swayne. |
|-----------|----------|--------------|--------------------|---------|---------|---------|
| O. L. A.  | 79       | 64           | 76                 | 70      | 63      | 86      |
| O. D. P.  | 29       | 32           | 25                 | 25      | 16      | 1       |
| O. D. A.  |          |              | 0.2                | 2       | 16      | 9       |
| O. L. P.  |          |              | 0.5                | 0.6     | 4       | 2       |

A working estimate may be roughly summarized thus: O. L. A. in 74 per cent. of vertex presentation; O. D. P. in 20 per cent.; O. D. A. in 5 per cent.; O. L. P. in 1 per cent.

It must be remembered that occipitoposterior cases generally change into occipito-anterior during labor, and are likely to be recorded as the latter if examination be made at too late a period.

#### Diagnosis of Vertex Presentations.—Occipito-anterior

**Positions.**—The diagnosis of occipito-anterior positions in vertex presentations is easily determined in the great majority of cases by external examination. On palpating the abdomen of the mother the back of the fetus is felt as a smooth, firm area without projections, close to the anterior wall of the uterus, the thoracic part of the back being more to the left or right of the middle line according to the position. The firm, round head is felt at the brim of the pelvis, variations being found in the portion that can be felt above the brim. Thus, in primiparae, in whom the head sinks considerably within the pelvis, during the last month of pregnancy very little may be palpated externally. Owing to the flexed attitude, more of the sinciput than of the occiput lies above the brim. Sometimes the lower jaw or even supra-orbital ridge may be palpated. A sulcus may usually be determined between the prominence of the anterior shoulder and the head, from 1 to 2 in. to the left or right of the middle line, a short distance above the inner end of Poupart's ligament. When the head lies above the brim, it may usually be moved in different directions if the uterus be not contracting, especially when there is abundant liquor amnii. When it has partly entered the pelvis, it may often be slightly elevated, but cannot be moved in a transverse or antero-

posterior plane. When it has deeply descended into the pelvis, it cannot be moved by abdominal palpation. Fixation does not usually take place until the biparietal diameter has passed the brim. The upper fetal pole is situated at the fundus uteri, and consists of the breech and lower limbs or of the breech alone. With the feet the breech may form a mass as large as the head, but of irregular contour; the breech alone is smaller than the head, less round and not so firm. No sulcus exists between it and the body, and it cannot be moved by ballotement, as the head may be, when it is situated at the fundus uteri. The back is felt firm and smooth and may be arched forward, as Budin has pointed out, when the fetal poles are approximated by pressure on the fundus. When the placenta intervenes between the examining hands and the fetus, the latter cannot be distinctly felt.

The heart of the fetus is heard through the abdominal wall of the mother between the umbilicus and Poupart's ligament, on the left side in O. L. A. positions, on the right side in O. D. A. positions. The point of maximum intensity of the heart sounds corresponds to the lower angle of the left fetal scapula. It is, therefore, at a lower level in women (*i. e.*, primiparæ) in whom the head is considerably below the pelvic brim at the beginning of labor than in those in whom it is mainly above. It must, however, be remembered that the point at which the heart is heard most loudly may not correspond to the lower angle of the left scapula; it may only be that part of the fetal chest that happens to be most closely applied to the uterine wall. In the great majority of cases the abdominal examination is sufficient to determine the relationships of the fetus. It may fail when the abdominal wall is very fat or tense, when the uterus is very firm or much distended, or when various pathologic conditions are present—*i. e.*, a tumor. Vaginal examination is, therefore, rarely necessary. *Per vaginam* before dilatation of the cervix it is usually only possible to feel the hard, rounded head. After the cervix is partly dilated it is possible in some cases to determine the position of the sutures or fontanels, but generally this can only be satisfactorily accomplished after rupture of the membranes. The sagittal suture is usually first felt by the finger; the anterior and posterior fontanels may sometimes be felt before the head has well descended. At a later stage usually only the posterior fontanel may be touched; it lies to the left or right of the middle line according to whether the position is O. L. A. or O. D. A. Ordinarily the fontanels are easily distinguished; when the anterior is small or compressed it may be mistaken for the posterior. It is important in cases of difficulty to determine the number of sutures entering into the fontanel; three in case of the posterior, four in case of the anterior. Abnormal deficiencies in the bone may easily be mistaken for the fontanels, and Wormian bones may be misleading.

Sometimes a large caput succedaneum may make it difficult to feel the sutures and fontanels. When the cervix is well dilated and the membranes ruptured, it may sometimes be advisable to push the fingers up behind the pubes in order to locate an ear. In carrying out these manipulations it is well to steady the fundus and upper pole of the fetus with the outer hand.

#### MECHANISM OF LABOR.

**Vertex Presentation.—Occipitolæva Anterior.**—In the most common form of labor—viz., that in which the vertex presents (O. L. A.), the head makes a series of movements in its passage through the pelvis that are generally described as the "mechanism of labor."<sup>1</sup> It is, therefore, to be applied mainly to the second stage, though it must be remembered that in some cases these movements may begin before the cervix is fully dilated; this is mainly found when the head lies partly within the pelvis before labor begins—*i. e.*, in primiparæ. These movements of accommodation are necessary to the passage of the head with the least difficulty, and they result partly from the shape of the head, partly from the shape of the hard and soft canals. Owing to the variations that these factors may present, the movements vary somewhat in different cases, though in general the main features of the mechanism are usually present. At the present time it is customary to describe the movements as follows: Flexion; internal rotation; extension; external rotation or restitution of the head; expulsion of the trunk.

*Descent* has been mentioned by many writers as one of the movements, but this is unnecessary, since it goes on throughout the whole second stage, and the movements take place merely to facilitate descent.

Synclitism was a term used by older authors to imply that there was a series of parallelisms between certain planes of the head and certain planes of the pelvis. Such a term is unnecessary, employed in this sense. If used in the general sense of adaptation, no objection may be raised, for it is self-evident that the mechanism of labor is but a series of adaptations of the fetus to the parturient canal. The idea of special planes is a creation of the imagination entirely unsupported by anatomic investigation, and must be abandoned. The exact relationships of the head at the beginning of labor have been fully described. During the first stage it does not ordinarily change much. After the cervix is dilated and the membranes ruptured,<sup>1</sup> it descends so as to be

<sup>1</sup> In some cases in which, after the cervix is fully dilated, the membranes do not rupture but remain and stretch before the advancing head (as in Braune's and Chiari's specimens), the mechanism of the second stage may continue, though somewhat more slowly than normal.

embraced by the lower uterine segment, and meets the resistance of the bony canal (if it has not already been lying partly within it). The ordinary normal movements may now be noticed in detail.

*Flexion.*—The current views concerning this movement must be modified as a result of recent studies of the anatomy of labor by means of frozen sections. The term has long been regarded as a dipping of the occipital end of the head, due to a bending of the chin on the chest, the object being to bring a smaller diameter of the head—viz., a suboccipitobregmatic, into relation with the girdle of resistance. Here again clinical examination has erred in trying to establish anatomic data, and has succeeded only in substituting speculation for facts. By the fingers it is impossible to determine accurately what takes place above the girdle of contact—*i. e.*, that part of the head embraced by the soft passage at any level; it is impossible to determine how the chin of the fetus moves. All that can be made out by digital examination is what takes place within and below the girdle of contact. Certain it is that in many cases a change occurs whereby the occiput descends more than the sinciput, the posterior fontanel becoming relatively lower than the anterior fontanel, but this might be brought about by a rotation of the whole fetus on a transverse axis as well as by the bending of the chin on the sternum.

Now, the facts derived from the study of bodies frozen in various stages of labor show that the chin is fairly constant in relation to the sternum throughout labor until the head begins to pass through the vulva. Barbour, who has made a careful study of this subject, states that flexion in labor is to be regarded as an attitude, as it is in pregnancy, rather than as a movement. He doubts if it is justifiable to speak of it as a movement of labor at all, but he does not imply that a movement of flexion may not occasionally occur; there may be a disturbance of the normal attitude of the head, as of any other part of the body, and this alteration may be corrected by a movement of flexion. The close relationship of the chin to the sternum in the advanced second stage of labor is well shown in Barbour and Webster's case (Fig. 114).

It is probable that in many cases the change in the position of the occiput, as a result of the movement to be next described—viz., internal rotation, is misinterpreted as a marked dipping of the posterior fontanel, or flexion. When the head is already partly within the bony cavity at the beginning of labor, internal rotation very soon brings the occiput into relation with the deficiency of the bony pelvis anteriorly, and being more easily palpated it may very easily be regarded as having descended markedly. In some cases it may be easily determined by clinical examination that no

increased flexion occurs at all in labor—*i. e.*, in roomy pelves or when the head is small. The most marked dipping of the occiput has been noted when the head meets with pronounced surrounding resistance either on the part of the soft or hard tissues. It occurs at different levels in different cases. Many theories have been advanced to explain how flexion occurs, but in view of the recent criticisms as to the nature and occurrence of this phenomenon they need not be discussed.

The necessity that has always been urged in connection with the supposed movement—*viz.*, the substitution of a shorter circumference of the head for a long one, does not probably exist in the majority of normal labors, because, owing to the attitude of the fetus early in labor, a sufficiently small circumference is in relation to the parturient canal. In cases in which the head is abnormally large or the canal small, the more rapid descent of the occipital end of the head does substitute a smaller circumference of the head, and it is probably due to the greater resistance that the sinciput meets as it descends the posterior wall of the parturient canal, which is so much longer than the anterior wall.

*Internal Rotation.*—This is a well-defined movement of the head whereby the occipital end turns to the middle line anteriorly as it approaches the outlet of the pelvis. The result of this change is to rotate the anterior or long diameters of the head into relation with the longest diameter of the outlet—*i. e.*, the conjugate. The movement varies in different cases as regards its extent and the level at which it occurs, but it probably always takes place below the level of the ischial spines. Various theories have been advanced to explain the reason for this movement. That which associates it with the shape of the head must be entirely discarded. Rotation occurs in presentations other than vertex—*i. e.*, face, breech, shoulder, when the relationship between fetal and maternal parts is very different from that found in normal vertex cases. So must that which attributes the movement to the influence of the inner surface of the bony canal on the fetal head, for rotation occurs in breech and transverse cases, and in pelves so distorted that the normal relationships are absent.

Olshausen believes that internal rotation of the head is merely the result of a movement of the trunk; he states that the compression of the uterine wall on the trunk after the escape of the liquor amnii causes its rotation, and consequently that of the head. This view is entirely incorrect because, clinically, it can be demonstrated that rotation does not take place immediately after the liquor amnii escapes; and that rotation of the trunk is not necessarily followed by rotation of the head. Indeed, in Barbour and Webster's second-stage case, in which the head (O. L. A.) is rotated so that the occiput is near the front, lying low in the pelvis, the trunk is so placed that the back looks to the front and

left; in other words, the head has begun to rotate while the trunk has not.

There can be no doubt that the chief factor in producing internal rotation is the sacral segment of the pelvic floor. This is made up of the tissues posterior to the vaginal slit, consisting mainly of fasciæ, ligaments, and muscles, with strong bony attachments, and it may be regarded as composed of a right and a left half, each of which slopes downward and inward from the bony wall. As the vagina is canalized by the advancing fetus the surrounding tissues are stretched, and as they possess some elasticity they exert a recoil action on the presenting part of the fetus. Berry Hart states that that part of the presenting part which first strikes a lateral half of the sacral segment must be rotated by the resiliency of the part which is pressed against. In the O. L. A. case (now under consideration) the occipital end of the head first strikes the anterior part of the left half of the sacral segment, having a shorter vertical distance to travel than the sincipital portion of the head, and is moved forward and inward. When the occiput looks directly forward the head lies symmetrically in the pelvis and is pressed equally by both halves of the sacral segment, so that no further rotation takes place. From what has been pointed out regarding the anatomic conditions in the pelvis during labor, it is very evident that this adaptation must take place. Barbour and Webster's second-stage section shows clearly that the shape of the vaginal canal during canalization is one in which the anteroposterior diameter is greater than the transverse, so that on cross-section it is somewhat oval. A mass, longer in one diameter than another, descending asymmetrically into relation with such a passage must tend to be rotated if the wall is elastic. It is, indeed, as Barbour states, largely a question of accommodation.

A series of cross-sections at different levels, made by Zweifel, shows well the relative increase in the conjugate and decrease in the transverse diameter as a result of the distribution of the soft tissues.

The direction of the rotation depends on the part that first comes into contact with the anterior part of the sacral segment. Dubois has experimented on the bodies of women who have died at full term, and has proved that by pushing the head through the pelvis rotation occurs if the floor be not injured by rupture or overstretching; he found that the occiput always turned forward if it reached the sacral segment before the sinciput. Edgar has obtained similar results in his experiments.

As regards the part played by the body of the fetus during the descent of the head to the perineum and during the process of internal rotation, the main change is an alteration in its attitude whereby it elongates. While, as has been shown, the chin re-

mains flexed on the chest during this period, there is an undoing of the bent condition of the back, so that the breech and lower limbs rise to a higher level. This is the explanation of the clinical fact that though the head be at the perineum, the breech of the fetus may be as high as at the beginning of labor. Rotation of the head is not necessarily accompanied by rotation of the body, as Barbour and Webster's sections show.

*Extension.*—This term is applied to the birth of the head after internal rotation has occurred. The combined action of the uterine and accessory muscles drives the fetus downward, the head stretching the anterior part of the sacral segment laterally as well as in an anteroposterior direction. The resistance of this segment is upward and a little forward. As a result of the action



FIG. 116.—Forward motion of head during stage of expulsion under the influence of forward thrust of sacrum and pelvic floor (one-sixth natural size).

of these two forces the head of the fetus is moved forward and upward, the occiput sliding under the symphysis, the sinciput and then the face passing over the perineum. During this movement the chin somewhat leaves the chest of the fetus, though this is not so marked as is generally believed. It is most evident in primiparæ, and in multiparæ with a well-preserved perineum. The latter feature also largely determines the amount of upward gliding of the occiput in front of the symphysis.

The birth of the head is not continuous. It is marked by advance during the pains and by recession between the pains until the posterior part of the head is fairly in the grasp of the vulvar girdle. Thereafter advance is usually steady and rapid.

*External Rotation or Restitution of the Head.*—This term is applied to a movement of the head that takes place immediately

after its escape from the vulva or with the recurrence of a pain. It consists of a rotation whereby the occiput turns toward the side to which it was directed at the beginning of labor. In the case now under consideration (O. L. A.) it turns to the left. This movement though referred to the head has nothing to do with the latter, being in reality a change in the body of the fetus, to which the head movement is secondary. By the time the head is born the shoulders of the fetus have come into relationship with the sacral segment of the pelvic floor. It has already been pointed out that internal rotation of the head is not necessarily accompanied by any corresponding rotation of the trunk, at least until the former is nearly complete (shown by Barbour and Webster's sections), so that ordinarily the long diameter passes through the upper part of the pelvis in an oblique diameter opposite that in which lay the long diameter of the head; therefore, in the case now being considered (O. L. A.), in the left oblique diameter.

Coming in contact with the sacral segment of the floor, rotation must take place in such a manner that an accommodation of diameters is brought about. The anterior or left shoulder of the fetus striking the right half of the sacral segment first is rotated to the front. Very rarely in an O. L. A. case may rotation of the head to the right be noted. The explanation is probably due to the shoulders descending transversely or even rotating somewhat, so that the bisacromial measurement occupies an oblique diameter opposite to that in which it lay early in labor.

Under these circumstances it is easy to understand how the shoulders might be turned at the pelvic floor so that the back is directed to the right, the occiput being correspondingly turned. It must be remembered that cases in which this abnormal rotation occurs may thus be wrongly diagnosed O. D. A. or O. D. P. cases, in which, of course, the normal rotation of the shoulders turns the occiput to the right side.

Some authors hold that the external rotation of the head is merely an undoing of the twisting of the neck produced during the movement of internal rotation. That this may play a part in some cases cannot be denied, but if it were always the cause, external rotation should occur as soon as the head is born. In very many cases there is a pause at this stage, the head turning only when pains drive the shoulders down into relationship with the floor of the pelvis.

*Expulsion of the Trunk.*—After the shoulders have rotated, the one that is anterior moves under the symphysis, the posterior gliding forward over the perineum. The arms and trunk then follow. The pelvis usually rotates so that its transverse diameter is in line with the anteroposterior diameter of the outlet; when the pelvis is small or the outlet large it may not fully rotate and may be born obliquely.

**Mechanism in Occipitodextra Anterior Cases.**—In O. D. A. cases the mechanism is similar to that in O. L. A. cases, save that rotation occurs in the opposite direction. Thus, in internal rotation the occiput turns from the right side to the middle line, while in restitution the shoulders turn so that the back of the fetus looks to the right.

*Anomalies in O. L. A. and O. D. A. Mechanisms.*—Very rarely the above-described mechanism may not take place. This may be found where the parturient canal is very large or the fetus is small. The head may be pushed through with its anteroposterior diameter transverse or oblique, internal rotation not taking place.

**Mechanism in Occipitoposterior Positions.**—This will be considered on page 492.

**Head-moulding and Head-marking in Occipito-anterior Cases.**—During normal labor the shape of the fetal head is altered by the effect of pressure, both the bones and the soft tissues being

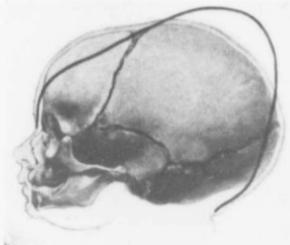


FIG. 117.—Configuration of fetal head after its delivery as a vertex presentation.

affected. As the head descends in the attitude of flexion it is compressed at successive levels by the stretched wall of the parturient canal. This pressure is relieved only when the head has passed through the vulva. The grip of the girdle of contact varies in different cases, from the suboccipitofrontal to the suboccipitobregmatic circumference of the fetal head. The effect is shown in the asymmetrical shape of the head after birth. If it be compared with the unmoulded head, it is found to be elongated anteroposteriorly, especially in the line of the maximum diameter of Budin. There is relative shortening of the suboccipitofrontal and the suboccipitobregmatic diameter. The parietal bone which is anterior in the pelvis during labor, may somewhat override the other. Thus, in O. L. A. cases the right parietal is higher than the other, while in O. D. A. cases it is the left. The reason of this relationship is that for a considerable time in labor the anterior parietal bone, being opposite the anterior deficiency in the bony

pelvis, is bulged in the direction of least resistance, while the posterior parietal bone is forced under the other. After internal rotation prolonged compression of the head at the outlet is likely to depress the frontal bones below the level of the parietal, and sometimes the latter may override the others. Very frequently the supra-occipital bone is somewhat pressed under the posterior edges of the parietals.

The soft tissues are altered as follows: During labor that portion of the scalp below and within the girdle of compression becomes congested, darker in color, and swollen as a result of edema, blood being sometimes extravasated. The elevation thus formed is known as the *caput succedaneum*. Sometimes it may develop before rupture of the membranes, but usually afterward, in the second stage. More than one swelling is often produced. The earliest is formed before internal rotation occurs, on that part of the head related to the anterior deficiency in the bony pelvis. Therefore, in O. L. A. cases it develops on the upper posterior part of the anterior or right parietal bone; in O. D. A. cases on the upper posterior part of the left parietal bone. As the head rotates to the front, the occiput reaching the middle line, the swelling develops toward the tip of the occiput. While the head is delayed at the outlet the occipital caput becomes larger. The earliest-formed swelling is sometimes termed the *primary caput*. The last formed, that over the tip of the occiput, being the *secondary caput*. After the birth of the child a sulcus may sometimes be noticed between these, though generally they form a continuous swelling.

Great variations are found in the extent to which these head changes are produced. When the skull is very small or the passages larger the asymmetry may only be slightly marked, and there may scarcely be any overriding of the bones or a visible caput succedaneum. A caput may be formed on the vertex in the first stage, especially if there be premature rupture of the membranes or if the latter be abnormally stretched and forced through the cervix as a pouching bag, leading to a diminution of resistance over the lowermost portion of the scalp. The caput usually disappears within thirty hours of birth, while the distortion of the bones also disappears to a considerable extent within the same period, though five or six days usually elapse before the disappearance is complete.

### THIRD STAGE OF LABOR.

**Anatomy and Physiology.—Uterus.**—Following the expulsion of the fetus and liquor amnii, retraction takes place in the greater part of the uterine wall, which becomes thickened and reduced in area. The stretched and thinned cervix partly recovers itself, becoming thicker and shorter. The lower uterine segment

only partially retracts, and may be folded on itself by the pressure of the upper segment. The most marked change is in the upper uterine segment, whose wall is everywhere considerably thickened where the placenta is not attached. At the placental site its thickness is only slightly increased because of the mechanical obstacle offered to retraction. (The same peculiarity was pointed out in describing retraction in the uterus during labor.) The

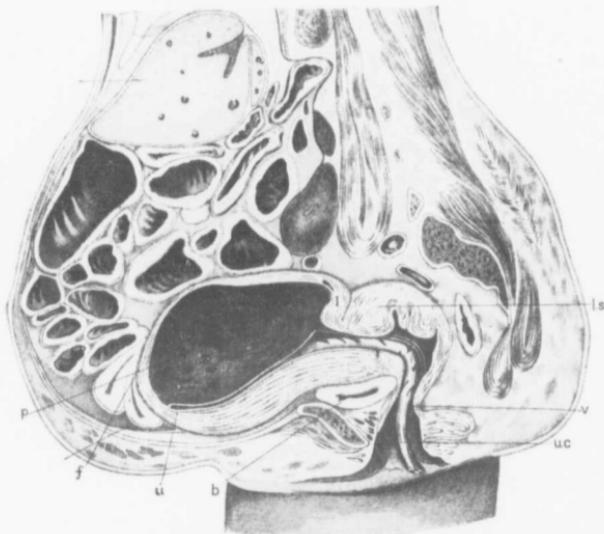


FIG. 118.—Vertical mesial section of the body in the beginning of the third stage. The body has been frozen in the erect posture, causing exaggerated antversion of the uterus (Pestaloza); *f*, Fundus; *p*, placenta; *u*, uterine cavity, appearing as a slit; *ls*, lower uterine segment; *v*, vagina; *uc*, umbilical cord; *b*, bladder. The placenta is as yet unseparated. The thinnest part of the wall of the body of the uterus is that to which the placenta is attached. The membranes are detached from the lower uterine segment.

placenta itself, while firmly attached to the uterus, diminishes somewhat in superficial area, becoming thickened and somewhat folded, and bulged at the borders. It forms a mass that is completely embraced by the retracted uterine wall, there being no space left *in utero*, the amnion-covered surfaces being in apposition. Pestaloza has published frozen sections of women who died in the beginning of the third stage, one being a single and the other a twin pregnancy. The various points mentioned are

therein well demonstrated. In the former the length of the uterus from the fundus to the os externum measures nearly 8 in., of which two-thirds were composed of upper uterine segment. The anteroposterior diameter of the latter measured 4 in. The thickness of its retracted wall averaged 1 in. except where the placenta was attached; there it measured  $\frac{1}{2}$  in. The membranes at this time were attached to the uterine wall save over the area cor-

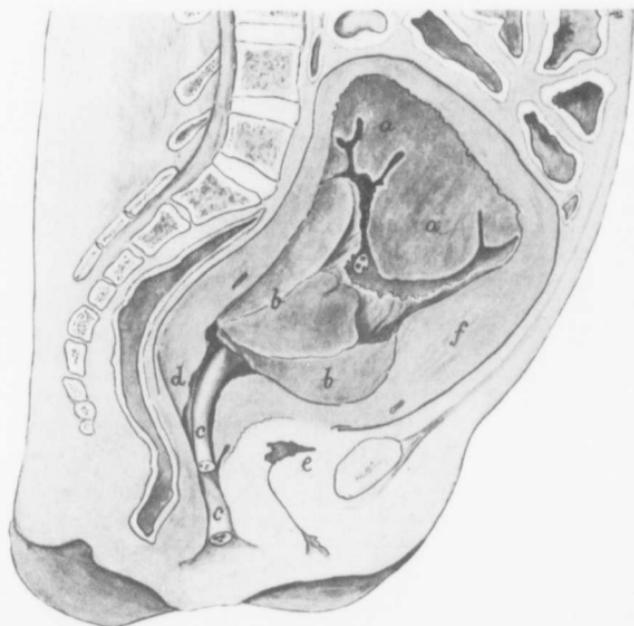


FIG. 119.—Vertical mesial section of a woman who died after the expulsion of twins from the uterus. The uterus is retracted on the two placentae, but there is no separation of the latter from the uterine wall (Pestalozza): *a*, Upper placenta; *b*, lower placenta; *c*, two umbilical cords lying in the cervix and vagina; *d*, cervix; *e*, bladder; *f*, thickest retracted portion of the uterine wall.

responding to the greater part of the lower uterine segment as it existed in the second stage of labor.

(It has been shown that they begin to be separated to form the bag of membranes during the first stage, and in the second stage are found separated along an irregular line as high or nearly as high as the retraction ring). Over the upper uterine segment they are attached, though much crumpled as the result of the reduction

in size of the area of the uterine wall. The decidua and chorion are together arranged in a series of folds, and a similar change is produced in the amnion, though the latter is entirely independent of the former save where the amnion and chorion are closely united. The foldings are not uniformly marked, being narrower and more numerous in the amnion. The chorionic and decidual folds vary according to the thickness of the spongy layer; where the latter is scanty very slight folding occurs. The independent arrangement of the amnion is made possible by the presence of delicate strands connecting the amniotic and chorionic connective tissue over a large area; they may be somewhat torn during retraction. In some parts these are absent, the amnion and chorion being firmly joined. The decidua and membranes thus form a layer considerably thicker than is present in pregnancy, as a result of the changes due to retraction. The alteration in the decidua is due to the large amount of reticulated structure that is present at the end of pregnancy. Before labor its spaces are flattened more or less obliquely or parallel to the muscular wall. During retraction they become crumpled and irregular.

The shape of the uterus varies according to the size of the placenta and its site of attachment. When it is situated on the anterior or posterior wall, the retracted organ is somewhat wider transversely than anteroposteriorly. The wall to which the placenta is attached may form a bulging that does not exist on the opposite wall. The anterior wall is wider than the posterior when the placenta is situated on it, and *vice versa*.

When the placenta is fundal the body has a more globular shape than when it is attached to the anterior or posterior wall. When the placenta is *previa*, being situated mainly or entirely in the lower uterine segment, the walls of the upper segment retract more than in normal cases; they are more thickened and form a mass of smaller bulk, since they are separated only by membranes. When the woman lies in the dorsal position the uterus lies against the spine, the fundus above the umbilicus, opposite the junction of the third and fourth lumbar vertebrae, or about  $6\frac{1}{2}$  in. above the symphysis, on an average, the bladder and rectum being empty. The height varies normally considerably—*i. e.*, from 14.5 to 17.8 cm. ( $5\frac{3}{4}$  to 7 in.), according to the size of the uterus, the size of the placenta, the shape of the pelvis, and the condition of the rectum and bladder. It may be symmetrically placed or may be deviated to one or the other side; in some cases it may be slightly rotated to one side or the other on its long axis. With the hand its position may easily be changed. When the woman sits or stands the fundus falls forward, becoming markedly anteverted, and the intestines rest on its posterior surface. (See Pestalozza's section, Fig. 119.) The consistence of the wall of the retracted uterus at this period is one of firmness, but it has not the hardness of the

empty contracted uterus. It may be dimpled easily by the pressure of a finger.

**Vagina.**—The wall of the vagina is soft and relaxed, a certain amount of retraction having taken place in it, more marked in the upper than in the lower portion, and varying in extent in different cases. There is usually a considerable amount of gaping in it, especially in the lower part. The perineum and vulva have somewhat recovered their shape by retraction of the tissues, but they are still very lax and stretched, marked variations being found in different cases. The bladder has sunk from the position occupied during the second stage of labor and has resumed its preparturient shape, though it lies at a slightly lower level. The pelvic peritoneum has retracted somewhat and has descended on each side where it was elevated in pregnancy. It is considerably wrinkled over the bladder and lower part of the uterus.

**Changes During the Third Stage.**—The processes to be studied during this stage are: 1. Separation of the placenta and membranes. 2. Expulsion of the placenta.

Different views have been current as to the method by which the placenta is separated from the uterine wall in normal labor. It was formerly taught that partial separation took place during the second stage as a result of uterine retraction, the placenta not being able to undergo a corresponding change; the cyanosis of the head of the fetus when delayed at the vulva was thought to be due to this. Frozen sections have, however, demonstrated that normally there is no separation during this stage, and that a small amount of retraction in the placenta takes place, accompanying the retraction that occurs in the upper uterine segment, though in the latter it is very much less marked in the placental part of the wall than in the non-placental part. The cyanosis is explained in some cases by pressure on the cord, but generally by the interference with the circulation of maternal blood to and from the intervillous spaces of the placenta, caused by the retraction of the musculature. Others have held that separation takes place immediately after the escape of the fetus and liquor amnii, as a result of the shrinkage in area of the uterine wall by retraction, the placenta not being able to follow, the diminishing area being thus forced from its attachment. This view is denied by many who hold that, while it may apply to some cases, it is not to be regarded as normal.

Barbour in particular has shown that the placenta that diminishes in area without separation during the second stage continues to shrink after the escape of the fetus, following the retracting uterine wall without separation. The area of the placental attachment at the beginning of labor is about 35 to 40 sq. in. Barbour has measured it in uteri removed by Porro-Cæsarean section and found it to be 14 to 21 sq. in. In two cases its diameters were

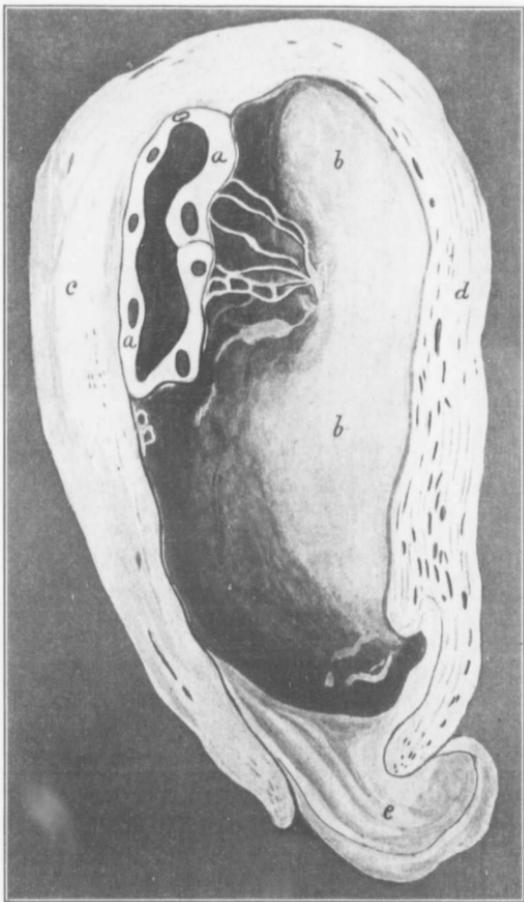


FIG. 120.—Vertical mesial section of uterus and contents removed after a Porro-Cesarean section. The cervix was divided below the os internum. The uterus is retracted on its contents: *a*, Umbilical vein; *b*, placenta; *c*, anterior uterine wall; *d*, posterior uterine wall; *e*, membranes bulging through the cervix. The placenta is attached to the posterior uterine wall and is not separated.

4 by  $4\frac{1}{2}$  in.; in a third case 5 by  $5\frac{1}{2}$  in. In these cases there was no separation and the placenta was embraced by the upper uterine segment, as has already been described. Frozen sections have corroborated these findings. I have already described those of Pestalozza. In Pinard and Varnier's section of a woman who died after the birth of triplets, there is only very slight separation of the lower edge of the placenta, the great mass having diminished without any separation; in such a case it might be expected that the normal process should not always be followed on account of the size of the placenta. Yet Pestalozza's twin case, in which the placenta was large, shows that the lower edge is not necessarily separated.

Of the views most prevalent at the present time the following may be mentioned:

(a) Separation associated with the formation of a retroplacental

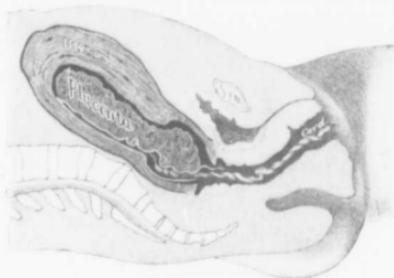


FIG. 121.—The more favorable mechanism of expulsion of placenta (Varnier).

hematoma. Schultze advanced the view that after the birth of the fetus a contraction of the uterus diminishes the placental area, so that the central part of the placenta is separated. Blood is poured from the uterine sinuses into the space between the placenta and uterine wall, and, continuing to increase, causes the rest of the placenta to be separated. He holds that the fetal surface of the placenta always presents at the os externum, and that a certain amount of blood is a necessary accompaniment of placental delivery. Various modifications of this view have been advanced.

Schultze's view must now be regarded as discredited as applied to the great majority of labors. Many specimens have shown that the edge of the placenta presents at the os externum far more frequently than the fetal surface, and that this usually occurs without the development of a blood-clot; the latter cannot, therefore, be regarded an essential cause. The retroplacental clot is

most frequent when the placenta has had a fundal attachment, but there is no proof that it is anything more than an accidental accompaniment of separation.

(b) The view which is most in keeping with the anatomic and clinical data at the present time is that of which Barbour has been the chief exponent. This authority has mainly emphasized the

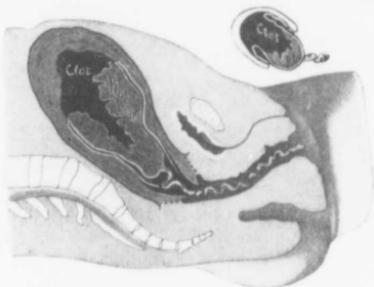


FIG. 122.—The less favorable of the common methods of expulsion of placenta (Varnier).

facts that the so-called cavity of the uterus at the beginning of the third stage is a mere slit; that the formation of a blood-mass between the placenta and uterine wall does not generally occur; that the retracted uterine wall is closed upon the placenta, which is folded and diminished in area to nearly half that which existed at the beginning of labor; that this shrinkage is possible because



FIG. 123.—Transverse section of uterus removed by Porro-Cesarean section. Note the retraction of the uterus on the placenta which is attached to the posterior uterine wall (Barbour).

of the spongy nature of the placenta. As the latter is compressed much maternal blood is squeezed out of the intervillous spaces into the uterine vessels, and fetal blood out of the villi into the vessels of the cord. The reduction in size is assisted if the child is allowed to breathe several minutes before the cord is cut, so as to aspirate the circulation in the villi; and afterward, as well, if

the cord is cut without being tied on the placental side, and allowed to bleed.

Beyond a certain point, however, the placenta cannot diminish. When contractions of the uterine muscle occur, causing a diminution in the size of the placental area, the placenta, not being able to follow this change, necessarily becomes separated. This probably begins at the lower margin, since this part of the placenta is subject to less pressure than the rest, being opposite the lumen that leads through the lower uterine segment and cervix. Clinically this separation of the lower margin may often be made out. There has been some difference of opinion as to whether entire separation may be brought about as a result of contractions that do not force the placenta downward, or whether, after the separation of the lower edge has begun, the rest is separated by being forced down. It seems likely that the downward direction of lessened resistance is an important factor in separation. Were the placenta surrounded on all sides by a muscle contracting with equal force, it is difficult to understand how any separation could occur, owing to the equality of the pressure. In the uterus the placenta folded on itself is compressed during contractions above and around, but not below it. The mass is, therefore, forced downward in the direction of least resistance, and separation can only occur first at the lower margin when the placenta is situated mainly on the anterior or posterior wall. Succeeding contractions, by forcing the placenta still lower, cause a corresponding separation from the uterus, and the process continues until the upper segment is empty. As has already been pointed out, the placenta is driven down edge first, folded and compressed, in the manner described by Matthews Duncan.

In the case of a fundal insertion the mechanism is believed to be somewhat different. Here a somewhat central area on the fetal surface is opposite the canal of the cervix—the direction of least resistance—and separation occurs at this point when contractions take place. The placenta is thus driven down inverted, the fetal surface presenting in the manner figured by Schultze; sometimes quite an amount of blood is poured out above the placenta—the so-called retroplacental hematoma. As this is not always present, it is rather to be regarded as accidental than essential.

The expulsion of the placenta from the lower uterine segment, cervix, and vagina is brought about solely by the accessory muscles, by gravity, or by a combination of these. As women are usually delivered in the lateral or dorsal position, gravity plays little or no part, the accessory muscles being the effective agent. If the latter be inefficient on account of some local or general condition, the placenta may remain in the lower segment and cervix, partly in the cervix and partly in the vagina, or entirely in the vagina. The membranes are separated somewhat as a result

of the crumpling produced by retraction of the uterus after the birth of the fetus, but they are mainly separated by being dragged out after the placenta. Bleeding does not occur to any extent from the body of the uterus during the normal third stage because of the retraction that greatly occludes the vessels in the wall before separation, and because of the further retraction and contraction accompanying and following the expulsion of the placenta.

### CHAPTER III.

#### CONDUCT AND MANAGEMENT OF LABOR.

**Lying-in Chamber.**—As the great majority of labors take place in private houses, special precautions must be taken to prepare the accommodation necessary for the care of the mother and child. The smaller the dwelling and the more limited the means of the inmates, the more difficult it is to attain to that perfection in the conduct of labor that is only attainable in a well-equipped maternity hospital.

The lying-in chamber should be roomy, quiet, and capable of good ventilation. One with an open fireplace is, therefore, advisable. Before the patient is ready for it, all unnecessary hangings and furniture should be removed and it should be thoroughly cleansed. It should not have been occupied by a sick person suffering from any infective condition. The sanitary arrangements of the house should be perfect. If there be a bath room adjacent to the chamber, its plumbing should be in good order. Preparations must be made for obtaining a plentiful supply of boiled water. A couple of small tables for holding instruments, dressings, etc., are advisable, and a large one—*i. e.*, a kitchen table, should be in readiness if certain manipulations or operations are to be satisfactorily carried out.

**Nurse.**—The selection of a nurse is too often a haphazard matter. It is generally left to the patient, who thinks only of her personal preference. Physicians are too lax in yielding to their patients' wishes in this matter. The choice of an obstetric nurse should be a matter of the gravest responsibility. Good character and pleasing personality are important considerations, but if they are not combined with strict cleanliness and an aseptic technic the patient will be subjected to great risks. The best intentions of the scientific obstetrician will be in vain if his nurse fall below the level of his ideal of work. She should not have been in attendance upon any case of infection for at least one week before the confinement. During that time she should take daily baths, her

hair being carefully washed, and the hands and arms being sterilized several times. When she enters the patient's house she should wear freshly washed dresses.

**Nurse's Arrangements.**—In private practice it is customary for the nurse to attend to the arrangements that are necessary preparatory to labor. She must see that the following are provided: A supply of clean towels; a sterilized packet of a dozen towels; a couple of labor pads, made of cheese cloth filled with absorbent cotton, wood-wool, or jute, 3 ft. square and 3 in. thick; two dozen vulvar pads of the same material, 10 in. long, 4 wide, and 2 thick, with end-pieces that may be fastened to the abdominal binder; a supply of sterilized pledgets of absorbent cotton; three or four binders of unbleached muslin,  $\frac{1}{2}$  yd. and  $1\frac{1}{4}$  yds. long; two pieces of rubber sheeting, 3 by 4 ft.; a bedpan to be used for evacuations; another bedpan to be used when the vulva is washed or the vagina douched; half a dozen fresh-boiled sheets; several sterilized pitchers and basins; sterile glycerin or vaselin as a lubricant; boiled new nail brushes and soap; a sterilized fountain syringe, sterilized safety pins and glass catheter; sterilized cord ligature and dressings; a piece of oil cloth or sheets for the protection of the floor; the child's clothing; antiseptics ordered by the physician.

**Preparation of the Bed.**—It is best that a narrow bed be used for the delivery, the woman being transferred to another afterward. The bed should have a thick, firm mattress. If it be not firm, boards may be placed underneath. Over it a piece of rubber sheeting is placed, and this is covered with a clean sheet or piece of muslin, which is pinned to the mattress. On this is placed the labor pad. In place of the latter folded sheets or a sterilized rubber pad may be used. The upper bedclothes should be light and the edges should be fastened with safety pins or stitched together. Ordinarily a special bed cannot be obtained. Then it is necessary to place a second rubber sheet over the first, covered by a sheet. The latter two are removed after they are soiled by the discharge of labor, the patient lying upon the lower sheets after she has been cleansed.

**Preparation of the Patient.**—A few days before labor the external genitals should be shaved. When the woman objects to this procedure, she should be informed of the increased risks that she incurs. Frequently it is possible only to cut the hair with scissors; this method, however, cannot ensure such cleanliness as the former. It is part of a conscientious physician's duty to educate women in this matter. When labor pains begin the patient should take a bath, unless she had taken one a few hours previously. The lower bowel must be cleaned out with an enema of soapsuds and olive oil. The nurse should carefully wash the external genitals with the antiseptic lotions ordered by the phy-

sician, and a pad soaked in the antiseptic solution should be fastened over the vulvar region. She then puts on a clean night dress and stockings, a clean skirt, and a loose wrapper. These are worn as she moves about during the first stage. During the second stage, as the patient lies on the bed, it is advisable to cover her limbs and body in sterile cloths, so that only the vulva is exposed.

**Physician's Outfit.**—The obstetrician should be provided with everything that is necessary for all the conditions with which he has to deal. In private practice he need not take these to every case of labor. It is more convenient to use an outfit for the ordinary cases, and to have in readiness at his home those things that are needed in special cases, so that they may be obtained at short notice. Various forms of obstetric bags are in use. That which the author has found most satisfactory is the form devised by Edgar, of New York. It consists of two trays made of aluminum or thin-plated copper; the larger fits in the smaller, resting on a narrow shelf near the top. In these trays are all the articles required at the labor. When filled they are placed in a light outer covering fastened by straps.

The trays and their contents should be sterilized after they are used, so as to be ready for another case. It is not necessary to sterilize them at the patient's house.

In the lower tray is a canvas case, divided into compartments, in which are placed: A bottle of sterilized glycerin; a hypodermic needle with the usual pellets; a case of aseptic ergot capsules; a case of capsules of amyl nitrite; a bottle of sterilized catgut, linen, or silkworm-gut ligatures; a small case of needles; a pair of scissors; an eye-dropper; a bottle containing an antiseptic; packets containing sterilized salt ready for making salt solution; dressing for the umbilical cord.

The outer case contains: A package of Barnes's and Champetier de Ribes bags; a pair of axis-traction forceps; a metal case containing sterilized cotton and antiseptic gauze; a metal case containing a long-curved glass uterine douche tube, a glass vaginal tube, and two glass vesical catheters; a package containing sterilized soft-rubber and gum-elastic bougies and catheters; a package containing a needleholder, long dressing-forceps, four artery forceps; two pairs of boiled rubber gloves, with a bottle of sterilized talc powder; a sterilized rubber douche bag; a sterilized apron; a sterilized nail brush and nail cleaner; a bottle of anesthetic, wrapped in a sterilized towel, may also be kept in this tray.

This form of bag is not in general use, the favorite being that in which the instruments are not kept sterilized, but are only prepared, when required, at the patient's house. The Edgar model is a far safer one.

At the bedside of the patient the obstetrician should wear a fresh

duck or linen suit, or should divest himself of his coat and waistcoat and put on a linen gown.

**Management of the First Stage of Labor.—Obstetrician's Duties.**—On arriving at the patient's house, it is the physician's duty to determine whether labor has actually begun and how far it has advanced. (If the woman be a stranger to him he must first find out if she is pregnant.) The attitude, presentation, position, and vitality of the fetus should be investigated; an effort should also be made to determine if there is more than one fetus. This information should be gained by questioning the patient and the nurse, by watching the former during pains, and by examining her. In the great majority of cases the only examination necessary is the abdominal.

Nothing is more to be deprecated than the routine vaginal examination of parturient women in obstetric practice. It is a frequent cause of infection. When it is employed, as much care should be exercised as if a major surgical operation were being carried out. There should be as much strictness as regards cleanliness in introducing the fingers into the vagina of the parturient woman as in exploring the peritoneal cavity in an abdominal section. In the latter proceeding every precaution is taken to cleanse the skin of the patient as well as that of the operator's hands and arms. In obstetric practice haste and carelessness are only too frequent. How often is the obstetrician satisfied with a hurried application of soap and water and a momentary dip in some antiseptic solution, not of measured strength, but made of an unknown number of drops in an unknown quantity of water? How frequently does he neglect to cleanse the external parts with the same thoroughness that he observes in preparing for surgical work? It matters not how clean the fingers are, if the hair-covered vulva be not attended to. Different workers have demonstrated that it is impossible to introduce the fingers into the vagina without carrying the external contamination. The only way in which this risk can be reduced to a minimum is by shaving the vulva before every labor, cleansing it thoroughly when labor begins, and keeping it covered during labor with dressings soaked in an antiseptic solution. As regards the hands, in addition to careful cleansing by one of the best methods employed by surgeons, boiled rubber gloves should always be used during examinations or operations. Recently a rubber dam containing a perforation, to whose edges a circular flap is attached, has been introduced into practice for use in examinations. The fingers enter the vagina through the perforation, the flap being pushed inward and the dam protecting the vulva from the hand. This is valuable if it be employed after external cleansing as above described. It is dangerous if used otherwise, since micro-organisms are certain

to be carried into the vagina by the rubber flap if they lie on the vulva.

When vaginal examination is necessary, it is best made during a pain, the effect of which can thus be estimated. The condition of the cervix and membranes, presenting part, rectum, bladder, and soft passages may thus be made out. (In all cases the state of the hard and soft passages should have been determined before labor if the physician has had the opportunity of examination.) The results of examination should not be communicated to the patient if they are unfavorable. Nothing should be said to depress her. If she inquires regarding the length of labor, an indefinite answer should be given. It may be necessary to speak to her husband or relatives as to the conditions found.

It is important that the arrangements made by the nurse should be carefully inspected during this visit, and every preparation made for the conduct of the labor. Sterilized dressings and instruments should be placed where they shall be ready for use. If everything is found satisfactory and the cervix is in an early stage of dilatation, the doctor may leave the patient in the nurse's hands, ordering her to inform him if the membranes should rupture, the pains change in character, or if any complication should arise. It is well that he should be present toward the end of the first stage. When he returns to be with the patient, it is best that he should not remain with her constantly, but should stay in another room, visiting her from time to time to encourage her, to estimate the progress of labor, and to observe the condition of the maternal and fetal hearts. Unnecessary persons must be excluded. As to the husband, his presence is sometimes desirable, but generally he should be advised to keep away from the lying-in room.

**Care of the Patient.**—The patient should not go to bed until near the end of the first stage, but she should not walk about too freely before the head is engaged lest a malpresentation or malposition be induced. She should be allowed to cry out during a pain in the first stage, and should be told not to press down. She should not take stimulants, but may be allowed to drink fluids. She should urinate from time to time, the amount being noted to determine whether there is any retention. Sometimes, even in the first stage, the dribbling of a distended bladder may be mistaken for frequency of micturition; the hypogastric region should be occasionally palpated, so that this condition may be diagnosed if it should occur.

When catheterization is necessary the patient should be placed on the bed, with her knees drawn up and separated. A clean sheet is placed over her limbs, her clothes being drawn up underneath. The vulvar region is exposed and the antiseptic pad removed. The hands of the nurse and physician must then be thoroughly sterilized (rubber gloves are safest). The labia and

vestibule are sponged with the antiseptic solution in use, and a boiled glass or metal catheter is held by its outer end and passed into the bladder. The urine is caught in a small, clean dish held in front of the patient's thighs. The soft rubber catheter is employed by many, but it is objectionable in the hands of those whose technic is not perfected, because in introducing it into the urethra it must be held by the fingers close to the end that enters the passage. Infection, therefore, may be introduced. After the catheter is withdrawn the labia are sponged and a fresh pad soaked in the antiseptic solution reapplied, the patient again rising from the bed.

Toward the end of dilatation her skirts should be removed and she should lie down in bed, on her back or side, as she desires. Her night dress may be folded or pinned high around her waist, and a folded sheet may be fastened around her hips to prevent the spreading upward of fluids. In cases of very tedious first stage, when the patient is very restless, the administration of chloral or opium in a full dose is often beneficial both in quieting the patient and in promoting dilatation of the cervix. When dilatation is well advanced and the membranes are doing no good and will not rupture, they should be ruptured during a pain, with the end of a pair of forceps, a probe, or even with the fingers, care being taken not to injure the scalp of the fetus.

**Management of the Second Stage.**—The patient lies in bed during the second stage, on her back or side, as she desires. In many hospitals special delivery tables are provided. In order that she may exercise her accessory muscles to the best advantage, a long towel or twisted sheet may be fastened to the upper end of the bed, so that she may pull on it during pains. She should also be encouraged to press her feet against a firm object placed against the bottom of the bed. When uterine contractions recur she must be told to hold her breath and to strain down. A vaginal examination may be carried out early in this stage under careful precautions, in order to determine whether there is any abnormality that requires attention. If all is right and labor proceeds satisfactorily no further internal examination is necessary. The physician may stay in the lying-in chamber or elsewhere. Usually it is best to see her only at intervals, when the condition of the maternal and fetal hearts and the character of the pains must be noted. When the head reaches the perineum he should remain constantly at the bedside.

When the pains are severe some relief may be afforded if the patient lies on one side and allows the nurse to press against the sacrum during the uterine contraction. If they should become infrequent or weak, the uterus may be stimulated by massaging it through the abdominal wall. The patient often cries out for an anesthetic during the pains. She should be encouraged to do

without it as long as possible. Generally it need not be given until the perineum begins to be bulged. A few drops of chloroform should be placed on an inhaler as the pain comes on, and the inhaler removed when it passes off. Great relief is thus often afforded without the inhibition of muscular contractions. The influence may be strengthened by the assurance of the physician. Indeed, the analgesic effect is often largely due to suggestion. The quantity of the anesthetic may be increased as the vulva is distended. Cramps in the muscles of the legs may give the woman distress. To give relief a handkerchief may be firmly twisted around the affected part for a few seconds, or strong contractions in an opposing group of muscles may be made.

In this stage the patient should not get out of bed to evacuate the bowel or bladder. The bedpan should be used. Special attention must be given to the bladder to prevent accumulation that may delay the advance of the head. Frequent dribbling may be present without evacuation. The urine may be retained in the part of the bladder that rises above the pubes and may cause a small swelling, which may sometimes be sensitive on palpation. To draw off this portion a long catheter is necessary. When the head presses against the symphysis a soft-rubber instrument will not pass into the bladder, as a rule. It is, therefore, necessary to use a hard-rubber or a slightly curved metal catheter. The glass tube had better not be employed in this condition, as there is a risk of breaking it. It may be used, however, to draw off water that may accumulate below the pelvic brim.

**Care of the Perineum.**—As the head bulges the perineum, dilating the anus, small masses of feces may be forced from the latter. They should be caught in pieces of cotton and the whole perineum washed in antiseptic lotion.

The passage of the head through the vulva is a source of great risk to the structures surrounding the outlet. They are enormously stretched and frequently are lacerated. The latter occurrence is most frequent in primiparæ, the most common tear being through the posterior commissure. This is lacerated in about 70 per cent. of primiparæ. According to Schroeder, there is a laceration of the tissues of the perineum in 34 per cent. of primiparæ and 9 per cent. of multiparæ. Olshausen, in ten years' work, reported 21.1 per cent. of lacerations in primiparæ and 4.7 per cent. in multiparæ. In the primitive races this lesion is comparatively rare. The vaginal wall is usually the first to tear, and the rent passes backward toward the rectum in the middle line. Very rarely a central perforation is produced. Various means may be adopted to prevent laceration. The position of the patient is important. The risk to the perineum is greatest when the thighs are well flexed toward the abdomen. The lithotomy posture, therefore, is the worst of all. The greatest relaxation of the

perineum is obtained by extending the thighs. If the patient be on her back or side this is easily managed, separation of the limbs being arranged by the nurse. The most marked relaxation may be got by placing the patient across the bed, her buttocks being on the edge and her limbs hanging down. The physician may conveniently attend to the delivery by sitting on a chair between her legs, which are carefully covered in sterilized sheets.

The perineum should be stretched slowly, and the head should not be allowed to pass through the vulva too quickly. When, therefore, the pains are very strong or the perineum not well relaxed, it is necessary to hold the head back in order that sudden or undue pressure may not be exerted. To effect this, Hohl recommends applying the thumb to the occiput under the symphysis, and the first two fingers to the part in relation to the lower part of the posterior vaginal wall. Others recommend placing the outspread fingers over the perineum (as the patient lies on her side), protected by a towel, so that they may press back the presenting part of the head. At the same time the patient may be told to diminish the force with which she bears down. Often she is unable to obey, and it may be necessary to push the chloroform in order to obtain the desired result.

The head must pass through the vulva with its smallest circumference parallel to the outlet. Consequently the occiput must continue to lead and extension must not occur too rapidly. This may be best ensured by Ritgen's method of pressing on the sinciput through the tissues behind the anus, or by introducing two fingers into the rectum and pressing on it. Occasionally, when the biparietal circumference is gripped by the vulva, such pressure between pains may gradually force the head safely onward, though generally the woman may accomplish this herself by forcing steadily downward. Fassbender controls the head by applying the index and middle fingers to the occiput and thrusting the thumb into the rectum, against the sinciput. Merkertschiantz advocates exercising pressure on each side of the middle line during pains to lessen the tension in the central portion of the perineum. Lusk, in cases of rigid perineum, was accustomed to draw the chin down by two fingers passed into the rectum until the head bulged the perineum, and then allowing it to recede, being careful to discontinue this maneuver during pains. In all the manipulations above described sterilized rubber gloves may be worn. When it is necessary to pass fingers into the rectum the glove should be discarded after the maneuver is finished.

When it appears certain, in spite of the physician's efforts, that rupture is likely to occur, the operation of episiotomy may be employed. This consists in making a slight incision at some distance from the middle line on each side, so that the tissues may not tear mesially toward the anus; in this way the sphincters of the bowel

are preserved. The chief resistance in the soft tissues of the outlet is not the vulvar edge, as a rule, but a ring about half an inch above this. The incisions should, therefore, be made mainly through this part. They are best made as a pain is beginning or passing off. A narrow, blunt-pointed bistoury should be introduced flatwise between the head and the tense ring, about an inch from the middle line when the parts are stretched. It is then held *parallel with the long axis of the mother's body*, and an incision made three-quarters of an inch long and one-quarter deep. The outer end is close to the vulvar margin but not involving it. Scissors are employed by many in performing episiotomy, but they

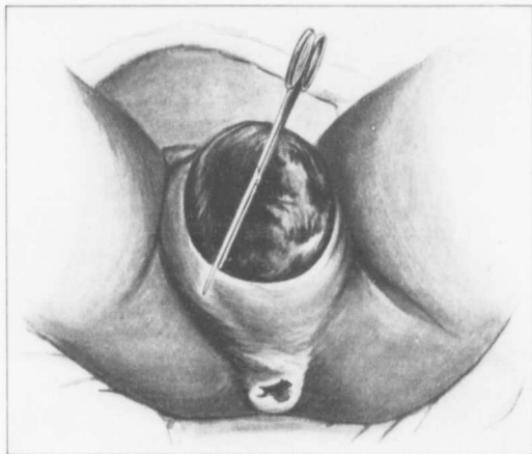


FIG. 124.—Method of performing episiotomy with scissors (Bumm).

are not so satisfactory, as they cut the skin unnecessarily. After delivery the raw surfaces are sutured.

**Delivery of the Body.**—As soon as the head is born the neck should be examined to find out if the cord is coiled around it. If it is, an effort should be made to draw the loop down over the head. If this procedure fails, it may be possible to slip it up over the shoulders; if this does not succeed, it may be divided and the ends ligatured or held with forceps. Mucus should then be cleared from the throat and mouth with a finger covered with gauze. The nose and eyes should be carefully wiped. The head is supported with a hand. The birth of the shoulders is not to be hastened unless there is an indication.

When a pain recurs the face becomes congested; when it passes off the congestion diminishes. If it continues and asphyxia threatens it is well to promote delivery. This should be accomplished by pressing downward on the pelvic extremity of the fetus through the fundus uteri. This may be done by one hand of the physician, or better by an assistant. If the physician presses down he should put a sterilized towel on the abdominal wall.

It is necessary that the passage of the shoulders should be carefully watched lest they increase the laceration of the perineum already produced or cause a fresh one. They should rotate at the pelvic floor, so that the biacromial diameter is anteroposterior. The hand should carefully guide them in the proper axis of the outlet. If there is undue delay at this period, and pressure from above does not bring about delivery, it is best to work a finger into an axilla, exercising cautious traction while the fundus is being

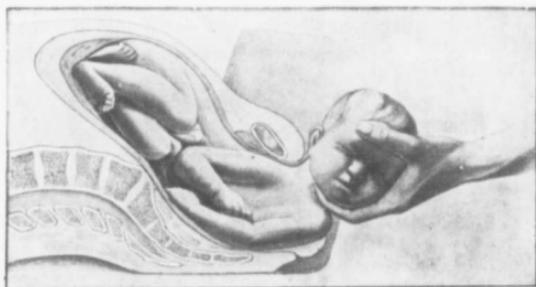


FIG. 125.—Expulsion of shoulders.

pressed downward. The patient should also press down with all her power. Hurried delivery must be avoided. As the child's body is born it should be guided by the hands in the axis of the outlet; as it descends the physician's hand or that of an assistant should hold the fundus firmly and follow it downward. The child after birth may be suspended by the heels for a few seconds until it begins to cry freely, when it is placed on its back, between the thighs of the mother.

**Ligature of the Cord.**—The cord should not be ligatured immediately after delivery in normal cases. Budin has showed that by waiting the child gains on the average three ounces of blood. This is due to aspiration as the pulmonary circulation is established, and to the pressure of the retracting and contracting uterus on the placenta. In feeble children this gain may be very important, though in those who are robust it does not seem to make much difference. Cavilgia has shown that relaxation of the

uterus prevents this blood from passing in any considerable amount into the fetus. Forcible manual compression of the uterus at this time should not be made, as it forces the blood into the fetus, raising the pressure too rapidly and endangering the heart.

Pulsation in the cord ceases usually in four or five minutes, but may continue twice or three times as long. If ligation be carried out after it has ceased, it appears that the loss of weight in the child that takes place normally in the first few days following delivery is less in amount and of shorter duration than where the cord is tied early. Porak and Violet state that such late ligation is apt to be followed by jaundice for a few days, due to rapid breaking up of red blood-corpuscles. This is often absent, however. In practice it is sufficient to wait until the child has breathed three or four minutes or has cried vigorously several times before ligaturing the cord. When the child is feeble, premature, or small the cord should not be tied until pulsation has ceased in it. In cases where the child does not breathe freely it may be stimulated, while still attached to the cord, by suspending it head down, by slapping the thorax, blowing on the face, sprinkling it with cold water, or employing Buist's or Sylvester's method of artificial respiration. (See p. 627.) When these are not at once satisfactory the cord must be ligatured and the child removed for more thorough manipulations. In cases of emergency—*i. e.*, severe hemorrhage, it may be necessary to tie the cord and remove the child at once, so that the complication may be attended to. Care must be taken in applying the ligature, so that the vessels may be firmly secured, and thorough asepsis should be observed lest infection follow. The physician should take care that no hernial protrusion is present in the part to be tied.

Different methods of ligation have been tried. These have been fully elaborated by R. L. Dickinson.<sup>1</sup> Of these he recommends the following:

(a) **Ligature of Vessels.**—With blunt scissors the junction of the cord covering and the skin is snipped with a pair of blunt scissors, the cord itself being held up by the nurse. The Whartonian jelly is then stripped outward, leaving the stalk of vessels bare. The latter is secured with a catgut ligature and the vessels cut externally. The stump tends to roll inward. A sterile dressing is placed over the surface, and kept in position by an abdominal binder.

(b) **Suture.**—The cord is held up by the nurse and the skin near it held between the thumb and finger. The cord is then cut away, the vessels being caught in a pair of forceps. A running suture of catgut is then placed in the raw tissue, the skin edges being also secured. The suture may also be passed before the cord is cut away, being tied afterward.

<sup>1</sup> *Trans. Amer. Gyn. Soc.*, 1899.

(c) **Pressure.**—If the cord be divided at the skin retraction of the vessels occurs, and if pressure be kept up with an aseptic pad and binder or adhesive strap bleeding ceases and healing takes place satisfactorily. Adhesive plaster is objectionable in that it often irritates the skin.

Neither of these methods is the one most frequently employed, mass ligation of the cord being almost universally adopted. It is satisfactory if ligation be carefully carried out and if strict asepsis be employed. The ligation, consisting of narrow linen ribbon or a strand of two or three twisted linen threads, may be applied about three-quarters of an inch from the belly, the part to be tied being firmly squeezed between the thumb and finger to diminish the risk of after-loosening by shrinkage of the Whartonian jelly. The cord may be cut about a quarter of an inch beyond the ligation.

If the end does not bleed it may be wrapped in an aseptic dressing. Powder is not necessary. The maternal end of the cord need not be tied unless there should be another fetus in the uterus. The child should next be wrapped in a blanket and placed in a warm place until the necessary attentions are given the mother.

**Management of the Third Stage.**—From the time the child is born the hand of an assistant should be kept on the fundus of the uterus, the patient lying on her back. If it relaxes excessively, becoming large and indistinct, it should be massaged through the abdominal wall.

In describing the anatomy of this stage, attention has been drawn to the relationships of the uterus after the birth of the child, when it retracts, closely embracing the still unseparated placenta and membranes. In this state the consistence of the wall varies according to whether there be retraction, contraction, or relaxation. These phases are usually met with, though occasionally the placenta is born immediately after the child. It is very important that the physician should be able to appreciate these variations by abdominal palpation. The length of time required for the delivery of the placenta varies in different cases. In a series of cases left to nature, delivery took place in the first hour in 44 per cent., in the second hour in 25 per cent., in the third in 11 per cent. In the great majority of instances the delay is not in the separation, but in the expulsion of the placenta, the latter having passed from the upper uterine segment into the lower segment and cervix, or, it may be, partly into the vagina. Sometimes it may remain entirely in the vagina. There is no doubt that the recumbent position is mainly to blame for this state of matters, for it is very infrequently found among women who habitually adopt a sitting or squatting posture in labor.

It is necessary, therefore, that nature must be aided if women

are to be delivered, in the highest states of civilization, in the recumbent posture. But it is of the greatest importance to know when and how to give assistance, since there is no sphere of obstetric practice in which there is more need for careful procedure. In the first place it should be remembered that nature's imperfection is usually *not in the separation of the placenta*. This process takes place normally in ten to thirty minutes in the great majority of cases if the uterus be allowed to act. It is, therefore, not necessary, as a rule, to squeeze the uterus and forcibly separate the placenta from it. Such a proceeding is very rarely required. If the physician thinks that the uterine contractions are too feeble, it is usually sufficient to rub the fundus through the abdominal wall. Nature's fault is in not expelling the separated placenta, and interference should take place when it is entirely or partly out of the upper uterine segment, lying inert in the lower passages. The determination of this period depends upon accuracy in diagnosis, and this is obtained only when the anatomic relationships are well known. These have already been carefully described. In almost every case abdominal examination alone suffices to make out the conditions. When the upper segment is empty and contracted, it is much harder and its area smaller than when the placenta is still attached, and it is often more mobile. The fundus may be as high, however, if the placenta has not descended well into the vagina. The difference between these two conditions is very often overlooked by careless clinical observers. It is when the placenta is only partly expelled from the upper segment, or the latter is somewhat distended with blood-clot, that the exact state is difficult to determine. On abdominal examination a bulging may usually be noted over the pubes, due to the distended lower uterine segment; frequently vaginal examination is necessary to make out the exact condition. When this is made and the placenta lies below the upper uterine segment, it is generally folded, or sometimes inverted, forming a large mass at the level of or below the lower uterine segment. An old-fashioned method of obtaining expulsion in this condition was to make the woman sneeze hard by giving her snuff, thus causing the placenta to be forced from the vagina. At the present time pressure through the abdominal wall is the favorite means.

The upper segment is grasped anteroposteriorly through the abdominal wall, between the thumb and fingers of one hand (both hands may also be employed), and is pressed steadily downward into the pelvis in the axis of the inlet, care being taken that the bladder is empty. The placenta slides gradually out of the vagina, except occasionally, when it may be partially adherent in the uterus or firmly gripped by the latter. As it emerges from the vulva the blood that escapes may be caught in a sterilized dish placed under the thighs or may be absorbed in sterile towels.

The placenta is held in the hand and generally pulled outward. The membranes usually follow easily, but if they do not the placenta may be rotated slowly two or three times, so that they become twisted into a rope. Slight adhesions of the membranes may in this way be separated. Excessive twisting may cause them to be broken. When they do not come away easily it is best to pass two fingers along the twisted mass, separating it where it is held.

In cases where the delay in the delivery of the placenta is due to its non-separation or to its retention in the upper uterine segment, massage of the uterus through the abdominal wall must be carried out. If this is inefficacious and half an hour has elapsed after labor the following manipulation should be employed: The

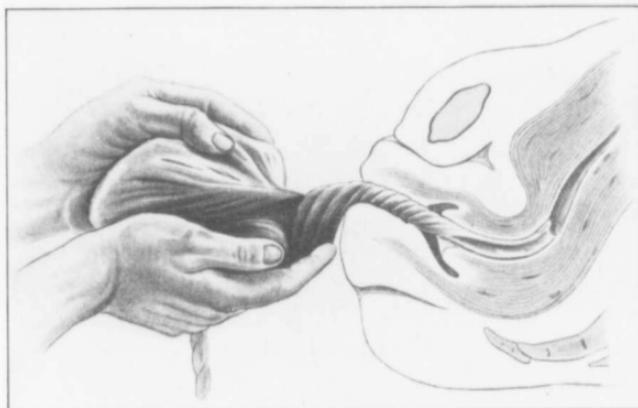


FIG. 126.—Rotation of the placenta twisting the membranes into a rope (Bumm).

uterus must be grasped anteroposteriorly with one or both hands (the bimanual grasp is the better, the thumbs being placed behind the fundus side by side), and as a contraction is felt should be firmly but not forcibly compressed in order to separate the placenta and squeeze it into the cervix and vagina.

As it passes downward the uterine body is felt to grow smaller. It is then pushed downward in the axis of the pelvic brim so as to further expel the placenta. This manipulation is generally known as "Credé's method," so named after the Leipzig professor, who recommended it first in 1853. There is no doubt that the very same procedure had been previously long practised and advocated in the Dublin School of Midwifery. Jellett has clearly established this fact, and has proved that Irish writers described it in the latter part of the eighteenth century. The terms have been loosely

applied, and there are differences of opinion as to what is exactly implied by the Credé and Dublin methods. A careful study of the literature of the subject proves that terms have been applied to cases in which the placenta is forcibly separated and pushed downward by compression and downward pressure of the uterus, and to those in which the separated placenta is expelled either from the uterus or lower genital canal especially by downward pressure of the uterus.

Great care must be observed in using the Dublin or the Credé



FIG. 127.—Credé's method of expressing the placenta, showing also episiotomy incisions (photographed from nature; Dickinson).

method. The wall of the uterus or the appendages may be injured, the placenta may be torn, part being left in the uterus, or the inner surface of the latter may be much lacerated. These evils are most apt to arise when strong efforts are made to force out a *placenta that is firmly adherent*. The method is, therefore, never to be employed when this complication exists. In this circumstance the placenta must be removed by the introduction of a hand into the uterus. Under ordinary conditions the Dublin or the Credé method is not to be employed until twenty to thirty

minutes have elapsed after the birth of the child. Only when marked hemorrhage is taking place from the uterus must it be used earlier to hasten the emptying of the organ.

Ergot is rarely necessary. It should not be given before the uterus is empty both of the fetus and after-birth, as it may cause such contraction upon the uterine contents as will lead to difficulty in delivery. It is used by many when the uterus tends to relax unduly or to bleed after the third stage. When rapid action is needed an aseptic preparation should be injected into the buttock muscles; otherwise, it may be given by the mouth. Careful massage of the fundus and the use of a hot intra-uterine douche reduce to a minimum the necessity for the administration of ergot.

**Immediate After-duties.**—After the placenta and membranes are born they should be carefully examined. This is most satisfactorily accomplished by placing them in a large dish of water. The maternal surface of the placenta must be studied to find out whether any part has been left in the uterus. The membranes and the hole in them must be carefully investigated to determine whether any portion has been retained; it is easy to decide when a large piece has been torn off, but impossible to be accurate regarding a small piece. Any deficiency in the placenta demands an exploration of the uterine cavity. This rule holds good with regard to the membranes only when a large portion has been left; small pieces of membranes are gradually discharged in the lochia. A distinct gap in the membranes lateral to the normal opening should suggest the possibility of a retained succenturiate placental lobe, and warrants immediate exploration of the uterine cavity.

The fundus of the uterus should be frequently examined during the half-hour following the third stage to see that the wall is not relaxed, and the massage should be carried out, if necessary. Douching of the genital tract is not necessary in the great majority of cases. When there is a tendency to the accumulation of blood-clots in the vagina, hot sterile normal salt solution may be used. Antiseptic solutions are only to be employed when local infection exists before labor or when the patient is subjected to the risk of infection during labor.

Lacerations of the genital tract that require to be sutured should be attended to after the delivery of the placenta. Following labor the soiled skin of the mother should be bathed in an antiseptic solution and the blood-stained clothes removed. She may be removed to a clean bed if there be one in readiness. The vulva should then be covered with a dry aseptic pad or one moistened in an antiseptic, which may be attached to the binder. An abdominal binder adds to the comfort of the woman in most cases. It may be made of linen or, better, of unbleached muslin, and should extend from just below the great trochanters to near

the sternum. It should surround the body, one edge slightly overlapping the other, and should be fastened with safety pins, tightly around the pelvis, loosely above. The binder may be worn a week or two. If there be anxiety as to undue relaxation of the uterus, three closely folded towels may be placed under the binder, one on each side and one above the uterus. These act as a mechanical stimulus to the uterine muscle. Under the cloth on which the patient lies the rubber sheet should be left five or six days. Over this linen draw-sheets may be used, and above this, if necessary, a series of prepared aseptic pads.

The general state of the mother is carefully examined, her pulse rate noted, and the condition of the uterus determined before the physician leaves the house. In ordinary cases he is free to go away about half an hour after her toilet is completed. He instructs the nurse to inform him if the woman should complain of severe pain, chills, or faintness; if marked relaxation of the uterus or hemorrhage should occur; if the pulse should become rapid or feeble.

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## CHAPTER IV.

### ASEPSIS AND ANTISEPSIS IN OBSTETRICS.

IN 1847 Ignatius Semmelweiss, by insisting that the students in his obstetric clinic should wash their hands carefully in chlorin water before examining patients, reduced the death rate due to puerperal fever from 10 to less than 2 per cent. The medical world paid no attention to his results save to scoff at them. In 1867 Lister published his observations regarding the part played by micro-organisms in causing wound infection and the method of preventing this by antiseptic agents. Very soon the antiseptic method in surgery became established. About 1870 antiseptics were introduced into obstetric work by Stadfeldt, of Denmark, and Bischoff, of Switzerland.

During the last thirty years, as the knowledge of bacteriology has increased, the rôle played by antiseptics in surgical work has become greatly restricted, asepsis being obtained largely by other means. As a result of the continued introduction of scientific principles established mainly by surgeons and bacteriologists, there has been an enormous reduction of wound infections in surgical work and a corresponding diminution in deaths due to sepsis.

In obstetric practice there has been no such marked progress. (See Chapter on Puerperal Sepsis.) The vital statistics of many civilized countries still show a lamentably high mortality due

to puerperal infection, and *this infection, it is safe to say, is almost entirely avoidable, being due to carelessness and ignorance.* The death rate does not, however, represent the extent of infections in obstetric work. There is a much larger percentage of cases in which death does not take place, but in which the health of women is injured and various disorders established, of every degree of gravity. There has been widespread neglect among medical practitioners to apply the principles of bacteriology and the practice of strict surgical technic in their work. This neglect, in the light of modern knowledge, deserves only to be branded as culpable and criminal. There may be some excuse for an ignorant midwife. The neglectful physician deserves only the severest condemnation. Labor is a natural process and has a low mortality under natural conditions; but in the artificial conditions of civilization and those introduced by the practices of the midwife and accoucheur it has been greatly complicated, and the dangers accompanying it enormously increased. Obstetric practice will never achieve what surgery has done until every parturient woman is treated as the modern scientific surgeon deals with his operative cases. One aim must be kept in mind, to handle every case so that all raw or damaged tissues should be kept aseptic until healing is complete.

Infection may take place in various ways: 1. By the hands of the obstetrician, his assistants, or nurses. 2. By means of instruments, apparatus, or other paraphernalia. 3. As a result of non-cleansing or imperfect cleansing of the patient. 4. By means of the air.

The attainment of an aseptic technic is only possible by continued thought and practice and by strict attention to details. Partial knowledge is as dangerous as ignorance. Those who trust to antiseptics to obtain asepsis are most apt to fall into error. Many obstetricians think that they satisfy all requirements if they dip their fingers for a few moments into water containing a few drops of carbolic acid, corrosive sublimate, or some other antiseptic. Others think that any procedure may be carried out during labor so long as the vagina is douched with an antiseptic solution at the end of the third stage. Others think that instruments and ligatures are rendered sterile by being dipped in boiling water a minute or two. Such mistakes as these can only be prevented by a careful study of bacteria and their properties, of antiseptics and their modes of action and limitations, and of the methods of sterilization. In describing the management of labor I have referred to the duties of the accoucheur and his assistants. (See p. 227.) It is here necessary to give special attention to some details of technic.

**Hand-cleansing.**—The hands and forearms of those who may touch the genitalia of the parturient woman or articles that

may be brought into contact with them must be carefully cleansed. The arms should be bared well above the elbows, and the hands and forearms thoroughly scrubbed in hot water, soap, and turpentine with a stiff nail brush for six minutes. The nails should be clipped short, and cleansed with a cleaner. The skin should then be well washed off in clean water and dried on a sterile towel. This mechanical process is very important and should not be hastened. It is often very hurriedly carried out. This can only be prevented by the use of a watch or clock to time the procedure. Thereafter, cleansing is usually completed by washing in antiseptic solutions, many of which are in use—*i. e.*, carbolic acid, lysol, creolin, mercuric chlorid or iodid, alcohol, permanganate of potash, and oxalic acid, etc. (Details as to the use of these are given in surgical works.) Regarding these chemicals, it has been clearly demonstrated that they are incapable of rendering the skin absolutely sterile. The stronger the solutions and the greater the time of their application the nearer is the approach to perfect sterilization. The strength of solution must be regulated by its destructive action on the arm and hand, and the period of application by considerations of practicability. The ideal chemical antiseptic in skin sterilization is one that can penetrate the hair follicles and glands of the skin, destroying micro-organisms in a very short space of time without injuring the skin. The nearest approach to such a preparation the author has found in crenasol. This preparation is pure creolin minus soda. It has an oily consistence and penetrates the skin well. Brûère, of Montreal, has shown that it is destructive to the pathogenic micro-organisms in two minutes. It should be applied to the skin after the latter has been well scrubbed and dried, and well rubbed in. It should then be washed off in sterile water or sterile salt solution. The application causes reddening and some smarting, but these soon disappear. The author has not known it to cause any serious skin disorder. But whatever be the method adopted, the author regards it as only preparatory to the wearing of rubber gloves. He believes that these are essential to ensure perfectly sterile hands. They may be used whenever it is necessary to make vaginal examinations or to carry out manipulations. They are sterilized by being boiled for eight minutes, wrapped in a cloth, so as to be protected from touching the metal dish. They should then be dried on a sterile towel. In order that they may easily be slipped on the hands, the latter should be covered with sterilized talc powder. If the gloves be made of rubber of medium thickness, the tactile sense is not interfered with. Indeed, after a little practice one learns to disregard the membrane. The gloves should protect the arm for three or four inches above the wrist. In all cases in which internal manipulations are to be employed, the wrist of the glove should cover the sleeve of a sterile gown.

The best-fitting glove is one made on a model shaped like the hand.

Many surgeons merely scrub their hands in soap and water before putting on the gloves. The author believes that the additional application of chemicals as above described is advisable, as there is much less risk of infecting the patient if the glove should tear during manipulations. Of course, if a glove be torn, a fresh one should at once replace it. Rents may easily be repaired, so that gloves may be made to last several weeks. Every assistant and nurse who may touch the genitalia, or handle anything that comes in contact either with the accoucheur's hands or with the genitalia, should also wear gloves. Once clean, they should remain so as long as they are needed in the manipulations. The most glaring faults are often committed by neglect of this rule. Thus, the nurse may have cleansed her hands in order to take charge of the dressings, and in the intervals of waiting she may touch an unsterilized bottle or adjust her dress. She may suddenly catch an arm or leg of the patient which has broken loose, and return to her work, forgetting that she is contaminated. Or she may carelessly drag her dressings or ligatures across her dress or some other unsterilized object. It is essential that the keenest attention be given to the smallest details if perfection in technic is to be attained.

In introducing the gloved fingers into the genital tract, it is sufficient to wet them in sterile water or salt solution. If the whole hand is to be introduced, it is best to use a little glycerin, weak lysol or creolin solution (1 : 200) as a lubricant. Vaseline is said to injure the rubber and should not be used.

**Instruments, Apparatus, Dressings, etc.**—(a) **Instruments.**—Instruments should be as simple as possible so as to afford no gathering-place for microbes, and should be made entirely of metal when possible, all locks being separable. They should be kept carefully scrubbed and polished. They may be sterilized immediately after use and kept always in readiness, wrapped in sterile cloths, or may be sterilized at the time they are required. They are best sterilized by moist steam or boiling. If the former be used a special sterilizer is necessary. Exposure to steam under pressure at 120° to 130° C. for half an hour is effective. Boiling is a quicker and simpler method. If the water contain 1 per cent. of pure sodium carbonate or bicarbonate and about the same amount of salt, the instruments need be boiled only five minutes, all microbes and spores being destroyed in that period. After sterilization they may be placed in a dry sterile dish or in sterile water.

(b) **Apparatus.**—All pitchers, basins, glass or metal douche tubes, etc., that may be used should be sterilized, if possible in a steam sterilizer. In private houses they may be boiled in a washboiler

containing the soda-salt solution. If this is impossible, the small articles should be boiled and the large ones should be thoroughly scrubbed in 1 : 500 chinisol, in a solution of formalin (5i to 1 pint), or in pure creolin or crenasol.

(c) **Gauze, Cotton-wool, Towels, Sheets, etc.**—Plain gauze, wool, towels, and sheets should be sterilized in the steam sterilizer in packets that should not be opened until required. In places where this cannot be carried out, they may be heated for three hours on three succeeding days in the oven of a cooking-range at a temperature of 148° C. (300° F.) or more, a thermometer being used to ensure the proper elevation. Such articles are penetrated very slowly by dry heat, and the moist-heat process is more reliable. Boiling is more satisfactory than the dry process if the articles can be afterward dried.

**Cleansing of the Patient.**—A few days previous to the onset of the labor the nurse should shave the woman's external genitals. (If this be not allowed, the hair should be clipped closely.) Every day thereafter the vulva should be well washed in soap and water. At the onset of labor, after the bowels have been moved by an enema, the external parts should be washed in alcohol and then in one or other of the following solutions—chinisol (1 : 1000), formalin (30 drops to a pint of water), lysol or creolin (1 : 100)—five minutes. Then a pad soaked in one of these solutions should be applied to the vulva and kept in position by a T-bandage during the progress of labor. Douching of the vagina at this time is not necessary unless there is some definite infective process that requires to be treated.

During the course of labor, whenever the patient urinates or defecates, the vulva and perineum should be carefully sponged with one of the above lotions and the pad reapplied. If important manipulations are to be carried out in the genital tract—*i. e.*, turning, application of forceps, etc., the patient must be placed in the lithotomy position on the edge of the bed or on a suitable table, and the external genitals and surrounding skin cleansed as if some surgical operation were to be carried out. The vagina need only be washed out with normal salt solution in clean cases. When any form of infection is present, one of the above-mentioned anti-septic solutions may be employed. Lysol and creolin have the advantage for this purpose of acting somewhat as a lubricant. The legs must then be covered with sterile sheets, and the perineal region entirely covered save opposite the vulva.

The author has entirely abandoned the mercury salts in obstetric and gynecologic work. If they be used in strengths of 1 : 500 or 1 : 1000 they are apt to hurt the tissues, and there is risk of dangerous absorption if they be used as internal douches. Chinisol and formaldehyd are as effective as the mercury salts, and cannot be absorbed so as to injure the patient, when used in

douches. (The author knows of several cases in which corrosive sublimate douches varying from 1:4000 to 1:2000 have caused symptoms of mercury poisoning. In one instance death was caused by absorption of the drug after several days' douching with a 1:4000 solution.)

**Air infection**, formerly thought to be so important, is now known to be of very little importance and may almost be disregarded. Too often has the death of a woman been attributed to a faulty sewer (perhaps a hundred yards away from the patient) when the physician's dirty fingers have been at fault.

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## CHAPTER V.

### ANESTHESIA IN LABOR.

In obstetric practice a general anesthetic may be used for two purposes:

1. To produce mere analgesia for the relief of the woman's suffering.
2. To produce deep anesthesia in order that unconsciousness and complete muscular relaxation may be brought about.

In the great majority of labors it is only necessary to attain the first of these objects. As a rule, the anesthetic should not be used during the first stage, because when once it has been given to the patient it is difficult to withhold it during the remainder of the labor. Moreover, too prolonged administration may weaken the uterine contractions and impair the cardiac strength. There are, however, exceptional cases, in which various complications make early administration advisable. These will be described at a later period.

To obtain analgesia, chloroform is by far the most satisfactory anesthetic because of its quickness of action, ease of administration, and comparative freedom from distressing after-effects. When it is used in a room in which gas is burning the vapor of the drug becomes decomposed, and may be very irritating to the air passages of the patient and other persons present.

The chloroform should be sprinkled in drops on a flannel inhaler or on a handkerchief held over the nose and mouth, the face having been coated with vaselin. In many cases a very few drops satisfy the patient, the analgesia produced being largely due to autosuggestion. She has longed for the drug and believes that it will relieve her suffering, and feels the greatest satisfaction when she smells the first drops. The physician's duty is to strengthen the suggestion. The chloroform should be started as late as

possible in the second stage, and should be given when a pain begins, being removed in the intervals. Usually it need be pushed only when the vulva is being much distended, a cause of much distress, as a rule.

Judiciously employed in this manner, there is little danger of prolonging labor by causing a weakened action of the uterus. Neither is there a danger of producing postpartum inertia and hemorrhage. Too often has the drug been blamed for these complications when it has been due to a long, tedious labor or to one that has been hurriedly brought to a close.

When deep anesthesia is necessary in obstetric work, the same rules and considerations are to be observed that are now established in regard to surgical operations. In America ether is generally preferred for these purposes unless there be distinct contraindications to its use. The full physiologic effect of the drug is necessary—viz., abolition of consciousness and of voluntary and reflex muscular movements.

Hensen, after an exhaustive study of the effects of ether and chloroform on labor, states that after ether anesthesia the muscular activity is much more quickly restored than after chloroform—five to twenty-five minutes after the former, two hours after the latter. Bearing in mind their influence on the postpartum condition of the uterus, he advises that ether should always be used for operative procedures save when there is a contraindication to the use of the drug.

Recently ethyl chlorid has been recommended in obstetric work. Lepage and Lorier state that it is easily administered, the dose being always the same. Anesthesia is obtained in thirty to sixty seconds, and lasts four minutes without repeating the dose; the return to consciousness is rapid and usually without nausea. It is, therefore, of great advantage when a short anesthesia is required.

**Spinal Anesthesia with Cocain.**—Since Kreis published an account of 6 cases of delivery at Bumm's Clinic at Basel, a considerable number of observations have been made, but this method of obtaining anesthesia has not been widely adopted in obstetric practice. In America Marx has had the widest experience. The injection is given as in ordinary surgical cases, but when the woman cannot bend well forward the left lateral position is adopted. The analgesia is usually complete as regards all the factors—uterine contractions, dilatation of the cervix, distention of the vagina and vulva, etc. All operations may be performed excepting, usually, those involving the introduction of the hand in the uterus, the cocain acting as a stimulus to uterine contractions. Complete analgesia lasts from one and a half to two hours; sometimes longer. It may be prolonged by continued injections, but the increased dosage is liable to produce toxic effects.

The injection usually causes cramps and trembling in the legs, nausea, headache, and rise of temperature; these symptoms usually subside quickly, but occasionally may persist one or more days. Marx states that the hydrobromate of hyoscin ( $\frac{1}{100}$  gr.) best counteracts these. The uterine contractions continue during the anesthesia, Doléris and others stating that they increase in force and frequency. Several authors have, however, reported cases in which cocain caused weakening of the pains.

A considerable number of normal cases have required artificial delivery owing to the absence of contraction of the abdominal muscles. The patient not being conscious of the uterine pains, only exercises voluntary expulsive efforts when asked to do so. As regards the influence on the fetus, if the dose of  $\frac{1}{3}$  gr. be not exceeded the fetus is not affected. Larger doses cause slowing of the fetal heart and may produce asphyxia.

PART III.  
THE PUERPERIUM.

CHAPTER I.

ANATOMY AND PHYSIOLOGY.

THE puerperium is the period during which the genitalia gradually recover from the marked alterations that they have undergone during pregnancy and labor.

On the average its duration is generally considered to be about six weeks; yet it is frequently longer. It is to be noted that the tissues never return to the condition that existed before pregnancy, many variations being found in different cases. As a rule, it may be stated that there is a more marked distinction between the pre-pregnant and postpuerperal state in primiparae than in multiparae. In the latter it is often difficult to make out the change that has resulted from a pregnancy and labor. The following facts regarding the anatomy of the pelvis and its contents are mainly derived from investigations made by myself on a number of cadavera, which were studied by means of frozen sections.

**Uterus.—At the Beginning of the Puerperium.**—The uterus is at this period several times larger than in the nulliparous condition. It occupies the greater part of the pelvic cavity, the highest point of the fundus being only  $1\frac{1}{4}$  in. above the brim. Measured vertically, the highest part of the uterus is on the average about  $4\frac{1}{2}$  in. above the top of the symphysis, the bladder and rectum being empty. This agrees with the average height found by Charpentier in the living subject. Other authors give a little lower figure as the average, Lusk making it  $4\frac{1}{3}$  in. Variations depend on various factors—*i. e.*, the size and condition of the uterus, the presence or absence of blood within it, the character of the pelvis, the state of the rectum and bladder. It is easy to understand how, in measuring this distance on the living subject, too short a suprapubic height might be given; it is usual in such cases to measure from the symphysis by pushing in the abdominal wall until the hand rests on the bone; in this way the thickness of the abdominal wall pressed against the symphysis may be left out of account, and hence the measurement may not

be perfectly accurate. An error of  $\frac{1}{8}$  to  $\frac{1}{2}$  in. might thus easily arise. As a whole, the uterus is anteverted, there being no flexion between the cervix and body; the fundus may be directed slightly backward owing to the pressure of the intestines against its anterior part, though this is not the most common condition of the fundus at the end of the third stage. It usually appears rounded, and is directed to the front against the anterior abdominal wall (as in my second-day specimen). In the former case the fundus, when felt through the abdominal wall, has not the round shape that is usually found after labor. The explanation of this would seem to be the flattening of the fundus from before backward.

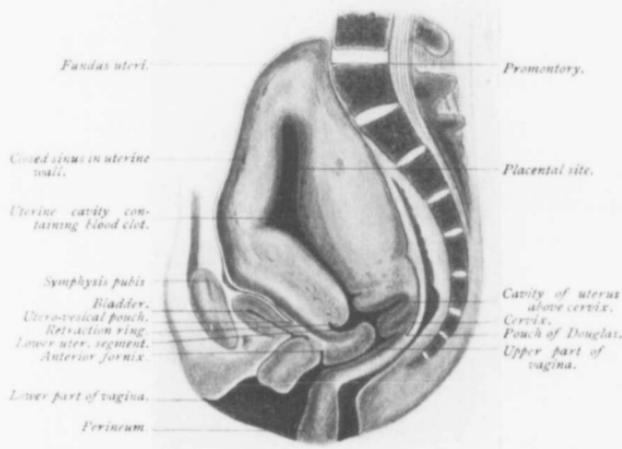


FIG. 128.—Vertical mesial section of uterus at close of labor, five minutes after delivery.

There can be no doubt that in normal conditions the uterus at the beginning of the puerperium is anteverted or, it may be, ante-flexed, the long axis of the body being at right angles to the brim.

In the specimen that I have described three parts can be distinguished in the uterine wall—viz., upper uterine segment, lower uterine segment, and cervix.

**Upper Uterine Segment.**—This forms the great mass of the uterus. Its walls, owing to retraction and contraction, are thick and have a compact appearance; it can be moulded, however, by the structures against which it rests. It is of a pale gray-pink color, darker opposite the placental site. Its vessels are closed,

the tissues appearing quite bloodless. It is thus evident that in this condition very little blood can circulate in the wall.

**Lower Uterine Segment.**—This still exists, though very much shorter than during labor. It is best marked in the anterior wall of the uterus, where it appears scarcely more than half an inch in length. Above it passes abruptly into the thick upper uterine segment, while below it suddenly joins the well-marked cervix. Posteriorly it is not so thin, and passes more gradually into the upper uterine segment above and the cervix below. There exists a well-marked retraction ring; this is not the same as the retraction ring of labor. It is relatively near the cervix—*i. e.*, the upper uterine segment of labor has been added to inferiorly by the amount of the lower uterine segment taken up into it.

**Cervix.**—The cervix, though quite thick, is not restored to the

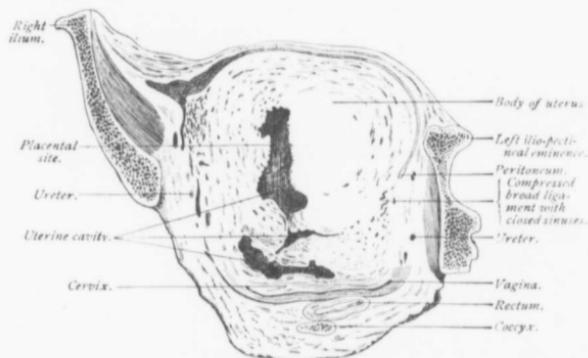


FIG. 129.—Vertical oblique section of pelvis in the beginning of the puerperium, five minutes after delivery.

preparturient condition. It is considerably flattened from above downward, though this is probably partly due to the pressure of the upper uterine segment; its cavity is also partly everted. It is congested, and thus stands out in sharp contrast with the body of the uterus. It is impossible clinically to define with accuracy either the os externum or os internum, especially the latter; hence the long tables of measurements of the cervix and body-cavity given by Milsom, Sinclair, Auefage, Charpentier, and E. Martin are not accurate. These writers have made the mistake of supposing that the prominent lower edge of the retraction ring is the os internum. The latter region in the early puerperium cannot be placed with accuracy even after the most careful microscopic examination, because of the transitional nature of the epithelium

lining the uterus at its level. There is another reason why these cavity measurements are fallacious. The folding between the upper uterine segment and the cervix is not taken into account. The actual length, therefore, of the cavity of the uterus will be greater than that obtained by the use of a sound or hystrometer. This fallacy is well brought out in Fig. 128.

The resistant ring described by various authors as constituting a well-marked boundary between the corpus and cervix uteri, and called by them the *os internum*, is in reality the lower edge of the retraction ring. It is the boundary between the upper and the lower uterine segment only, not that between the cervix and the rest of the uterus. To appreciate the change that has been

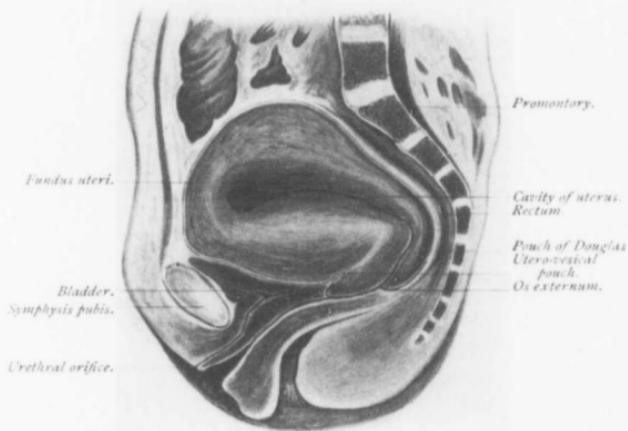


FIG. 130.—Vertical mesial section of uterus, second day of puerperium.

brought about in the uterine wall, it is interesting to compare this early puerperium case with the second stage of labor case described by Barbour and Webster, in which the cervix is greatly thinned out, and the retraction ring  $3\frac{1}{4}$  in. from the os externum.

The uterus as a whole is symmetrically placed in the pelvic cavity, though the fundus may be higher above the brim on one side than on the other. It is generally believed that, after the third stage in a normal pelvis and with empty bladder and rectum, the uterus is central and not deflected to one or the other side. Clinical observations by Börner and Croom seem to show that in some cases it lies nearer to one side of the pelvis than to the other. Out of 60 cases Croom found that in 4 the uterus was nearer the

left, while in 10 it was nearer the right side of the pelvis. I have found that by clinical observations it is very difficult to measure accurately the distance between the uterus and the bony wall in the early puerperium. If, as in my case, the fundus be most prominent on one side, one is apt to conclude that the uterus as a whole is deflected to that side, whereas asymmetry of the fundus may be coexistent with a central position of the uterus as regards the pelvic cavity. Also, in examining a large number of women, unless one is careful to include only those who have had a perfectly normal pelvic condition, error is sure to arise because of the deviations of the uterus due to previous cellulitis or perimetritis. Moreover, the uterus is frequently congenitally nearer one side of the pelvis than of the other. The position of the patient also is important. As Croom has shown, the results will not be the same when examination is made in the dorsal position as when it is made in the lateral position.

There was no rotation in most of my specimens. That this is not always the case, even in an empty condition of the bladder and rectum, is now well established. Croom found in 40 cases that 10 only were rotated, while Börner found that out of 64 cases 14 were rotated. Kehrer has found that out of 100 cases 30 were rotated, 26 to the right and 4 to the left. In the majority of cases the rotation is to the right—*i. e.*, the anterior surface of the uterus looks to the front and right. Neither of these authors, however, gives the amount of rotation. Spiegelberg says it is only slightly twisted. This is an exceedingly difficult point to ascertain with accuracy on the living person. It is best determined in the cadaver by means of frozen sections, the parts having been undisturbed.

**Uterus after the First Day.**—In all cases after the first day the uterine wall cannot, from its naked-eye appearance, be divided into the three portions noticed at the beginning of the puerperium—*viz.*, upper and lower segments and cervix. Owing to the continued retraction of the uterine muscle after the end of the third stage, the lower segment is gradually taken up into the thick portion above it, so that in my sections, by the thirty-sixth hour after delivery, it is completely obliterated, the body of the uterus and the cervix being continuous and gradually diminishing in thickness from above downward. It is impossible to define with accuracy the os internum. We can place it fairly correctly by noting the level of ante flexion, the level of attachment of the uterosacral ligaments, and the point of reflection of the peritoneum from the uterus to the bladder. (In my early puerperium cases the uterovesical pouch is abnormally high.) One can, therefore, say that the following table is approximately correct:

| CASE                              | Cervix.         | Body.           | Whole uterus.   | Cavity.         |
|-----------------------------------|-----------------|-----------------|-----------------|-----------------|
|                                   | Inches.         | Inches.         | Inches.         | Inches.         |
| Beginning of puerperium . . . . . | . . . . .       | . . . . .       | 7 $\frac{1}{2}$ | 6 $\frac{1}{2}$ |
| Second day . . . . .              | 2 $\frac{1}{4}$ | 4 $\frac{1}{2}$ | 7 $\frac{1}{2}$ | 6 $\frac{1}{2}$ |
| Third day . . . . .               | 2               | 4 $\frac{1}{2}$ | 6 $\frac{1}{2}$ | 5 $\frac{1}{2}$ |
| Fourth day . . . . .              | 2               | 5 $\frac{1}{2}$ | 7 $\frac{1}{2}$ | 6 $\frac{1}{2}$ |
| Sixth day . . . . .               | 1 $\frac{1}{2}$ | 3 $\frac{1}{2}$ | 5 $\frac{1}{2}$ | 4 $\frac{1}{2}$ |
| Fifteenth day . . . . .           | 1 $\frac{1}{4}$ | 2 $\frac{1}{2}$ | 3 $\frac{1}{2}$ | 3 $\frac{1}{2}$ |

These specimens would thus seem to show that for some time after labor the cervix may be double the normal nulliparous length. The shortening that takes place in it is coincident with that which takes place in the body, though probably not *pari passu*. This diminution is scarcely perceptible for the first three or four days, but has become quite marked by the sixth day and well pronounced by the fifteenth day. Statements are made in the books regarding the decrease in the size of the uterus, based

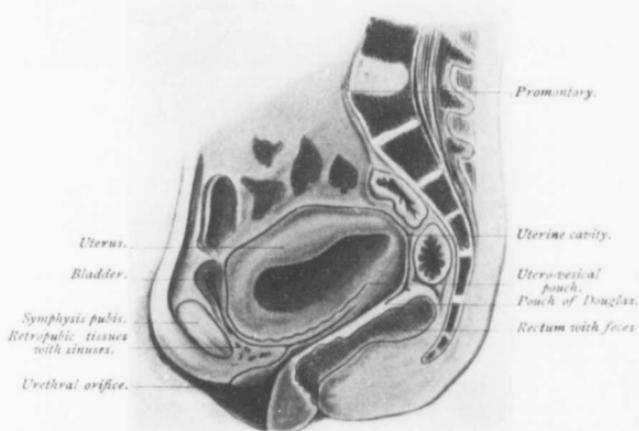


FIG. 131.—Vertical mesial section of uterus, sixth day of puerperium.

upon clinical observations and instrumental measurements on the living subject. Owing, however, to the fallacies associated with these methods (already pointed out), we cannot depend upon them. Lusk says that a diminution in the size of the uterine body is apparent in the course of the first twenty-four hours; Winckel, that the decrease commences as early as twelve hours afterward, and that there is a daily decrease in length of 2.6 cm. Frozen sections do not in any way tend to support these views, but are more in

agreement with Heschl, who says that the change does not begin until at least the fourth day.

On the fourth day the uterus has practically the same relationships as on the second day, being not appreciably altered in size or position in the majority of cases. On the sixth day it has become lowered somewhat, and, though it is considerably above the brim laterally, it appears in my specimen in vertical mesial section just below the brim conjugate. (In this case, however, owing to the feces in the rectum, the uterus is somewhat higher than it would have been with an empty condition of the bowels.)

In the description of puerperal uteri removed from the body, published by different authors, Barbour was not able in the early puerperium to trace a gradual diminution in the length of the uterus corresponding to the successive days. He explained this by the existence of pathologic conditions in most of the cases, affecting involution. It is evident, however, that with uteri removed from the body a considerable amount of error is likely to be made in comparing measurements made in different cases and by different observers. The amount of disturbance of parts caused by removal from the body is not inconsiderable, and varies in different cases. The measurements that most approach accuracy are those taken after frozen sections have been made. On the fifteenth day the uterus is entirely a pelvic organ. Exactly when this condition is brought about one cannot yet say. Some authors place it about the tenth day.

Frequently the uterus is found retroverted or retroflexed after the tenth day without being of any pathologic significance, the condition being temporary, return to the normal afterward following. The ligaments being much relaxed, the uterus may be turned back by a distended bladder or bowel and by prolonged lying in the dorsal position. Of course, in some cases the organ may have been retroverted before pregnancy.

**Naked-eye Appearance of the Uterus.**—(a) *On Section.*—For four days, at least, the sections have the appearance of contracted and anemic non-striped muscle. The vessels are closed and can scarcely be distinguished save under the placental site. On the sixth day the uterus has a darker red appearance, the vessels being more filled with blood and more easily distinguished. On the fifteenth day it is of a dark reddish color. Of my specimens the third-day uterus is paler than any of the others. There is no appearance of the extremely fatty appearance that Spiegelberg described as being well marked between the fifth and the eighth day, nor could any fat globules be removed. Neither after thawing took place did I find that the texture was extremely soft and friable. It was compact and rather to be described as of a spongy nature, fairly easily indented with the finger, the indentation, however, disappearing. It was certainly more easily torn than either

the non-pregnant or the pregnant uterus. The cervix is softer than the body and is somewhat congested.

(b) *Outer Surface*.—During the early days of the puerperium the peritoneum is wrinkled over a considerable part of the uterus. The wrinkling is especially marked near the broad ligaments and the pouch of Douglas. It results from the diminution in the size of the uterine musculature as a result of contraction and retraction taking place to a relatively greater degree than the shrinking of its peritoneal covering. By the sixth day the wrinkling has already disappeared save near the junction of the broad ligaments.

The shape of the uterus, viewed either from the front, the back, or the side, is somewhat pyriform, diminishing in thickness from above downward. In some cases the posterior wall is well

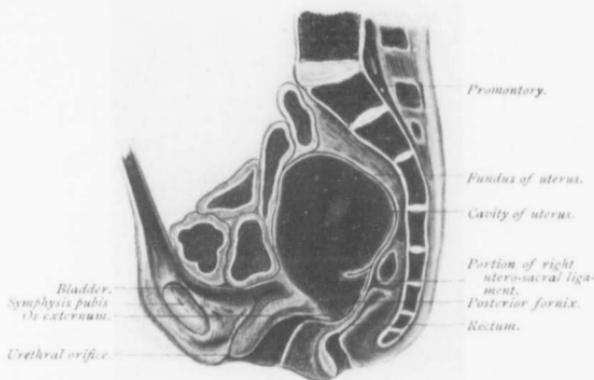


FIG. 132.—Vertical mesial section of retroverted uterus, fifteenth day of puerperium.

rounded, the anterior being more flattened, but in other cases these conditions are reversed. The puerperal uterus differs in this respect from the normal non-pregnant uterus, in which the posterior wall is always more rounded than the anterior. It usually returns to the normal condition during the puerperium.

(c) *Inner Surface*.—In a specimen from a patient who died of lung disease a few hours after labor the following appearance was presented:

Three areas could be distinguished:

1. *Placental Site*.—This occupied the posterior, the left lateral, and part of the anterior wall. It was somewhat lemon-shaped, the length being  $4\frac{1}{4}$  in. and the greatest breadth  $2\frac{3}{4}$  in., this area being about  $11\frac{1}{2}$  sq. in., that of an average man's palm. In gen-

eral the color was dark red, being purplish in places. It was more ragged and irregular than the rest of the inner surface, and showed the openings of torn blood-sinuses.

2. *Site of the Attachment of the Membranes.*—This was larger than the placental portion, less deeply colored, being of a red-brown color, and less ragged. Toward the cervix it was smoother than in its upper part. Small shreds of decidual tissue were adherent all over it. This smoother area represented that part of the body-wall that formed the lower uterine segment.

3. *Cervical Area.*—Two parts could be distinguished in this area—viz., a lower and an upper portion. The lower, about  $1\frac{1}{4}$  in. in vertical extent, was comparatively smooth, with ridges here and there, due probably to the remains of the *arbor vite*. It was deeply congested, and echymoses were seen below the surface. The lower edge was irregular.

The upper portion was of a light bluish gray, with ridges here and there. It became gradually continuous with the non-placental site of the body-cavity, there being no well-marked line of distinction between the two. (It was interesting to compare the placental site with the placenta from the same case. The latter was rounded in form, with an average diameter of about 6 in., its area being about 28 sq. in. It was evident that a great disproportion between the area of the placenta and the site of its former attachment to the uterus had been brought about.)

**Relation of the Uterus to the Extra-uterine Tissues and to the Pelvis.**—In a pelvis of average size at the beginning of the puerperium the uterus fills the greater part of the pelvic cavity and compresses the extra-uterine tissues. This compression is especially marked between the uterus and the bony wall, and to a much less extent inferiorly owing to the softening and relaxation of the fascial and muscular tissues of the pelvic floor. In consequence of this condition of the parts, the circulation of blood in the intrapelvic tissues is interfered with to a considerable extent, those parts of the pelvic floor that are least affected—*i. e.*, subpubic tissues, vaginal walls, and perineum, being congested, the tissues between the uterus and the pelvic wall, however, being anemic, their vessels being closed or nearly closed.

The effect of contraction and retraction of the uterus on its blood-circulation has already been referred to. The compression of the organ as a whole on the tissues outside of it is that it further interferes with the flow of blood to itself; the ovarian and the uterine arteries, as well as the uterine branches of the vaginal arteries, are, owing to the rearrangement of the broad ligaments, twisted, and at the same time compressed against the bony wall by the uterus. The only part of the uterus that is not anemic is the cervix. It is neither retracted in the same degree as the body, nor is it subject to much compression; at the same

time it is in close relation to the vascular vaginal walls and paravaginal tissues that have been so recently engorged with blood, and may, therefore, become deeply congested.

Owing to the very slight diminution in the size of the uterus, this condition of things, as my sections show, is kept up for three or four days. As a result, bleeding from the inner surface of the uterus is greatly interfered with, both as a result of the interference of contraction and retraction with the intramural circulation, and also through the mechanical pressure of the uterus as a whole upon the broad ligaments and the tissues lining the pelvic wall containing the vessels passing to it. An enormous influence must be exerted by this greatly altered blood-supply, in the way of initiating or stimulating those retrogressive changes that bring about the involution of the organ, whatever those changes may be.

Further, the condition of the cervix helps us to understand why, after labor, there is so often bleeding as a result of even small tears, and why, if the laceration has extended into the parametric and paravaginal tissues, so rich in venous sinuses, there may be very serious hemorrhage. If this cannot be checked by the ordinary means—*i. e.*, hot or cold douche, it is evident that pressure of the uterus from above will tend to diminish the flow of blood to the cervix by compressing it, while a firm rectal or vaginal plug might be used as a resisting structure against which the lacerated part could be more firmly compressed. During several years I have made careful observations regarding postpartum hemorrhage as a result of torn cervix in a considerable number of cases, and I have found it to be most profuse and most difficult to stop in women with abnormally large pelvises—*i. e.*, justomajor, kyphotic, or in those with abnormally contracted pelvises—*i. e.*, rickety. The reason of this is clear if we examine sections of such pelvises. Barbour's section of a puerperal woman with a kyphotic pelvis shows that the uterus in no way acts as a plug owing to the great size of the upper part of the pelvic cavity, and the condition is undoubtedly more favorable to excessive bleeding. Indeed, in this case death resulted from hemorrhage one and a half hours after labor. In a well-marked rickety pelvis, as Stratz's section shows, the uterus cannot sink down into the pelvis, but remains to a large extent above the brim, the cervix and lower uterine segment as well as the tissues adjacent to them being put on the stretch and remaining greatly congested. Stratz's case also died of postpartum hemorrhage half an hour after labor.

**Bladder.**—My frozen sections show that after labor the bladder returns to practically the same shape it had before labor, variations being noted in different cases. Immediately after labor it may lie at the level occupied by it during pregnancy, or even slightly lower; this depends mainly upon the softening and stretching of its supports that take place during pregnancy and labor.

The conditions that affect the lay of the viscus are: 1. Softening and stretching of its supports. 2. Intra-abdominal pressure. 3. Weight and position of the uterus. As the puerperium progresses a gradual elevation takes place. I can find nothing to support the statement of Halliday Croom that immediately after labor the bladder is on a higher level than during pregnancy.

In none of my cases is it exactly central in the pelvis. It is slightly deflected either to the right or to the left side. From the relation of the bladder to the uterus, it is evident that its distention with urine must cause the uterus to be less anteverted—*i. e.*, must make the fundus take a higher position; probably, also, the uterus must be raised as a whole. The elevation of the fundus, found some hours after delivery, is due in most cases to the filling of the bladder. Filling of the lower part of the rectum also raises the uterus, though in a less marked degree.

**Vagina.**—The vagina is larger in all its dimensions after labor than before. Its wall presents some rugosities, and is congested, edematous, and ecchymotic in some places near the lower end. In its long axis it usually has a somewhat sigmoid shape. In the early puerperium, only in its upper part are the walls in apposition, the lower part gaping considerably. Immediately after delivery the vaginal slit has the usual transverse direction in its upper portion; in the lower part, owing to the stretching that has taken place, the direction seems to be more vertical, the side walls tending to approximate one another, though the lower part of the anterior vaginal wall often may bulge down between them. By the sixth week retraction is almost complete, though the surface is less rugose than before the pregnancy.

**Perineal Body.**—In none of my cases was there any marked tearing of the perineum. The sections show that after labor, in spite of the great stretching of this part, it may return almost to its preparturient shape, though it is soft and slightly lower in position. As the puerperium advances it becomes firmer and more compact.

**Pelvic Floor Projection.**—Its measurement in my cases is given in the following table:

|            |             |            |             |            |                |
|------------|-------------|------------|-------------|------------|----------------|
| First day. | Second day. | Third day. | Fourth day. | Sixth day. | Fifteenth day. |
| 2 in.      | 1½ in.      | 1½ in.     | 2½ in.      | 1½ in.     | 1 in.          |

After labor we thus see that the projection is greater than in the nulliparous condition.

Compared with the measurements made in cases of pregnancy and labor by Barbour and myself, it is found to be less than it was during the second stage, and about the same as, or a little greater than, it was in advanced pregnancy.

**Broad Ligaments.**—The upper part of each broad ligament, with tube and ovary, has in the beginning of the puerperium much

the same appearance as in the pregnant condition, being freely movable and having its layers separated only by a small amount of tissue. It is larger than in the non-pregnant woman. The lower part is quite different; it has scarcely any width whatever, because the uterus has extended between its layers almost to the lateral pelvic wall. The peritoneal layers are considerably wrinkled, and the tissues between them are compactly pressed between the uterine and pelvic walls. In fact, macroscopically it is very difficult to say where the uterine muscle stops and the broad-ligament tissue begins. At the end of labor the highest part can be traced as a ridge that arises in the iliac fossa, passing downward and forward, crossing the brim, its layers gradually getting wider, until about half an inch below the brim the anterior layer passes to the bladder, the posterior descending to form the pouch of Douglas. As the puerperium advances the ligaments gradually return to their normal nulliparous condition.

**Tubes and Ovaries.**—At the commencement of the puerperium they lie almost entirely above the brim on each side, packed between the uterus and the pelvic wall and covered with intestines, having descended from the position occupied by them at the beginning of labor. They do not always bear the same relation to one another and to the uterus. This variation is mainly due to the mobility of the upper free portion of the broad ligaments. This mobility chiefly affects the tubes, allowing them to lie either in front of or behind their level of attachment to the uterus, folded in various ways. The ovaries, however, have a much more limited range of movement, less than that possessed by them either in the non-pregnant or pregnant woman. Before labor they are still separated from the wall of the uterus, the ovarian ligament being well marked. After labor, however, owing to lateral extension of the retracted and contracted uterus into the broad ligaments, the ovaries lie closer to the uterine wall, their inner ends appearing to be attached to it directly, the ovarian ligaments being practically obliterated, having become spread out on the wall of the uterus. The ovary, thus fixed at its uterine end, is only capable of moving around this fixed point; the outer free end may thus be found in front, above, behind, or below the attached end. In no case are the relations the same on both sides. The appendages also may be a little higher on one side than on the other. During the first four days, at least, they do not become lowered to any marked extent. When they reach their normal position we do not yet know.

**Abdominal Wall.**—After labor the abdominal wall is lax and often wrinkled, especially in multiparæ. Striæ are visible in large or small numbers. If examination be made it will be found that the linea alba is wider than in the non-pregnant condition, the recti-abdominis muscles being separated, especially near the

umbilicus. Great variations are found in the extent of separation; it is most marked in multiparæ. As the puerperium advances the laxity of the wall gradually diminishes, and the separation of the recti becomes less marked. In some cases the *linea alba* remains overstretched, and in this state is liable to be a cause of after-trouble.

**Involution of the Uterus.**—The minute changes occurring in connection with the reduction of the uterus in size are not yet satisfactorily determined. Different opinions are held as to the nature of involution. Robin, in 1848, claimed that it is due to atrophy of the muscular fibers without destruction. Kölliker, in 1849, described a process of atrophy accompanied with fatty degeneration. Kilian, in 1850, from his studies of the puerperal uterus in the rabbit, stated that the musculature became reduced as the result of fatty degeneration. Heschl, in 1852, stated that the entire musculature was removed by fatty degeneration, not a fiber of the old uterus being left. He believed that the change began after the fourth day, taking place last of all in the cervix. He believed that formation of new muscle took place from without inward. Luschka held that while involution is associated with the appearance of fat in the muscle fibers, the latter are not destroyed or absorbed but only diminish in size. Meola, in 1884, stated that the process of involution was a simple granular atrophy and not a fatty degeneration, the cause of the atrophy of the muscle being a hypertrophy of the connective tissue that takes place during the puerperium. Sânger has made a series of studies of the puerperal uterus, examining the muscle fibers after maceration of portions of the uterine wall for one or two days in a 30 per cent. solution of nitric acid, which removed the intermuscular elements. The tissue was then teased with needles instead of being cut into sections. He made the following measurements:

|   |        |
|---|--------|
| Length of the fiber in the normal non-pregnant uterus . . . . . | 34.1#  |
| " " " " pregnant " . . . . .                                    | 208.7# |
| " " " " first few hours post partum . . . . .                   | 158.3# |
| " " " " at the fourth day of the puerperium . . . . .           | 117.4# |
| " " " " in the beginning of the second week . . . . .           | 82.7#  |
| " " " " third " " . . . . .                                     | 32.7#  |
| " " " " at the end of the fifth week . . . . .                  | 24.4#  |

As regards the breadth of the fibers, he found:

|  |       |
|--|-------|
| Breadth of the fiber in the normal non-pregnant uterus . . . . . | 5.1#  |
| " " " " pregnant uterus . . . . .                                | 10.6# |
| " " " " first few hours post partum . . . . .                    | 12.2# |
| " " " " at the fourth day of the puerperium . . . . .            | 10.5# |
| " " " " in the first half of the second week . . . . .           | 8.0#  |
| " " " " at the beginning of the third " " . . . . .              | 6.1#  |
| " " " " end of the fifth " " . . . . .                           | 6.0#  |

According to these measurements it appears that during the first hours after labor the fibers increase in breadth, the subsequent

diminution proceeding more slowly than does the shortening in length. The greatest loss both in breadth and length occurs in the third week. It is interesting to note that at the end of involution the fiber is actually shorter than it is in the normal non-pregnant uterus. Sanger states that at this time the whole uterus in nursing women may often be found to be actually smaller than in the non-pregnant state (actually superinvolved). He points out that longitudinal and transverse folds or ridges are noticed in many fibers, due to their retracted and contracted condition. He finds no such destruction of tissue as was believed to take place by Heschl and Kolliker. Fatty degeneration is present in many fibers, but in the great majority of instances only a small portion of the protoplasm is affected; in a few instances where it is extensive, Sanger believes it to be due to pathologic processes. He regards the most prominent changes as a finely granular and a hyaline degeneration. Benecke has also described a hyaline change.

These changes are attributed by Sanger to three factors—viz., increased oxidation, continuous retraction and contraction, and relative anemia. Much of the protoplasm is oxidized without the intervention of any fatty change. It is possible that much of the fat is derived from a transformation of the hyaline matter. Nowhere has Sanger found fatty detritus outside of the muscle fibers. There is no proof that there is increased fat in the blood of normal puerperal women. Sanger states that degenerative products do not enter the blood as such, but are oxidized where they are. The intermuscular connective tissue does not hypertrophy, but undergoes involution changes that lead to its diminution. He states that when the fetus dies *in utero* involution changes occur in the uterus, even though the contents be not at once expelled.

Mayor, in 1887, described a process of atrophy of the fibers not uniform, but more marked in the submucous than in the subperitoneal area. Some fibers escaped this change and had a waxy appearance. In the first twenty-four hours very fine fat granules appear. After the fourth day the volume of the fibers diminish and the fatty granules become more numerous. On the fifteenth day the reduction amounts to one-half or two-thirds of the original volume. By the twenty-fourth day many fibers in the inner part of the wall are empty of fat. By the thirty-eighth day almost all have returned to their normal state. Mayor regards this change not as a destruction, but as an atrophy, accompanied by the transitory appearance of fine fatty granules. Along with this change in the muscle he found great accumulation of fat in the intermuscular connective tissue, from which it was gradually absorbed by the circulation.

Helme, in 1889, in studying the rabbit's uterus, found no fat whatever in the muscle during the puerperium. The cell-sub-

stance of the fibers became dimmer and more granular, diminution in size gradually taking place. It occurred simultaneously in all parts. He regarded the change as a kind of peptonization of the cell-protoplasm, the fibers diminishing in size as the soluble material became absorbed by the circulation. Nowhere could he find evidence of new fibers being formed from pre-existing muscle cells—*i. e.*, no nuclear figures could be observed. The connective tissue showed gradual diminution and disappearance, hyaline and granular changes being found in many cells and fibers; in a few places very fine fat granules occurred in the cells. Scattered through this degenerating connective tissue were plasmodial masses that he believed to perform the function of absorbing the degenerating material, afterward leaving the uterus by the circulation, probably being broken up. The great majority of these had disappeared by the sixth day; a few that remained were filled with blood-pigment. Helme's view that the muscle protoplasm diminishes by a process of peptonization is one that must be regarded very seriously. It is not unlikely that the part of the fiber that is thus changed may be absorbed into the circulation as soluble peptones. Several observers have found peptones in the urine after the second or third day. Fischel states that peptonuria is a constant occurrence in the normal puerperium, and that it was not found in a case in which Porro-Cesarean section had been carried out. Peptones have been found in the urine after death of the fetus *in utero*, though expulsion has not immediately taken place.

Broers states that the first cause of diminution in volume of the muscle fibers is a discharge of glycogen from them, the edematous intermuscular connective tissue at the same time parting with much water through absorption. The glycogen is probably removed by lymphatics. The muscular coats of the compressed arteries also lose glycogen. He states that after twenty-four hours fatty degeneration may be detected in the muscle fibers.

Uterine involution varies in different cases. Knapp states that it is quicker in multiparæ. MacLennan believes that this is true only for the first week. It is stated that instrumental and tedious labors and those associated with much loss of blood retard involution. The older the primipara the less rapid it is; nursing favors it. There is some difference of opinion as to the influence of ergot in this connection. (Subinvolution is considered under "Pathology of the Puerperium.")

**Changes in the Vessels of the Uterus.**—My frozen sections demonstrate the anemic condition of the great mass of the uterus, due partly to pressure of the organ against the vessels external to it, but mainly to the marked change in the branches running in its wall. When the pregnant uterus, so richly vas-

cularized, is compared with the early puerperal uterus in its retracted and contracted state, it is evident that the vessels must have been greatly twisted and compressed, circulation through many of them being an impossibility. The least interference is in the cervical region. Many of these vessels become closed by adhesions in the lumina after disappearance of the endothelium, which often undergoes hyaline and granular changes. In some proliferation of the intima or thickening of the outer covering is found, though this may have been in progress before labor began. In several arteries hyaline changes in the entire thickness of the wall are noticed. Many of the vessels that remain patent after the puerperium are markedly convoluted and thickened; in parts the lumen is large. These conditions may be found years after labor. Toward the cavity of the uterus thrombi form in the blood-sinuses that have been torn across. The red blood-corpuscles left in vessels whose circulation has been obstructed and those that have escaped into the surrounding tissue are broken up, the pigment being partly removed by white corpuscles, part of it remaining *in situ*.

**Changes in the Uterine Mucosa.**—Immediately after delivery the appearance of the decidual tissue is very different from that which is found before labor begins. Owing to uterine retraction and contraction, notwithstanding the amount removed with the placenta and membranes, it is considerably thickened, especially in the placental area. The surface of this area is irregular, being thrown into a series of elevations and depressions. Its thickness is mainly made up of the strands of the spongy portion; remains of the compact layer exist only as a thin, broken layer. Though very spongy in nature, the arrangement of spaces and trabeculae is very different from that which existed in the preparient condition. Then the spaces were mostly flattened, somewhat parallel to the muscular part of the uterine wall. In the postpartum condition the spaces are very irregular in size and shape, and are no longer mainly parallel with the muscle. The vessels of the decidua are greatly contorted and compressed in various directions. In a considerable number of places the trabeculae appear to have been torn across. All of these changes are consequent upon uterine retraction and contraction.

In the non-placental area the decidua is thinner, but its arrangement is similar to that of the placental area. In both areas the musculature is sometimes quite bare in spots. These are either parts from which the decidua has been entirely absorbed by the end of pregnancy, and which had not been entirely obliterated during the diminution of the uterus in size, or the decidua had been very thin and had been removed along with the placenta or membranes.

Soon after labor the surface of the decidua becomes covered

with a layer of blood and fibrin, varying in thickness in different parts, being generally most marked over the placental area, where it fills the depressions on the surface and the openings of the maternal sinuses. Gradually well-marked thrombi develop in the latter, forming rounded elevations on the surface. Thereafter there is a gradual transformation in these tissues. The large, irregular spaces of the spongy layer gradually diminish in size; many decidual cells undergo a process of involution, hyaline, granular, or fatty changes taking place in them, some being discharged in the lochia. Other portions of the connective tissue may also break down and escape. The thrombi in the vessels gradually become organized and shrink. Deposits of blood-pigment may remain in the placental area for a considerable time. Many variations are found as regards the disappearance of all traces of decidual cells. In some instances they have been found in scrapings taken from the uterus months after a labor or abortion. In seven or eight weeks the endometrium is entirely reformed, being lined by columnar epithelium and containing numerous glands.

**Lochial Discharge.**—For some time after labor a fluid discharge known as the lochia escapes from the genital canal. In the first three or four days it is composed almost entirely of blood and small coagula. When the uterus does not remain firmly retracted and contracted the clots may be of considerable size. Thereafter the color becomes light reddish brown as the amount of blood diminishes, the flow consisting mainly of blood-serum mixed with red and white corpuscles, broken down decidual elements from the interior of the uterus, epithelium from the vaginal wall, and mucus. The discharge becomes paler in color, and by the seventh day is pale yellow or greenish. Afterward it becomes somewhat white and opaque, according to the number of pus cells in it. Krönig states that normally pus does not come from the interior of the uterus, but from torn surfaces of the cervix and vagina. If these are absent there may be little or no creamy condition. The lochia is normally sterile. The ordinary vaginal micro-organisms may be found in it. At the vulva it becomes contaminated by many others.

At first the discharge is alkaline. In the later stages it becomes slightly acid in the vagina, probably due to the influence of various non-pathogenic vaginal organisms.

The quantity of discharge varies considerably and is very difficult to estimate accurately. (Gassner has estimated it at 54 oz., Giles at 10 oz.) Normally it becomes scanty after the fifteenth day, and may have almost disappeared by the twenty-first day. It may, however, last two or three weeks longer. It lasts longer in non-nursing than in nursing women, and is more profuse where involution from any cause is imperfect. During the first three or

four days the odor of the lochia is that of fresh blood or raw meat. Later it has a slightly disagreeable or sickening smell. A fetid odor is due to the influence of saphrophytes growing on blood-clot or on dying or dead tissue in some part of the genital canal. Sometimes marked changes in the color of the lochia are caused by pigment-producing organisms.

Fischel and others have pointed out that the lochia may contain peptones as well as the urine. The former found them in the uterine musculature, but not in the remains of the decidua lining the uterus.

**Alimentary Tract.**—The bowels tend to be constipated for several days after labor. This is partly due to the increased activity of the skin, kidneys, and breasts, and to the loss of fluid in the lochia. It is also thought to be due to weakening of intestinal peristalsis as a result of the laxity of the abdominal parietes and the change in intra-abdominal pressure. But very often the rectum is loaded, showing that peristalsis in the rest of the intestine may be satisfactory. Thirst is usually marked. There is generally some enfeeblement of digestion for solid food.

**Metabolism.**—The body weight is less after labor than before. This is due to the loss of the fetus, placenta, membranes, liquor amnii, blood, and sweat. Diminution continues during the first eight or nine days, varying in different cases. Non-nursing women and primiparae lose less than nursing women and multiparae. The loss is actually but not relatively greater in proportion to the body weight. Baumann estimates the loss one-tenth of the total. There seems to be a lessening of body metabolism in the early puerperium. According to Grammatikati, the excretion of nitrogenous elements has a marked relation to milk secretion. In the first day or two it is less than when the milk flow begins. When the child is removed from the breast the urea excretion diminishes. In 40 analyses as to the occurrence of phosphates in the urine, he found a marked increase on the first day, diminution on the second, and a gradual increase afterward, as the milk secretion became established; then there was a lessening until the sixth day. He obtained similar results as regards the sulphur compounds. The sodium chlorid gradually increased.

Great variations are found in the quantity of urine passed. This is affected by the amount of lochia and sweat, by the condition of the feces, and by the liquids taken into the system. Yet, apart from these conditions, it is probable that the quantity diminishes after labor until about the fourth day, when the minimum is reached. Kehler estimates that in the early days there is 21 per cent. less than the quantity passed before labor. Kleinwächter stated that the average specific gravity in the puerperium is 1015 to 1016. Sugar is frequently found in the urine, generally appearing about the third day. It is not grape sugar, but lactose,

and is derived from the changes in the breasts. The quantity varies considerably, being most marked when the breasts are imperfectly emptied. Some have claimed that the sugar is hepatic in origin. Carstairs Douglas finds that 96.5 per cent. of cases show lactosuria after full lactation has been established. It may last several days after nursing has ceased. He states that there is no very good test for lactose in urine, but holds that a specimen that responds fairly well to Fehling's test (fallacies being excluded), but does not yield crystals with phenylhydrazin, and does not ferment (except very slowly) with yeast, is practically certain to be lactose. Winkel states that acetone is found in small quantities. Lehmann found butyric acid in cases where there was no nursing. Peptones are found in the urine after the third day, rarely before; Truzzi states that they most frequently occur on the fourth or fifth day, rarely after the tenth. It is probable that they are derived from the involution of the uterus, as has been suggested by Helme and others. Fischel has reported that they were absent in a case in which the uterus was removed by Porro-Caesarean section. He stated that peptonuria is constant in the normal puerperium.

**Urination.**—For some hours after labor, varying in different cases, there is usually no desire to urinate, and the urine may largely accumulate in the bladder. This is mainly due to the altered intra-abdominal relationships and to the great relaxation of the parietes, whereby there is easy accommodation of the distended viscus. In some cases there may be a reflex inhibition of the desire to urinate, or of the detrusor muscle of the bladder as a result of injuries to the urethra or external genitals; or the sphincter of the urethra may be reflexly markedly contracted. In some cases there is merely inability to urinate while the woman lies in the dorsal position, and the function may be normal if she is raised in bed.

**Perspiration.**—The skin is usually moist, the sweat glands acting freely. Under modern conditions of cool, well-aired rooms, women do not exhibit the profuse sweats that were common in old days, when they were kept too warm. The distinct odor due to fatty acids in the abundant perspiration was regarded as a normal and favorable sign, its absence indicating danger.

**Respiration.**—After labor abdominal breathing again comes into play, the number of respirations diminishing. Kehrer finds that the chest circumference diminishes from the highest point reached in pregnancy to the third day of the puerperium by 9.5 per cent. in primiparæ, and by 8.8 per cent. in multiparæ; the transverse diameter by 9.6 per cent. in primiparæ, and by 6.7 per cent. in multiparæ. There is a narrowing of the transverse and an increase of the anteroposterior diameters. As regards lung capacity, different statements are made. Dohrn finds in examining

100 cases that on the fourteenth day of the puerperium it is greater than in the pregnant condition in 60 per cent., unchanged in 14 per cent., and diminished in 26 per cent. Vagas, in 50 cases, found it unchanged in 26 cases, increased in 17, and decreased in 7. The explanation of the differences is not known.

**Temperature.**—The normal puerperium runs its course without febrile phenomena. Yet in many cases variations in temperature are found within the range of the normal. Frequently there is a slight rise immediately after labor, succeeded by a fall to or below normal within twelve or twenty-four hours. Baumfelder states that after this fall there is a gradual slight rise, which reaches its maximum on the fourth day. It then remains constant for two days, falling on the evening of the sixth day and rising during the next two days. All these variations are very slight. On the ninth day it remains normal.

Elevations may be caused by various conditions in the early puerperium—*i. e.*, errors in diet, constipation, mental anxiety, etc. It is held by many that the filling of the breast causes a rise before the third or fourth day, apart from pathologic conditions. This statement is misleading. It is possible that a slight elevation may be induced in this way, but it is unimportant and often escapes observation. Too often is a marked elevation attributed to the milk when it is due to an infection. Zweifel holds that an axillary temperature of 99.5 to 100° F. is always pathologic. Certainly such a rise should always lead at once to a suspicion of infection.

**Pulse.**—After labor the pulse falls immediately or within twelve hours to 60 or less. Rarely it may be lower than 40. The explanation of the slow pulse has given rise to much speculation. Blot thinks it due to increased arterial tension; Löhlein, to disturbed innervation by the altered constitution of the blood; Ols-hausen, to absorption of products of degeneration in the uterus; Fritsch, to the mental and physical rest succeeding labor. Schroeder thought that the heart beat slowly because it had less to do. Vejas believed it due to increased vital capacity of the lungs. Swiecicki thought that the vagus was reflexly inhibited as the result of chemical irritation of the uterine nerves in the process of involution. Neumann, who has given the subject special study, believes that the bradycardia is due to stimulation of the cardiac inhibitory fibers, resulting from irritation of the vagus center in labor. After the second or third day it gradually rises to normal. The blood-pressure is not increased, but often may be lessened. The rate is easily raised by slight causes. It is important to bear in mind its elevation early in infective processes.

**Blood.**—Henderson states that during the first few days there are changes in the size and shape of the red cells, pointing to blood regeneration. He observed no nucleated red cells in normal

cases, but only in some pathologic conditions—*i. e.*, syphilis, clamspsia—he noted several. After the second day the number of red cells increased up to the ninth day, as did the percentage of hemoglobin.

During the first two or three days of the puerperium there is a considerable diminution in the number of leukocytes. Thus, on the first day he found the average to be 21,365 per cubic millimeter, while on the fourth day it was 13,752; thereafter there was a more gradual fall. On the eighth day it was 10,147; afterward there was a slight rise. Hibbard and White have also pointed out the tendency to increase about the end of the first week. Henderson thinks that along with the reduction in leukocytes during the first few days, there is as well some leukocytosis. The diminution in leukocytes is undoubtedly assisted by a free lochial discharge. When the latter is scanty or suppressed the reduction may be expected to be less. The increased number of leukocytes may last several weeks in the puerperium, though there is no definite information on this point. In weak and ill-nourished women the leukocytes are greatly diminished. Pray regards the persistence of leukocytosis as due to the part they play in effecting the involution of the hypertrophied pelvic organs and breasts.

**General Condition.**—After most labors there is some degree of exhaustion in the maternal system. Great variations are found, depending on a variety of factors—*i. e.*, the general health of the woman, her nervous organization, the difficulty, duration, and painfulness of the labor, loss of blood, etc. Sometimes there may be considerable shock. Frequently there may be an attack of shivering at the end of labor; this is generally of nervous origin, but may result from undue exposure of the body, especially if there has been much perspiration. In some cases the woman may remain in a nervous state for some hours. Ordinarily, however, there is a tendency to sleep.

**After-pains.**—During the first few days of the puerperium intermittent pains may be felt in the lower abdominal or pelvic region. These are often compared to modified labor pains, and are usually due to active contractions of the uterus, expelling clots that have formed in its cavity; they are far more frequent in multiparæ than in primiparæ. The formation of clots is associated with a tendency to undue relaxation in the uterine wall. The pains are aggravated, as a rule, when the child is put to the breast. Relief follows expulsion of the clots, though there may be a recurrence of the condition.

In some cases after-pains are present when no clots are in the uterus, the explanation being not always certain. They may be caused by retained portions of the after-birth. Sometimes they are caused by traction of the uterus on old inflammatory tissues. Occasionally bladder distention or tenesmus may cause the pains.

They must be distinguished from pain due to a fresh inflammatory attack following infection.

**Renal Function.**—The excretion of urine is normally increased after labor. Winckel points out that this is most marked during the first two days. The increase is mainly in water, the specific gravity being low, averaging 1010. The percentage of urea, phosphates, and sulphates is lessened, that of sodium chlorid is not changed. During the first day the average is 2025 c.c. (74.4 fl. oz.), during the second 2271 c.c. (76.5 fl. oz.). Thereafter the total quantity is diminished, varying somewhat from day to day, a return to normal gradually taking place. Albumin occasionally appears in the urine and disappears, no evident cause being present. Maguire states that it is not serum albumin, but globulin. In every case of albuminuria the possibility of definite important causes should be remembered.

Milk sugar is frequently found in the urine, both when the milk supply in the breasts is abundant and when it is failing.

Grammatikati has found that the amount of urea in the urine increases with the amount of milk, as do the phosphates.

Fischel has demonstrated the following facts regarding peptones. They are found constantly in the urine in the puerperium, the quantity varying in different cases. They appear after the first day and increase until the fourth, when a gradual decrease is noted. As a rule, they disappear about the twelfth day. They are probably derived from direct conversion of the uterine musculature. In cases in which peptonuria has been present before labor, it is found afterward in the early hours of the puerperium. The length or character of the labor appears to have no influence on its production. After the delivery of a dead, macerated fetus there is little or no peptonuria. The specific gravity of the urine varies according to the quantity of peptones. They are in direct relationship to the number of leukocytes in the blood. Winckel has reported a case of Porro's operation in which peptonuria was absent. Acetone is stated to be constantly present in the urine during the puerperium.

## CHAPTER II.

## MANAGEMENT OF THE PUERPERAL STATE.

**Lying-in Room.**—The patient should be kept in a room that can be well aired and lighted. The light should be rather subdued for the first few days. Ventilation should be arranged without exposure of the woman to draughts. The temperature should be about 65° F. Quietness must be strictly enjoined in the neighborhood of the patient, and she must be carefully protected from unnecessary incursion of visitors. In many cases the accoucheur must give strict orders with regard to their admission. The child should not be kept near enough to disturb her if it cries. She should not be distressed or worried in any way. The child should not rest in bed with the mother on account of the risk that she may lie on it in her sleep, and in order that she may not be disturbed by it.

After the cleansing of the mother, following the birth of the child, the room should be darkened and she should be allowed to rest quietly for a few hours. When she feels faint or tired she should take a cup of beef tea or chicken tea, bouillon, or milk and hot water. In cases of extreme nervousness and restlessness it may be advisable to administer a soporific—*i. e.*, trional, paraldehyd, etc.

After a few hours the child should be put to each breast for a few minutes. During the first three days the mother should lie mainly on her back, changing to her side when she feels tired or when the child is fed. After the first twenty-four hours her back and head may be somewhat elevated with pillows for an hour or two each day unless there is some contraindication—*i. e.*, heart disease, marked anemia, etc. She should be enjoined not to raise the body suddenly lest syncope should be caused. After three days she may be allowed to lie on her back or side at will.

In normal cases the mother may be allowed to get out of bed between the tenth and fifteenth days. At first she should remain in a half-recumbent posture on a sofa for an hour or more, and should walk a little each day. If the weather be suitable she should lie or sit out-of-doors during the third week. In the fourth she may go down stairs, walk out-of-doors, and take her first drive. This program may be greatly changed by circumstances—*i. e.*, in cases of very difficult or exhausting labors or of marked lacerations the woman may not be allowed out of bed until during or even after the third week. No fixed rules can be given. The physician must exercise his judgment in each case.

Systematic general massage during the lying-in period and,

later, in the puerperium is a valuable means of improving the woman's general condition. Unless there is some contraindication the woman may also be allowed to take some exercise while in bed. Bacon recommends the following: On the second or third day flexion and extension and swinging movements of the upper limbs and flexion and extension of the feet may be carried out each day during the first week, the duration varying according to the condition of the patient. At first it should be only a few minutes; later on ten to fifteen minutes. At the beginning of the second week flexion and extension movements of the lower limbs may be commenced; by the twelfth or fourteenth day flexion of the trunk on the thighs by contraction of the muscles of the abdominal walls. Resistance movements with apparatus have also been recommended.

**Urination.**—The desire to urinate is feeble for many hours after labor. In some cases the woman may perform the act normally, but often she may go twelve hours or more without emptying the bladder if she be allowed. The practice of allowing her to wait such a period is an unwise one. Sometimes overdistention may be followed by frequent dribbling, which may be mistaken for complete evacuation; the uterus is displaced and the normal relationships disturbed, favoring increased loss of blood in the lochia. If the bladder be not emptied voluntarily ten hours after labor, the woman should be encouraged to urinate in the bedpan. If she fail, a sterilized pad soaked in a hot antiseptic solution should be applied to the vulva, or the solution should be poured over the vulva. Sometimes the sound of running water may assist the woman to urinate. If these means fail and the patient's condition be good the nurse may raise her nearly to the sitting-posture in order that she may be more advantageously placed. Only when these methods are not successful should the catheter be employed. A boiled glass or silver instrument should be used, and the same thorough technic must be observed that has been described in Part II., Chapter III. The quantity of urine passed at each emptying of the bladder, during the first twenty-four hours at least, should be measured. When the quantity is small the physician should suspect that there is not complete evacuation, and should examine the abdomen very carefully to determine the condition of the bladder. After the first urination the woman should be encouraged to repeat the act every five or six hours.

**Care of the Bowels.**—If the bowels have been thoroughly opened before labor they need not be moved before the third day. To ensure that this happens, it is well, as a rule, to administer a mild laxative on the evening of the second day—*i. e.*, sodium phosphate, citrate of magnesia, or Hunyadi János water. When there is colic, castor oil with a small dose of laudanum may be given in a capsule or in warm milk. On the morning of the next

day a movement may be expected. If it does not occur, an enema of sweet oil (5iv) or one of soapsuds and olive oil may be given. During the rest of the lying-in period these measures may again be required to secure regular evacuations. When the woman is troubled with piles, aloes administered in half-grain doses night and morning is very beneficial.

**Dietary of the Mother.**—The woman should be fed according to the physiologic requirements. As a rule, during the first three days she prefers liquid to solid food, as there is usually thirst. She may have at this time milk, gruel, bouillon, weak cocoa, tea, milk toast. During the next few days eggs, fish, sweet-breads, chicken, rice, and cooked fruits may be gradually added. Thereafter an ordinary simple dietary is allowable, all indigestible articles—*i. e.*, gravies, pastries, fancy puddings, pickles, etc., being avoided. In special circumstances this dietary may be changed according to the indications.

**Care of the Genitalia.**—Immediately after the external genitals have been cleansed, a dressing of sterilized wool or gauze should be applied to the vulva and fastened to the abdominal binder. During the first six or eight hours this should be changed every two hours; afterward every three or four hours during the first five days, according to the degree of soiling; thereafter less frequently. Four times daily, at least, when the dressing is changed, the external genitalia should be well washed with one of the antiseptic lotions already mentioned, sterile wool being used for the purpose. If there has been much bruising and tearing of the vulva, or if there be any doubts as to the cleanliness of the parts, it is advisable to apply gauze dressings, soaked in the antiseptic solution, continuously for four or five days, instead of dry dressings.

As regards the use of the vaginal douche in the puerperium there has been much discussion, the groundwork of which has already been stated. (See p. 111.) Though the last word has not been stated, it must be conceded that if the parturient woman be healthy, presenting no signs of an infective process in her genitalia, and if her labor be conducted with strict asepsis, antiseptic douching is not a necessity in the puerperium. But if this scientific position is to be sustained, the strictest care must be exercised in the care of the external genitals and in the avoidance of contamination after labor. If this be not done, there is always danger that infective organisms may develop in torn tissues or in the blood-clot that tends to collect in the vagina as a result of the dorsal posture so universally adopted in civilized countries. Many patients prefer to be douched and feel better afterward because their tastes are satisfied with regard to cleanliness. There is no objection to the use of warm sterile water or saline solution as a daily vaginal douche, provided the external genitals, the douching

apparatus, and the nurse's hands be thoroughly cleansed. It has been clearly demonstrated that a douche tube cannot be passed into the vagina, if the vulva be dirty, without introducing micro-organisms.

Antiseptic douching should be carried out in the early puerperium after labors in which there has been a failure to employ rigid asepsis during labor, or when there is evidence that the genital tract has recently been the seat of an infective process. The antiseptic douche may be given twice daily for five days (or longer); thereafter, once a day for a week or two. The tube and reservoir should be sterilized before use, and when not in use should be covered, so that dust cannot enter. The nozzle that enters the vagina should be of glass, ten inches, at least, in length, and should be boiled for eight minutes in weak soda solution each time before it is used. The nurse should cleanse her hands as if preparing for a surgical operation before administering the douche. The greatest cleanliness is obtained if she wears rubber gloves that have been sterilized by boiling in plain water for ten minutes. She should hold the nozzle near its outer end with one hand, and with the other separate the cleansed labia as she introduces the point. As the lotion runs the nurse should take care that there is a free return flow and that no distention of the vagina be caused.

### CHAPTER III.

#### THE NEWBORN CHILD AND ITS MANAGEMENT.

As soon as the child is born, attention should be given to its respiration before the cord is divided. If it does not breathe freely at once, a finger covered with sterile gauze should be inserted into the mouth, in order to wipe out any mucus and blood that may be in the mouth or pharynx. The nose should also be wiped. To stimulate respiration the child may be held up by the feet, the face or body may be slapped, cold water may be sprinkled on it, or one may blow on its face. The methods to be followed in cases of asphyxia are described later (p. 626).

The eyes should be well washed out with normal saline solution. Whenever there is any possibility that they may have been contaminated in the maternal canal, a solution of protargol (10 per cent.), nitrate of silver (2 per cent.), or corrosive sublimate (1 or 2 grains to the pint) should be dropped into them as early as possible after birth.

Ligation of the cord has already been discussed (Part II., Chap-

ter III.). The stump should be wrapped in aseptic gauze; it is not necessary to apply powder or oil to it. Thus dressed the stump is laid flat on the belly, and kept in position by an abdominal binder. The stump usually separates in four to seven days, leaving a small moist area at the navel; this should be kept dry with boric acid and covered with sterile gauze until satisfactorily healed.

**Cleansing the Child.**—The child must be cleansed in a well-warmed room. In normal cases it should be rubbed with sweet oil or vaselin in order to remove the vernix caseosa, and afterward wiped with a soft, clean cloth. Then it may be washed in water at a temperature of 95° F., mild soap—*i. e.*, Unna's superfatted or white castile, being employed. Strong soap is apt to irritate the conjunctivæ. The skin is then dried with a soft, warm cloth, and afterward covered with dusting-powder—*i. e.*, borated talc or a mixture of starch and talc. In succeeding washings, if soap irritates the skin, a muslin bag containing oatmeal may be used as a substitute. When the child is weak at birth or if it has been much exposed, it should be warmed in a dish of water at a temperature of 100° F., then wrapped in blankets and placed near a fire or hot-water bag. The first cleansing need not be carried out for several hours. At the time of washing a careful examination should be made to see if any malformation exists. When the first visit is made after the labor, inquiry should be made as to the emptying of the bladder and rectum.

**Clothing.**—After the cleansing the child should be dressed. The abdominal binder may be soft flannel in winter and light merino in summer. Outside of this the clothing should be warm and loose, not interfering with respiration nor with the movements of the hands and feet. During sleep a light shawl may be used to cover the sides of the head, neck, and shoulders.

**Nursing.**—The mother should always nurse her child unless there be contraindications. About six hours after labor it should be put to each breast for two or three minutes. This practice should be repeated every four hours during the day until milk has abundantly appeared in the breasts. The infant in this way becomes accustomed to sucking, which acts also beneficially in stimulating the mammary tissue and the uterus. The colostrum that may be withdrawn has a laxative effect on the infant's bowels. If there is a special reason for not putting the child to the breast for the first two or three days, the child should be given a teaspoonful of warm sterile water at intervals. When the milk secretion is well established, nursing should be carried on with as much regularity as possible. At first the infant may be fed every two hours during the day and once during the night. If the milk be plentiful the duration of suckling should be about fifteen minutes, and the breasts should be used alternately. If the milk be not

very abundant both may require to be suckled at each feeding. The night interval should be gradually increased as the infant grows, until at the sixth month there should be no feeding between 10 P. M. and 5 A. M. The day intervals should also be gradually increased, until by the sixth month the infant needs to be nursed only five or six times in twenty-four hours. Too frequent feeding is apt to upset the infant's digestion. The mother must be taught to refrain from feeding the child whenever it cries. Irregular feeding is also productive of disorder. The nipples should be cleansed after each feeding with boric lotion and sterile water, being dried with sterile absorbent cotton; rubbing is not necessary. If the nipples are sore or cracked they should be anointed with sterile vaselin or cocoa butter.

When the infant hurts the nipple a nipple shield may be worn to give relief. In extreme cases it may be necessary to use a breast pump, the milk being afterward given to the infant. In very tender states of the nipples the application of lead and opium lotion after nursing gives much relief; but it must be carefully washed away before the infant is again put to the breast. When the breasts are uncomfortably distended a compressing or suspensory bandage may be worn. Sometimes in these cases it may be necessary to draw off some milk with the pump in addition to that which the infant takes; or the nurse may carefully massage the breasts with clean, oiled fingers.

Ordinarily the breast is rubbed from the periphery to the nipple. Bacon advises against this method, stating that the fulness in the breasts is more due to overdistended blood- and lymph-vessels than to accumulation of milk. He recommends, therefore, rubbing the surface outside and above the breasts in the direction of the venous and lymph flow toward the axillary and subclavian trunks; afterward the breasts are gradually encroached on.

If the infant be too weak to suck the milk may be withdrawn by a pump and administered with a spoon. If the infant appears restless and unsatisfied after successive feedings the milk should be examined chemically and microscopically. In such cases the mother's health must be carefully investigated and all irregularities corrected. It must always be remembered that the breasts may excrete as well as secrete, and that drugs—*i. e.*, opium, belladonna, etc., may thus enter the milk and affect the infant.

When the milk is poor the dietary of the mother should be altered; very often an increase in milk and eggs will improve the mammary secretion. Sometimes malt liquors, maltine, or malted milk is necessary. In the dietetic measures adopted the mother's digestion must not be upset. When the quantity of milk is insufficient, accessory artificial feeding must be carried out, the infant must be weaned, or a wet-nurse employed. In cases where the infant does not nurse, it is necessary to check the mammary

secretion with as little disturbance to the mother as possible. To accomplish this she should take a minimum quantity of liquids in her diet and should keep the bowels well opened. A compressing-bandage should be applied to the breasts. In some cases it is necessary to administer atropin or potassium iodid internally, or belladonna ointment or plaster locally to the breasts.

In certain conditions the infant should not nurse—*i. e.*, mastitis; depressed, deformed, or badly cracked nipples; tuberculosis, syphilis, rheumatism, sepsis, bad cardiac or renal disease, marked anemia, chronic skin diseases, and various nervous diseases.

If menstruation appears during the nursing-period the infant may not be affected by it. Sometimes its digestion is upset and artificial feeding may be necessary. If the flow becomes excessive or irregular it is advisable to wean the child, since the mother's health is likely to suffer by the excessive drain on her system.

If the nursing mother becomes pregnant the child should be weaned.

**Lactation.**—At the beginning of the puerperium the breasts contain colostrum, a white or whitish-yellow, viscid fluid, somewhat resembling milk, but being richer in sugar, fat, and salts; it contains characteristic "corpuscles" that are epithelial cells filled with fat globules. It coagulates on boiling, due to the presence of a special form of proteid. The fat globules are less uniform in size than those of milk, and the corpuscles are four or five times as large as milk globules.

Woodward gives the following average of several specimens of colostrum:

|                            |                           |
|----------------------------|---------------------------|
| Specific gravity . . . . . | 1024 to 1034 <sup>1</sup> |
| Water . . . . .            | 87.5 per cent.            |
| Proteid . . . . .          | 1.9 " "                   |
| Fat . . . . .              | 4.0 " "                   |
| Sugar . . . . .            | 6.5 " "                   |
| Mineral matter . . . . .   | 0.2 " "                   |

Considerable variations are found by different observers as regards the percentage of proteids. During a week or more colostrum corpuscles may be found in the milk in gradually diminishing numbers. The true milk secretion begins usually on the third day, often on the second, sometimes on the first, occasionally on the fourth or fifth day. In some cases it may not appear at all. The breasts at this time become more sensitive, being firmer and larger, these changes varying much in different cases.

The woman may be nervous and restless as the breast phenomena develop, and the condition may be aggravated by the child's attempts at nursing. Sometimes these disturbances may cause a slight rise in temperature for several hours. This must

<sup>1</sup> Variations are due to different quantities of fat.

be carefully distinguished from febrile states due to actual infection. The "milk fever" described by the older authors is in reality an infection fever.

The quantity of milk secreted varies greatly in different women. During the first three days the whole quantity is between 50 and 200 c.c. At the end of the first week the daily secretion amounts to about 400 c.c.; at the end of the second week about  $\frac{1}{2}$  to 2 liters. Variations depend on a number of factors—*i. e.*, the size and activity of the breasts, the amount of fluid taken into and discharged from the system. When a woman does not nurse her child the secretion generally ceases in two or three weeks and the breasts atrophy, though for a considerable time afterward, in some cases, a small amount of fluid may be squeezed from the nipple.

The characters of normal milk are as follows: It is a slightly alkaline fluid, 1024 to 1035 specific gravity, being an emulsion of minute oil globules in a colorless plasma. The latter is derived from the blood, and holds in solution milk sugar and morganic salts. The fats, sugar, and proteids are derived from the cells of the acini of the glands. Many differences are observed in the records of milk analyses, due to variations in the technic and in the composition of different specimens. One of the most important recent records is that of Camerer and Söldner, who give the following analysis of milk during the second week of nursing:

|                               |       |           |
|-------------------------------|-------|-----------|
| Water . . . . .               | 87.75 | per cent. |
| Solids . . . . .              | 12.25 | " "       |
| Proteids . . . . .            | 1.62  | " "       |
| Fat . . . . .                 | 3.14  | " "       |
| Milk sugar . . . . .          | 6.62  | " "       |
| Mineral matter . . . . .      | 0.27  | " "       |
| Citric acid . . . . .         | 9.05  | " "       |
| Unknown extractives . . . . . | 0.91  | " "       |

Attention is to be drawn to the unknown extractives containing nitrogen. These formerly were classed as proteid material, which accordingly bulked as a larger quantity in the older analyses. The proteids and mineral matter tend to lessen in amount as lactation advances, the sugar increasing rapidly up to the end of the second week, and afterward at a slower rate; the fat reaches its highest percentage during the second month, falling off after this period.

These points are shown in tables of Camerer and Söldner:

| Period.                     | Total nitrogen | Proteid. | Fat. | Sugar. | Ash. |
|-----------------------------|----------------|----------|------|--------|------|
| 5th day . . . . .           | 0.33           | 2.0      | 2.8  | 5.4    | 0.34 |
| 8th to 11th day . . . . .   | 0.27           | 1.6      | 3.1  | 6.2    | 0.27 |
| 20th to 40th day . . . . .  | 0.20           | 1.1      | 3.8  | 6.4    | 0.22 |
| 70th to 120th day . . . . . | 0.17           | 1.0      | 2.9  | 6.7    | 0.20 |
| 170th and after . . . . .   | 0.14           | 0.8      | 2.6  | 6.8    | 0.19 |

It is interesting to compare this change in milk with the increase in the daily weight of the child. Pröscher shows that the average daily increase in weight is 35 to 40 gm. during the first six weeks, a decrease taking place afterward, until at the sixth month it amounts to about 18 gm. During the first few weeks the child grows much faster than afterward and requires relatively more building material; hence the abundant nitrogenous and mineral elements in the early period. The after gradual increase in carbohydrates is related to the growing muscular activity. It is evident from the latter that milk does not get richer as the child grows older; this defect is made up by the greater quantity taken by the infant.

The variations found in the milk of a nursing woman from time to time are not always explainable. They may sometimes be more marked than those found on comparing the milk of different women at the same period of lactation. Baumm and Illner have emphasized the fact that the composition of milk is markedly independent of outside influences. Weakness, various diseases, pregnancy, and emotional conditions, as a rule, affect it inappreciably. Menstruation rarely alters the milk so as to disturb the child. These observers have clearly shown that a feeble child does not necessarily mean poor milk. On the contrary, they found that in such cases the milk was usually richer. They analyzed milk produced during various dietaries, and found that on the whole fat was the only element in the milk that was appreciably affected by the diet. It was increased only when an abundant ordinary mixed diet or a highly nitrogenous diet—*i. e.*, one with much cheese, eggs, and meat, was given.

Abundant carbohydrates did not increase the fat, nor did fat taken in the diet; indeed, increase of the latter was usually accompanied by a diminution of that in the milk. Increase of fluids consumed caused no appreciable increase in the quantity of the milk. It is thus evident that the composition of milk is largely independent of diet. Even though the food be largely diminished, milk is produced at the expense of the maternal tissues. Alcoholic beverages do not directly affect the quality of the milk. Too frequent suckling tends to cause increased richness of the milk, and it may become less digestible and thus affect the child.

**Substitute Feeding.—Wet-nursing.**—When a good reason exists for not feeding the child from the mother's breasts, the best substitute is to use another nursing woman. In practice it is not often possible to obtain a thoroughly suitable wet-nurse. In selecting one the physician must exercise great discretion. The woman should not be too young, twenty-one to twenty-six being the best age. She should be healthy and free from tuberculosis, syphilis, or any other taint. Her own child should be examined and found free from disease; its age should be as near as possible

that of the one to be nursed. The wet-nurse's habits as regards diet, exercise, etc., must be carefully regulated.

**Mixed Feeding.**—In some cases the mother is unable to supply all the milk necessary for her child, an additional quantity of artificial milk being needed. The latter may be given two or more times during the twenty-four hours. The mother should be regular in her hours of nursing.

**Artificial Feeding.**—Frequently it is necessary to nourish the infant entirely on artificial food. Within recent years this system

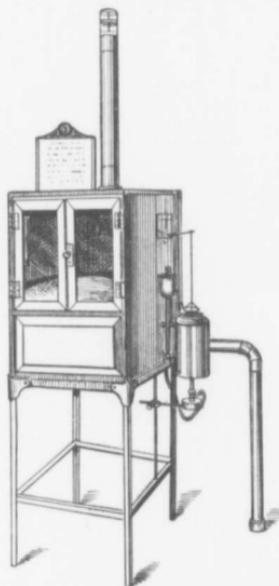


FIG. 133.—Incubator of the system established at the Chicago Lying-in Hospital (De Lee).

has been greatly improved and very satisfactory results have been obtained. (For full information works on Infant Feeding should be consulted.)

**Infant Incubation.**—In many cases infants are born with such enfeebled vitality that special care must be taken to rear them. For this purpose the incubator is of great value. At the present time there are differences of opinion as to the extent to which this apparatus should be employed, but the following indications given by De Lee may be observed:

1. *Prematurity or Smallness.*—All infants born earlier than three weeks before term, and all which do not weigh more than five pounds at birth, should be placed in the incubator.

2. *Congenital Weakness.*—Full-time infants of low vitality, as indicated by subnormal temperature, cyanosis, tendency to sclerema or edema, should be treated as though premature.

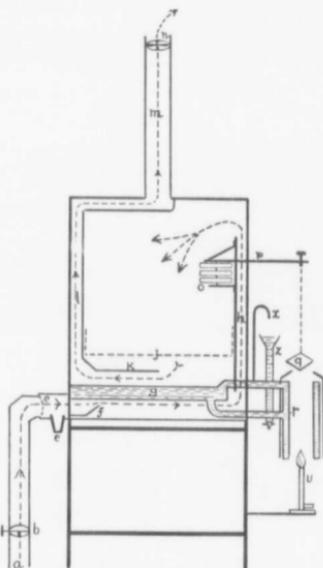


FIG. 134.—Diagrammatic section of incubator system in Chicago Lying-in Hospital (De Lee): *a*, Pipe bringing air from outside; *b*, damper; *c*, cotton filter; *g*, water pan; *h*, flue conducting air into bed-chamber; *j*, bed; *l*, escape flue; *m*, chimney; *n*, anemoscope; *o*, ethyl chlorid discs; *p*, lever; *q*, cover of air-flue; *u*, hot-water boiler; *v*, gas-burner.

3. *Shock* following difficult labors, asphyxia, various diseased conditions.

4. *Hemorrhagic diathesis*—*i. e.*, melena, morbus maculosus Werlhofii, etc.

The infant should be placed in the incubator at the earliest moment after birth, to get the greatest benefit.

Various forms of incubators have been devised. A good one should be simple in construction and should be capable of easy cleansing. It should provide for the continual admission of fresh

air properly heated and moistened. One of the most satisfactory known to the author is that devised by De Lee and used in the Chicago Lying-In Hospital. It consists of a box 29 in. high, 22 in. deep, and 20 in. wide; it has two compartments—a lower, containing a water pan, and an upper for the infant, which rests on a cotton mattress swinging in a basket. The compartments are connected by air flues only. There are doors in the front, through which the infant is handled, and one at the side, through which it is observed and fed.

The heating-system consists of the water pan inside the box, near the floor, connected with an outside boiler.

The air is kept at 86° to 93° F., and the bed of the infant at 94° to 100° F. There is an automatic regulator attached to the box. It consists of three biconvex hollow disks containing ethyl chlorid, which expand and contract with heat and cold; these are placed in the upper chamber, and are connected by a lever system with a movable cover on the air flue of the hot-water boiler. When the incubator cools the hollow disks contract, the cover falls, the hot air is confined, the water is heated, and the temperature rises. When the incubator gets too hot the disks expand, the cover rises, and the hot air escapes from the flue, and the temperature falls. The gas burner that furnishes the heat is provided with a pressure regulator to ensure a steady supply. The admission of cold air to the lower chamber is regulated by a damper. The air passes from outside the house to the incubator in a three-inch pipe; it is filtered through cotton at the side of the lower chamber and passes under the water pan. As it is heated it rises through a flue and enters the upper chamber where the infant lies. It escapes by another flue, the lower end of which is placed below the level of the bed, and the upper end forms a chimney placed above the box. Above the latter is an exhaust flue with a funnel, which creates a current toward the ceiling and tends to prevent strong down draughts from entering the incubator chimney.

Moisture is supplied by a dish of water and a wet screen placed internal to the cotton filter. A Mason hygrometer is placed in the bedchamber to determine humidity.

Most of the incubators in use are simpler in construction than the above. Auvard's form is a wooden box heated by cans of water, with an opening for air at the bottom, a vent at the top, and a sliding glass cover. The air is moistened with a wet sponge. Such incubators are very imperfect and do not allow of the admission of fresh, uncontaminated air. They may, however, serve to transport weak and premature infants from private houses to a hospital, where a proper stationary incubator may be used.

**Care of the Infant.**—The temperature in the bedchamber should be on the average 89° F. When the infant is very weak

it should be a degree or two higher. The temperature may be reduced gradually to 82° F.

The moisture may also be regulated by altering the size of the wet screen or the amount of water in the dish. The range of humidity is ordinarily from 35 to 50 per cent. De Lee states that the moisture must be increased the more puny and weak the infant.

The dress should be woollen, simply and loosely made, so that it may easily be changed.

As regards the diet, there can be no doubt as to the great value of mother's milk for incubator infants. Indeed, according to De Lee, it is almost impossible to raise them satisfactorily or at all without it. Mixed feeding is the next best method. The frequency and amount of the feedings are regulated by the size and vitality of the infants.

Planchon gives the following tables:

FOR INFANTS WEIGHING LESS THAN 1800 GRAMS (3 lbs. 12 oz.).

|           |        |                         | Every hour about—   |
|-----------|--------|-------------------------|---------------------|
| First day | 63 gm. | 2 oz. $\frac{1}{2}$ dr. | 45 drops.           |
| Second "  | 127 "  | 4 " $\frac{1}{2}$ "     | 75 "                |
| Third "   | 151 "  | 5 " "                   | 2 $\frac{1}{2}$ dr. |
| Fourth "  | 200 "  | 6 $\frac{1}{2}$ " "     | 2 "                 |
| Fifth "   | 224 "  | 7 " 2 dr.               | 2 " .15 M           |
| Sixth "   | 230 "  | 7 " 4 "                 | 2 " "               |
| Seventh " | 263 "  | 8 $\frac{1}{2}$ " "     | 2 " .45 M           |
| Eighth "  | 281 "  | 9 " "                   | 3 " "               |
| Ninth "   | 303 "  | 10 " "                  | 3 $\frac{1}{2}$ "   |

FOR INFANTS WEIGHING FROM 1800 TO 2200 GRAMS (3 lbs. 12 oz. to 4 lbs. 9 oz.).

|           |         |                   | Every hour about—   |
|-----------|---------|-------------------|---------------------|
| First day | 120 gm. | 4 oz.             | 75 drops.           |
| Second "  | 173 "   | 5 $\frac{1}{2}$ " | 2 $\frac{1}{2}$ dr. |
| Third "   | 247 "   | 8 " "             | 2 $\frac{1}{2}$ "   |
| Fourth "  | 281 "   | 9 " "             | 3 " "               |
| Fifth "   | 312 "   | 10 " "            | 3 $\frac{1}{2}$ "   |
| Sixth "   | 347 "   | 11 " 2 dr.        | 3 $\frac{1}{2}$ "   |
| Seventh " | 364 "   | 11 " 7 "          | 4 " "               |
| Eighth "  | 393 "   | 12 " 5 "          | 4 $\frac{1}{2}$ "   |
| Ninth "   | 404 "   | 13 " "            | 4 $\frac{1}{2}$ "   |

FOR INFANTS WEIGHING FROM 2200 TO 2500 GRAMS (4 lbs. 9 oz. to 5 lbs. 4 oz.).

|           |         |            | Every hour about—   |
|-----------|---------|------------|---------------------|
| First day | 153 gm. | 5 oz.      | 1 $\frac{1}{2}$ dr. |
| Second "  | 266 "   | 8 " 5 dr.  | 3 " "               |
| Third "   | 299 "   | 10 " "     | 3 $\frac{1}{2}$ "   |
| Fourth "  | 341 "   | 11 " "     | 3 $\frac{1}{2}$ "   |
| Fifth "   | 365 "   | 11 " 7 dr. | 4 " "               |
| Sixth "   | 390 "   | 12 " 5 "   | 4 $\frac{1}{2}$ "   |
| Seventh " | 400 "   | 13 " "     | 4 $\frac{1}{2}$ "   |
| Eighth "  | 413 "   | 13 " 3 dr. | 4 $\frac{1}{2}$ "   |
| Ninth "   | 418 "   | 13 " 4 "   | 5 " "               |

Overfeeding must be avoided. When the infant can suck and swallow a small vial with a nipple is used; when it cannot the fluid may be introduced through the mouth or nose with a medicine dropper.

When sufficient food cannot be given in this way gavage may be employed, a catheter being passed into the stomach and the fluid poured in. Plenty of water must be administered. When it is difficult to give enough by the mouth, normal saline solution may be injected at intervals into the bowel. During the early days the infant should remain in the incubator while being fed. As it gets stronger it may be lifted out into the warm room.

The infant should not be bathed at first, but should be anointed daily with sweet oil or benzoated lard. During the second week, if the infant thrives, it may be bathed in a hot room, in water at a temperature of 102° F. Each day massage and passive movements must be carried out with care and gentleness. The rectal temperature should be taken morning and evening, and a record of the infant's weight kept. The infant's position in its bed should be changed from time to time.

The period of incubation varies usually from a few days to a month, but sometimes may be prolonged beyond this period. Its removal depends upon the circulation of the infant and its power to maintain its body temperature. As the infant grows stronger the temperature of the incubator may be gradually reduced to 82° F., and later to the temperature of the room in the daytime, the heat being turned on somewhat at night. Full-time infants which have suffered from shock need only be kept in the chamber until they have recovered.

PART IV.

THE PATHOLOGY OF PREGNANCY.

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UNDER this heading are considered the most common diseased conditions that complicate pregnancy. Many of these morbid processes run a course in no way different from that noticed in the non-pregnant condition; some are considerably modified by pregnancy. Several diseased conditions are entirely due to causes associated with the gravid state. Many of these affections profoundly influence the course and duration of the gestation and the health of the mother.

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CHAPTER I.

TOXEMIA OF PREGNANCY.

WITHIN recent years an increasing amount of attention has been given to the influence of toxic matters accumulated in the body of the pregnant woman as a factor in producing many of the disturbances described under the Pathology of Pregnancy. At the present time the subject is still in the speculative stage. The nature of the toxic materials and the variations in the toxicity of the blood and excreta are not known with any certainty; in the chapter on Eclampsia I have given an account of various experiments to determine these.

Poisonous matters in the body arise from various sources. They are produced as the result of all cell-activity both in the mother and the fetus. In pregnancy metabolic changes are more marked than in the non-pregnant state, and increased waste material is produced from the combined metabolism of the mother and the fetus. Various toxic salts, extractives, etc., are eaten with the food. Many poisonous substances are produced in the alimentary canal in connection with digestion and as the result of the action of micro-organisms. These toxic agents are continuously eliminated from the body by the lungs, skin, kidneys, and intestine, or destroyed in various methods that are not yet well under-

stood; it is believed that the liver and the thyroid and other glands play an important part in this connection. In normal cases the destruction and elimination of poisons is carried out so that health is in no way disturbed. In many cases these processes are imperfect as a result of defective activity of the protective organs, excessive accumulation of poisons, or of a combination of these. Many factors contribute to these abnormalities—*i. e.*, overeating, imperfect digestion, lack of exercise, inattention to the condition of the skin, etc., being frequently noted. Pinard has drawn attention to the influence of corset constriction in impairing the activity of the liver, whose function he considers of prime importance in destroying the toxins circulating during pregnancy. The altered abdominal relationships brought about by the increased size of the uterus may also interfere directly with the activity of organs through increased pressure as well as through alterations in the circulation of blood in them. In some cases the protective organs act inefficiently because they are congenitally imperfect or diseased.

The results of toxemia or autointoxication vary greatly. Many of the so-called "minor disturbances" in early pregnancy are supposed to develop because the protective mechanism does not ordinarily rapidly accommodate itself to the necessity for destroying increased toxic material in the system. Various disturbances may be noted, notably those in connection with the nervous system. The alterations in the skin so frequently noted are believed to be thus brought about. The liver is frequently affected; sometimes it may be markedly degenerated—*i. e.*, in acute yellow atrophy and eclampsia. The kidneys may also be altered, many variations being found as regards the changes in the glandular tissue and in the excretion of waste products.

**Diagnosis.**—The diagnosis of toxemia in pregnancy is to be established, in accordance with the views above expressed, by studying the symptomatology of the patient and by noting changes in the various systems. These need not be given here, because they are detailed in the following pages.

**Treatment.**—Prophylactic measures, mainly hygienic and dietetic, such as have been described under the Hygiene and Management of Pregnancy, are of prime importance in preventing the development of toxemia. When a toxic condition actually exists, measures, such as are described in the chapter dealing with Eclampsia, should be adopted.

In dealing with the so-called "minor disturbances" of pregnancy the physician must not be satisfied with seeking for a nostrum that may give relief. He should make a careful study of the patient's system and, remembering the toxic theory of the disorders, strive to carry out such measures as are calculated to reduce toxicity to a minimum.

## CHAPTER II.

## AFFECTIONS OF THE NERVOUS SYSTEM.

SENSORY disturbances are frequent. Various forms of neuralgia are found—*i. e.*, toothache. The breasts are sometimes very sensitive. Headaches are troublesome to some. Abdominal and pelvic pains may be present as the result of old inflammatory troubles or independently of them. Sometimes there is much distress in the region of the coccyx. (Many abdominal and pelvic disturbances are alimentary in origin or are due to altered pressure relationships.) In some cases there are symptoms related to the sense organs—*i. e.*, ringing in the ears, altered taste and smell, and disturbed vision. These and various other nervous alterations are often found in women whose health is deteriorated and in those who are neurotic. It is, however, very important to note that many of these disturbances may be due to serious disorders, and that they should never be treated lightly unless a careful and systematic examination of the woman be made.

At the present time the view gains ground that they are in large measure due to the influence of toxins that circulate in the blood, acting as direct irritants as well as making the nervous centers more sensitive to all reflex stimuli. Great variations are found in the extent to which they are affected. Various minor hysteric manifestations frequently occur; extreme outbreaks are rare. Insomnia is not uncommon; it may be due to overworry, excessive excitement or fatigue, overuse of tea, coffee, and other stimulants. Sometimes it is a precursor of insanity; sometimes it is associated with an organic disease. It is most frequent in neurotic women.

**Mental Affections.**—In describing the signs and symptoms of pregnancy various common minor psychological disturbances were noted. (See p. 115.) In some cases these may be marked and may persist throughout pregnancy, disappearing after labor; occasionally they may be followed by insanity in labor or, more frequently, in the puerperium. An outbreak of insanity in pregnancy is rare in an adult woman. Clouston states that after the age of twenty-five there is no period in a woman's life when she is less liable to an attack than during gestation. It is more frequent in primiparæ than in multiparæ, especially in cases of illegitimacy. An important predisposing condition is a hereditary tendency to insanity. It rarely develops before the third month; generally not until after the sixth month. The onset of an attack is generally gradual and marked by apathy. There may be marked sluggishness and stupor. There may be a perversion of affection toward

husband, children, or other near relatives. Sometimes there is marked fear of an impending calamity. The condition may rapidly get worse and a state of dementia follow. Occasionally the insanity may be of a maniacal type. There may be marked hallucinations and delusions; sometimes there is a suicidal tendency. Death may sometimes follow an acute attack of mania. Recovery may occasionally take place before labor. More frequently it lasts until after labor, when improvement or exaggeration may be noted.

**Treatment.**—Insane pregnant women should be treated like those who are not insane. They should not be taken to asylums unless it is impossible to attend to them in a quiet private house. Premature delivery is not indicated.

**Paralysis and Paresis.**—These may be mere manifestations of an hysterical condition or they may be due to serious organic disturbances. The lower limbs are occasionally affected as the result of the pressure exerted by the uterus. In cases of paralysis due to brain and spinal-cord lesions, pregnancy is not usually interfered with if the woman lives. When the lesion is higher than the lower lumbar region, labor may go on satisfactorily even though the abdominal muscles may be paralyzed.

**Epilepsy.**—When this disease occurs in pregnancy there is usually a history of an attack at a previous period in the woman's life. Pregnancy occasionally may modify the epileptic state, diminishing the violence and number of the convulsions or even stopping them, reappearance being noted during the puerperium or nursing-period; but in most instances there is no such alteration. Sometimes a cessation of the attacks may follow labor for a time. Epilepsy does not seem to influence the course of pregnancy, though injury produced during a convulsion might induce premature emptying of the uterus. Cases should, therefore, be watched with special care. The convulsions of epilepsy must be diagnosed from those associated with hysteria, uremia, chorea, eclampsia, and apoplexy.

**Chorea Gravidarum.**—After childhood chorea rarely occurs save in pregnant women, and it does not frequently affect them. In more than half of the cases the women are primiparæ. They are usually neurotic or have a family history of neuroses, sometimes of insanity. In a considerable proportion there is a personal or family history of rheumatic affections. Occasionally the attack may follow fright, shock, or marked emotional excitement. There is no particular association with illegitimacy. In about 50 per cent. of cases the manifestations develop during the first three months; in nearly all the remainder during the next three months; in only a few instances does the chorea begin during the last three months. Sometimes the disease recurs in successive pregnancies. When gestation occurs in women already suffering

from chorea the disease may rarely be checked. Usually it continues during part or all of the gestation, and may, indeed, last after labor. Frequently the disease is intensified. When mild the movements may only be unilateral; in severe cases they are bilateral, and may continue during sleep or induced narcosis. They are often increased as the result of fetal movements or of a physical examination.

Chorea may lead to marked deterioration of health, sleeplessness, loss of flesh, pareses, and to various mental disturbances. In severe cases premature expulsion of the ovum may be caused. Recovery from the disease is rare until pregnancy has terminated. The mortality of the disease is much higher in pregnant women than in children. Buist has shown, however, that in a considerable number of cases the mortality has been due to associated conditions—*i. e.*, eclampsia, sepsis, etc. The fetus may die *in utero*, or it may reach term and be born weakly or well developed. In some cases it may develop chorea in early childhood. The disease must be chiefly distinguished from hysteria. Marie, Gilles de la Tourette, and others hold that true chorea is rare, and that it is mistaken for hysteria and for *maladies des tics*. Sometimes chorea and hysteria may occur together.

**Treatment.**—The general and medical treatment of the disease is the same as in the non-pregnant state. Mild cases may be improved or cured and carried satisfactorily to term. In severe attacks anesthesia may be necessary to control the movements. When the movements are violent, sleeplessness is marked and health deteriorates; the uterus should be artificially emptied.

**Tetanus.**—Pregnancy seems to produce a condition particularly favorable to the growth of the specific organism of tetanus. In the tropics, where the state of the soil favors the prevalence of this germ, the disease is not infrequent in pregnant women. It is more common in multiparæ, especially where the surroundings are damp and dirty. The attacks generally begin in the early months; the maternal mortality is high, and abortion is apt to occur.

**Tetany.**—Tonic spasms varying in degree may occasionally affect the pregnant woman; they may be widespread or localized. In mild cases they usually occur only in the upper and lower limbs. They are usually short in duration and intermittent, and may be preceded or followed by numbness or tingling. Compression of the main nerves or vessels in the affected parts may renew the spasms. The application of cold usually checks them. In marked cases the face and trunk muscles may be affected. There is usually a slight rise of temperature, quickened pulse, and disordered digestion. Rarely death may occur from interference with respiration. Consciousness is never lost. The condition must be diagnosed from tetanus, epilepsy, and hysteria.

**Treatment.**—The general health should be improved and all weakening or irritating conditions removed. Quietness and sleep are necessary. Bromids and other sedatives are often advisable. In severe cases it is necessary to empty the uterus.

**Shock.**—The effect of shock on the pregnant woman varies greatly. She may recover quickly, no apparent disturbances following. Various nervous and mental affections may result. Frequently premature expulsion of the ovum is caused. In general, therefore, it may be said that no unnecessary surgical procedure should be carried out during pregnancy, even though recovery may take place after such operations as ovariectomy, herniotomy, myomectomy, etc., without interruption of the gestation. General anesthesia should always be used. Local anesthesia is contraindicated; for while it may be satisfactory so far as the operation is concerned, it cannot prevent psychical disturbance or shock, which may be sufficient to cause abortion.

**Hysteria** is rarely influenced favorably by pregnancy. Its manifestations may sometimes disappear, but often they are aggravated. It does not tend to interfere with the course of gestation.

**Catalepsy** is a very rare complication of pregnancy. The infant may be affected at birth.

### CHAPTER III.

#### AFFECTIONS OF THE HEMOPOIETIC AND CIRCULATORY SYSTEMS.

**Changes in the Spleen.**—Excessive enlargement of the spleen sometimes takes place in pregnancy. It may cause a swelling in the abdomen and produce aching or pain in the side. Rarely rupture has occurred during pregnancy, usually as the result of a strain or fall; this has also taken place during and after labor.

**Changes in the Thyroid.**—Exophthalmic goiter sometimes begins in pregnancy, the disease being usually of an aggravated type. It may cause fetal death and premature emptying of the uterus from circulatory disturbances. After pregnancy the condition generally improves. In extreme cases, if symptoms are becoming serious, pregnancy should be ended. Cystic disease of the thyroid or bronchocele may begin in pregnancy, especially in districts where the disease is endemic. Sometimes a rapid growth may endanger respiration. In these cases the uterus should be emptied. Altered activity of the thyroid and parathyroids is

believed by many to explain some of the pathologic changes complicating pregnancy—*i. e.*, eclampsia and vomiting.

**Changes in the Blood.**—The normal changes have already been described. (See p. 107.) True anemia or chlorosis may begin in pregnancy, but generally it is an aggravation of a condition that existed before gestation. The disease may be much intensified. Sometimes pernicious anemia may develop; if it has existed before pregnancy it becomes worse afterward. Of 25 cases of the latter affection reported by Graefe only 1 was cured; 2 became somewhat better after labor; most died within ten months of the onset. H. W. Freund states that most deaths occur after labor, generally within five months. Anemia may cause abortion by death of the fetus from imperfect nutrition, deficient oxygenation, and placental hemorrhages. The treatment of anemia is the same as in the non-pregnant state. When the condition is marked and does not improve or is pernicious the uterus should be prematurely emptied.

Hemophilia is rare; it may develop in pregnancy and is a dangerous complication. If hemorrhage occurs during pregnancy or labor the result may be fatal. Purpura hæmorrhagica may also be very serious during pregnancy. Hemorrhages in the placenta may kill the fetus and its expulsion may follow. The fetus itself is usually free from purpura. In these cases calcium chlorid should be administered internally. If marked bleeding occurs a sterile 2 per cent. normal saline solution of gelatin may be tried subcutaneously. Adrenalin chlorid may also be administered.

**Changes in the Arteries.**—Sometimes fatty changes are found in the intima of the aorta or other large vessels; more rarely in the media. These may be succeeded by sclerosis and calcareous deposition. Dissecting aneurysm may thus be caused. Telangiectatic tumors may form during pregnancy. Aneurysm is unfavorably affected by pregnancy because of the cardiac hypertrophy, increased quantity of blood, and interference with the circulation; the artery-wall is likely to degenerate still more. A case should be treated on the lines laid down for the management of pregnancy complicated with heart disease. Rupture may occur during or after labor.

**Changes in the Veins.**—As a result of the increased difficulties encountered by the pelvic circulation in pregnancy, owing to the growth of the uterus, its relationship to the pelvic brim, the increase of intra-abdominal pressure, and the altered state of the blood, venous engorgement in the pelvis is common in pregnancy, varicosities being formed in different parts—*i. e.*, broad ligaments, external genitals, bladder, rectum, lower limbs, and abdominal walls. The saphena veins are most frequently affected; next, the veins on the inner side of the calf; the vulvar veins are less often

varicose. The condition is more common in multiparæ. Chronic constipation is an important factor in its production, especially in the rectum. Sometimes edema may accompany the varicose condition. Rupture of a vein may occur, forming a hematoma, which occasionally may suppurate. Thrombosis and phlebitis may occur. From an infected vein the lymphatics may be affected. As the result of scratching the skin may become infected. Hemorrhoids may lead to loss of blood and to much distress; they may become inflamed, ulcerated, or gangrenous.

**Treatment.**—The alimentary tract should be well regulated. The patient should be enjoined to lie on her back, the hips being higher than the head, an hour or two in the early afternoon every day. It may be necessary to keep her in bed for a considerable time in order to improve the varicose condition. Elastic pressure over the vulva is sometimes necessary. Elastic stockings are valuable when the lower limbs are affected.

When there is phlebitis or thrombosis absolute rest is necessary, the limb being wrapped in cotton and slightly elevated. If there be much pain, soothing applications—*i. e.*, lead and opium lotion, may be used. In these conditions the greatest care must be taken and the danger of embolism remembered. Scratching of the skin over affected areas must be prevented. A suppurating area must be opened early and treated with antiseptics. Piles should be treated as much as possible by medical means. When they continue to bleed extensively or are badly ulcerated or gangrenous it may be necessary to employ surgical measures.

**Edema** may occur in different parts of the body as the result of the various causes that may produce the condition in the non-pregnant woman. In pregnancy it is most frequent in the lower extremities and vulva; sometimes in the lower abdominal region. It is sometimes associated with varicose veins. It is found in anemia, in heart, kidney, and some liver diseases; in conditions where there is abnormal intra-abdominal pressure—*i. e.*, hydramnios, twin pregnancy, tumor with pregnancy, etc. Edema may sometimes be associated with gangrene.

**Treatment.**—Attention should be given to the primary cause. Increased diuresis and diaphoresis must be encouraged. Regular daily rest or even continuous rest may be necessary. In cases of extreme swelling it is advisable to allow the fluid to escape by puncture under careful aseptic precautions.

**Cardiac Affections.**—The normal changes in the heart during pregnancy have already been noted. (See p. 108.) The organ may become weakened in action and somewhat dilated in various states of pregnancy—*i. e.*, advanced hydramnios or twin gestation, abdominal swellings coexistent with pregnancy, and some lung affections. Palpitation, breathlessness, irregular pulse, cyanosis, etc., may occur as a result. Sometimes these symptoms may be

caused by extreme flatulence in advanced gestation. They may also appear as neuroses.

True valvular disease rarely begins in pregnancy. When it does it is probably mainly due to one of the influences that lead to its production in the non-pregnant state—*i. e.*, rheumatism. Certain authors, however, think that a true pregnancy endocarditis may arise. They point out the conditions that may favor valvular changes—*i. e.*, hypertrophy, dilatation, altered blood-pressure, and increase of fibrin elements in the blood. Ollivier has described 3 cases in which endocarditis seemed to develop as a result of pregnancy influences. He thinks that the mitral valve is most likely to be affected. The question is not easy to settle, though it must be admitted that the circulatory conditions of pregnancy would undoubtedly favor the development of valvular disease if a rheumatic or septic influence were present.

Acute endocarditis is very rarely found in pregnancy, and must be regarded as a more serious disease than it is in the non-pregnant. The great majority of cases are those of chronic valvular disease of the left side of the heart that existed before the pregnancy began. Right-sided disease is so rare that it need not be especially considered. The gravest cases are those in which pregnancy occurs before compensation has been well established after recent mitral or aortic disease, especially after the latter. Of the cases in which the endocarditis is not recent, compensation having been well established, mitral stenosis is the most serious form of heart lesion. Of the two valves, the mitral is more frequently affected than the aortic; sometimes both are diseased.

The effects of pregnancy on a woman who has a valvular lesion vary greatly. These depend upon a variety of factors—*i. e.*, the situation and extent of the disease, the degree of compensation existing at the beginning of pregnancy, the general health of the patient, her habits, occupations, etc. The nutrition of the cardiac muscles may be affected by an abnormally poor state of the blood. The resulting weakness would tend to favor early or rapid failure in compensation. There is always a danger, especially when the disease is recent, that fresh fibrin vegetations may form on the valve owing to the increased hyperinosemia of the blood of the pregnant woman. In some cases also, apart from mechanical stretching that may gradually affect the valve, there may be recrudescence of the original disease, which may lead to further destruction of the valve. The main element of danger common to all cases is undoubtedly the increased work thrown on the heart, due to the greater quantity of circulating blood. This factor is most serious in the advanced months of gestation, when the uterus reaches a large size.

Another influence that plays a rôle is distention of the abdomen, especially if this be abnormal from excessive size of the

uterus, as in hydramnios, twins, or single large child; in disordered alimentary states where flatulence and constipation occur. Of great importance are disturbed metabolism and imperfect elimination, whereby toxic matters circulate and directly poison the cardiac muscle. Indeed, the various factors introduced by pregnancy are so serious that effects may be brought about that in the non-pregnant state might not be met with until after a period of years. The woman with heart disease, *ceteris paribus*, has a shorter life expectation if she exercises the function of child-bearing, and her dangers increase with succeeding pregnancies. In some cases, owing to the perfect response of the heart to additional strain thrown upon it, the woman may pass through pregnancy with no more discomfort than may be found in normal cases. When, however, cardiac compensation is not sufficient, one or more of the well-known signs and symptoms—*i. e.*, breathlessness, cough, dyspnea, edema, etc., make their appearance. In aortic disease disturbances are less common and usually less severe than in mitral disease, and they appear in most cases during the late months of gestation. The symptoms are mainly palpitation and dyspnea. In some cases premature emptying of the uterus may be caused. It is in mitral disease, especially where stenosis exists, that the most marked symptoms occur, and though they usually supervene after midterm, they may often develop earlier. The increased risk to the woman in mitral disease, especially in stenosis, is pulmonary congestion, and dilatation and weakness of the right side of the heart.

The health of the fetus tends to be impaired, both from the imperfectly oxygenated condition of the maternal blood as well as from the destruction of portions of the placenta by hemorrhages into it from the maternal vessels. Expulsion of the uterine contents may thus be brought about. In pregnancy death may result sometimes from heart failure without the occurrence of premature emptying of the uterus, but in most cases the fatality is associated with this event or follows it. It has been reported in connection with an abortion in early pregnancy, though this is rare. Very few women go to full term without the appearance of some abnormal signs and symptoms. These vary considerably in different cases. Most frequent are dyspnea, palpitation, and edema, and these may be slight or marked. When pulmonary congestion and dilatation of the right heart increase the outlook is serious. Ascites, albuminuria, hemorrhages, and embolism are also very grave signs. The majority of cases which go to term become worse during the last weeks, the symptoms being more pronounced if there be alimentary disorders causing flatulence, and thereby increased pressure on the heart through the diaphragm. In addition, patients often become despondent and nervous, lose their appetite, and suffer from sleeplessness at this time.

**Treatment.**—As regards the influence of cardiac disease in deciding the question of marriage different views are held. Very common is the opinion that no woman with organic heart disease should marry if her well-being alone be taken into consideration. Some authorities would insist upon this restriction only in special cases—*i. e.*, mitral stenosis, when the woman's general health is not good, or when some other lesion exists. When pregnancy takes place the woman should be carefully looked after from the beginning, her daily routine being regular and well ordered. She must be guarded from strain, worry, anxiety, and sudden shock. The diet should be very nourishing, easily digested, and the bowels should be carefully regulated. The woman should stay out-of-doors as much as possible in fine weather, avoiding chills and dampness. She may take easy walks and carriage drives, but in the late months must be kept more at rest. Massage of the limbs is frequently beneficial.

As to medicinal treatment, none is required in the few cases which have no abnormal symptoms or signs during pregnancy. In most cases, however, tonics are needed—*i. e.*, iron, arsenic, and strychnin. Strophanthus and digitalis and nitro-glycerin are of the greatest value in strengthening the heart muscle, and are indicated when there are signs of heart failure—*i. e.*, breathlessness, dyspnea, cough, edema, increasing irregularity and weakness of pulse, etc. When digitalis is used a nitrite should be given at the same time in order to counteract the effect of the former in contracting the arterioles and so raising arterial resistance.

If abortion or premature labor threatens, what is to be done? It is difficult to speak decidedly with reference to this question. Some authorities advise encouraging the emptying of the uterus; others are guided by the condition of the mother. If she be in a good state an effort should be made to carry on the gestation. This is effected by enjoining absolute rest in bed, together with morphin administration. Sometimes it is advisable to bleed the patient once or twice. If the patient shows evidence of heart failure in connection with the signs of premature expulsion, many authorities believe that the pregnancy should be terminated. When symptoms of cardiac weakness develop in pregnancy, though premature expulsion of the ovum be not threatened, should the uterus always be emptied? Here again different views are expressed. Some hold that any symptoms whatever justify the termination of pregnancy; this is too advanced a position. Many cases may be carried to full term by careful therapeutic measures, even though they may be troubled with palpitation, dyspnea, or edema of the limbs.

When more severe signs arise—*i. e.*, increasing dilatation and irregularity of the heart, pulmonary edema and congestion, ascites, albuminuria, etc., the uterus should be emptied in the great ma-

majority of cases unless the husband and wife refuse their consent. Occasionally the failure in heart compensation may be checked even where one or two of these grave conditions are present; but if improvement is not noted early too much time must not be wasted before the uterus is emptied. In all cases in which rapid benefit is desired, venesection stands prominent as a therapeutic measure. In considering the question of terminating pregnancy, it must always be remembered that this procedure may be as dangerous as a full-time labor, especially when the signs of cardiac failure are marked. The operation must be carried out with special precautions, which have for their object the avoidance of all straining on the part of the woman and of sudden rise in the blood-pressure. These will be described in connection with the Pathology of Labor.

#### CHAPTER IV.

#### AFFECTIONS OF THE RESPIRATORY SYSTEM.

**Cough.**—Pregnant women are frequently troubled with a cough that is not due to recognizable changes in the respiratory tract. In such cases it is usually regarded as a neurosis of reflex origin. Apart from this variety, it may be due to any of the causes that exist in the non-pregnant state. Excessive or protracted coughing may cause abdominal and pelvic pains and may bring about abortion.

**Sneezing.**—Occasionally sneezing is a complication of pregnancy, especially in the early months. It may lead to nasal hemorrhage; sometimes abortion may be caused. The application of cocain has proved a valuable remedy.

**Dyspnea.**—Occasionally dyspnea affects pregnant women, especially in the early months, being of reflex nervous origin. In advanced gestation it is frequently present, being due to the increasing abdominal distention. It is most marked when the uterus is abnormally large, when there is extreme flatulence, or when there is a new growth in the abdomen. It may also be caused by various diseases affecting the respiratory and circulatory systems.

**Bronchitis.**—This disease may cause much distress if it be extensive, especially in the later months. The woman may become weakened from the troublesome coughing, which may cause abortion.

**Lobar Pneumonia.**—This is a serious complication of pregnancy, especially when both lungs are affected. The circulation is more embarrassed than in the non-pregnant state. Owing to

imperfect oxygenation the nutrition of the cardiac muscle is affected, and there is, consequently, a tendency to heart failure. The high temperature and imperfectly oxygenated blood may destroy the ovum and so lead to its premature expulsion. The cough may also be a factor in bringing this about. Wallich states that the uterus is emptied in one-third of the cases in which the pneumonia occurs before the sixth month, and in two-thirds after this period. Sometimes premature labor takes place, the child being born alive; occasionally it may show signs of pneumonia. The greatest risk to the mother is in the puerperium. Wallich estimates the maternal mortality at more than 50 per cent., and the fetal at 80 per cent.

**Treatment.**—The woman must be treated by the ordinary well-recognized methods. When there is marked cyanosis or asphyxia oxygen inhalation is indicated; wet-cupping and venesection are also of great value. Continued cardiac stimulation is imperative. The uterus should not be emptied, but, rather, every effort should be made to prevent this from taking place, in order to avoid increased risk to the woman.

**Asthma** occurs in some women only in pregnancy or labor, disappearing afterward. When pregnancy takes place in women who are subject to asthma the attacks are usually aggravated.

**Pleurisy** appearing as an acute attack may not have any special effect on pregnancy. If, however, an extensive effusion forms, cardiac embarrassment may be caused. In cases of old-standing extensive pleuritic adhesions the heart may be affected, so that it may not be equal to the increased work thrown upon it as a result of pregnancy.

**Emphysema**, if extensive, may be a serious condition if it has caused cardiac changes. Premature expulsion of the ovum is apt to occur.

**Hemoptysis** is almost always due to phthisis or heart disease.

**Phthisis Pulmonalis.**—Advanced phthisis tends to prevent conception, but in its early stages the disease has no effect in this direction. The progress of pre-existent phthisis is only rarely retarded by pregnancy. The popular belief that gestation is beneficial is wrong, and probably arises from the observation that the woman often gains fat. In most cases the disease develops more rapidly and terminates sooner because of the pregnancy. In women predisposed to the disease, gestation may determine the beginning of an attack before or after labor. Sometimes such women may have one or more children before the disease starts. Occasionally a woman dies from rapid progress of the phthisis during pregnancy. When it is advanced, premature emptying of the uterus may take place. When a diseased woman goes through labor she is usually much weakened and generally has little milk. The children are usually feeble and are predisposed to tuberculosis.

Occasionally they are tuberculous at birth, dying soon afterward.

The question of inducing abortion in phthisic women, both on account of the mother and the fetus, is one the physician may be asked to decide. There can be no doubt as to its justifiability.

## CHAPTER V.

### AFFECTIONS OF THE OSSEOUS SYSTEM.

**Tuberculosis** of bones tends to become aggravated in pregnancy.

**Osteomalacia.**—This disease, which causes softening and deformities of the bones, is very rare in America; it is chiefly found in Germany, Italy, Austria, and Switzerland. In some parts it seems to be endemic. It affects both sexes, but is chiefly found in women. There are different statements as to the frequency of its occurrence in pregnant women. Litzmann says that it is found in them in 64.88 per cent. of the cases; Hennig, in 68.2; Casati, in 64.9; Geepke, in 94.8. Durham states that in 131 cases the first symptoms appeared in 91 at or soon after childbirth. The pelvic bones are first and most seriously affected in women. Ritchie points out that the frequent recurrence of pregnancy favors the production of the disease. He states that it is doubtful if prolonged lactation is a favoring condition. Fehling says that the disease is limited to the years of sexual activity.

**Symptoms.**—The onset of the disease is obscure. Pains in the sacrum, in the other pelvic bones, or in the spinal column are usually early symptoms; they are generally constant, though they may vary in degree, being increased by pressure or movements. Then difficulty in walking, or in flexing the thighs on the abdomen, is noticed, and the gait becomes awkward and waddling. Then the bones may bend, the height of the patient diminishes, the spine may become twisted and the thorax deformed. (Changes in the pelvis are described in the chapter on Deformed Pelves.)

Frequently there is early increase in the knee-jerk and ankle-clonus. There may also be rhythmic movements like those in cerebrospinal sclerosis. Paresis of the flexors of the hip and contracture of the adductors may be noted. Pregnancy causes the disease to advance rapidly, and the patient is generally compelled to take to her bed.

There are variations in the morbid changes. The chief feature is the absorption of bone; in some cases only the earthy salts are

removed. With the absorptive process, regeneration may also be in progress. In the late stages the bones may easily be cut with a knife. There is congestion in the bone-vessels, and often small hemorrhages, but there is no evidence of inflammation.

Fehling has pointed out the tendency to marked friability in the ovaries and to the frequent occurrence of extreme congestion in the uterine adnexa.

**Etiology.**—As to the etiology there are different theories, the most plausible being that of Curatulo, who holds that the ovaries introduce into the blood an internal secretion that promotes oxidation of the phosphoric organic substances necessary to form the bony salts.

**Treatment.**—In early pregnancy the uterus should be emptied and the ovaries removed; in late pregnancy Cæsarean or Porro-Cæsarean section and oöphorectomy. Removal of the ovaries is followed in many cases by cure. Sometimes the cure is only partial; occasionally there is no change. Senator treated a case by administering oöphorin. There was a certain degree of improvement, the patient excreting a smaller quantity of lime salts, but the results were not satisfactory.

## CHAPTER VI.

### AFFECTIONS OF THE ALIMENTARY TRACT.

**Caries of the Teeth.**—The teeth are apt to decay in pregnancy, and the change is more rapid than in the non-pregnant state. Toothache is apt to be troublesome in these cases. Severe or extended dental work should not be carried out in pregnancy; temporary fillings only should be made. Toothache is sometimes present when no caries exists. Assuma points out that the cause of caries is not that which has frequently been asserted—viz., absorption of mineral matter from the teeth. He shows that the disease is due primarily to the erosive action of acid secretions, permitting the subsequent growth of leptothrix. The buccal secretion, normally alkaline, readily ferments and becomes acid in pregnant women. A mouth wash of sodium bicarbonate is a valuable prophylactic measure in pregnancy.

**Ptyalism.**—This is frequently found, though varying in extent in different cases. Sometimes it may be very marked and may recur in succeeding gestations. It may sometimes be reflexly induced by pathologic conditions in the pelvis, and may be lessened by improving these. Thus, the replacement of a retroverted uterus may lead to its disappearance.

**Treatment** is not very satisfactory. Ptyalism may be somewhat checked by the sucking of ice or by astringent washes; belladonna may be necessary. Galvanism applied to the salivary glands is sometimes beneficial, 2 or 3 milliampères being given five or ten minutes daily.

**Gingivitis.**—Sometimes this affection is very troublesome, the gums being inflamed or even ulcerated and bleeding easily. It may be associated with catarrhal changes in the stomach. In treating the condition strict regulation of the diet is advisable. Astringent antiseptic mouth washes should be used.

**Pica or Malacia.**—The craving for eating various articles has already been described. (See p. 115.) This peculiarity may or may not be associated with digestive disorders.

**Pyrosis.**—Heartburn is frequent, especially in the late months of gestation. It is usually associated with alimentary disorders. It is often worse toward evening, in some cases being present only at that time.

**Diarrhea.**—This disorder is generally associated with other digestive disturbances and may alternate with constipation. If the condition continues the woman may become much weakened and abortion may result.

**Constipation.**—This disturbance is often found, and is aggravated by indiscretions of diet and lethargic habits. It may lead to loss of appetite and to various digestive disorders. Hemorrhoids are frequent and prolapse of the rectum may take place. Of great importance is the poisoning of the system as the result of absorption of toxic matters from the bowel.

**Hepatic Toxemia.**—Alterations of the liver function are more frequent in pregnancy than is generally known. The organ plays a very important rôle in destroying various circulating toxins. When it is unequal to the demands put upon it, increased work is thrown on the kidneys and other organs. Sainte-Blaise says that the following conditions are indicative of hepatotoxemia: 1. Diminution in urea and increase in uric acid excreted. 2. The presence of extractives—*i. e.*, leucin, tyrosin, xanthin, and hypoxanthin. 3. Urobiluria, peptonuria, indicanuria, and albuminuria. 4. Glycosuria, the liver being unable to perform its complete glycogenic function if considerable glucose be taken daily in the food. Enlargement or tenderness of the liver may sometimes be felt. In extreme toxic cases it may be much reduced and destroyed.

**Jaundice.**—Any of the well-recognized causes of this condition may produce it in the pregnant woman. Sometimes it appears in the late months as the result of an exceptional degree of increased intra-abdominal pressure.

**Acute Yellow Atrophy.**—This affection occurs in both sexes, but especially in women. In a considerable percentage of

cases it affects pregnant women and is frequent in the early months.

Its **etiology** is unknown, but it is probably associated with an invasion of the bile tracts with toxic matter from the intestines.

The **symptoms** vary considerably. There are usually premonitory phenomena, but these are variable; they are gastro-intestinal disorders—*i. e.*, nausea, vomiting, loss of appetite, furred tongue, diarrhea, constipation, and slight pyrexia. There may be vague pains or uneasiness in the epigastric region, which may last days or weeks. Jaundice develops, as a rule, gradually, but sometimes suddenly. It may affect only the upper part of the body or be more extensive; it is not usually intense. Vomiting becomes more and more marked as the case advances, food, mucus, bile, or altered blood (like "black vomit" in yellow fever) being ejected. Constipation may be marked. Sometimes there is diarrhea and the stools are occasionally bloody. Pain is felt in the region of the liver, and the area of hepatic dullness diminishes as the liver atrophies. Peritonitis is very rarely present. Frequently there are muscle and joint pains; sometimes the joints are swollen. The patient is restless and irritable and complains of headache. As the case advances there may develop muttering delirium, subsultus, muscular tremors or rigidity, stupor, coma, convulsions, retention or incontinence of urine, and incontinence of feces.

The temperature, while usually slightly elevated in the early stages, rarely reaches  $101^{\circ}$  F.; in the late stages it may be sub-normal. The pulse varies; early it may be raised, but falls when the jaundice appears and rises when cerebral symptoms develop. The urine is dark, often containing albumin or blood. There is diminution of urea, uric acid, chlorids, sulphates, and earthy phosphates. Leucin and tyrosin are formed when the urine stands. Hemorrhages are common in the stomach, bowels, nose, or in the subcutaneous tissue; occasionally in the decidua and placenta. Premature emptying of the uterus always occurs unless the mother dies early. The disease is almost always fatal within twenty-four hours or a few days.

The **treatment** is unsatisfactory. The action of the skin, kidneys, and intestines must be assisted. Stimulants must be given freely. Injections of normal saline solution should be given subcutaneously or per rectum.

**Nausea and Vomiting.**—These disturbances have been described as they ordinarily occur in pregnancy, being universally recognized as reflex neuroses, unassociated usually with any definite pathologic changes. (See p. 114.)

Evans has advanced the hypothesis that the rhythmical contractions of the pregnant uterus are the primary cause of the reflex irritation resulting in paroxysmal nausea and vomiting. Some authors believe that increased thyroid secretion is the cause

of the vomiting of pregnancy. At the present time the view gains ground that an important factor in causing these disturbances, especially the severe forms, is autointoxication from circulating toxins, there being different opinions as regards the production of these; it is often noted that pregnant women in whom elimination is active rarely suffer from gastric or other disturbances. It is important to remember that vomiting may also be due to any of the causes that produce the disturbance in the non-pregnant state—*i. e.*, organic disease of the stomach, nephritis, etc.

**Pernicious Vomiting.**—In some cases the vomiting persists and becomes more frequent, the stomach being unable to retain anything. Straining and retching are intense. The vomit contains food, mucus, bile, and in advanced cases small quantities of blood. Sometimes there is diarrhea. The condition is usually worse at night in bad cases. Distress and pain in the chest and upper abdominal region are present, and there is sometimes a cough. The patient usually takes an aversion to food, complains of thirst, and becomes weakened, emaciated, and depressed. In the advanced stages the mouth and throat become dry, the breath offensive, and sordes forms on the teeth. There may be incontinence of the urine and feces. The extremities become cold and clammy. Small extravasations of blood may occur in different parts. The pulse becomes weak, rapid, and irregular. The temperature may rise as high as  $103^{\circ}$  or  $104^{\circ}$  F. The urine has a high specific gravity, is dark, scanty, and contains albumin, casts, and blood-corpuscles. Later the weakness becomes marked and there may be attacks of cardiac syncope. There may be mental disturbances—*i. e.*, stupor, coma, and delirium. In some cases the disease becomes steadily worse; in others there are intervals in which the condition appears to improve. If the patient be not well nursed, bedsores and ulceration of the cornea may develop. The worst cases usually end fatally within a month; many continue several weeks longer. The mortality is high, different statistics placing it at 30 to 60 per cent. Sometimes the fetus may die *in utero*. This may or may not be followed by cessation of vomiting.

The **etiology** is uncertain. In some cases the vomiting seems to be reflex from various pelvic disturbances—*i. e.*, uterine displacements, rigidity and stenosis of the cervix, inflammation in the uterus or its adnexa, or in other tissues in the pelvis. In some cases no lesion can be made out and the disturbance appears to be a neurosis, such as may be found sometimes in non-pregnant hysteric women. It is possible that in some cases the vomiting may be due to the influence of unknown toxic agents. Certainly in the late stages many of the signs are the same as those produced by toxins. Cloudy swelling and fatty degeneration are usually found in various organs—*i. e.*, liver and kidneys. Linde-

mann found neuritis in some cases in various nerves—*i. e.*, phrenic, vagus, median, etc. It must be remembered that intense vomiting in pregnancy may sometimes be due to organic lesions, such as cerebral tumors, nephritis, gastric ulcer, gastritis, cancer of the stomach, etc.

**Treatment.**—Careful examination should always be made to determine whether any definite lesion exists that might cause the vomiting—*i. e.*, nephritis, in order that necessary therapeutic measures may be instituted. Sometimes a patient improves after a bimanual examination or after the insertion of a vaginal tampon. A retroverted uterus should be replaced if possible. Inflammatory areas on the cervix may be swabbed with iodized phenol and warm formalin douches (Mxx-Oj), taken twice daily. Nabothian cysts should be punctured. When there are intrapelvic inflammatory conditions, vaginal tampons of ichthylol glycerin (1:15) may be used. A series of blisters in the iliac regions are sometimes beneficial. If the cervix be stenosed and rigid it may be dilated somewhat, though this procedure should be postponed as long as possible, owing to the risk of causing abortion. It is recommended by some that dilatation be accompanied with stripping of the membranes for a slight distance above the cervix. Where no definite lesion can be made out, treatment on hygienic, dietetic, and medicinal lines must be adopted. Bearing in mind the part that may be played by toxins, every effort should be made to promote elimination. The importance of exercising a strong psychical influence over the patient must always be remembered. Sometimes a brilliant cure may be effected by suggestive therapeutics. Tibone has advocated the subcutaneous injection of hydrochlorate of cocain in the hypogastrium. This has also been recommended by Pozzi.

Sexual intercourse should be stopped and all causes of excitement or distress avoided. In bad cases the woman should be put to bed and carefully nursed. Small quantities of easily digested or predigested foods—*i. e.*, pancreatized milk, liquid peptonoids, peptonized beef tea, beef juice, etc., should be given at regular intervals. Sometimes a patient may retain some special article of diet that she strongly desires. Sometimes small quantities of alcoholic beverages may be retained. Food may sometimes be satisfactorily retained if the fauces be previously sprayed with cocain, or if it be introduced into the stomach through a tube. Sometimes repeated small doses of sodium bicarbonate are helpful. Lavage of the stomach is sometimes beneficial. When these measures fail nutrient enemata must be given (4 or 5 oz. in each). With these a patient may be fed several weeks. A high enema of normal saline solution, given in addition two or three times each day, helps to relieve thirst and dilutes circulating toxins as well as stimulates renal activity. When the patient needs alcoholic

stimulants that cannot be given by the stomach, they may be added to the enemata.

As to medicinal treatment not much is to be said; there is no true specific. Various drugs have been recommended—*c. g.*, cerium oxalate, iodine, bismuth, dilute hydrocyanic acid, menthol, etc. Strychnin is valuable when cardiac stimulation is necessary. Various sedatives may be required—*c. g.*, sodium bromid, chloral, and codein. Morphin should only be used in extreme cases to quiet the patient and to cause her to sleep. These drugs may be given in the enemata when the stomach will not retain them. Mustard poultices over the epigastrium sometimes act beneficially.

Finally, when the patient grows worse after careful treatment on the above-mentioned lines has been tried, the uterus should be emptied. This procedure usually succeeds in checking the vomiting, but it may sometimes fail. While this should only be undertaken as a last resort, it should not be postponed too long lest the patient be too weak to recover from the operation.

## CHAPTER VII.

### ACUTE FEBRILE DISEASES.

**Influenza.**—Pregnant women enjoy no immunity from this disease. It may rarely cause premature expulsion of the ovum. In a few cases postpartum hemorrhage has been reported.

**Cholera.**—Premature emptying of the uterus is frequent in this disease, the causal factors being the poisons circulating in the blood, hemorrhages into the placenta, and the mechanical irritation of purging and vomiting. According to Schütz, the tendency to interruption of pregnancy is greater the later in gestation the patient is attacked. The disease is very fatal to the fetus in any stage. The patient frequently dies before abortion occurs. If labor starts it should be completed artificially, as the pains are apt to be weak. Frequently a child born at or near term dies within a few days of birth.

**Typhoid.**—This disease is not believed to be more dangerous to the pregnant than to the non-pregnant woman, but the effects on the fetus are very serious. In about 65 per cent. of cases, according to Duguyot, it is expelled prematurely. This is due to the high temperature, the alteration of the blood, hemorrhages into the decidua or placenta, and in some cases the direct transmission of the disease to the fetus. The fetus may be born dead

or alive, and in it typhoid bacilli may be found, or its blood may give the Widal reaction. When it does not die it is likely to develop into a weakly infant.

In the **treatment** of this disease Vinay and others advocate strongly the cold-bath treatment. He reports the maternal mortality as being 6 per cent., whereas when the bath is not used it is 17 per cent. The bath treatment only slightly lessens the tendency to abortion. It should be employed after this complication as long as the temperature is high.

Abortion and labor do not aggravate the disease, according to Vinay and Brand. They point out, however, that typhoid starting in the puerperium has a very high mortality, 50 per cent. in a series of cases collected by Vinay.

Lynch has recently made a study of reported cases of typhoid in pregnancy and arrives at the following conclusions: That the typhoid bacillus may pass from the mother to the child *in utero*; that the resulting disease is a fetal septicemia; in cases of placental transmission there are generally placental lesions of a hemorrhagic type; that the child dies either *in utero* or soon after birth; and there is no evidence that the fetus may survive the infection *in utero*; placental transmission is not the rule in typhoid; the Widal reaction is not always given with fetal blood, even though placental transmission be proved, and when present it cannot be determined whether the agglutinating substances result from the presence of the typhoid bacilli or whether they have filtered through the placenta from the mother's blood; the agglutinating substances may be transmitted through the milk of a typhoid mother to her nursing. The reaction in the nursing's blood is but transient, and is always weaker than that of the mother's.

**Typhus.**—This disease is not aggravated by pregnancy. There is less tendency to abortion than in typhoid, probably because intra-uterine hemorrhages are less frequent.

**Scarlatina.**—Pregnancy is believed by some to prolong the incubation period of this disease, because a woman exposed to the risk of infection may pass through her pregnancy and not take the disease until the lying-in period. In such cases the explanation is rather that the disease develops because her power of resistance is diminished by the exhaustion of labor. When the disease develops in pregnancy premature emptying of the uterus is common. The fetus may contract the disease *in utero* and present well-marked signs at birth, though in some cases it escapes. Sometimes the mother may have a very slight attack and the fetus a severe one. The skin of the latter may desquamate *in utero* or after birth.

**Malaria.**—Pregnancy is said to modify the character and periodicity of the malarial attacks. Abortion may be caused chiefly

by hemorrhages *in utero*. Negri found this in 18 per cent. of his cases. Various authors state that the disease may affect the fetus, causing periodic disturbances, while it is in the uterus or soon after birth, though it is doubtful if the plasmodium has been found in the fetal blood. The development of the fetus is interfered with by the malarial poison. Quinin should always be administered to the pregnant woman affected with this disease.

Maggi has recently reported 20 cases in which this drug was freely administered without causing abortion, the condition of the patients being markedly improved and the infants being born healthy and robust; the drug was given in the form of intramuscular injections of the bichlorid.

**Measles.**—This disease causes abortion in a large percentage of cases. Rarely the fetus may be affected *in utero* and present signs at birth, or may develop them a few days afterward.

**Small-pox.**—Pregnancy is very frequently interrupted in the course of an attack of small-pox. According to Voigt, half the cases of pregnancy in women suffering from small-pox, who have been vaccinated in youth end prematurely. The mortality of such cases varies from 30 to 35 per cent.; it is higher among those who have never been vaccinated. Hemorrhagic and confluent small-pox are much more frequent in pregnant than in non-pregnant cases. Voigt states that about 60 per cent. of women delivered while suffering from small-pox die. In some cases the fetus may have the disease *in utero* and may perish as a result. It may go to term and show signs of small-pox or it may be born immune. In most cases, however, the fetus is not infected, though it usually dies at or soon after birth. There are marked variations in its susceptibility to attack. Sometimes in the case of twins one may suffer and the other escape. It is possible for the fetus to have the disease, the mother escaping. A pregnant woman should always be vaccinated in epidemics. The effect on the fetus varies. Behm has reported 33 cases in which vaccination was carried out during pregnancy, the children being also vaccinated after birth; in the latter there were 25 successful results. Wolff states that he has always been able to vaccinate the children of women vaccinated in pregnancy. Chambrelent had 7 cases, in which only 3 children were successfully vaccinated. Ballantyne believes that 1 fetus in 3 is protected by vaccination in the second half of gestation. Maude, from a study of cases in England, states that the child was rendered insusceptible if the mother's vaccination took place before the sixth month; that during the sixth and seventh months the protection afforded to the child is doubtful; and that after the seventh month no protection at all is produced. Fulton points out that the period of protection, however complete, is very short, all or nearly all the infants giving some reaction to vaccination after eighteen months or two years. Shuter reports a case in

which protection was afforded when the mother had been vaccinated immediately before conception.

In the interests of the child it is always advisable to vaccinate it after birth if the mother has had the disease during pregnancy or if there is an epidemic.

**Erysipelas.**—This disease, if severe, may cause premature emptying of the uterus. This is a serious complication, since the infection may attack the genital tract. The fetus may suffer from the disease *in utero*, streptococci being found in it, but this is a rare occurrence.

**Diphtheria.**—This disease may cause premature expulsion of the ovum, an occurrence attended with great risk on account of the liability of the genital tract to infection. The specific organism has sometimes been found in the tissues of the fetus.

**Rheumatic Fever.**—This is a very rare affection in pregnancy, the latter state increasing its seriousness. There is a greater risk of thrombosis and of the formation of vegetations on the heart valves. Abortion may be caused. Rarely the fetus is also affected with the disease.

**Septicemia.**—General septic infection of a pregnant woman, if not fatal to her, may cause death of the fetus and emptying of the uterus. There is no doubt that the micro-organisms may pass from the maternal tissues into the fetus.

**Tuberculosis.**—The relationship of pregnancy to pulmonary consumption has been noted. Direct transmission of tuberculosis from the mother to the fetus is a very rare occurrence. Experimentally the inoculation of pregnant animals has exceptionally led to the passage of tubercle bacilli into the fetal tissues. It is more likely to occur in the human subject if the mother is affected with extensive and rapidly advancing tuberculosis. The ovum is probably not affected before, but after, conception, when the chorion enters into relationship with the maternal blood, the tubercle bacilli passing through the placenta. There is no certain proof that the semen from a tuberculous father has ever caused fetal tuberculosis. The children of tuberculous parents frequently present malformations or structural peculiarities.

## CHAPTER VIII.

## SYPHILIS.

SYPHILIS is found in various relationships to pregnancy.

**I. Acute Primary Syphilis.**—(a) **At or Near the Time of the Fruitful Intercourse.**—The local manifestations vary in different cases; they are sometimes slight, but may be very marked. There may be much swelling, redness, and irritation; excoriation may be present, and sometimes there may be sloughing or abscess formation. Frequently no distinct hard area is noticeable, or may be present only for a short time. The mother's health often deteriorates considerably. The ovum becomes affected and abortion is frequent. Gestation may in some cases continue several months before terminating; occasionally full time is reached, the child being born in a weak condition with a syphilitic taint, which soon becomes manifest, generally causing death.

(b) **In the Early Months.**—When a pregnant woman contracts a primary sore in the early months abortion may occur; but more frequently premature labor takes place in the late months, or the child is born at full time with congenital syphilis.

(c) **Late in Pregnancy.**—When the woman gets the disease in advanced gestation labor usually occurs at full time. The child may or may not have contracted syphilis *in utero*, but it may become inoculated by contact with the infected area on the maternal parts during birth.

**II. Secondary or Tertiary Maternal Syphilis.**—When a woman presenting signs of past syphilis becomes pregnant the ovum becomes affected, except occasionally when she has very late tertiary signs. Abortion or premature labor may occur, or the child may be born at full time with a taint that may manifest itself within a few weeks of birth, or sometimes only after months or years. If pregnancy be interrupted and successive gestations follow the same result ensues unless treatment be carried out, though the interruption tends to occur at later periods.

**III. Secondary Syphilis in the Husband.**—When a woman is impregnated by a man who has secondary syphilis she may by accident be directly infected from him—*i. e.*, through a mucous patch. In most cases such an infection does not occur. The ovum becomes affected and pregnancy is interrupted in the early months or after midterm. Through the ovum the mother may become diseased, and in some cases she may exhibit one or more of the well-known signs—*i. e.*, sore throat, loss of hair, eruptions, etc. In some cases these may be so slight as to escape her observation, or they may be entirely absent. She may thus early acquire a state of constitution that protects her, so that she cannot after-

ward contract syphilis (Colles's law). The nature of this change is not well understood. It probably consists in a passage through the placenta of products from the fetus, capable of immunizing the maternal system without actually inducing syphilis. Indeed, these cases prove that the immunizing material may pass from the fetal to the maternal circulation, and that the actual syphilitic virus does not pass or is ineffectual. In some instances the woman is not immunized and is capable of being syphilized after her pregnancy. Why in other cases she should actually be infected with syphilis from the ovum is uncertain. It may be due to some alteration in the villi whereby the poison is able to pass through them. Veit has recently suggested that the maternal infection may arise from portions of the villi that may become detached and enter the maternal circulation. The immunized mother may nurse her child with impunity, whereas a healthy wet-nurse may be infected by nursing such a syphilitic infant.

As regards the ovum in successive pregnancies, its expulsion tends to occur at later and later periods, until finally a full-time delivery takes place, the child being born in a feeble and diseased state. Occasionally in these cases pregnancy may be interrupted at successively earlier periods and not at later ones. The reason of this peculiarity is not known. A woman who has been immunized through the influence of the ovum may bear healthy children to a healthy man. There is some doubt as to whether in some cases the ovum may not be affected.

**IV. Tertiary Syphilis in the Husband.**—In the majority of cases neither wife nor child is affected when two or more years have elapsed after the disappearance of the secondary phenomena. In some instances this is not the case, and the child may be born with inherited syphilis, occasionally prematurely. The factors that explain these variations are not well understood. It is to be noted in general that a child has a better chance of escaping if the father has tertiary syphilis than if the mother is thus affected.

**V. Syphilis in both Parents.**—When father and mother are syphilitic the risk to the fetus is greater, the mortality being very high. As regards the manifestations of syphilis in the fetus, there are probably no differences depending upon the stage of the disease in one or the other parent. With succeeding pregnancies there is a general tendency to the lessening of the effects of the syphilitic poison. In the case of a series of children, the older usually have a more marked inheritance than the younger, but sometimes the latter may be as seriously affected as the former. In some instances there is an irregular distribution of the inherited disease. One child may escape entirely or may be only slightly affected and the next one may be markedly tainted. Sometimes in the case of twins one may be diseased and the other remain free.

With regard to the question of marriage, it must be remembered that there is a risk that the syphilitic taint may exhibit itself years after the period of primary infection, and that the effect on offspring can never be predicted with absolute certainty. Though it may be urged that the syphilitic should not marry, the advice has little influence, and it is necessary to warn those who contemplate taking this step and who ask for a medical opinion, in order that the risks should be diminished as much as possible. A diseased person should not marry until three or four years have elapsed from the time of the primary infection, and until all secondary symptoms have been absent two years. The individual should have had a thorough course of mercurial treatment. If there are cerebral symptoms or serious organic changes marriage should not take place.

**Treatment.**—When advice is sought because of premature emptying of the uterus or the birth of diseased children, conception should not be allowed to take place, and the parents should be put on a course of mercurial treatment until all symptoms have disappeared, if any have been present, and pregnancy should not take place until two years have passed after the last one. When conception does again occur the woman should be carefully watched. It is advisable to administer potassium chlorate and iron if she tends to become anemic. A mercury salt may also be given in small doses, or, if this does not agree with the woman, iodid of potassium may be substituted.

With such care a healthy child may be obtained. Sometimes this happy result is not brought about, and it is then necessary to subject both parents to another thorough course of treatment. In cases where pregnancy is discovered in a woman with primary or secondary syphilis she should be placed on a vigorous course of treatment, mercury being freely used. Local sores should be made well as rapidly as possible in order to diminish the risk of infection of the child during delivery. When a living child is born it must only be nursed by the mother and not by a wet-nurse, because of the possibility of infection of the latter. If it develop any symptoms of syphilis it must be treated by the inunction of mercury.

## CHAPTER IX.

## AFFECTIONS OF THE URINARY SYSTEM.

**Incontinence and Frequency of Micturition.**—In the early months of pregnancy frequency of micturition is often present as a result of the pressure of the growing uterus on the bladder. This is most marked when there is some prolapse of the uterus or adjacent structures. In troublesome cases a suitable vaginal pessary may bring about improvement. It should always be remembered that frequency of micturition in early pregnancy may be associated with retroversion of the gravid uterus, the bladder being really overdistended while dribbling takes place from it. In the late weeks, especially in multiparæ, frequency of urination may be present as the result of increasing pressure of the uterus on the bladder. In women with very lax abdominal walls, whose recti are much separated, there may be continued dribbling of urine on the slightest exertion. This is aggravated by a weak condition of the pelvic floor. It may also be caused by an unusual relationship of the fetus to the uterus—*i. e.*, when it lies obliquely or transversely. Incontinence in pregnancy may also be due to other conditions that may cause it in non-pregnant women.

**Retention.**—This is much less frequent than incontinence in pregnancy. It may occur with retroversion of the uterus, as the result of pressure of the cervix against the pubes. It may also be due to the pressure of tumors. Sometimes it is a neurosis.

**Cystitis.**—This condition may be very troublesome. If it be acute there is great risk of an infection of the uterus and kidneys. In connection with retroversion of the gravid uterus, cystitis may be very severe; the inner part of the bladder-wall may become gangrenous and may slough away.

In the **treatment** of cystitis absolute rest is advisable, while the ordinary measures are adopted to check the disease.

**Diabetes Insipidus or Polyuria.**—Occasionally a woman is troubled by the passage of large quantities of urine of low specific gravity during weeks or months of her pregnancy. She complains of thirst and has a dry skin. The cause of this disturbance is not known. It usually passes off after delivery. Sometimes it causes premature delivery.

**Peptonuria.**—Peptones are sometimes found in the urine in pregnancy. It has been stated that they indicate death of the fetus, but they may be found while it is living.

**Hematuria** may be sometimes due to vesical hemorrhoids, but it is also produced by other conditions that may be found in

the non-pregnant state. It has been reported in a few cases as being due to renal disturbance, passing off after delivery, and sometimes recurring in a subsequent pregnancy.

**Glycosuria.**—Reference has already been made to the occurrence of sugar in the urine in pregnancy. Statistics vary greatly as regards the frequency—2 to 30 per cent. In the great majority of cases the glycosuria is due to milk sugar absorbed from the breasts. This lactosuria is mainly found toward the end of gestation. It is more frequent after delivery.

**Diabetes Mellitus.**—This disease, in which glucose exists in the urine, may be present before pregnancy. It is not to be regarded as favoring sterility. It is no more frequent in pregnant than in non-pregnant women. In 53 cases of diabetes in females, Griesinger found that only 2 were pregnant; Frerichs found 1 in 104 cases. The disease may disappear after labor and develop in a succeeding pregnancy, but sometimes it does not cease. It may be aggravated by pregnancy and the mother may die, the danger being greatest in the late months. Fatal cases are more frequent in the puerperium. The fetus is apt to perish and to be expelled prematurely. Sometimes it is also affected with the disease. Sugar and sometimes acetone may be found in the liquor amnii. Hydramnios is sometimes found.

The **treatment** is the same as in the non-pregnant state. If the condition cannot be improved and tends to become worse it is best to empty the uterus.

**Changes in the Kidneys during Pregnancy.**—For many years there has been much discussion as to the alterations occurring in the kidneys during pregnancy, and at the present time there is considerable difference of opinion as to the nature of these changes, their frequency, causation, and significance. The literature of the subject is abundant in speculative inquiries, while records of trustworthy facts derived from careful and systematic observation are scanty. Indeed, though theories have multiplied, it is doubtful whether we are much wiser than we were fifty years ago, for the latest and most favored views, originating among French workers, are only an elaborated expression of the opinion published by Virchow in 1848.

This authority then pointed out that of all the organs in the female organism the most frequent functional or structural alterations due to pregnancy were found in the kidneys. He regarded the cause mainly as connected with altered metabolism, changes being induced not only in the kidneys, but in the liver, spleen, and other parts. In association with these alterations he pointed out the frequency of albuminuria.

That the kidney becomes somewhat hypertrophied as a result of pregnancy most are agreed, though the nature of the enlargement and range of variations are not at all definitely known.

The quantity of urine is increased and is of a lower specific gravity.

With regard to the occurrence of albumin in the urine and its significance there is an amazing difference of opinion. Its frequency has been variously estimated by different workers. The following statistics are given by different German authorities: Meyer, in 76 parturient women, found albumin in 40.78 per cent.; Litzmann, in 100 parturient women, found it in 43.7 per cent.; Löhlein, also in 100 parturient women, found it in 37 per cent.; Flaischen, in 537 parturient women, found it in 16.9 per cent.; and Winckel, in 367 parturient women, found it in 19.4 per cent. Trantenroth states that in 50 per cent. of pregnant women slight albuminuria is present during the second half of gestation, and that in labor it is the rule.

These percentages are noticeably higher than those given by leading French obstetricians. Thus, Pinard states that out of 1249 parturient women in the Baudelocque Clinic in 1890 only 73 cases of albuminuria (6 per cent.) occurred; of these slightly less than 3 per cent. were associated with pregnancy, the rest with labor. Charles has found albuminuria in 2.5 per cent. of pregnant women.

So far as may be gathered from more recent observations, it may be stated that serum albuminuria occurs in about 2 per cent. of all pregnant women who are healthy at the beginning of pregnancy. The process of labor causes albuminuria in a still larger percentage of cases. Aufrecht found it was produced in 18 out of 32 women examined; Ingerslev, in 50 out of 153 cases of labor. It is most frequent in women during the first pregnancy, especially in those who are no longer young or in those who are very young. Of all cases it is believed to be most associated with the presence of more than one fetus *in utero*. It occurs mainly in advanced pregnancy, only rarely in the early months. According to Blaudeau, albuminuria is most frequent in first, second, and third gestations, becoming much rarer in succeeding ones. He studied a number of multiparæ in whom albuminuria had occurred in previous pregnancies. In 8 out of 23 cases it recurred, though in a less marked degree; in 2 only was it worse.

What is the significance and explanation of this albuminuria in pregnancy? Is it, as some hold, a physiologic process of no importance, or is it to be regarded, as many authorities consider it, as the result of pathologic changes induced in the cortical portions of the kidneys? In favor of the former view may be adduced the cases of healthy men and non-pregnant women in whom a temporary albuminuria may be caused by various factors—*i. e.*, changes in temperature, food, exercise, etc. The investigations of the late Grainger Stewart and others undoubtedly appear to justify the view that there may be an albuminuria that is to be regarded

as a physiologic peculiarity and not the indication of a pathologic process. *A priori*, then, it must be conceded that a like explanation may suffice for some cases of the albuminuria in pregnancy.

Regarding the view that a morbid process in the cortices of the kidneys is the essential cause, the following facts may be stated: In very many cases of albuminuria other signs of renal disease may be present. Thus, edema may be frequently met. Winckel's statistics may be noted: In 1874, in 319 pregnant women, he noted edema in 20 per cent.; in 1876, in 1058 pregnant and parturient women, in 4.35 per cent.; in 1877, in 1091 pregnant and parturient women, in 6.96 per cent., and in 1878, in 1050 pregnant and parturient women, in 5.52 per cent. Leyden is of the opinion that anasarca is much more common than albuminuria, and that when they coexist the edema has appeared first. Then again there is often a deficiency in the quantity of urine passed and in the total solids excreted. But most important of all is the occurrence in the urine of various formed elements—viz., casts and blood-corpuses. Fischer, who has given much attention to this subject, points out that these are mostly found in the last weeks of pregnancy, when they often show progressive increase. Hyaline casts are frequent, while granular and epithelial ones and broken-down epithelium may also occur. Red blood-corpuses and leukocytes may be passed continuously or at intervals. Now, as to the relationship between the above findings of physical examination on the living subject and those obtained by postmortem investigation, it is impossible to speak with absolute certainty. The great majority of such patients do not die, and comparatively only a small number of postmortem studies have been made. There can, however, be no doubt that sufficient work has been done to establish the probability that renal cortical lesions generally occur, though with a considerable range of variation.

The most frequent changes found are as follows: The kidneys are enlarged and less firm than normal; the cortices are swollen, anemic, and of a pale-gray color; cloudy swelling and granular changes are found in the cells of the tubules, and often fatty degeneration. In a small number of cases it is certain that the kidneys may not recover from this condition after labor, but may pass into a permanent true parenchymatous nephritis. In the majority of instances, however, there is every reason to believe that they may be restored to their normal condition in a short time. Olshausen has described an interesting case in which the urine contained abundant albumin, casts, and blood-corpuses at the time of labor, eclamptic phenomena being also present. The patient died five days after delivery, and at the postmortem examination no changes whatever were found in the kidneys.

Of extreme interest is the consideration of the etiology of the albuminuria and renal changes above described. The subject is

an extremely difficult one, and has been the occasion of much speculation and much polemic writing. Only a brief reference to the most important views is here possible.

*Compression of the Ureters.*—Halbertsma, of Utrecht, from his studies of eclampsia, believes that increased intra-abdominal pressure due to the pregnant uterus may, by interference with the functions of the ureters, lead to alterations in the renal structure. He thinks that the special tendency to these alterations in primiparæ—hydramnios, multiple gestation, contracted pelvis—in all of which the pressure is increased, strengthens his view. Ries, holding somewhat similar views, believes that in some cases compression of the ureters by the presenting part of the fetus is the most important factor. These views have not been accepted by most authorities. Halbertsma's statement that dilatation of the ureters is frequent in such cases has not been corroborated. Ols-hausen found dilatation only 7 times in 37 postmortems. In Herzfeld's 81 autopsies of eclamptics bilateral dilatation of the ureters was found in 18, all of whom were primiparæ. (See chapter on "Eclampsia.")

For my own part I believe that too little attention has been given to the opinions of Halbertsma and Ries. While it is true that the anatomic relationships of the ureters are such that they are generally protected from the pressure of the pregnant uterus or its contents at any special point, the possibility of an abnormal pressure over a considerable extent of the ureters in certain cases cannot be denied. Though the projecting vertebral bodies are the main safeguard from pressure on the ureters, they cannot entirely protect it. My frozen sections and casts of pregnant women show that the enlarged uterus moulds itself accurately along the spine and on each side of it. At the brim this moulding is particularly well shown. In conditions of tense abdominal wall, such as is found in young or old primiparæ, or of abnormally large uterus, as in hydramnios or multiple pregnancy, it is very evident that the general pressure on the uterus must be increased. In the late weeks of pregnancy, as is well known, the fetal head lies in the pelvic cavity in primiparæ, and if the pelvis be justo-minor or funnel-shaped in type, or the head be abnormally ossified or enlarged, the ureters can scarcely escape being unduly compressed against the pelvic wall. Even though in these various conditions there may not be a local interference with the flow through the ureters, there may be produced a paresis of their walls, as Halbertsma first suggested, leading to a marked weakening of their peristaltic action.

The earlier critics of this worker pointed out that the pressure theory could not explain the cases in which renal disturbances developed in the puerperium. My recent studies of the puerperal woman by means of frozen sections supply a very evident expla-

nation. I have shown that the postpartum uterus, in its retracted and contracted condition, fills the greater part of the normal pelvic cavity to such an extent as to form a ball plug, compressing all extra-uterine tissues firmly against the pelvic wall, interfering considerably with the circulation of blood through them. The ureters share in this compression. This condition of affairs lasts for three or four days, during which period renal disturbances most frequently occur. The postpartum uterus varies somewhat in size, and, therefore, if it be rather larger than normal, or if the pelvis be justo-minor or funnel-shaped in type, greater compression is produced. Ries, Halbertsma, and others have shown that pelvic inflammatory exudates may cause compression of the ureters, and consequent renal disturbance in the puerperium. It is interesting to note in this connection that large fibroid and ovarian tumors, especially the former, are not infrequently associated with changes in the urine, kidneys, and ureters similar to those found in pregnancy; and in some cases the renal function may be very markedly altered.

Finally it is interesting to note certain experiments on animals. Aufrecht ligated a ureter in a dog and killed the animal three days later. The corresponding kidney was much swollen, its pelvis, along with the upper part of the ureter, distended. The cortical tubules of the kidney were damaged, being somewhat dilated and containing abundant hyaline or fibrinous casts, their epithelium showing granular and fatty changes.

Apart from compression of the uterus, it may be that the kidneys themselves are so affected by certain degrees of increased intra-abdominal pressure as to undergo degeneration; or it may be that in the same manner the renal circulation is interfered with. Compression of the renal arteries or interference with the flow of blood in the veins is sufficient to induce albuminuria and degeneration in the kidneys if continued long enough.

*Influence of the Products of Metabolism.*—Virchow, in 1848, stated that disturbances in the kidneys during pregnancy were mainly due to the influence of altered body metabolism, and he pointed out the frequency with which the renal changes are accompanied by corresponding conditions in the liver. During the past fifty years different theories have been advanced to explain the nature of the alterations induced by the metabolic processes in pregnancy. At the present time the majority of authors holds to this theory in a general way, though there is very great divergence of opinion as to its actual application.

In pregnancy the increase in maternal metabolic activity is evident. This means a greater quantity of excrementitious matter to be eliminated. As the ovum develops fetal metabolism becomes a more and more important factor. Fetal waste products almost entirely enter the maternal blood by transmission through

the walls of the villi from the fetal circulation. An extra burden is, therefore, thrown upon the maternal kidneys, and if they cannot respond to the increased demand on their activity they are apt to suffer. The waste products may exert a direct poisonous action on the cells of the tubules, or indirectly through their influence on the arteries in the kidneys, constricting them and thereby interfering with the nutrition of the tubules. The changes are believed to be similar to those found in such conditions as ptomain-poisoning and acute yellow atrophy, where the destruction of the kidney tissue may be very rapid.

The influence of the skin, lungs, liver, and intestines aids in getting rid of the waste products of metabolism, and it is evident that interference with their functions will throw greater burdens on the kidneys. It is in pregnancy especially that these functions are apt to be interfered with; in most civilized countries a large percentage of pregnant women are prejudiced against free cleansing of the skin of the body. The production of albuminuria in a healthy dog by varnishing its skin is a well-known experiment. Then the tendency to irregularity in the digestive tract and to constipation in pregnant women is a very common one. Clinically it is very easy in the albuminuria of pregnancy to prove that promotion of free action of the skin or bowels, or of both combined, may rapidly lead to a diminution in the quantity of albumin in the urine.

With regard to the influence of the fetal waste products, it has been noted in cases of albuminuria that death of the fetus may lead to a rapid diminution or disappearance of the albuminuria, and this is believed to be due to the cessation in the transmission of the waste products from the fetus to the maternal blood. There is much speculation as to the nature of the waste products that exert the destructive influence. Various subjects are mentioned—*i. e.*, leukomains and ptomains formed in the bowel and reabsorbed when the bowel action is faulty; also kreatin, inorganic salts of potash, various alkaloidal products of digestion, etc. The extent to which the kidneys may be affected depends, therefore, on a variety of factors. In the majority of cases in which they are affected no permanent damage results, nor do serious complications arise. In a certain number of cases serious renal disease may be induced, and in a considerable number of cases, where the disproportion between circulating poisonous waste products and rectal excretory action becomes too great, the serious phenomena known as eclampsia supervene, the woman's life being greatly endangered.

As might be expected, a number of workers have advanced the view that the main factor in producing the toxemia of pregnancy is microbial infection. Some have found germs in the blood, some in the kidneys, others in the placenta; in some cases

cultures injected into animals have produced general toxemia and changes in the kidneys resembling those found in the altered kidney of pregnancy. Other workers have obtained negative results.

While it is impossible at the present time to postulate any well-ascertained results regarding the relationship of micro-organisms to the toxemia of pregnancy, in view of such experiments as those of Doléris and Poney, Blanc, Favre, Gerdes, and others, and in the light of Adami's work on subinfection, it cannot be denied that in some cases of pregnancy toxemia the important agent may be some form of microbe, and that in their effort to destroy and remove the organisms the kidneys may be so affected as to undergo the pathologic changes to which I have already referred, with consequent accompanying alterations in the urinary secretion.

Veit has recently suggested as a cause of albuminuria in pregnancy the deportation from the placenta of peripheral portions of the chorion, leading to the formation of a toxic "lysin."

Finally, after reviewing the most important theories advanced by those who have worked in this difficult sphere, it must be admitted that much is to be said in favor of each. Indeed, it is highly probable that something of the truth is contained in all of them, that in most cases no single factor is causal, but rather a combination of various factors, these varying greatly in different instances. The most important of these is undoubtedly the toxic element. Only from such a standpoint is it possible to group into an intelligible synthesis the heterogeneous clinical phenomena and physical changes found in the abnormal condition of pregnancy under consideration.

Recently an attempt has been made to explain albuminuria and eclampsia by faulty action of the thyroid gland. (See chapter on "Eclampsia.") Lange has stated that albuminuria is common when the normal thyroid hypertrophy is wanting.

Albuminuria due to catarrhal condition of the bladder, ureters, or pelvis of the kidney is occasionally found in pregnancy.

**Nephritis.**—Where true nephritis exists before or begins during pregnancy the disease, as a rule, is more serious than in the non-pregnant state and the prognosis is unfavorable. In the case of chronic nephritis an acute exacerbation is usually induced. The patient may die from kidney failure, and uremia is very apt to occur. Only in a small percentage of cases are the phenomena of eclampsia noted, as has been pointed out by Fehling and Leyfert.

As regards the influence on the course of pregnancy, the tendency to premature emptying of the uterus is to be particularly noted. According to P. Müller it occurs in more than 40 per cent. of cases; it is attributed mainly to the occurrence of hemor-

rhages into the placenta or to infarct formation, causing destruction of portions of the chorionic villi, and to the accumulation of toxic material in the system. The fetal mortality is very high. Hofmeier noted that the fetus died in 20 out of 23 cases of nephritis. Braun has estimated the mortality at 80 per cent. In 110 cases of albuminuria without eclampsia reported by Charles, 8 mothers and 20 children died; there were 61 premature labors and 8 post-partum hemorrhages.

**Treatment.**—The treatment of a pregnant woman with symptoms pointing to disturbed renal functions is to be carried out on the lines followed in the non-pregnant state. The strictest watchfulness on the part of the physician is necessary. With regard to the question of allowing the pregnancy to continue it is difficult to decide. There are, however, certain indications that point imperatively to the induction of premature delivery, in the interests of the mother—viz., visual disturbances, continued headache, pulmonary or other marked edema, marked cardiac disturbance, frequent nose-bleedings, continued increase in casts and albumin in the urine, and uremia. In a number of cases the woman may respond to treatment so satisfactorily as to go to full term and be delivered of a healthy child.

**Pyelonephritis.**—This condition is occasionally found and may easily be mistaken for cystitis. The disease usually develops in the second half of pregnancy, the infecting organism being most frequently the colon bacillus, though the route by which it gains entrance is not always certain. Infection is favored by increased pressure on the ureters, cystitis, constipation, cold, fatigue, and overwork. The onset of the disease is usually very sudden, being marked by pains in the side. In almost all cases the right kidney is affected. Sometimes the corresponding ureter may be infected; the bladder may also be involved. After labor the disease tends to disappear steadily. If the kidney becomes distended with pus, it is best to empty the uterus and to treat the diseased organ surgically somewhat later. Surgical interference with the kidney during pregnancy is not advisable. The prognosis is fairly favorable both for the mother and child. Premature emptying of the uterus rarely occurs.

In pregnancy the patient must be carefully watched. She should live on a milk diet and should take urotropin.

**Pregnancy after Nephrectomy.**—It is interesting to note that in women who have become pregnant after the loss of a kidney by operation no special tendency to eclampsia has been noted. Cases have been observed by Schramm, Twynam, Fritsch, Israel, myself, and others. In a number of these pregnancy and labor have proceeded normally, no changes even having been noted in the urine; nor has the fetus been abnormal.

## CHAPTER X.

## AFFECTIONS OF THE SKIN.

**Herpes.**—From the supposed frequency of this condition in pregnancy it has been termed *herpes gestationis*. It is an eruptive condition consisting of erythema, vesicles, and bullæ. It may appear early in pregnancy and may continue throughout its duration. Frequently it is associated with neurotic manifestations.

**Impetigo herpetiformis** is a pustular development, occurring especially in the parts subjected to moisture—*i. e.*, armpits, groin, navel, and under surface of the breasts. It is accompanied with systemic disturbances—*i. e.*, fever, rigors, weakness, vomiting, and sometimes delirium; it may end fatally. Acne, eczema, and urticaria sometimes develop during gestation. Occasionally these conditions improve when a woman becomes pregnant.

**Loosening of the finger nails** sometimes occurs, and is associated with considerable pain. It may recur in succeeding pregnancies.

**Pruritus.**—This condition may be found in any period of gestation, but is probably most common in the early months. It is most frequently localized in the vulvar region, but it may be more or less widespread. Itching may be due to any of the conditions that produce it in the non-pregnant state, but in pregnancy there may often be no evident cause, and it is generally regarded as a neurosis.

**Pigmentation.**—The ordinary color changes have already been noted. Sometimes there is excessive pigmentation deposited in patches. These tend to disappear after pregnancy, but generally some traces remain.

## CHAPTER XI.

## AFFECTIONS OF THE REPRODUCTIVE SYSTEM.

**Pruritus Vulvæ.**—Itching may be troublesome in the region of the labia, perineum, anus, or groin. Sometimes the affected area may extend widely from these parts. The disturbance may be caused by excessive leukorrhœa, marked congestion, and irritation of the parts by exercise; sometimes diabetes is a cause. Local skin disease may be present. Hemorrhoids or worms in the rectum may lead to itching. In some cases no local cause can be found and the condition is then regarded as a neurosis. The

woman is sometimes so distressed that she becomes sleepless, worn, and excitable, and may completely lose control of herself. She may scratch herself so severely as to cause bleeding; or she may infect the skin, setting up inflammatory changes.

**Treatment** is often very unsatisfactory. Any local cause should be corrected so far as possible. External inflamed conditions are best relieved by a series of boric starch poultices. When the vagina or cervix is affected, warm astringent antiseptic douches may be tried—*i. e.*, formalin (Mxvj-Oj). Sometimes the itching is relieved by hot or cold fomentations. Ointments of menthol, cocain, bismuth, or carbolic acid are also used. Silver nitrate solution (2 per cent.), vinegar, and tobacco infusion have also been recommended. When the affected area is small and the itching intense, no relief being obtained by the ordinary remedies, the question of excising the itching portion of skin may be considered. When the health of the patient suffers markedly it may be necessary to empty the uterus.

**Varices** may cause considerable swelling of the vaginal wall or vulva. Rupture may be caused by a strain or contact with a hard body and dangerous or fatal bleeding result.

**Hæmatoma vulvæ** is generally caused by a kick or fall, leading to the subcutaneous rupture of a vessel, which may or may not be varicose. When the swelling is large the skin becomes much thinned over it and infection may occur, leading to suppuration. Small blood-extravasations may be absorbed if the patient be kept at rest and cold be applied to the affected area. Large ones should be incised, the clot removed, and the cavity stuffed with antiseptic gauze, being allowed to shrink gradually.

**Vulvar Cyst.**—A small Bartholinian cyst need not be interfered with until after labor. A large or growing one that may be so large as to interfere with the birth of the child should be removed if there is sufficient time to get healthy closure of the wound before labor. Otherwise the cyst may be evacuated by puncture at the time of delivery, the wound being kept clean; at a later period the cyst may be removed.

**Inflammations of the External Genitals.**—All infective conditions, whether venereal or not, require to be treated with great thoroughness during pregnancy, in order that the parts may be in a healthy state at the time of labor. Venereal vegetations may require to be cut away.

**Vulvar Abscess.**—This is a serious complication if it occur near the end of pregnancy, since it may lead to infection in labor. It should be opened and thoroughly cauterized and packed with moist antiseptic gauze until all the infective organisms are destroyed and healthy healing is in progress.

**Vulvar Tumors.**—If large enough to interfere with labor, these may be removed in pregnancy or at the time of labor.

**Edema.**—Edema of the vulva may be found on one or both sides. It may be due to heart or kidney disease, but is also found when these are not present—*i. e.*, when the circulation is interfered with by excessive intra-abdominal pressure. Thus, it may occur with hydramnios, twin pregnancy, pendulous belly, pregnancy complicated with a tumor, etc. It may also be associated with local inflammatory conditions. If there be marked edema at the time of labor the swelling may cause serious delay; it may be increased by the labor, and as a result of the pressure may be so damaged that infection may cause inflammation of the tissues,



FIG. 135.—Prolapsed lower portion of anterior vaginal wall, deeply congested and resembling a polypus. The patient was a multipara near the end of pregnancy.

abscess formation, or even gangrene. In treating the condition it is important to attend to the chief cause. In all cases the activity of the skin and kidneys should be promoted. Rest in bed is of great importance, elevation of the lower end of the bed being advisable unless distressing to the patient. Hot fomentations may be applied to the vulva. When all measures fail the swelling should be punctured under strict aseptic precautions in order to remove an obstacle to delivery.

**Hypertrophy of the Vaginal Wall.**—Occasionally local swellings form during pregnancy in the region of the introitus

vagina. They may develop in the remains of the hymen or in the vaginal wall, especially anteriorly. The tissues are markedly discolored from intense congestion. In some instances the swellings resemble polypi. They disappear after labor. Leukorrhœa may be due to vulvar, vaginal, or cervical inflammation. In the early months it may also be due to changes in the endometrium, above the os internum. It may be very annoying to the woman. Formalin douches (Mxxv-Oj) are of value in diminishing the leukorrhœa when it is cervical or vaginal in origin. Sometimes in addition it is advisable to apply iodized phenol or a



FIG. 136.—Elephantiasis of the labia (one-fourth life size).

30 per cent. solution of carbolic acid in glycerin to the affected area.

**Hydrorrhœa Gravidarum.**—This term is applied to a profuse thin discharge that may escape from the genital canal of a pregnant woman, continuously or intermittently. It varies in appearance, and may be pale, yellow, greenish, or sanious. In early pregnancy it is most frequently due to endometritis, the fluid passing into the space between the decidua vera and reflexa and thence escaping into the vagina through the cervical canal. A catarrhal condition of the cervix may also cause a considerable discharge. In hydatidiform degeneration of the chorion there may be a marked outflow of clear fluid, sometimes blood-stained. It is also probably sometimes due to the escape of liquor amnii through a small opening in the membranes. Malignant disease of the cervix may also lead to a free discharge. Grimodie believes that the condition may be produced in cases of valvular heart

disease in the mother. In some cases of hemorrhage under the placenta in pregnancy a clot may form, and from it serum, clear or slightly blood-stained, may escape downward under the membranes and pass into the vagina. The author had under observation a patient in whom such a discharge continued nearly two weeks before labor began. In all cases the woman should be kept at rest and the most thorough physical examination made.

**Hemorrhage from the Genital Tract.**—Bleeding during pregnancy may be due to various causes—*i. e.*, rupture of the decidua reflexa when the placenta is attached to it, separation of the placenta when it is entirely serotinal, threatened abortion due to various causes, simple and malignant growths of the uterus, menstruation occurring in the early months, and inflammation in the decidua. It may also take place from the uterus when the gestation is ectopic. It may also be due to new growths of the vagina and vulva or to injuries of these parts.

**Inflammation in the Uterus.**—Acute metritis is very rare in pregnancy. It may occur in some of the infectious diseases—*i. e.*, cholera. It may follow septic infection—*i. e.*, in attempted abortion; sometimes this takes place when the retroflexed gravid uterus becomes impacted in the pelvis. The wall becomes soft and may rupture. Chronic metritis is common, having existed before pregnancy. It frequently renders the diagnosis of gestation difficult in the early months, because the uterine wall is larger and harder than normal. In such cases the pregnancy may easily be overlooked. Careful and repeated examinations during the course of several weeks may be necessary to establish the diagnosis. Chronic endocervicitis may cause a profuse discharge that may be very troublesome. Catarrhal patches on the vaginal portion of the cervix may be treated by the application of iodized phenol or nitrate of silver and warm astringent antiseptic douches. All such measures must be carefully carried out on account of the risk of starting an abortion. This risk should always be explained to the patient.

**Chronic Endometritis.**—This condition is usually a continuation of an inflammation existing before pregnancy. It may affect all parts of the decidua in varying combinations. It occurs in the following forms:

1. A general diffuse thickening, the changes affecting both glands and interglandular tissue, changes in one or other of these tissues being usually predominant.

2. Localized changes. The inflammatory changes may be limited to certain areas or may be much more intense in some parts than in others. The decidua may be thickened so as to form elevations that may sometimes assume a polypoidal shape; these consist largely of interglandular tissue, the cells being of the decidual type.

Hemorrhages may occur in connection with chronic inflammatory changes in the decidua, and may affect both the decidua and the fetal tissues. Thrombosis, and thickening of the walls of vessels, may be found more marked and earlier in pregnancy than in normal cases. Retention cysts may develop from obliterated glands. The chorionic structures attached to the decidua may also become affected and both tissues may become very firmly united. In the early months of pregnancy the woman usually complains of a thin mucous, mucopurulent, or blood-stained discharge, which varies in quantity in different cases. It is frequently aggravated at the times corresponding to the menstrual periods. There is a tendency to abortion. Very little can be done in treating these conditions during pregnancy. Afterward careful measures should be employed before another gestation takes place.

**Fibromyoma Uteri.**—Uterine fibroids are frequently associated with sterility. Charpentier's statistics show that in 1554 cases there was sterility in 476. Hofmeier states that the percentage is not greater than in women with a normal uterus. The exact relationship between this disease and conception is unknown, since pregnancy or sterility may be found with all varieties of fibroids.

In some instances pregnancy and labor may run a normal course. This is especially the case when the fibroids are small or few, when they are subperitoneal and placed high on the uterine body, and when they do not grow rapidly. But in many cases complications more or less serious are produced.

Pressure symptoms may be present in the early months when the tumor or tumors lie within the true pelvis, especially if they are intraligamentous. Sometimes at this period a pedunculated subperitoneal growth may lie deeply in the pelvis, and in such cases the mass may become impacted. Occasionally prolapsus or retroversion of the uterus may be caused in the early months. In advanced gestation pressure symptoms may be caused by multiple or large tumors. Intra-uterine hemorrhages may be caused, especially when submucous tumors are present. Placenta prævia is found in a larger percentage of cases than where the uterus is normal. Rarely, spontaneous thinning and rupture of the uterus may take place. Fibroids are frequently a cause of premature emptying of the uterus, though Hofmeier believes that this is not so common as is generally believed. He states that in 796 cases this complication took place only in 6.9 per cent. Nauss, however, describes it as occurring 47 times in 241 cases.

In a number of instances in advanced pregnancy death of the fetus has not been followed by its immediate expulsion, even though the liquor amnii has escaped; decomposition of the uterine contents is likely to follow retention. Pujol finds that in

100 cases, 53.82 per cent. presented by the head, 27.18 per cent. by the breech, and 19 per cent. were transverse. Malpresentations and malpositions are frequent. Labor pains may be weak, irregular, and ineffectual. Of great importance are the effects produced by large fibroids (which may also be present when they are not complicated by pregnancy)—viz., degeneration of the cardiac muscle and of the renal and hepatic epithelium. The heart may also be dilated more than in normal pregnancy.

The **symptoms** vary considerably. In some cases the tumors cause no disturbance. When pressure is present there may be pains in the abdomen or pelvis, varicose veins, edema, weakness or pain in one or both lower extremities, edema or varicose veins in the vulva, and hemorrhoids. There may be various disturbances of the bowel and bladder. There may be diminution of the quantity of urine and of its solids; albuminuria and casts may be present. There may be symptoms resulting from cardiac weakness. Frequently the patient's discomfort is aggravated on exertion. The rhythmic uterine contractions, which normally are painless, are sometimes excessive and painful. Blood may escape from the uterus at times even though abortion be not induced.

The effect of pregnancy on fibroids varies. They tend to grow, the rate varying greatly; those that are interstitial increasing most rapidly. The consistence may change considerably; sometimes a tumor may become much softer. Occasionally there may be a complete breaking down of the central portion. Tarnier and Budin state that fibroids may become alternately harder and softer, like the uterine wall in pregnancy; it is uncertain whether this is due to activity of the muscle fibers in the tumor or to that of the surrounding uterine muscle, the tumor remaining inert. It is doubtful if this muscular activity is found in any but soft myomata, and in more than a very slight extent.

The **diagnosis** of fibroids and pregnancy is beset with difficulties. In some cases the fibroids may be regarded as parts of the fetus, or they may be missed when situated on the posterior part of the uterus. Frequently the pregnancy may be entirely overlooked, or diagnosed as a cystic swelling in connection with the tumors. Sometimes pregnancy with fibroids is regarded as multiple pregnancy. In the early months a single fibroid with pregnancy may resemble an enlarged metritic uterus. Very frequently a fibroid may simulate the uterine body in shape, the pregnancy being considered as ectopic; or sometimes the latter may be diagnosed as an ovarian cyst. Occasionally there may be a simulation of a bicornute uterus with pregnancy in one horn. Sometimes a fibroid may be mistaken for a tubal or ovarian swelling. Examination must be carried out repeatedly and with great care, anesthesia often being necessary. In some cases an absolute diagnosis cannot be established.

**Treatment.**—When there are one or more small tumors, causing no symptoms, the case may be allowed to proceed to full time, frequent examinations being made to determine the relationships of the fibroids and their rate of growth. If in the early months a subperitoneal tumor lying in the pelvis is in danger of becoming impacted, an effort should be made to raise it above the brim by placing the patient in the genupectoral position, the lower bowel and bladder having been emptied, and digital pressure being made through the vagina and rectum. If this is unsuccessful after two or three attempts have been made, either abortion must be induced or an abdominal section must be performed in order that the tumor may be removed. After the latter operation there is a considerable chance that the pregnancy may continue. When a large interstitial tumor is situated in the fundus of the uterus it is possible that the pregnancy may continue without danger. Such growths may sometimes be safely removed by myomectomy without interruption of the pregnancy. This operation may, however, lead to abortion. Staveland, in 1894, published an account of 33 cases of myomectomy during pregnancy. The maternal mortality was 24.25 per cent.; in the cases operated upon between 1885 and 1889 it was 16.66 per cent.; in those operated upon between 1889 and 1894 it was 11.75 per cent. In 30.30 per cent. abortion occurred. Twenty of the cases went to full term. Duncan Emmet has reported 44 cases as occurring between 1890 and 1900, with a maternal mortality of 9 per cent. The operation of myomectomy must have a very limited sphere in pregnancy. It is unnecessary to remove very small tumors. Those which are large and interstitial should not be removed in this way because of the risk of rupturing the stitched area in case abortion should occur, or even if a full-time labor should take place. Practically it need be carried out only in the case of subperitoneal fibroids that are situated low enough to be a source of danger at full time, or which have such long pedicles that they are apt to fall into the pelvis.

If an interstitial fibroid be situated near the cervix there is risk of impaction in the early months and of obstruction in the case of labor in the late months. Abortion should, therefore, be induced early if it can be carried out safely and without much difficulty. Otherwise it may be advisable to perform hysterectomy by the vaginal or abdominal route. Removal by myomectomy should not be attempted in such cases, at least until the uterus has been emptied. Where there are several tumors large in size, rapid in growth, or causing pressure symptoms, abdominal hysterectomy should be performed. In a number of cases in advanced pregnancy a viable fetus may be removed from the uterus before the latter is excised. Sometimes the parents desire to prolong gestation as far as possible in order to ensure viability. They should

always be warned that delay may increase the risk to the mother if the tumors cause much pressure or if the heart and kidneys are not acting satisfactorily.

In opening the uterus for the removal of the fetus it may be necessary to make an irregular incision, and bleeding may be profuse because the tumors prevent the uterine wall from retracting and contracting firmly.

Cervical fibroids are very rare. They may be usually removed *per vaginam* and pregnancy may not be interrupted. Even a submucous fibroid polypus projecting into the cervix may sometimes be removed without rupture of the amniotic membrane.

(The conduct of labor in cases of fibroids will be considered later.) (See "Pathology of Labor.")

**Carcinoma Uteri.**—In the great majority of cases cancer occurs in the cervix, and this form need only be considered in relation to difficulty in labor. The disease is a rare complication of pregnancy. Cohnstein, in 1873, was able to find records in literature of only 127 cases; Theilhaber, in 1893, found 165 references from the preceding twenty years. Early cancer does not interfere with conception, whereas advanced cancer certainly does. The disease may begin in pregnancy. Its progress is hastened as a result of gestation; the tumor is softer and breaks down more easily and spreads more rapidly to other tissues. Hemorrhage and foul discharge are usually well marked. The woman's life expectancy is much shortened by gestation. The effect of the cancer in the course of pregnancy varies. Frequently abortion is caused, especially when the disease extends above the cervix. According to Bar, full term is not reached in two-thirds of the cases. Frequently the fetus dies. Herman gives a percentage of 42.8 in premature cases and 21.7 in full-time cases. Occasionally the pregnancy may proceed beyond term even though the pains of labor may have taken place at the normal period, the fetus usually dying. A number of cases die undelivered and a large percentage immediately after delivery. Cohnstein found that out of 126 cases, 31 died during or immediately after labor and 42 during the puerperium. Of 116 infants, only 42 were born alive. (The relationship of carcinoma to full-time labor will be considered in a later chapter.) (See "Pathology of Labor.") It should here be noted that when abortion or premature delivery occurs the undilatability of the cervix may prove an important obstacle to the escape of the uterine contents. In some cases this is not found, the friable tumor tearing readily. Rupture of the uterus above the cervix may sometimes take place if the disease has extended upward. Septic infection is very apt to occur because of the dirty condition of the cervix; this is a frequent cause of death. Hemorrhage and extravasation bring about a fatal issue in other cases.

The **diagnosis** of carcinoma is uncertain in the early stages of

the disease; later it is easy. The symptoms and signs are the same as are found in the non-pregnant condition. In doubtful cases a small portion of the suspicious part of the cervix should be removed for microscopic examination. The disease must be diagnosed from chronic inflammatory changes in the cervix, mucous polypi, simple papilloma, ulcerating fibroid polypus, breaking-down mass of fibrin, placenta prævia, and incomplete abortion.

**Treatment.**—If the disease is recognized early in the first four months of pregnancy, abdominal or vaginal hysterectomy should be performed. If the disease has spread beyond the cervix into other structures only the uterine contents should be removed. In carrying out this procedure there may be much hemorrhage and there is great risk of infection. All operative procedures should be preceded by thorough curettage of the carcinomatous tissue and the application of the cautery or a 50 per cent. formalin solution. When sufficient dilatation of the cervix cannot be obtained for the removal of the ovum, vaginal Cæsarean section may be performed where the pregnancy has advanced beyond the fourth month, even at full term, the uterus being removed immediately after its evacuation. Most authorities favor the delivery of the viable fetus in advanced gestation by the natural passage if the condition of the cervix offers no hindrance to delivery, or by abdominal Porro-Cæsarean section if it does. The latter operation must be preceded by thorough curettage and cauterization of the cancerous cervix in order to lessen the risk of infection. In some cases the mother will allow no interference until pregnancy is far advanced, in the hope of obtaining a living child. The relationship of cancer of the cervix to labor will be considered later. (See "Pathology of Labor.")

**Cervical Polypi.**—Mucous polypi may cause hemorrhage during pregnancy; they should be removed by twisting. They are never large enough to cause obstruction in labor. Fibroid polypi of the cervix are very rare. If they cause hemorrhage or are large enough to obstruct the passage in labor they should be removed.

**Prolapsus Uteri.**—Pregnancy may occur in a uterus already prolapsed or descent may take place after pregnancy has commenced owing to the influence of one or more of the causes that lead to the displacement in the non-pregnant state. Generally the organ rises gradually after the fourth month of pregnancy as the fundus grows into the abdomen. Sometimes incarceration in the pelvis occurs; this is most apt to take place if the uterus is retroverted as well as prolapsed. Occasionally the organ remains more or less prolapsed throughout pregnancy, though it may grow upward into the abdomen. In many cases the appearance of prolapse is exaggerated by marked hypertrophic elongation of the cervix.

The latter condition alone may be found in pregnancy and may be wrongly diagnosed as prolapsus uteri. The symptoms vary considerably and are similar to those found in the non-pregnant state—*i. e.*, bearing-down, disturbances of micturition and defecation, etc. When impaction occurs the disturbances are similar to those described in connection with the incarceration of the retroverted gravid uterus. In a considerable proportion of cases pregnancy is interrupted in the early months, chiefly owing to congestion and hemorrhages in the uterus; this may also take place in the late months.

**Treatment.**—When the condition is discovered the uterus should be elevated by suitable postural and manual manipulations. A suitable vaginal pessary should then be used to prevent the uterus from sinking. It should be worn for at least four months, antiseptic vaginal douches being used for cleansing purposes. The woman should not wear corsets and should suspend her skirts from the shoulders. She should not engage in work that involves straining, lifting, or long standing. Each day she should rest for several hours on the flat of the back or with elevated hips.

In some cases adhesions prevent the elevation of the uterus. This complication necessitates either abortion or abdominal section for the purpose of freeing the adhesions and elevating the uterus. When the organ is impacted in the pelvis, abortion should be induced if attempts at elevation fail. If the uterus become infected vaginal hysterectomy should be performed.

**Retroversion and Retroflexion.**—Backward displacement of the gravid uterus is most frequently found in women in whom the non-pregnant organ was similarly displaced. But the condition may arise in early pregnancy *de novo*, due to one or other of the causes that bring it about at other times—*e. g.*, a strain or fall, the pressure of a loaded bowel or of a distended bladder. Sometimes the fundus may be pushed backward, as the uterus enlarges, by the projecting promontory of an anteroposteriorly contracted pelvis. Sometimes the displacement may be due to the presence of a tumor in the pelvis—*i. e.*, ovarian cyst, fibroid of the anterior uterine wall, interfering with the normal upward development of the uterus.

**Results.**—In some cases the displacement is gradually righted, the uterus rising above the brim in the normal manner. Occasionally the anterior wall of the uterus develops above the brim, the rest remaining below as a posterior sacculation or diverticulum, more or less developed. The most serious result is impaction of the whole uterus in the pelvis. This is most apt to occur when the pelvis is contracted or when the uterus is fixed by adhesions, though it does not necessarily take place when the latter are present, since they may become stretched or torn, allowing the

uterus to rise. In these conditions spontaneous abortion may take place. If it does not occur and the uterus becomes incarcerated the rectum and bladder are greatly interfered with. The urethra is compressed against the pubes and the bladder becomes distended. Infection may occur and bad cystitis follow; gangrene may take place and a large portion of the bladder-wall may be destroyed and discharged. Sometimes the bladder may rupture. The kidneys and ureters may become infected. The uterus may also become septic or gangrenous and peritonitis develop; the rectum and vagina may also become gangrenous and may rupture. The nerves and vessels of the pelvis may be subjected to great pressure and marked edema and congestion of the vulva and lower limbs may be produced. General sepsis, pyemia, or uremia may develop.



FIG. 137.—Pregnant uterus of early part of third month (Braun's frozen section), with retroversion: D, D, Decidua vera.

**Symptoms.**—In early cases of backward displacement of the uterus there may be no symptoms or those found ordinarily in the non-pregnant state—*i. e.*, backache, bearing down, frequency of micturition, etc. Reflex vomiting or other neuroses may be present. As the growing uterus fills the pelvis, vesical and rectal disturbances increase. Micturition may be painful or may be impossible. The urine may be passed very often when the bladder is much distended. Sometimes a period of retention is followed by much dribbling. As the bladder rises into the abdomen it tends to lift the cervix, so that the pressure of the latter on the urethra is relieved for a time, allowing some escape of urine.

Constipation is common, though for a time there may be an irritative diarrhea.

When the uterus is incarcerated a bowel movement may be impossible. Pressure on nerves may lead to weakness and pains in the lower limbs, and walking may produce much displacement. Pelvic distress and pain are usually constant when impaction occurs.

**Physical Signs.**—In the early stages of backward displacement various positions of the uterus may be found. The fundus may be placed high or low in the hollow of the sacrum; sometimes it may be found in the lowest portion of the pouch of Douglas. The cervix is also variously placed; it may be directed downward and forward or forward and upward, in extreme cases being found above the symphysis, scarcely within reach of the finger. The fundus may be raised by bimanual manipulations unless it is held by adhesions or is impacted, especially when the

patient is placed in the genupectoral position. When the bladder is distended it forms a tumor in the lower abdominal region, which may rise as high as the umbilicus or even higher. When cystitis occurs the urine is altered accordingly. When the wall necroses, portions of the mucosa or of the mucosa and musculature may be passed in the urine or they may completely block the urethra. Sometimes from the infected bladder-wall an abscess may form in the anterior abdominal wall and a urinary fistula may develop. When the uterus is incarcerated there may be marked edema of the vulva and congestion of vessels both in the vulva and anus. The same changes may be found in the lower limbs. When infection or gangrene takes place the system shows the changes due to toxic absorption. Acute peritonitis may be present, and may or may not follow rupture of the bladder or uterus.

**Treatment.**—(a) *When the Uterus is not Incarcerated.*—In every case thorough examination of the patient should be made before treatment is carried out, anesthesia being used if necessary, in order that an exact knowledge of the pelvic viscera may be obtained. If this rule be not observed serious troubles may result. Thus, one instance is known to the author of a case complicated by an ovarian abscess. The latter was not discovered before manipulations were employed to replace the uterus, and was ruptured, leading to a fatal peritonitis. The bladder should be catheterized, and the bowel washed out by means of a long rectal tube before replacement of the uterus is attempted. Reposition may usually be effected by putting the patient in the genupectoral position. When the first attempt is not successful the woman should be sent to bed and kept on a low diet thirty-six or forty-eight hours before the manipulations are again repeated. Occasionally the reposition may be assisted if the cervix be pulled downward as the fundus is pushed up *per rectum* or *per vaginam*. This should be carefully done to avoid tearing. When adhesions are present manipulations must be carefully conducted. If they are not extensive they may be gradually stretched and divided by gentle massage in the genupectoral position or by tampons placed frequently in the vagina. Instead of tampons a rubber bag may be introduced into the vagina or rectum and be left distended for six hours. Sinclair recommends the use of a watch-spring vaginal pessary, the patient lying on her side, with the hips elevated. If the adhesions do not yield on account of their size or number abdominal section should be performed, in order to break up the adhesions and to replace the uterus. Jacobs has carried out reposition in 11 cases without mortality. In 10 pregnancy continued to full term; in 1 only abortion took place, four days after operation. If there be a suspicion of infection in the tubes or ovaries manipulations should not be carried out. Neither should this be

attempted when the displacement is complicated by a tumor of some size. If the patient will not agree to this procedure, abortion must be induced. In all cases in which reposition is performed a suitable vaginal pessary should be introduced and worn until the end of the fourth month.

(b) *After Incarceration.*—When the uterus is incarcerated most authorities recommend that pregnancy be terminated as follows: The bladder should be emptied, in the first place. This is best effected by means of a long metal catheter. When the urethra

is much compressed by the cervix the latter, if it can be reached, may be pulled backward with a volsella while the catheter is passed. Sometimes these methods may fail and it is necessary to perform suprapubic puncture of the distended bladder. The uterus may be aborted through the cervical canal; but if this be very high and inaccessible it is advisable first of all to evacuate the liquor amnii by puncture of the uterine body through the posterior fornix. Then it is usually possible to draw down the cervix and carry out the abortion.

Recently abdominal section has been successfully employed to raise an incarcerated uterus out of the pelvis, pregnancy continuing satisfactorily after-



FIG. 138.—Frozen section of retroverted uterus of three and a half to four months. Death from rupture of bladder (*Arch. f. Gyn.*, Band 41, Taf. 8, f. 1).

ward. Such a procedure should always be recommended as an alternative to the induction of abortion in case the patient and her husband desire gestation to continue. The section should, however, only be carried out if the conditions permit of its performance by an expert.

Rupture of the bladder demands early abdominal section. Gangrene of the uterine wall is very fatal, and demands emptying and vaginal removal of the organ if possible.

**Anteversio.**—Normally in pregnancy the body of the uterus presses on the bladder in the early months, so as to be felt with great ease through the anterior vaginal wall. This

explains the frequency of micturition that is so often found at this period.

When adhesions exist between the uterus and bladder the latter viscus may be greatly interfered with, and as the uterus rises into the abdomen may be markedly dragged on. Micturition disturbances may thus be very pronounced. Extreme anteversion is found when pregnancy takes place in a uterus that has been fixed to the vagina or bladder by operation, the pregnant organ remaining anteverted, being prevented from rising normally. In advanced pregnancy abdominal swellings or spinal kyphosis may force the fundus of the uterus abnormally forward. The most frequent cause is laxity of the abdominal wall, associated with separation of the recti muscles. The uterus may fall forward between the muscles in extreme cases so that it is at right angles to the long axis of the spinal column. This condition is aggravated when the waist is constricted by a corset or skirt bands or by the lifting of heavy weights.

**Treatment.**—In early pregnancy, when discomfort is caused by abnormal anteversion of the uterus, some relief may be afforded if the patient gives up the wearing of corsets and supports her skirts from the shoulders. A Hodge vaginal pessary may also be helpful by raising the uterus as a whole. When adhesions exist vaginal tampons may be employed or careful massage may be made through the anterior fornix. When no benefit is obtained by these measures it may be necessary to perform abdominal section in order to separate adhesions and elevate the uterus; otherwise abortion may be carried out. In the second half of pregnancy, anteversion due to a lax abdominal wall may be benefited if the patient wears a broad silk-elastic belt and gives up constricting her waist with corset or skirt bands.

**Lateral displacement** of the uterus may be congenital in origin. The whole organ may lie near one side of the pelvis or the fundus only may be inclined toward it. The displacement may also be produced by inflammatory adhesions or by the pressure of a pelvic or abdominal swelling. When one horn is imperfectly developed the main portion of the uterus lies lateriverted.

**Hernia.**—The pregnant uterus may sometimes develop in a ventral or inguinal hernia, rarely in the latter. The most frequent form is that which develops in connection with separation of the recti muscles, and has been referred to in considering anteversion of the uterus.

**Treatment.**—The uterus should be replaced, and kept in position by a broad silk-elastic belt. If reposition is impossible the uterus should be emptied or abdominal section carried out, in order to replace the organ or to deliver the fetus by the Cæsarean operation.

**Sacculation.**—This condition is also described as “retrover-

sion of the gravid uterus at term" and "sacciform uterus." It is usually first recognized in advanced pregnancy, and consists of an abnormal development of the posterior wall of the uterus into the pouch of Douglas, whereby the vagina is pushed downward and forward. This may go on to such an extent that the sacculation may fill almost the entire pelvis. The cervix may be pushed high above the pubes, and the vagina may be so compressed as not to admit more than one finger. The bladder is usually drawn into the abdomen and the urethra is compressed against the pubes, resulting in retention of urine and distention of the bladder. The rest of the uterus may develop normally above the brim.

Posterior sacculation may sometimes develop in a retroverted gravid uterus impacted in the pelvis, in a uterus held down by adhesions, in one complicated by a large fibroid tumor of the anterior wall, or in one whose upward extension is prevented by a tumor outside of the uterus. The condition leads to marked pressure symptoms; its diagnosis is difficult. The sacculated portion may be mistaken for an ectopic gestation or for an ovarian tumor. The removal of the fetus by abdominal Cæsarean section is advisable.

It is interesting to note that when pregnancy occurs in a uterus held in an anteverted position by a former vaginal or ventral fixation a sacculation of the posterior wall containing the ovum may develop upward, while the anterior wall remains unexpanded as a thick mass immediately above the cervix.

**Rupture of the Uterus during Pregnancy.**—Rupture of the uterus in pregnancy is very rare. In 306 cases of rupture collected by Trask only 38 were related to pregnancy, the rest to labor. In 12 of these the accident occurred during the first six months, in 26 at term. Spontaneous rupture is very infrequent; in Trask's 38 cases it was noted only in 14, pregnancy being nearly always in an advanced stage. It has, however, been described in the fourth month. It has been reported as taking place during rest, though usually during or after exertion, not necessarily excessive—*i. e.*, vomiting, walking, bathing, working. In some cases the uterine wall has been abnormal—*e. g.*, thinned, due to malformation or to stretched cicatricial tissue that has followed a previous incision or wound of the uterus; weakened by new growths—*viz.*, cancer and fibroid, or by fatty degeneration. In some instances rupture of an interstitial gestation has been undoubtedly reported as rupture of a normal pregnant uterus. In a number of cases it is possible that the rupture has been initiated by the passage of an instrument into the uterus for the purpose of inducing abortion. The majority of ruptures in pregnancy are due to traumatism—*i. e.*, a blow, fall, or marked compression of the abdomen. In several instances the uterus has been perforated

through the abdominal wall by a sharp instrument, stake, or cow's horn. In other cases rupture has followed criminal or legitimate instrumental attempts to induce labor by the vaginal route.

The site and extent of the rupture vary according to the cause. In spontaneous cases any part of the wall may be torn when it is altered by disease—*i. e.*, carcinoma. While in labor it is the lower uterine segment that is most frequently torn, in pregnancy this is not the rule. In 17 cases of rupture during gestation reported by Lewers the fundus was the site of the lesion. The results of rupture vary. The ovum or part of it may be expelled into the abdominal cavity, the patient's life being endangered from loss of blood. Generally the hemorrhage is more or less checked by retraction of the uterine muscle. Death of the fetus usually occurs and peritonitis may develop. Rarely the fetus may escape in the amnion and continue to develop, the membranes becoming adherent to the peritoneum, the placenta remaining in the uterus. Leopold has described such a case in which rupture took place in the fourth month, the fetus escaping in its membranes into the peritoneal cavity, the placenta remaining in the uterus; the gestation advanced until the end of the eighth month, when death of the fetus occurred.

After rupture the viscera may enter the uterine cavity, obstruction of the bowel sometimes resulting. Strangulation has led to perforation and the establishment of a utero-intestinal fistula. In some cases the uterine contents may escape into the extraperitoneal tissue between the layers of the broad ligaments. When rupture occurs in early pregnancy it is most apt to be regarded as a ruptured ectopic gestation. It has also been diagnosed as a case of acute poisoning. Indeed, abdominal section may be necessary to establish its real nature. In advanced pregnancy the lesion may be mistaken for intra-uterine hemorrhage associated with separation of the placenta. It may also be regarded as a case of rupture of intestine, spleen, or other viscera. (See "Rupture of the Uterus in Labor.")

**Intraperitoneal Inflammations.**—An acute pelvic inflammatory process rarely develops *de novo* in pregnancy. Sometimes this may be due to an appendicitis, salpingitis, or ovaritis; generally such attacks, when occurring in the pelvic structures, are exacerbations of previous processes. More commonly pregnancy is accompanied with old chronic inflammatory remains in the shape of adhesions of appendages, bowel, omentum, etc. These tend to become stretched as the uterus grows and they may break. Sometimes a distended tube or ovary may rupture. Adhesions may prevent the uterus from rising out of the pelvis, and thus may lead to its impaction, or may cause abortion. The symptoms are the same as are found in the non-pregnant state. Reflex phe-

nomena are usually more marked. Sometimes the rupture of adhesions or of a tubal or ovarian swelling may cause shock.

The **treatment** of these conditions has not yet been placed on a satisfactory basis. In acute cases it is the same as in the non-pregnant state. In chronic conditions very little can be done by local minor measures. Vaginal tampons and gentle vaginal and rectal massage are recommended by many, but are not of much value and may cause abortion. Careful dieting and regulation of the bowels are important. The woman should not engage in much exertion, should avoid tight clothing, and ought to rest a great deal, exercise being obtained by regular massage. Where the adhesions cause much distress or interfere with the proper expansion of the uterus the induction of abortion is usually regarded as the last resort, though abdominal section would be justifiable for the purpose of removing the adhesions or diseased structures. Celiotomy is advisable if a tubal or ovarian swelling is likely to interfere mechanically with labor or if it contains a fluid that is not certainly sterile. Such swellings may rupture in pregnancy or labor with serious consequences, and should, therefore, be removed as early as possible in pregnancy.

**Appendicitis.**—This complication of pregnancy has only been described in literature within recent years. Mundé was the first to call attention to the condition in America. In 1897 Abrahams collected 11 cases reported by American writers and added 4 observed by himself. Since that time various other papers have appeared. In Europe Pinard, Vinay, and a few others have collected cases. It is very probable that the disease is much more frequent than is suspected, being very often overlooked. It may occur for the first time or as a recurrent attack, and may develop during pregnancy, labor, or the puerperium. According to Donoghue, 80 per cent. of the reported cases of acute appendicitis have occurred during the first six months of pregnancy. It is a more serious disease than in the non-pregnant state. Premature emptying of the uterus is apt to be caused, and in some cases infection of the uterus and contents may spread from the diseased appendix. The fetal death rate is high. Labor may seriously complicate the disease, especially if the appendix be adherent in the neighborhood of the uterus. Owing to the great risk both to mother and fetus that may result from acute appendicitis in pregnancy, it is advisable that a non-pregnant woman who has had a definite attack should have appendectomy performed before she becomes pregnant. When an attack develops in a pregnant woman this operation is also indicated, as being less risky than non-interference.

The incision preferred by the author is an oblique one, parallel to Poupart's ligament on the right side and about  $2\frac{1}{2}$  in. above it, which divides the anterior sheath of the right rectus and the fascia

external to it for an inch or more. This incision is stretched widely and the rectus muscle is divided vertically, the two portions being pulled apart. The peritoneal cavity is then opened and the appendix removed. The incision in the peritoneum, rectus, and fascia are closed independently with catgut. In this way a firm abdominal wall is left, the liability to rupture being very slight.

**Intestinal Obstruction.**—Rarely in labor may the intestine be interfered with so as to cause symptoms of obstruction. This may occur as a result of pressure and straining if a hernia exists in any part. It may be caused by the constriction of adhesions tightened as a result of the changed size and position of the uterus resulting from labor. Gangrene of the bowel and death may follow. Early operation is indicated. Vuic has reported a case of intestinal trouble in a woman three months pregnant, due to an omental tumor. He removed the latter and 13½ in. of small intestine. Peritonitis followed, but the woman recovered and pregnancy continued.

**Carcinoma of the Rectum.**—Endelmann has collected 13 reported cases of this condition. In 7 the fetus was removed by Cæsarean section. When the disease is discovered in pregnancy and is operable the uterus should be emptied and the cancer removed afterward. If it is inoperable it may be advisable to allow the pregnancy to continue, so that Cæsarean section may be performed and a living child obtained.

**Pregnancy after Operative Measures for Retroversion of the Uterus.**—It is too soon to speak decisively with regard to the various operative measures at present practised for posterior displacements of the uterus, but sufficient statistics have been published to warrant the following statements:

The Adams-Alexander operation has no deleterious influence on the course of pregnancy or labor. The shortened ligaments stretch and allow the uterus to rise normally. As to the condition of the uterus after labor there is little information; several cases have been reported in which the organ was found to be normally placed. The author has observed several in which displacement of the uterus returned. All other operations for shortening the round ligament by vaginal or abdominal section, whatever be the method employed—*i. e.*, folding the ligament on itself, implanting it in a new part of the abdominal wall, or attaching it to the back of the uterus, do not tend to complicate pregnancy or labor.

After ventrosuspension, where the uterus is kept to the front by a fibrous ligament, pregnancy usually develops normally. The uterus rises without interference because the fibrous band stretches or breaks. Labor is not necessarily abnormal.

After delivery the fibrous ligament remains stretched or broken, and consequently the uterine displacement may return.

Ventral, vaginal, and vesical fixations are apt to interfere with

pregnancy and labor in a considerable percentage of cases. I have collected 554 reports of pregnancies following ventrofixation. Of these, 341 were normal both in gestation and labor; abortion occurred in 61; various complications were present in 152. In labor turning was necessary 19 times, forceps 28 times, Cæsarean section 10 times. In 9 there was marked inertia of the uterus, and in 4 severe postpartum hemorrhage. Forty-seven infants and 9 mothers died.

In 70 cases of pregnancy following vaginal fixation, 39 were normal; abortion occurred in 4. In labor version was necessary 4 times, forceps 3 times, Cæsarean section 12 times. In 8 various other complications existed. Seven mothers died. In the face of such statistics as these, all operations that bring about a fixation of the uterus in women who are likely to become pregnant must be pronounced unjustifiable.

Of the different methods employed, vaginal fixation appears to be the worst. When pregnancy takes place in these cases the normal expansion of the uterus is prevented. In many instances the adherent portion is stretched or broken; otherwise the percentage of complications would be much greater. When the organ remains firmly attached the fundus is unable to rise and dragging-pains result. The uterine cavity is apt to enlarge by stretching and thinning of the posterior wall (an upward sacculation, as it were), the anterior wall remaining unexpanded and forming a more or less fixed mass above the cervix, which may markedly interfere with the size of the birth canal. Frequently the cervix is displaced upward, sometimes being drawn so high as not to be reached with the finger. This constitutes a serious complication in labor.

**Ovarian Tumor.**—This condition is rare as a complication of pregnancy. There is no ground for believing that pregnancy is in any way a causal factor in the production of ovarian tumors. They are not found more frequently in women who have been pregnant than in nulliparæ. Indeed, Sir J. Williams states that the tumors are proportionately far less frequent in the married than in the single. There is no proof that pregnancy accelerates their growth. In pregnancy, as in the non-pregnant state, some ovarian tumors grow quickly, others slowly, for unknown reasons, a great range of variations being found. Sometimes a rapidly growing tumor may increase slowly when pregnancy occurs, though generally the same rate continues. In some cases a slowly growing tumor may continue steadily before, during, and after pregnancy. In other cases increase in size may occur only during a portion of the gestation period or after pregnancy. Leopold has stated that pregnancy favors malignant growth in the ovaries, and Wernich that it occasions malignant degeneration in ovarian

cysts. Williams shows that there is no foundation whatever for these statements.

Twisting of the pedicle may occur in pregnancy with the various sequelæ noticed in non-pregnant women. According to Williams, it is found three times more frequently in the pregnant than in the non-pregnant. It is much more likely to take place when the tumor is above the brim than when it is below. The risk of rupture of the cyst is very slightly increased by pregnancy; this accident most often occurs in connection with delivery. Abortion and premature labors are frequent, though it is not possible to state from an analysis of published cases the exact percentage due to the tumors. It must be remembered that though an ovarian cyst complicates pregnancy, the interruption of gestation may be due to a number of other causes. Williams found that in 461 pregnancies, abortion or premature labor took place in 58; Remy found 55 in 321 cases. In Williams's cases the percentage was greater with multilocular cysts than with dermoids. It was large in cancerous ovarian growths. Suppuration in a cyst is very rare in pregnancy; it is more frequent after labor. Hemorrhage into the cyst is also rare. Intestinal obstruction is very unusual.

**Treatment.**—An ovarian tumor should be removed by abdominal section in pregnancy unless it be very small and above the pelvic brim. The maternal mortality is very slight after this operation, and frequently pregnancy is not terminated. The older methods of dealing with these cases are responsible for an enormous death rate. In Heilberg's statistics of 271 cases there was a maternal mortality of more than 25 per cent., and a fetal mortality of more than 66 per cent. In Williams's series of 461 cases the former was 25 per cent., the death rate being as large in the easy cases as in the difficult ones; in cases requiring little or no help as in those needing the most skilful assistance. Few of the deaths occurred in pregnancy when not interfered with. One took place suddenly, probably from rupture of the cyst; 5 resulted from suppuration of the cyst. The great majority of the deaths occurred at or after labor or in the puerperium, the largest percentage being after delivery. The chief causes of death are rupture of the cyst, septic infection, gangrene of the cyst-wall, hemorrhage, and peritonitis. Such a record is sufficient to discredit the various methods employed in the past—*i. e.*, tapping the cyst, inducing abortion and labor, delivering by version, forceps and craniotomy. Removal of the cyst by abdominal section is the safest method. If it cannot be removed without performing Cæsarean section the latter procedure should be as well carried out. (This subject will again be considered in connection with Dystocia.)

Gordon, in 1894, collected 176 cases of ovariectomy in preg-

nancy. Of these 93.2 per cent. recovered. In 69 per cent. gestation continued to full term. He shows that in the most recent years the percentage of recoveries and of full-time labors is even greater. The most favorable results are obtained when the operation is performed in the first four months. Of 12 cases of double ovariectomy all the women recovered, but abortion occurred in 42 per cent. In 10 cases cysts of broad ligaments were removed, with 1 death and 6 abortions. Fehling has collected 266 cases with a mortality of 5.4 per cent.; in 33 per cent. of the cases the fetus was lost through abortion or premature labor.

## CHAPTER XII.

### DISEASES OF THE OVUM.

#### AMNION.

**Hydramnion (Hydramnios; Polyhydramnios; Dropsy of the Amnion).**—This is the condition in which the liquor amnii is in excess of the normal quantity, which at the end of pregnancy averages between 1 and 2 pints. The range of variation is considerable, and it is impossible to state definitely the frequency of moderate degrees of increase, especially in advanced gestation. Neither can it be stated how much fluid is necessary to produce well-marked disturbances. Undoubtedly the uterus and abdomen will tolerate in one woman what could not be borne without marked disturbance in another. The amount of fluid noted in different cases varies from 2 to 25 quarts.

**Associations.**—Hydramnios is more frequent in multiparæ than in primiparæ. It often occurs in twin pregnancies, especially in those of uniovular development; and where there are two amniotic sacs one or both may be distended. It has been found in anemic and weakly women; in those with dropsical conditions; in tuberculosis, diabetes, and syphilis (Winckel). In a number of instances diseases of the placenta and membranes have been described; in some cases edema of the cord and placenta. It has sometimes been found in women with valvular heart disease. Frequently fetal anasarca, ascites, anencephalus, spina bifida, or other fetal malady is present. It is important, however, to note that in a large number of cases (44 per cent. according to Bar) no maternal or fetal peculiarity can be found.

**Pathology.**—The origin of the excessive fluid is not at all definitely known. Theoretically it may be due to oversecretion, imperfect absorption, or to a combination of these. It may be

derived from maternal or fetal sources or from both combined. That the normal liquor amnii is mainly of maternal origin seems now well established. Zuntz's experiment of injecting sodium sulphindigolate into the veins of a pregnant rabbit, producing thereby blue coloration of the amniotic fluid but not of the fetal kidneys, points strongly in this direction. The contribution of the fetal kidneys has always been believed to be important, but Schaller's experiments greatly discredit this belief. He administered phloridzin to pregnant women and tested the liquor amnii at various periods for sugar. As the glycosuria caused by this substance is produced mainly in the kidneys, it is possible to estimate the activity of the fetal kidneys. (His results are given on page 85.)

In the light of his researches it is extremely probable that in hydramnios the increased fluid is most frequently maternal in origin. Certain it is that dropsical conditions in the mother are apt to be associated with excess. Fehling has noted that the more hydremic the maternal blood the more abundant is the amniotic fluid. Indeed, it is not improbable that an important factor in explaining normal differences in the quantity of liquor amnii in pregnancy is a variation in the hydremic condition of the maternal blood. As to the relative influence of overproduction and deficient absorption nothing can be said, since we do not know the relationship between normal production and absorption. A. R. Simpson thinks that another important factor is loss of tone in the uterine wall. This suggestion is certainly worthy of much consideration in view of the frequency of hydramnios in multiparæ, especially in those who have born several children, and in multiple pregnancies. Many believe that the increased amniotic fluid is derived from the following sources:

(a) *Altered States of the Circulation.*—Some have noted the persistence of the early subamniotic vasa propria of Jungbluth in certain cases of hydramnios and have believed the increased fluid to have arisen by exosmosis from them. This is altogether unlikely, because in most cases of hydramnios no such vessels are found. Then it is known that vascularization of the connective tissue of the amnion may be found without any hydramnios.

(b) Others believe that any condition that can raise blood-pressure in the umbilical vein and vessels of the villi may cause hydramnios. Thus, it has been noted in some cases of lesion of the fetal heart, of tumors of the fetus obstructing the circulation, and in abnormal conditions of the cord—*i. e.*, marked torsion, etc. Brindeau has reported a case occurring at the fifth month where there was sarcoma of one fetal kidney. The umbilical vein was dilated, and when fluid was injected into it transudation was observed; the fetus was ascitic and the placenta very large. It is to be noted, however, that these conditions may exist without any

hydramnios; consequently it is impossible to have any accurate knowledge of their importance as causal factors.

(c) *Excessive Fetal Urination.*—That abnormal activity of the fetal kidneys may sometimes lead to hydramnios is possible, though in no way proved. As has already been stated, the fetus probably does not normally excrete urine *in utero* until the process of labor begins. Why this function should prematurely develop (if, indeed, it does), leading to an excessive quantity of liquor amnii, is inexplicable.

(d) The fetal skin may occasionally be the source of hydramnios. This view is pure hypothesis and is based upon the very rare finding of hydramnios along with a thickened and folded condition of fetal skin. Budin has noted a case in which there were abundant nevi. These fetal changes may, however, be in no way connected with the production of the increased amniotic fluid.

(e) Alterations in the amnion are stated to be an occasional cause. Some think that inflammation of the membrane may possibly explain the production of acute hydramnios. A few observers have described fissures between the amniotic cells in certain cases, through which they believe the fluid entered the amniotic sac. In some cases the placenta is large, dropsical, or otherwise altered, but no constant alteration is found. The relationship to twin pregnancy is of interest. The greater frequency in uniovular development has been noted. Where two amniotic sacs are present there is usually a considerable disproportion in the sizes of the fetuses. Hydramnios occurs in the sac containing the larger fetus. In the latter hypertrophy of various organs may often be found, especially in the heart; also in the kidneys, liver, or spleen. It is believed by many that the cardiac hypertrophy causes abnormal activity of the kidneys, thus leading to hydramnios; but this is not proved. Sometimes, though rarely, both amniotic sacs may contain an excessive quantity, even though one fetus is not much larger than the other. Hydramnios may also be found where there is only one amniotic sac.

**Physical Signs and Symptoms.**—The disease rarely may develop rapidly. Usually the accumulation of fluid takes place slowly. In the great majority of cases the onset is noted after the fifth month.

The uterus is larger than it is at the corresponding period in normal pregnancy and generally stands at a higher level; its wall is tenser than normal. Fetal parts are more difficult to palpate and the heart sounds may not be so often auscultated. Fluctuation is usually easily obtained. It is of great importance to note that the normal variations in the consistence of the uterine wall may be absent for long periods. Hardening may not be felt at all in a series of examinations, or may be very slightly marked.

In acutely developed hydramnios there may be much distress

and pain in the abdomen. Vomiting and other reflex disturbances are present. In the ordinary chronic case marked trouble usually develops in advanced pregnancy, though there are many variations in the degree to which patients may be affected. There are gastro-intestinal disorders, difficulty in respiration, and frequency or irregularity of cardiac action as a result of the pressure of the large uterus. There may be weakness in the body and legs and inability to move about with any ease. Varices and edema of the lower limbs, vulva, and abdominal wall may develop. The abdominal wall is greatly thinned and the linea alba markedly stretched, so that the recti are widely separated. Sometimes spontaneous reduction of the hydramnios occurs.

**Differential Diagnosis.**—In the early months the conditions may be mistaken for pregnancy with hydatidiform degeneration of the chorion. Fluctuation is not present in the latter condition, which sooner or later leads to escape of blood from the cervix along with the characteristic vesicles. When the swelling is large the condition may be readily mistaken for ovarian or parovarian tumor. Scott Skirving has reported an interesting case in which the abdomen was opened on the mistaken diagnosis of ovarian cyst. Pregnancy continued, the hydramnios slowly disappearing, and a normal delivery occurred at term, there being no sign of hydramnios. Repeated examinations should be made in order to determine especially the presence of a fetus, and, as well, other signs of pregnancy. Ascitic distention of the abdomen, especially associated with tubercular or malignant masses, may simulate hydramnios, the swellings sometimes simulating fetal parts. A distended bladder along with pregnancy may lead to a diagnosis of hydramnios. Twin pregnancy may sometimes be distinguished with difficulty from it.

**Prognosis.**—In about 50 per cent. of cases pregnancy ends prematurely. The fetus is often born dead, sometimes shrivelled or macerated. Out of 33 cases, McClintock noted 9 dead-born; of the rest which were born alive, 10 died within a few hours. The influence of hydramnios on the fetus is not known.

**Influence on Labor.**—In the advanced months labor is usually slow, the pains being weak. Malpresentations and malpositions are frequent. Sudden escape of much liquor amnii may lead to complete inertia of the uterus. Rupture of the uterus has been noted in several cases. In the third stage the placenta is slow in being expelled, and on account of uterine weakness there is great risk of hemorrhage. The danger of infection is also greater than in a normal case.

**Treatment.**—There is no known method of preventing the increase of liquor amnii. In cases where the patient is fairly comfortable no interference is necessary. A well-fitting binder may relieve abdominal distress somewhat. In marked cases, when the

mother's health is much affected, it is advisable to draw off some of the liquor amnii with a small trocar, the membranes being punctured, if possible, above the level of the os internum. Rarely this procedure is followed by improvement without the occurrence of premature labor. Generally, however, the latter is induced. The viability of the fetus is not to be considered in cases where the mother's condition is distressing.

When labor takes place the mother must be attended with great care. When dilatation of the cervix is well advanced a quantity of amniotic fluid should be drawn off slowly with a fine trocar. If dilatation is very slow it may be promoted by artificial means. Delivery of the child by forceps or version may be indicated. In the third stage artificial removal of the placenta may be necessary. The uterus should be packed with gauze for twenty-four hours to stimulate the organ and to prevent bleeding, and large doses of ergot may be administered.

**Oligohydramnion.**—This is the condition in which there is a deficient quantity of liquor amnii. Nothing is known as to its etiology. A few cases have been described in which oligohydramnion in late pregnancy has been associated with absence of one or both fetal kidneys or with imperforate urethra. Gussacrow and others believe that such cases are proof that the fetal kidneys contribute largely to the liquor amnii. The fetus is often malformed as a result, probably, of abnormal pressure. Imperfect nutrition of parts, resulting in ulceration, has been noted. Ankylosis of joints and fractures of bones have been described.

**Amniotic Adhesions.**—Bands of various shapes and sizes are sometimes found passing from the fetus to the amnion, generally where oligohydramnion also exists; they are non-vascular. It is believed that they arise in early embryonic life, as a result of deficiency in the liquor amnii, the surface of the fetus being thereby allowed to come in contact with the amnion, union occurring at one or more points. As the ovum develops the joined areas stretch. Berry Hart has recently advanced the view that the amniotic cavity is formed by the breaking down of the central portion of a mass of epiblast in the early embryonic area. He considers that amniotic bands are derived from unobliterated portions. Sometimes the bands break across, remaining attached by their ends to the fetus or amnion. In some cases they may cause damage to the fetus. The umbilical cord may become twisted in one and the life of the fetus endangered. Parts of the fetus may atrophy from constriction by a band; it has been held by many that amputation of a limb may be brought about. Various malformations may be produced—*e. g.*, eventration, anencephalus, encephalocele, etc. Several cases have been described in which localized destruction of the skin has resulted from the traction of an adhesion, an appearance like an ulcer being produced. The

child when born may show this recently formed or partly cicatrized.

**Other Variations in the Liquor Amnii.**—The fluid varies considerably in color and consistence. Early it is usually dull grayish white; in the late months it is greenish, the color varying according to the amount of meconium in it. In consistence it may be limpid and thin or thick and syrupy. The odor is usually only slight, but it may sometimes be distinct and unpleasant. When the fetus is macerated or decomposition has set in the liquor is usually very dark-colored and may have a bad odor.

#### CHORION.

**Hydatidiform Degeneration (Vesicular Mole; Hydatid Mole; Cystic Mole; Uterine Hydatid; Dropsy of the Villi; Myxoma Chorion Multiplex).**—This condition is one in which swellings develop on the chorionic villi, varying in size from 2 mm. to 2 cm. They are found at the ends of villi or in any part of their extent; sometimes several enlargements may form like a chain of beads.

On microscopic examination there is found to be marked and irregular proliferation of the epithelial covering of the villi, Langhans's and syncytial layers, especially at the ends of the villi. In some areas the former or the latter may be very thinned or wanting. The epithelium shows vacuolation and granular degeneration in many parts. Syncytial extensions into the connective tissue of the villi have been described, but Findley thinks that this appearance may be merely due to a peculiarity in making the section; at any rate, it is very rarely found. The wall of the uterus tends to be invaded to a degree not found in normal pregnancy.

The interior of the villus varies considerably. The connective tissue is of the mucoid type, and is best marked near the periphery, where it may be somewhat compressed concentrically. The cells may be greatly separated in parts, there being an increase in fluid between them. In large swellings no cells can be distinguished, as a rule, in the central portions, which stain faintly or not at all.

Findley shows that granular degeneration occurs in the cells, beginning in the connective-tissue core of the villus; as it disappears the spaces fill with fluid containing mucin and some albumin. Rarely it is slightly tinged with blood.

The capillaries of the altered villi are usually obliterated. There is no evidence that the change is a primary mucoid degeneration of the stroma, as described by Virchow. Storch has termed it a "cystoid" degeneration. Various workers consider it to be an edema associated with a disturbed circulation.

There can be little doubt that the most prominent feature in the disease is marked proliferation of the epithelium of the villi. The changes in the stroma are probably secondary in importance, though they are usually coincident.

Marchand believes that normally the fetal blood is of minor importance in supplying nourishment to the villi, and points out

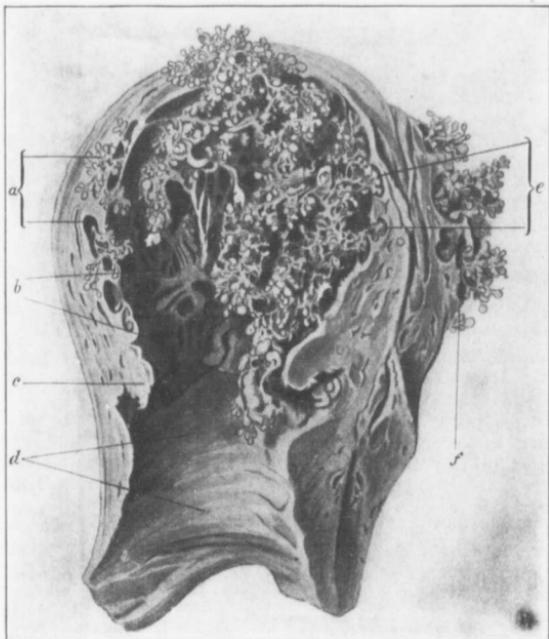


FIG. 139.—Section of uterus containing a hydatidiform mole (Bumm): *a*, Vesicles extending into blood-sinuses in uterine wall; *b*, openings of maternal blood-sinuses; *c*, os internum; *d*, cervix; *e*, vesicles extending into uterine wall; *f*, uterine veins and degenerated chorionic villi.

that in the absence of the syncytium, even though the fetal circulation be intact, there is likely to be degeneration in the stroma. He holds that the syncytium exercises an influence in determining the nourishment of the villi by the maternal blood.

Findley believes that impaired nutrition from the maternal blood favors the degenerative changes in the villi. It must be

noted, however, that in every case of normal pregnancy, degeneration of the decidua reflexa and impairment of the maternal nutrition supplied to the villi of the chorion leave attached to it are not followed by the changes found in vesicular mole, but by simple atrophy and degeneration. The swellings on the ends of the villi may extend as far as or into the uterine musculature; rarely the peritoneal covering may be perforated. This extension is due to the phagocytic action of the epithelium. The walls of the veins and sinuses may be entered and portions of the villi may be carried away in the circulation. Several specimens have been described in which the reflexa in early pregnancy was perforated, the swellings on the villi extending into the space between it and the vera. In well-marked cases the whole mass of the chorion reaches the size of a cocoanut, weighing several pounds. Sometimes hydramnios is also present.

The disease usually begins in the early weeks of pregnancy. It may affect both the chorion frondosum and laeve, in part or entirely. In some cases only one of these may be affected, partially or completely. The ovum when expelled from the uterus presents, therefore, different appearances in different cases. The effect on the embryo also varies considerably. If the disease be extensive, particularly if the chorion frondosum be affected, the embryo dies and disappears. When only a small part is affected its life may not be endangered and it may reach full time. In twin pregnancy the degeneration may be present in one ovum and absent in the other. It may occur in tubal pregnancy.

**Etiology.**—The causation of this disease is not known. Findley has studied 210 cases, and finds that the greatest number occurred between the ages of twenty and thirty, the extremes being thirteen and fifty-eight and the average age twenty-seven; it was two and a half times as frequent in multiparæ as in primiparæ. The disease may sometimes recur in one or more succeeding pregnancies. No general or local maternal diseases can be shown to influence the development of a mole—*i. e.*, nephritis, cystic ovaries, endometritis.

**Results.**—Early expulsion of the degenerated ovum may occur, usually between the third and sixth months. In cases where the fetus has not been affected owing to the small amount of degeneration, pregnancy may reach term.

A few cases have been reported in which the mole has not been expelled, even where the embryo has disappeared, but has remained *in utero* several weeks beyond the period of normal pregnancy. In some instances they have been described as being partially expelled, the rest remaining in the uterus for years. In some cases hemorrhage may be so excessive as to endanger the patient's life; during expulsion of a mole this danger is great. Occasionally the contractile power of the uterus may be consid-

erably weakened; intraperitoneal bleeding may sometimes take place as a result of perforation of the uterine wall by the mole.

If all the vesicles are not expelled subinvolution of the uterus results; decomposition may take place in the portions left behind. In recent years it has been shown by various workers that remains of a vesicular mole may give rise to one form of the disease known as "deciduoma malignum." Metastatic growths tend to develop in the vulva, lungs, and other parts, in which there may be reproductions of the molar structure.

**Symptoms and Physical Signs.**—In the earliest stage there is no indication of the change. Later in a well-marked case it is usual to note that the uterus increases more rapidly than in normal pregnancy. Thus, at the third month the organ may be as large as though it contained a fourth- or fifth-month ovum. Very frequently hemorrhage occurs; it may be sudden and profuse, or may escape in dribbles either as pure blood or serum; when the discharge is intermittent the intervals may be long or short. Vomiting is sometimes present and may be very severe. Occasionally the vesicular masses are expelled with the blood, resembling "white currants in red-currant juice." As a result of the loss of blood patients often become very much debilitated. Where rapid increase of the uterus takes place, excessive vomiting has been noted in a few cases.

On bimanual examination, when the condition is well marked, the uterus has a firm, somewhat doughy, boggy feeling, its outline being occasionally irregular; rarely it may be quite hard. Poter states that contractions in the wall may be irregular and prolonged, the contracted portions being sometimes mistaken for fibroids. Sometimes the round masses of the mole may be palpated when they develop in the uterine wall. The usual auscultatory phenomena of pregnancy are generally wanting; ballottement is absent; fetal parts are not palpable.

In cases where the mole ceases to develop and is not expelled from the uterus the latter is smaller than it should be for the period of pregnancy represented. Thus, though nine months may have elapsed since conception, the uterus may only be as high as the umbilicus.

In 50 cases collected by Kehrer hemorrhages occurred in 41, being very severe in 14. In 20 there was abdominal pain, in 15 edema of the legs. Debility was very common. Vomiting was not frequent. Abortion occurred at the second month in 2 cases, at the fourth in 15, at the fifth in 13; only 2 went to term. In 45 cases labor was completed within twenty-four hours, and in two-thirds within six hours. In most cases the pains were strong or moderately strong. In more than half the cases severe flooding occurred in labor, 16 of the women fainting. In two-thirds

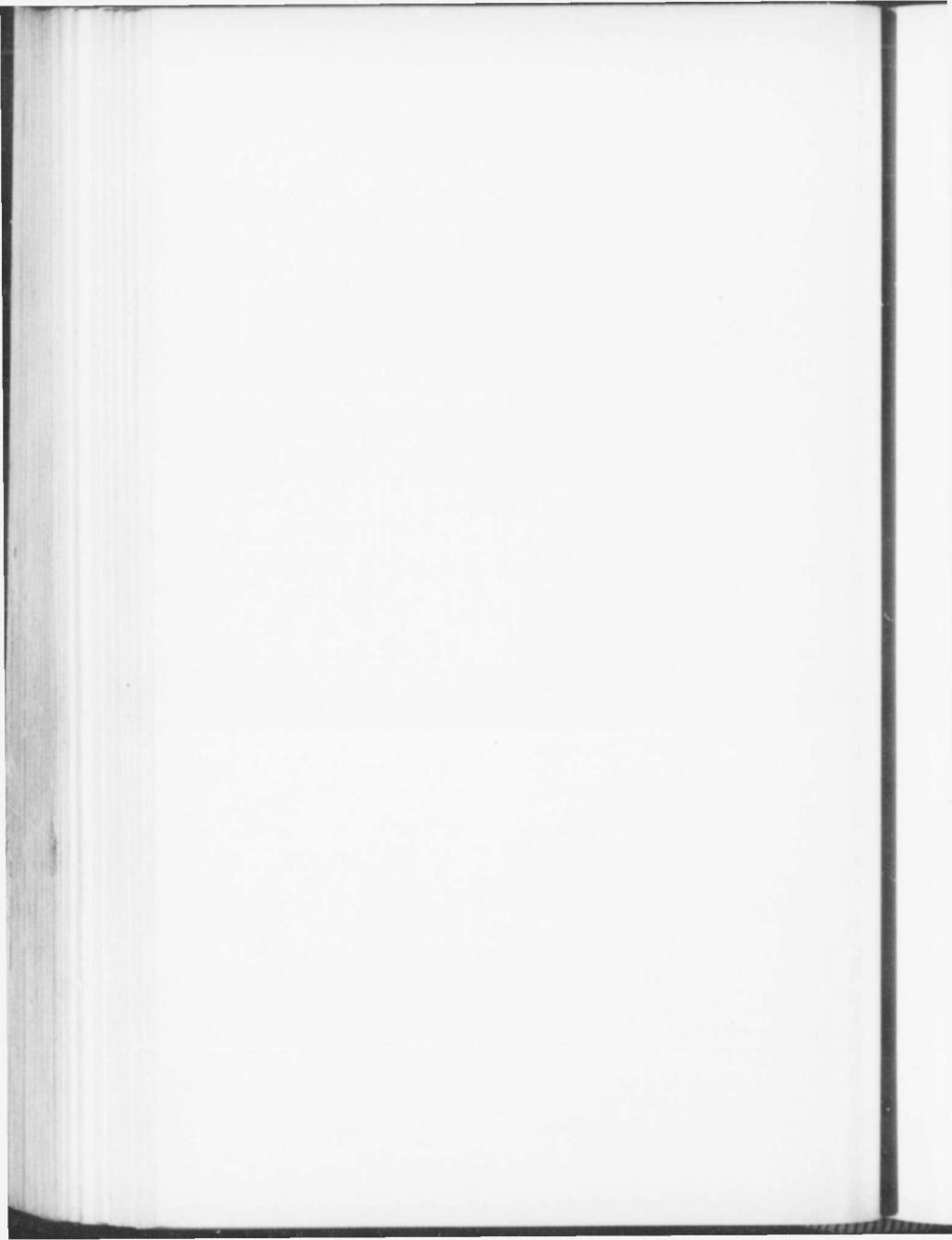
PLATE 9.



FIG. 1.—Altered villus in hydatidiform mole. There is marked irregular development of syncytium (Findley).



FIG. 2.—Altered villus in hydatidiform mole. The syncytial layer is much thickened (Findley).



the puerperium was normal and recovery rapid. Among the rest there were prolonged debility, infection, etc. No death occurred.

**Differential Diagnosis.**—The diagnosis may be very difficult in some stages. Thus, the rapid increase in size may simulate hydramnios. When early hemorrhages occur ordinary abortion may be suspected. Sometimes vesicular mole is mistaken for a uterine neoplasm. When, after hemorrhages, expulsion does not take place the diagnosis of missed abortion may be made. It is interesting to note that true hydatid development due to the echinococcus may very rarely be found *in utero*. Their nature is made evident by the presence of echinococcus heads and hooklets.

**Treatment.**—When the diagnosis is established the uterus should be emptied. This is best carried out as follows: If the cervix is patulous it and the vagina should be firmly tamponed and the patient placed in bed. When the cervix is closed it should be partly dilated artificially in order that the gauze may be inserted. If after twelve or fourteen hours the mole is expelled the patient should be anesthetized and the uterine cavity carefully explored with one or two fingers, all vesicles remaining in it being carefully removed. If the mole be not expelled by uterine efforts, dilatation of the cervix should be carried out and the mole removed with the fingers. After the uterus is emptied the cavity should be packed with gauze for twenty-four hours. It is inadvisable to use a curet, on account of the risk of perforating the uterine wall at some thinned portion.

When vesicles are firmly united to the uterine wall no force should be employed in trying to detach them. It is best to remove those that easily come away and to curet the uterus after a week or two.

**Relation of Vesicular Mole to Malignancy.**—In a considerable number of cases vesicular mole takes on a malignant type of development. This will be described under the heading Chorio-epithelioma Malignum. Findley states that the change occurs in about 16 per cent. of all cases. He states that no sharp histologic distinction can be made between the simple and malignant forms, and that the length of time the mole remains in the uterus bears no relation to the tendency to become malignant.

In all cases it is advisable to curet the uterus a couple of weeks after it has been emptied, in order to make a microscopic examination of the tissues. Only in this way is it possible to detect malignant transformation in its earliest stages. If at any period during the succeeding three years uterine hemorrhage should occur, curettage and microscopic examination of the tissues should be carried out.

**Myxoma Diffusum.**—Very rarely a mucoid hypertrophy may be found in that portion of the chorion from which the villi

spring. It may be spread over a large area, forming a gelatinous layer under the amnion  $\frac{3}{4}$  to 5 mm. thick.

**Myxoma Fibrosum.**—Occasionally a fibroid thickening of the chorion is found either in the subamniotic layer or in the villi. It is found usually in advanced pregnancy.

#### PLACENTA.

**Anomalies.**—At term the shed-placenta is a rounded disk weighing about a pound. Its average diameter is about 7 in.; its thickness varies from  $\frac{7}{8}$  to 1 in., being greatest near the middle. In some cases the thickness is fairly even in all parts; in others it varies considerably in different parts. There may be marked fissuring in some cases and a complete absence in others. The size of the placenta also varies considerably, the largest development being found in uniovular twin cases.

There are many variations as regards shape. Thus, it may be rounded, oval, ovoid, reniform, crescentic, and regularly or irregularly lobed. One or more detached portions may exist (*placenta succenturiata*). The latter may be related to maternal blood just as the main part of the placenta. Rarely the detached portion may be as large as that to which the cord is attached, explaining what is sometimes described as a double placenta with a single fetus. In such a condition the cord may end in the membranes between the placental portions, its vessels going to each. Sometimes the villi of the detached mass are functionless; to such a mass the term "*placenta spuria*" has been applied.

Very rarely the placenta may extend around the uterus in a ring-like manner, similar to the condition found in some mammalia. Sometimes it has a gap in its substance (*placenta fenestrata*). The cord may have a central, lateral, or marginal insertion. In the latter condition the arrangement has often been compared to the shape of a battledore. Rarely the cord may be inserted into the membranes, its vessels running in the chorion to the placenta.

**Myxomatous Degeneration.**—This change has already been described in connection with hydatidiform changes in the chorion. The effect on the fetus depends mainly on the amount of change in the villi.

**Calcareous Deposits.**—Occasionally small portions of calcareous material are found on the maternal surface of the placenta. They may be in the decidua attached to the ends of the villi, or sometimes in the substance of the latter; their causation is unknown.

**Edema.**—The placenta is sometimes swollen and edematous. The causes are probably both maternal and fetal, but are not well understood. It has been several times noted in connection with obstructive conditions in fetal circulation.

**Fibrous Degeneration.**—This change in the stroma of the chorionic membrane and villi is a very common one in the advanced stages of normal pregnancy, and there is no evidence that



FIG. 140.—Portion of placenta with diffuse fibrous thickening of chorionic layer. I. Fetal surface with amnion removed. II. Section through thickness of above portion. *a*, Branches of umbilical vessels; *b*, thickened chorionic layer; *c*, normal placental tissue.

it is an indication of a diseased process. The delicate mucoid stroma of the early weeks gradually changes into a dense structure, in many parts resembling connective-tissue sclerosis. There

is a relatively large quantity of the matrix in proportion to the nuclei. Many cells are shrivelled and lie in spaces. In many of the vessels great thickening of the intima is found. Remains of the early mucoid tissues may usually be found only in some of the small (latest-formed) villi. In many of the villi attached to the decidua the disappearance of the covering epithelium may make the connective tissue of the stroma appear to be continuous with that of the decidua, and it may be difficult in some instances to distinguish between them.

**Fatty Degeneration.**—This has been described as occurring when the nutrition of the villi is interfered with, frequently in connection with fibrous changes in the villi, and following death of the fetus where the placenta is not immediately expelled.

**Inflammation.**—The relation of the placenta to inflammation is not at all well understood. Much of the published work dealing with diseased conditions is worthless, because it was written when the true nature of the normal placenta was not understood. As regards the maternal decidua to which the fetal villi are



FIG. 141.—Section across a placenta extensively atrophied and degenerated. Seventh month of pregnancy; *a*, Unaltered portion of placenta; *b*, portion greatly atrophied and degenerated; *c*, portion partly atrophied and degenerated; *d*, membranes. (Reduced.)

attached, there is no doubt that occasionally it may be affected along with the rest of the mucosa in an inflammatory process often termed "deciduitis." That the change may spread to the attached villi is possible. As to inflammation in the main tissue of the placenta, which is entirely of fetal origin, we know little. Fränkel has shown that such a process is not infrequent in syphilis. He has described the infiltration of villi with inflammatory products, resulting in hypertrophies and distortions.

**Syphilis.**—While the influence of syphilis in its various forms on the life of the ovum has been well described from the clinical point of view, we are as yet in want of correspondingly accurate data regarding the pathologic changes accompanying its different manifestations. This is largely due to the rarity of specimens of the pregnant uterus removed from syphilitic women. The ovum alone is often enough obtained, but no complete account of the pathology can be given until the condition of the uterus has been carefully studied. It is of extreme importance to ascertain whether the vessels and other tissues of the maternal mucosa are affected in all forms of the disease or only in certain cases; whether local

maternal changes are necessarily preliminary to fetal changes; which of the fetal structures are most prone to be affected, and what are the variations related to the different kinds of syphilitic infection. At present it is sufficient to state that inflammatory changes and gummatous formations have been described in the decidua; endarteritis has also been noted. In the chorionic membrane and villi, chronic thickening due to inflammatory products may easily be demonstrated. Infarcts in the placenta are common. When numerous and of old standing they lead to the destruction of many portions of the placenta, which are recognized as whitish or yellowish, firm areas. Thrombosis may also occur in the intervillous space, the thrombi, when of old standing, becoming organized, the resulting fibrous tissue compressing and destroying many villi.

**Cysts.**—These are occasionally found, especially near the fetal surface of the placenta. Some are believed to arise from a localized myxomatous degeneration of the chorion; others, from the degeneration of infarcts and hemorrhages.

**Tumors.**—Myxomatous and fibromyxomatous swellings have already been noted. Occasionally a single large swelling occurs, of combined fibrous and myxomatous nature. Sometimes the swelling may consist mainly of angiomatous tissue, the tumor being termed *fibromyxoma telangiectodes*. These forms probably arise in the chorion. Albert has collected a number of these cases, and has pointed out the frequency of abnormalities in connection with the pregnancy—*i. e.*, hydramnios, hemorrhages, and premature emptying of the uterus. Certain tumors described as fibromata are probably merely organized blood-clots or thromboses. In this connection deciduoma malignum may be mentioned, as the new growth usually develops in connection with placental remains; occasionally the disease probably begins before the birth of the ovum.

**Tuberculosis.**—The effects of tuberculous infection on the placenta are not fully known. Local lesions have been noted in the decidua and in the chorion. In cases in which the mother presents distinct tuberculosis elsewhere, tubercle bacilli may be found in the fetal tissues, though no changes may exist in the placenta. Lehmann, however, points out that placental lesions may be so slight as to be easily overlooked; the most careful microscopic examination is necessary. Tubercle bacilli may be found in them, though in small numbers. (See p. 87.)

**Placental Infarcts and Apoplexies.**—The frequent occurrence of localized areas of pale, dense tissue in the placenta has been noted by many observers, and different views have been advanced to explain their formation. Perhaps the most widely held opinion is that which regards them as due to hemorrhages in the placenta. In the light of recent work it would appear that

this explanation is not correct. Indeed, true apoplexies or localized extravasations of maternal blood are very rare.

Williams, one of the most recent workers in this subject, supports the view, originally advanced by Ackermann, that the primary cause of infarct formation is to be found in a thickening of vessels in the villi, mainly in the inner wall. As a result, he states, there is a coagulation-necrosis of portions of the villi just beneath the syncytium, with subsequent formation of canalized fibrin. As the process advances the syncytium degenerates and is changed into canalized fibrin. This is followed by the coagulation of the blood in the intervillous space, which results in the matting together of groups of villi by masses of fibrin. In the advanced stages the stroma of the villi degenerates, so that it resembles the fibrin around it. While Ackermann's explanation may be correct as regards the development of many infarcts, it is probable that it does not apply in all cases. Degeneration and disappearance of syncytium occur apart from primary degeneration in the stroma of the villus. The removal of the anticoagulating influence of the syncytium may thus suffice to induce fibrin formation in the maternal blood in localized areas.

Moderate degrees of infarct formation are not to be regarded as pathologic, being frequently found in normal cases, but are probably due to senile changes in the chorion. There is no doubt that diminution in the caliber of the vessels of the chorion is a normal change toward the end of pregnancy, owing to thickening of the intima. The endothelium is swollen in some parts and proliferated in others, while often an appearance like hyaline degeneration is noted. These infarcts are for the most part white or yellow in color; they vary in size from small dots to large portions of the placenta. They may be found next the amniotic surface in the substance of the placenta, or at the maternal surface; frequently they are situated at the edge. Sometimes they are found as a thick band, running around the fetal surface at some distance from the edge. In the latter condition the placenta is often termed *placenta marginata*. In some cases this ring-like band is found half an inch or more internal to the edge. Rarely pinkish infarcts are noted, and still more rarely bright-red or dark plum-colored masses are found. Occasionally white infarcts are found, termed by Eden "non-fibrinous." These are an agglomeration of villi not bound together with fibrin. Marked infarct formation may be noted in various diseased conditions of the mother, particularly where there is albuminuria. They may be found in syphilitic cases, though they are not particularly characteristic of this condition.

## UMBILICAL CORD.

**Anomalies.**—The cord presents many peculiarities of development. It may be abnormally long, sometimes measuring 5 or 6 feet. It may be very short, being only 4 or 5 in. in length; the latter condition is to be distinguished from relative shortness, an artificial production due to excess of convolutions around the fetus or to adhesions to the amnion or amniotic bands.

The Whartonian jelly of the cord may be very irregularly distributed; in some parts it may be almost entirely absent, so that the diameter of the cord is much diminished. Sometimes the cord may contain two veins and one artery or one vein and one artery; sometimes two cords pass to one placenta.

**Velamentous Insertion.**—The cord may sometimes not enter the placenta, but may end in the membranes at some distance from its edge, the vessels separating and running in the chorion to the villi. The condition is most frequent in multiple pregnancy. It is a cause of danger to the fetus both in pregnancy and labor. Sometimes it may lead to premature rupture of the membranes. It is a predisposing cause of prolapse of the cord. Pressure on the membranes during labor may bring about fetal death. Rarely the vessels may be ruptured. Lefèvre believes that the anomaly explains some cases of hydramnios and fetal dropsy.

**Torsion.**—Different arrangements of torsion in the vessels have already been described. Some variations are probably natural, but in some cases marked torsion of the whole cord on its longitudinal axis is due to movements of the fetus. In most cases the torsion is most evident near the fetus. Occasionally the turns are so numerous as to make the cord resemble a coil of wire spring. In a case noted by Schauta 380 twists were counted. Edema and cystic changes have been found with marked torsion. Great narrowing of the cord and partial or complete obliteration of its vessels may also be brought about.

**Convolution.**—The cord may be arranged in various ways in relation to the fetus. Frequently it passes from the umbilicus over the chest, around the neck, and down in front of the other shoulder. Occasionally it is coiled once or several times around the neck, body, or limbs. The largest number of turns around the body yet described is 9. Extra convolutions are almost always associated with abnormal length of the cord. Division of the soft tissues of the neck has rarely been noted as the result of coiling; amputation of a limb has been more frequently described. Direct strangulation of the child is very rare. As regards labor, Bruttan states that in Dorpat, where convolution of the cord has been frequently observed, stillborn children are not more frequent than in cases where convolutions are absent, though a larger percentage

are born more or less asphyxiated; there is more risk of pressure on the cord in primiparae. The greatest risk exists where there is some form of dystocia. Excessive convulsion may cause delay in labor when the free portion of the cord is thereby made very short.

**Knots of the Cord.**—Occasionally the cord may be knotted as a result of the movements of the fetus *in utero* during pregnancy; sometimes it may occur during labor. Generally only one knot is formed, but there may be more. In the case of twins in an amniotic sac there may be marked twisting or knotting of the cords. In the great majority of instances no damage to the fetus results from the presence of these knots, since they are usually loose. Very rarely is the circulation interfered with. The Whartonian jelly may be displaced where the folds of the knots cross when the latter have lasted some time. Sometimes a condition of the cord exists to which the term "false knot" has been given, to distinguish it from the above-described "true knot." It consists of a projection along the course of the cord, due to a localized accumulation of Whartonian jelly or to a sharp bend or curve in one of the vessels.

**Changes in the Vessels.**—The alterations associated with maternal and fetal diseases have not been well established. Winckel and Swiecicki have pointed out the frequency of excessive narrowing of the vessels from changes in the intima and outer wall in syphilis, heart and kidney diseases of the mother, and in other affections. The vein or arteries or both may be affected. Torsion may lead to a partial or complete stenosis of the vessels. Varicose enlargements occasionally occur; rupture has been described.

**Hernia.**—Sometimes at birth the fetal abdominal viscera lie in an extension of the celom into the cord; otherwise the fetus may be healthy. Frequently some other abnormality exists—*i. e.*, imperforate anus, malformations of the outer genitals, etc. The hernia varies in size; it may contain only small intestines, but in some cases large intestine, stomach, liver, and other viscera.

**Swellings of the Cord.**—These are rare. Cysts are sometimes found; also blood-effusions, myxomata, and telangiectatic myxofibroma.

## CHAPTER XIII.

## PREMATURE EXPULSION OF THE UTERINE CONTENTS.

**Abortion ; Miscarriage ; Premature Labor.—Definition.**

—By many the term abortion is applied to expulsion of the ovum during the first three months; miscarriage, to expulsion during the second three months; premature labor, to expulsion during the last three months. Others use the first two terms synonymously, referring to expulsion of the ovum before viability of the fetus; in the great majority of cases this takes place in the twenty-eighth week. In this article the latter definition is employed.

**Frequency.**—No accurate statement can be made regarding the frequency of premature emptying of the uterus. Statistics given by different authorities vary considerably. Thirty-seven per cent. of all childbearing women are said to abort at least once before the age of thirty-one, and after this the percentage is higher. Probably many very early pregnancies terminate without being recognized as an abortion, the attendant hemorrhage being regarded as a menstrual disturbance. Abortion is much less frequent during the first than during succeeding pregnancies. The third and fourth months are those in which it is most apt to take place. Very often the date of its occurrence is that corresponding to a menstrual period.

**Etiology.**—The causes of abortion are very numerous, being all conditions that set up uterine action. They are often classified as maternal, fetal, and paternal; but it is impossible to arrange them into distinct divisions, assigning to each a definite form of action. In many cases more than one factor is in operation, and it is often impossible to state which is the most important determining cause. Thus, there are many maternal conditions in which abortion occurs, in which the causal factors may be a high febrile state, poisons circulating in the blood, which may cause death of the fetus; intra-uterine hemorrhages, causing fetal death or stimulating the uterus to contraction.

Speaking generally as regards the mother, conditions that are associated with high temperature, extreme exhaustion, nervous shock, accumulation of poisons in the blood, hemorrhages in the decidua or in the attached fetal structures or which lead to mechanical interference with the normal development of the pregnant uterus, are among the most important causes leading to abortion. Among the conditions are: 1. The acute infectious diseases, syphilis, and tuberculosis. 2. Various diseases of the nervous, urinary, circulatory, respiratory, and alimentary systems. 3.

Various inflammations, displacements, and neoplasms of the uterus and other pelvic structures. 4. All forms of mental shock and emotional excitement. 5. Traumatism—*i. e.*, dancing, riding, falls, passage of foreign bodies into the uterus, etc.

As regards the ovum, there are many factors that lead to abortion, either by causing death of the fetus or by stimulating the uterine muscle directly. Such are diseases and abnormalities of the chorion, amnion, or cord; hydramnios; sudden escape of liquor amnii; diseases or malformations of the fetus, causing death. The paternal influences causing abortion are not well understood. Syphilis is the best known. Tuberculosis and some other conditions markedly affecting health are believed in some cases to induce premature emptying of the uterus. Advanced age or extreme youth is thought to act in the same way.

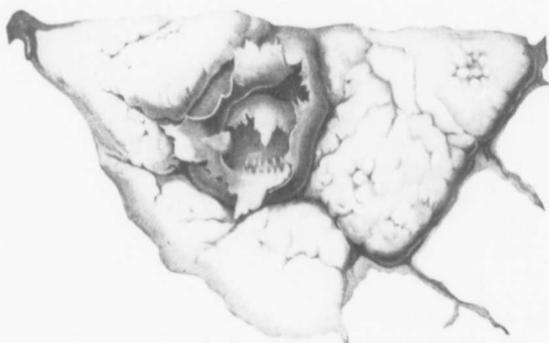


FIG. 142.—Ovum embedded in blood-clot (Abfeld).

**Symptoms.**—*Signs of Abortion.*—These vary greatly. The chief clinical phenomena are: (1) Pains in the pelvis, (2) hemorrhage, and (3) expulsion of part or the whole of the ovum and decidua tissue.

In some cases the uterine contents may be expelled suddenly without the previous occurrence of any of the above symptoms. As an illustration may be mentioned the case of a woman who passed a three months' ovum while in the middle of a dance in a ball room, without any warning whatever. In some cases pain is entirely absent; in others there may be little or no bleeding before the ovum is expelled. Sometimes only blood-serum escapes; sometimes the liquor amnii first gushes out. Very frequently pain is felt early in the sacral region as a continuous aching. Often intermittent labor-like pains are present. Fulness and

weight in the pelvis and frequency of micturition may be noted. Bleeding may precede pains, may be noticed synchronously, or may follow them. It may pass in dribbles or as a profuse flow; or may collect in the vagina and form large clots. The blood may be retained in the uterus, distending it and increasing the pain. Clotting may occur in the cervix, only the blood-serum escaping. Sometimes bleeding takes place only at night, when the patient lies down, ceasing when she walks about. This is probably due to the sinking of the reflexa and ovum, which acts as a plug to the internal os while the woman is in the erect posture.

The duration of an abortion varies greatly. As stated above, it may take place in a very few minutes, so far as the woman's subjective knowledge is concerned; ordinarily it lasts over a period of several hours. In some cases the phenomena may extend over several days, being more or less constant or intermittent in character. When the ovum is not entirely expelled certain effects may be produced that may be evident months or years afterward. On physical examination in the early stages of abortion the enlarged uterus may be palpated. When pregnancy is advanced only two or three weeks it is impossible to be certain as to the nature of the enlargement. Usually variations in its consistence—alternate hardening and softening—may be distinguished. Very early no dilatation of the cervix may be felt, even though blood may be escaping from it. Later it is more or less patulous, so that a finger may readily be introduced, and presenting portions of decidua, ovum or blood-clot be felt.

**Mechanism of Abortion.**—Berry Hart has pointed out that in many cases in which a complete abortion is expelled we may have a definite mechanism, which he terms "normal." Of this there are two varieties: First, that in which expansion of the lower uterine segment is accompanied by a separation of the decidua vera, the whole abortion mass consisting, from below upward, of the outer portion of the vera and serotina, reflexa, and contained ovum; second, that in which, as the vera gets separated, the reflexa and superficial part of the serotina with the contained ovum are driven down into the cervix, the vera, following afterward as the abortion proceeds. As regards the separation plane in the case of a complete abortion, my researches show that it passes mainly through the compact layer of the serotina and vera in the middle or outer part; in certain areas the whole compact layer and bits of the spongy may be shed. It is exceptional to find any considerable quantity of the latter removed. Probably the majority of abortions do not take place in either of these manners; very often the uterine contents come away in successive portions, the expulsion often being only partial. In these abnormal cases sometimes everything may escape except the vera.

The reflexa, along with the superficial part of the serotina and the contained ovum, may easily be mistaken for a complete abortion on careless examination. In other cases parts only of the vera may be left, or again parts or the whole of the serotina may be left along with attached villi and with more or less of the reflexa.

Sometimes the reflexa may be broken off at its junction with the serotina and expelled with or without the amniotic sac and its contents. Sometimes the fetus alone or the entire ovum may be expelled through the reflexa, the decidual structures being expelled partly or entirely at a later date. Occasionally the entire amnion and its contents may alone be expelled. Very frequently saprophytes invade the retained tissues, leading to a foul-smelling discharge, fever, chills, etc.; at the same time septic infection may

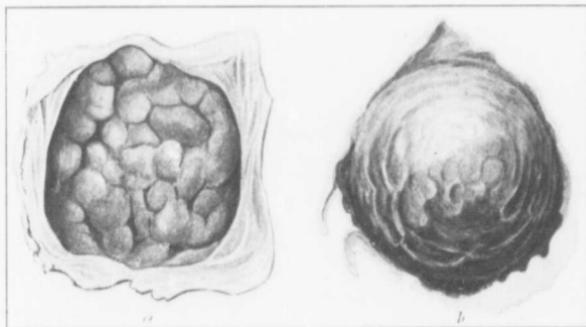


FIG. 143.—Fleshy mole (after Fothergill): a, Amniotic surface; b, uterine surface.

also occur. In some cases fibrinous deposits may accumulate on the remains of the ovum, forming a large intra-uterine polypus; this may also become infected. In cases of long retention of portions of the ovum in the uterus, changes similar to those to be described in connection with *Missed Abortion* take place in the tissues.

**Varieties.**—Different terms are employed to describe the various stages in which abortions are met with clinically.

*Threatened Abortion.*—This condition is one in which there are symptoms pointing to the commencement of expulsion of the uterine contents; as already indicated, these vary in different cases. Ordinarily there are pelvic pains, with or without hemorrhage and with little or no dilatation of the cervix. In many cases of early pregnancy the threatening occurs at the time corresponding to a menstrual period.

*Inevitable Abortion.*—This is the condition in which the threatening symptoms have become more marked and persistent, so that all hope of preventing the abortion must be given up. In this stage usually the cervix is dilated, so that a finger may be introduced. Often, however, it cannot be passed through the internal os. Expulsion of portions of the decidua vera is generally

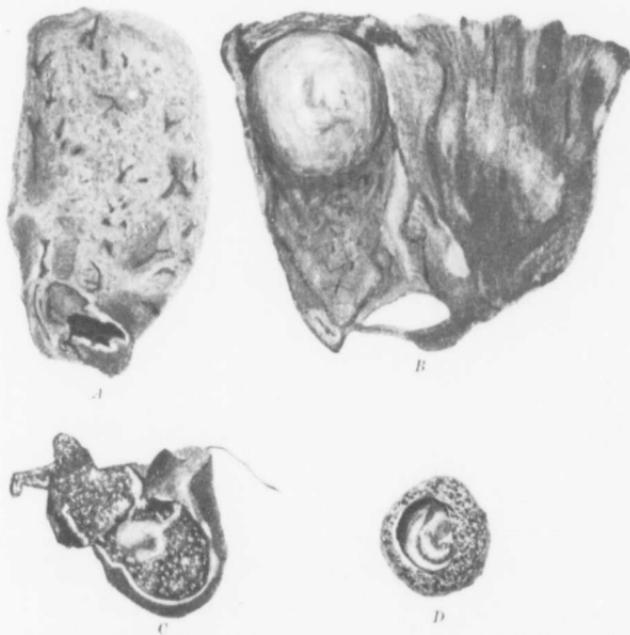


FIG. 144.—Complete abortion about twenty-fourth day of pregnancy: *A*. Outer surface of decidua vera, with an opening at site of os internum. *B*. The same opened, showing prominence of decidua reflexa containing ovum. *C*. Portion of decidua reflexa with chorion lutea dissected from amnion, showing embryo in the amniotic cavity. *D*. Portion of amnion removed, showing embryo in the amniotic cavity.

regarded as a sign of inevitable abortion; but this is not always the case, for occasionally this may take place in a threatening abortion, and yet pregnancy continue afterward.

*Complete Abortion.*—This is the condition in which everything that should be expelled escapes from the uterus. The constituents of the complete abortion have already been described.

*Incomplete Abortion.*—In this condition there are left in the

uterus decidual tissue, fetal structures, or parts of both. The variations that occur have been noted above.

*Habitual Abortion.*—This term is applied to the repeated occurrence of abortion in the same woman. In some instances pregnancy may be interrupted successively at the same period; in other cases, however, the time is variable.

*Missed Abortion.*—Occasionally a fetus may die *in utero* and no abortion occur; in some cases no threatening even taking place at the time of fetal death. The uterus may retain its contents for weeks, months, or sometimes for years. This may happen in twin as well as in single pregnancy. Sometimes both ova, sometimes only one, may perish; the latter may occur even when two fetuses lie in one amniotic cavity. The appearance of the uterine contents when expulsion finally does occur varies considerably in different cases. Sometimes the fetus is preserved in a shrivelled condition, wrapped up in the membranes and placenta, the liquor amnii having been absorbed or previously expelled; the term "blighted ovum" is applied to this condition. In other instances the ovum and decidual tissues are largely altered by hemorrhagic effusions, forming a mass termed the carneous, fleshy, or sarcoous mole, or molar abortion. The fetus may be entirely or partially absorbed; sometimes only a small part of the umbilical cord may be recognized. The villi in these masses are found in various stages of degeneration, similar to those already described in placental infarcts; the maternal blood may be found in all stages, from the recently effused red clot to the well-advanced, organized, pale fibrin mass. The term *fibrous mole* is applied to the mass when the connective tissue of the villi is changed to dense, wavy, fibrous tissue, with few corpuscular elements. Berry Hart has recently described such a mole that had remained *in utero* nine months, the threatening of abortion having occurred in the third month of gestation. The mole was a white, glistening mass, with a small amniotic cavity at one end, but with no fetus; it was composed almost entirely of fibrous villi massed together. In places where the villi did not touch, the epithelium covering them was partially preserved; many well-marked decidual cells were found. In some early abortions may be noticed hemorrhagic effusions in the decidua and chorion, forming bulgings inward toward the amniotic cavity. To this condition Breus has given the name of *tubercle subchorionic hematoma of the decidua*. He holds that death of the embryo precedes the development of the hematomata, the amnion and chorion continuing to develop, being thrown into folds that become filled with blood. Neumann has criticised Breus's views, rightly holding that he is mistaken in believing that the amnion and chorion grow after the death of the embryo; he urges that the condition described by Breus is merely a form of the fleshy mole, the protuberances being caused by

irregular extravasations under the chorion. Berry Hart states that there is undue blocking of the serotinal sinuses, leading to a slow engorgement of the intervillous circulation. Blood-swellings thus form, thrombosis gradually developing. The embryo dies as the result of this interference with the intervillous circulation.

The clinical history in these cases of missed abortion varies. Usually after a period of amenorrhea, during which various signs and symptoms of pregnancy may be present, there are hemorrhage from the uterus and perhaps some other signs of abortion (often believed by the patient to be an actual abortion); afterward another period of amenorrhea, lasting for weeks or months, until the mass is expelled from the uterus. Instead of a second period of amen-



FIG. 145.—Tuberosed subchorionic hematoma of decidua: *a*, Amniotic surface of early abortion sac; *b*, embryo; *c*, large blood-clot in decidua, forming a bulging in amniotic cavity; *d, d, d*, small blood-clots.

orrhea there may be irregular discharges of blood; sometimes there is no hemorrhage at all. Occasionally putrefactive changes may occur and a fetid discharge result; sometimes septic infection may occur. During this latter period the uterus may diminish somewhat in size, thereafter remaining in a stationary degree of enlargement, or it may become slowly and progressively larger owing to a succession of fresh hemorrhages in the ovum.

The length of time that a missed abortion may remain in the uterus is not definitely known and accurate observations are wanting. Resnikow has reported a case in which a febrile attack in a woman seven months pregnant destroyed the life of the fetus.

Labor pains came on for a short time, followed later by a purulent discharge and rigors; amenorrhea then succeeded. After four years the uterus was dilated and the bones of a seven months' fetus removed. Sometimes in such cases a communication may be established between the uterus and the rectum, through which some of the fetal bones may escape. Landucci has reported such an occurrence. The subject is of considerable importance from the medicolegal point of view, as was recently shown in a well-known trial in London. On February 23, 1894, a physician removed from a woman a piece of tissue left after an abortion that was regarded by him as of recent origin. The woman maintained that it was a portion of the product of a conception that had occurred at least eighteen months previously, being part of a blighted ovum retained in the uterus from October, 1892, when the threatening of an abortion had occurred, resulting in the death of the fetus.

No difficulty should exist in the determination of the probable age of an abortion. If the chorionic tissue be of recent origin, well-formed villi with preserved epithelium can be made out, whereas in missed abortion of some duration characteristic alterations can be made out. These are gradual disappearances of the fetal epithelium, amniotic and chorionic; fibrin formation in the blood of the intervillous spaces; and gradual invasion of the fibrin by connective tissue of decidual type. Fothergill believes that these decidual cells gradually absorb the fibrin and the remains of epithelial cells, and that thus the connective-tissue cores of the villi tend to be surrounded by decidual tissue, the whole forming a firm mass. To it Hartman and Toupet have applied the name "*deciduoma benignum*." Sometimes calcification may take place in the villi.

**Prognosis.**—Loss of the mother's life rarely accompanies spontaneous abortion. Yet a fatal result may sometimes take place from hemorrhage or rupture of the uterus; sometimes it may be due to an acute or chronic infective process. *Deciduoma malignum* may develop in connection with an abortion, causing death.

In many cases results follow that do not prove fatal, but lead to much ill health. These are mainly associated with incomplete abortion, which may lead to protracted loss of blood, to the development of a fibrinous polypus, to subinvolution of the uterus with hypertrophied and congested mucosa, and in cases of infection to various forms of pelvic and systemic disturbances. Complete abortion may be followed by ill health, due to great loss of blood or to the results of septic infection. A rapid succession of abortions usually leads to deterioration of the system from one or more of the above causes. Many women injure themselves by regarding an abortion as a matter of no importance. They either refuse to cease from ordinary routine of their life, or if they go to

bed, rise too soon and work too early. As a consequence, protracted weakness, subinvolution, displacements, etc., are apt to result. In criminal abortion the risks to the mother are enormously increased owing to the unskilful use of instruments, to the lack of aseptic measures, or, when drugs are employed, to their destructive effects on the system.

**Differential Diagnosis.**—There are difficulties of diagnosis in connection with the different varieties of abortion. A threatening abortion may simulate a number of conditions, and *vice versa*. The most important point in making a diagnosis is to determine whether or not pregnancy exists. To do this is often impossible, especially in the early weeks. Consequently there is often much uncertainty in diagnosing abortion. In women who have irregular menstruation, a flow of blood coming on after several weeks of amenorrhea may be mistaken for abortion. The error is more easily made when the flow is accompanied with uterine pains of a labor-like character. The case may be more complicated when there is some uterine enlargement, such as may be due to inflammation or new growth of the uterus and when some of the reflex signs and symptoms of pregnancy are present. Sometimes there may be pelvic pain and loss of blood, due to some condition outside of the uterus altogether—*i. e.*, vaginal new growths, hemorrhoids, etc. Haultain has described an interesting case in which a clot in the bladder caused dilatation of the sphincter urethrae, thus allowing blood to escape, a threatening abortion being closely simulated. A uterine hemorrhage occurring in the course of an ectopic pregnancy is often mistaken for an abortion, sometimes with serious results. In some cases of pregnancy there is in the early months an escape of blood from the uterus before the space between the reflexa and vera is obliterated; it may occur in successive gestations in the same woman. Usually such a case is regarded as a threatened abortion.

The fact of threatened abortion being established, it is often difficult to decide whether or not it is inevitable. If the bleeding be profuse, or if under treatment it ceases and begins again; if uterine contractions are frequent and strong and continue in spite of treatment; if the cervix be dilated so that a finger may feel parts of the ovum or decidua bulging into the cervical canal; if the amniotic cavity be ruptured or the fetus be dead, the abortion must be regarded as inevitable in the great majority of cases. Occasionally, however, the physician makes a mistake and is surprised to find that abortion does not occur, even though the symptoms have been so marked as to lead him to believe it inevitable. Cases have been recorded in which even the amniotic cavity has been ruptured and yet pregnancy has continued to full time. With regard to the condition of the fetus, it is to be noted that in the first three or four months it is impossible to know when

it has died. Usually this occurrence is soon followed by emptying of the uterus, but in a few cases this does not follow, and it is then found that there is gradual disappearance of the various reflex sympathetic symptoms and signs of pregnancy.

In the early months the latter may be very slight in certain cases, and their disappearance may, therefore, be unrecognizable. When an abortion has occurred it is very important to decide whether it has been complete or incomplete. It is possible to give a positive diagnosis only when the physician is able to examine what has been passed from the uterus; in the great majority of cases he is unable to do this. If he cannot decide in this way, he may gain information either by examining the interior of the organ under anesthesia or by watching the clinical phenomena for some time after the abortion. The first method is satisfactory in a certain measure, but it is impossible to be accurate, especially with regard to determining whether or not the decidual tissue has separated. In all cases of doubt the uterus should be curetted if the operation can be properly carried out. The second method is fairly satisfactory, though it subjects the patient to risks. If an abortion be incomplete, the uterus does not remain as firm and small as after complete expulsion; the lochial discharge is usually more profuse, the loss of blood more marked, remaining continuous or intermittent for days and weeks, and the patient's health depressed.

A complete abortion may itself be easily mistaken for other conditions, and *vice versa*. Thus, a period of amenorrhea followed by a profuse loss of blood, which may continue intermittently afterward with excessive leukorrhœa and general weakness, may be due to inflammatory conditions of the uterus, retroversion, mucous or fibroid polypi, or other conditions. Sometimes these diseased states may reflexly set up some of the well-known signs and symptoms of pregnancy. When a fibrinous polypus has formed after an incomplete abortion, it may easily be mistaken for a true neoplasm, simple or malignant. When putrefactive changes take place in the remains of an incomplete abortion, the signs and symptoms may closely simulate those of malignant disease or of a sloughing fibroid.

Missed abortion may often be very difficult to diagnose. Sometimes it is regarded as a second pregnancy, an abortion having been thought to occur when only a threatening has taken place. Generally the pregnancy is regarded as continuing satisfactorily following upon a threatened interruption. The observation of a few weeks, however, shows that the uterus is not developing in a normal manner. In some cases the diagnosis of new growth of the uterus is made. This is particularly apt to be the case if hemorrhages occur, if the finger introduced into the cervix feels

a mass in the cavity, or if putrefaction has begun, leading to a foul-smelling discharge from the uterus.

**Treatment.**—*Prophylactic.*—When a woman has aborted once or several times, the most careful examination should be made and treatment carried out before she becomes pregnant again. If her health be much run down, an effort should be made to restore it. If there be a syphilitic taint, the parents should be subjected to a long course of antisiphilitic remedies before pregnancy is allowed to occur again. Diseased conditions in the pelvis should be treated. Thus, a retroverted uterus may require to be replaced and supported by a pessary. Sometimes the removal of adhesions by operation may be necessary. A tumor may require to be taken away. If there be chronic inflammation in the uterus, it should be reduced. After an abortion has occurred, at least eight months (in the syphilitic cases much longer) should elapse before pregnancy is allowed to take place again.

When the woman falls pregnant she must take particular care of herself, avoiding excitement and fatigue and paying attention to the digestive tract. She should rest in bed during the times corresponding to menstrual periods, not rising even to urinate or defecate.

Coitus during pregnancy should be prohibited, especially in the first half. Purgatives should be avoided. Iron and other tonics need be given only when the system requires them. The administration of potassium chlorate, as recommended by Simpson, is thought by many to exercise a beneficial influence. The correction of pelvic disorders may be necessary.

*In Threatened Abortion.*—The patient must be kept absolutely at rest in bed. For defecation and urination a bedpan should be used. If the bowels do not move naturally, laxatives should not be given; it is best that the bowels remain quiet for a few days. The diet should be simple, light, and non-stimulating. Opium or morphin should be administered. At first, if uterine contractions are marked, a hypodermic injection of the latter ( $\frac{1}{4}$  gr.) may be given, followed in four hours by a rectal suppository ( $\frac{1}{4}$  gr.). This may be repeated every four or five hours until uterine contractions are quieted; then the quantity may be cautiously diminished. In some cases the drug may be continued several days. *Viburnum prunifolium* (liquid extract) given by the mouth in half-dram or dram doses every six or eight hours is used by many physicians as an accessory to the morphin. Chloral and bromids are also used. Cocain rectal suppositories are recommended by MacVie. To obtain a movement of the bowels a glycerin and olive oil enema should be used.

When the treatment is satisfactory, the pains and hemorrhage gradually disappear. The woman should not then be allowed to rise, but should be kept at rest a week or more. When she gets

up she should be very careful to avoid all strain, fatigue, excitement, and worry, and should lie down in the middle of the day for an hour or two during the succeeding few weeks. At the succeeding periods corresponding to her menstruation she should spend a few days in bed.

*In Inevitable Abortion.*—There is some difference of opinion as to the best method of conducting such an abortion case. Should nature be allowed to act, or should artificial means always be adopted? There is no doubt that artificial cleaning out of the uterus under proper aseptic precautions is a most satisfactory procedure, but it is best not to employ this method unless conditions are suitable to a perfect technic. Very often the patient will not allow it to be employed. The carelessness on the part of women in regard to the conduct of abortion is much to be deprecated; on the part of the physician it is unpardonable. The recklessness with which many practitioners carry out surgical interference without any regard to asepsis is the cause of much calamity.

In a number of cases the uterus may entirely empty itself if the patient be left at rest in bed, and no interference may be necessary. If, however, it be feared that the vagina is not aseptic by reason of digital examination, recent coitus, or some diseased condition, it is best to make use of antiseptic agents in order to prevent infection. These may be applied in the form of frequent antiseptic vaginal douches. In cases in which hemorrhage is excessive it is best, after cleansing the vagina, to tampon the latter firmly with antiseptic or aseptic gauze. In cases also in which the abortion proceeds slowly a tampon is advisable: it acts both as a stimulant to uterine contraction and as a mechanical obstruction to bleeding. It must be noted that in pregnancies later than the fourth month bleeding may go on *in utero* in some cases even though a firm vaginal tampon be in position. To avoid this it is well to allow the liquor amnii to escape by puncturing the amnion, and then to introduce the gauze into the uterus before tamponing the vagina. The plug may be removed in ten or twelve hours, when the complete abortion mass may often be found in the vagina. If this is not the case, another tampon may be introduced for twelve hours longer. If, however, the uterus be not emptied, the patient may be anesthetized, and the mass removed with fingers and curet. A hot intra-uterine douche is then given and the patient kept at rest for ten or twelve days. Many advise the use of ergot in order to promote expulsion and to check hemorrhage. In the author's opinion this is an unnecessary procedure. In diminishing the hemorrhage of abortion it is not so satisfactory as the vaginal tampon, and the large doses necessary are very apt to contract the uterus to such an extent that the os internum will not allow the uterine contents to pass through easily. If the

drug be used at all, it should be given in small doses to improve the tone of the uterine musculature, in cases in which it acts feebly, without producing violent contraction. Quinin is also recommended for this purpose.

*In Complete Abortion.*—When the uterus has spontaneously emptied itself, the patient should be kept in bed and treated as though normal labor had occurred; she should not be allowed to rise before the tenth day. If there is reason to suspect that the vagina is not sterile, warm antiseptic vaginal douches should be given twice daily for at least a week. When much blood has been lost or the uterus does not contract well, ergot may be given for a few days. Intra-uterine douching is necessary only when blood-clots tend to accumulate above the os internum or when there is evidence of intra-uterine infection; it should be carried out only by means of a double catheter. Sometimes so profuse a hemorrhage may occur after a complete abortion as to require an intra-uterine or a vaginal tampon for twenty-four hours or more.

*In Incomplete Abortion.*—The ordinary practice of administering ergot when the uterus is incompletely emptied cannot be too highly condemned. Though bleeding may be checked for a time, the woman is left in a condition very favorable to the development of after-troubles—*i. e.*, recurrent hemorrhage, subinvolution, and acute or chronic infective processes. An incomplete abortion mass is a foreign body that should be removed from the uterus. There is some difference of opinion as to whether this should apply to a non-separated and retained decidua vera. As nature's method in spontaneous abortion produces exfoliation and delivery of the superficial vera, discussion is surely needless. There is no doubt that retention of a considerable portion of the vera may lead to after-troubles in many cases—*i. e.*, congestion and subinvolution.

Removal of the uterine contents should be carried out as a surgical operation, with the strictest attention to technic. The patient should be anesthetized and placed in the lithotomy position. The vulva and vagina should be thoroughly cleansed, the bladder and rectum having been emptied. The cervix, held by a volsella, should be dilated with a series of graduated dilators until one or two fingers can be introduced into the cavity of the uterus. The other hand presses down the uterus through the abdominal wall while the intra-uterine fingers explore the cavity, separating the abortion remains from the wall. These portions may be removed in some cases by the fingers; when this is impossible, the curet forceps may be employed. Small shreds may be washed out with a stream of water. When it is impossible to separate all the tissue from the wall with the fingers, a curet forceps and a curet may then be employed. In some cases in which the cervix contracts even after dilatation has been carried out these instru-

ments alone can be used. In the fifth or sixth month, when the fetus is of considerable size, if contraction of the cervix is very marked, it is best to dilate as much as possible and then to introduce a Barnes bag. After twelve or fourteen hours, if the abortion has not occurred, the uterus may then be more easily emptied. The after-treatment is the same as that already described.

*In Missed Abortion.*—When this condition is diagnosed, the uterus should be emptied. Sometimes the vaginal tampon may stimulate the uterus to contraction. In other cases the introduction of a tampon or Barnes bag into the cervix for a few hours may be necessary. Sometimes dilatation may be carried out so that the uterine contents may be removed by fingers, curet, and curet forceps. In every instance the uterus should be carefully explored to insure that nothing be left behind.

## CHAPTER XIV.

### ECLAMPSIA.

ECLAMPSIA is an acute convulsive attack, characterized in a typical case by tonic and clonic muscular contractions and loss of consciousness. The disease may begin in pregnancy, labor, or the puerperium.

**Frequency.**—It is difficult to form a correct estimate of the frequency of eclampsia. Veit and others give a general proportion of 1 in 500; Parvin, 1 in 333, for the United States; and Corson, 1 in 300. The percentage is greater in hospital than in private practice, because these complicated cases are so frequently sent to institutions. Löhlein, in 1891, gathered statistics from 30 German, Austrian, and Swiss hospitals, and found a proportion of 1 in 161, or 325 cases in 52,328 labors. Newell reports 79 cases in 6700 labors, or 1 in 84.8. Veit, in 1896, found a proportion of 1 in 166, or 905 cases in 149,366 labors. Charpentier, among 258,969 labors in France, found 731 cases of eclampsia, or 1 in 354. Schreiber, among 42,609 labors in Vienna, found 137, or 1 in 311.

Great variations may be found in different parts of the same country. Schmitt has published the following statistics regarding various lying-in institutions:

| Place.                                       | Years.  | Ratio.    |
|--|---------|-----------|
| Berlin (Universitäts-Frauenklinik) . . . . . | 1877-85 | 1 in 49   |
| Berlin (Charité) . . . . .                   | 1882-83 | 1 in 91   |
| “ “ . . . . .                                | 1874-70 | 1 in 246  |
| Königsberg . . . . .                         | 1874-77 | 1 in 261  |
| Dresden . . . . .                            | 1873-78 | 1 in 275  |
| Munich . . . . .                             | 1850-79 | 1 in 522  |
| Tübingen . . . . .                           | 1869-90 | 1 in 1697 |

The figures for Tübingen are remarkably low. Von Säxinger, in that town, had not a single case in his clinic during twelve years.

Some authors have pointed out a tendency to the occurrence of eclampsia at special periods. Olshausen, in five and a half years' experience in Berlin, noted that the cases occurred especially between September and February, sometimes being so close together as to be termed epidemic. Schroeder held that damp weather might determine an outbreak. Other authors, however, deny that there is any epidemic tendency.

Eclampsia is more frequent in primiparæ. The percentage among them has been given by Löhlein at 85.4, by Schauta at 82.6, by Braun at 86.3, by Olshausen at 74, and by Newell 72.2. Goldberg states that in 10,705 cases of labor collected by Leopold, of which 5363 were primiparæ and 5342 multiparæ, eclampsia occurred in 1.32 per cent. of the former and in 0.21 per cent. of the latter. Geuer reports 5000 labors in the Cologne Maternity, among which 50 cases of eclampsia occurred; of these, 42 were primiparæ. In Schreiber's 137 cases, 100, or 79.5 per cent., were primiparæ.

It is generally stated that a considerable percentage of eclampsia cases is found in very young primiparæ—*i. e.*, in those under twenty—and in those over thirty. Thus, Dührssen reports 195 cases in which the eclampsia occurred in those below twenty and in those over thirty in 40.5 per cent.; Zweifel reports a percentage of 25. In Olshausen's cases 25 per cent. were primiparæ over twenty-eight.

In most cases eclampsia develops during labor, and there is a slightly lower percentage in the puerperium than in pregnancy. The following statistics may be quoted:

|                     | Pregnancy.   | Labor.       | Puerperium.  |
|---------------------|--------------|--------------|--------------|
| Schroeder . . . . . | 20 per cent. | 60 per cent. | 20 per cent. |
| Braun . . . . .     | 28 "         | 53 "         | 19 "         |
| Winckel . . . . .   | 23 "         | 60 "         | 17 "         |
| Olshausen . . . . . | 40 "         | 46 "         | 14 "         |
| Dührssen . . . . .  | 27.5 "       | 48.5 "       | 24 "         |
| Goldberg . . . . .  | 25.9 "       | 57.14 "      | 16.8 "       |
| Geuer . . . . .     | 12 "         | 74 "         | 14 "         |
| Schreiber . . . . . | 16.78 "      | 62.04 "      | 21.16 "      |

Green's statistics during eight years' experience at the Boston Lying-in Hospital were as follows:

|                                  | Maternal mortality. | Fetal mortality. |
|----------------------------------|---------------------|------------------|
| Eclampsia before labor . . . . . | 46 per cent.        | 69 per cent.     |
| " during " . . . . .             | 25 "                | 25 "             |
| " after " . . . . .              | 7 "                 |                  |

In Schreiber's 137 collected cases the maternal mortality of

cases commencing before labor was 30.43 per cent.; during labor, 18.82 per cent.; after labor, 13.79 per cent.

Dührssen gives the following analysis of his 195 cases :

| Eclampsia.                                | Primiparae. | Multiparae. |
|---|-------------|-------------|
| Before labor . . . . .                    | 25          | 6           |
| Before and during labor . . . . .         | 13          | 2           |
| Before and after labor . . . . .          | 6           | 0           |
| Before, during, and after labor . . . . . | 3           | 0           |
| During and after labor . . . . .          | 40          | 7           |
| During labor . . . . .                    | 41          | 5           |
| After labor . . . . .                     | 35          | 12          |
| Totals . . . . .                          | 163         | 32          |

It is interesting to note how frequently the disease develops among primiparae during labor. As regards the occurrence of eclampsia in pregnancy, it is to be noted that it is most frequent in the late months. It has, however, been observed as early as the fourth month by Willis. Tarnier gives the following statistics of 52 cases :

|                     |                       |
|---------------------|-----------------------|
| 1 case at 5 months. | 14 cases at 8 months. |
| 5 cases at 6 " "    | 5 " 8½ "              |
| 4 " 7 " "           | 16 " 9 " "            |

Bar's statistics of 48 cases are :

|                      |                       |
|----------------------|-----------------------|
| 2 cases at 6 months. | 10 cases at 8 months. |
| 1 case at 6½ " "     | 4 " 8 " "             |
| 8 cases at 7 " "     | 20 " 9 " "            |
| 3 " 7½ " "           |                       |

As regards the puerperium, eclampsia very rarely develops after the fourth day—generally within a few hours of labor.

**Recurrence.**—A small percentage of women are affected more than once in a series of pregnancies. In Leopold's 81 cases it occurred more than once in 2.5 per cent.; in 1 case it developed in 3 successive pregnancies. In Olshausen's cases it occurred in 1 per cent. There may sometimes be an interval of one or more normal labors.

**Symptomatology.**—In a number of cases eclampsia develops suddenly, when the woman is apparently in a good state of health. Frequently, however, there are prodromal or pre-eclamptic phenomena. These vary considerably in different cases. Very often severe headache is present, generally in the suboccipital region. There may be neuralgic pains in one or more terminal branches of the sensory cranial nerves, amaurosis, color-blindness, photophobia, diplopia, strabismus; deafness, increased acuteness of hearing, ringing and buzzing in the ears; occasionally there are disturbances of general sensation—*i. e.*, hyperesthesia, anesthesia, formication, and tingling. Disturbed brain functions are some-

times found—*i. e.*, sleepiness, stupor, insomnia, mental confusion or excitement, and despondency. Sometimes an attack is preceded by terrifying dreams, nightmare, and restlessness during sleep. Rarely there is a dread of impending trouble.

Pain and distress in the epigastrium are frequent, and may be accompanied by nausea and vomiting. Constipation is not infrequent, but diarrhea may sometimes exist. In some cases dyspnea is a prominent feature; it is usually aggravated by the slightest exertion. The temperature is generally normal. Albumin is frequently present in variable quantities in the urine; sometimes it may increase considerably just before the attack. The urea may be deficient or the quantity of urine may be below normal. Edema is found in a considerable number of cases.

These signs and symptoms occur in great variations, and they may be found during hours, days, or weeks preceding an attack. When some of these phenomena are found in a pregnant woman, eclampsia does not necessarily follow. Their presence should, however, always be regarded as a warning and should lead to careful examination and treatment of the woman.

The eclamptic attack occurs after a variety of conditions; it may come on after sleep or after a period of quiet living. Sometimes it may follow exercise, emotional excitement, or depression, change of diet from simple to indigestible food, etc. It is very often impossible to establish with accuracy a causal connection between the attack and an event that preceded it. Very rarely there may be an aura or warning that an attack is coming; it may be motor, sensory, or psychic. In a typical eclamptic seizure three stages may be described:

1. **Stage of Invasion.**—Fine, rapid choreic movements are seen in the facial muscles. The eyelids move quickly and the eyeballs roll up and down. The *alæ nasi* and mouth are moved convulsively, the latter often being twisted to one side. The pupils may contract and then dilate, becoming insensible to light. Almost immediately similar movements may be noticed in other parts, especially in the arms. The fingers are frequently clenched and the forearms pronated. The abdominal muscles are rarely affected. The face becomes cyanosed. This stage rarely lasts longer than a minute.

2. **Stage of Tonic Convulsions.**—The face becomes fixed, the jaws firmly shut, resulting often in injury to the tongue. (Injury to the tongue may be accompanied by septic infection. In a few cases tetanus infection has occurred.) The neck may be bent back and the back markedly curved. The arms become extended and stiff, the fists being firmly clenched. The thighs may be flexed on the body. The muscles of respiration are affected, the glottis being closed and the chest more or less fixed, and breathing may be suspended for a short time, or there may be one or two

spasmodic respirations. There is some asphyxiation. Loss of sensation and consciousness is generally complete. This stage lasts only a few seconds.

3. **Stage of Clonic Spasms.**—Clonic movements rapidly supervene after the tonic convulsions, often following a long respiration. They begin in the face and spread to the neck, arms, and other parts. The face may be markedly distorted and congested; the eyelids and jaws open and close rapidly. Blood and saliva flow from the mouth. This stage may last a few seconds or one or two minutes; sometimes it may be prolonged. Tarnier has reported it as lasting twenty minutes in one case.

In many cases the eclamptic attack does not follow this typical course. All degrees of movements may occur. Sometimes there may be very slight contraction of the facial muscles, the attack not proceeding beyond a few of the phenomena of the invasion stage. In some cases the tonic stage is very short and scarcely perceptible, clonic movements being mainly noticeable. In other cases the attack may be unusually prolonged in one or more of the stages—most frequently that of clonic contractions. Sometimes the whole attack may last thirty or sixty minutes. Rarely only one attack occurs. When there are several, they succeed one another at intervals of varying length—seconds, minutes, or hours. Sometimes a period of one or more days may intervene.

During an attack the pulse is small in volume and rapid. The arterial tension is increased, especially during the height of tonic convulsions, when the pulse usually becomes irregular. After the attack the pulse improves. When a series of attacks rapidly occur, Ballantyne has shown that the blood-pressure lessens, the pulse becomes dicrotic and very rapid, the sphygmographic curve resembling that found in acute anemia. During an attack the temperature usually rises, many variations being found. When attacks are frequent, ending fatally, the temperature continues to rise to 104° F., or higher, and may even become higher after death. In some cases it is not so affected by frequency or intensity of attack, and may remain stationary or rise very slightly. In some cases where the attack ceases the temperature may rise. Occasionally a fall is noted before death occurs. Sometimes after a considerable rise there may be a gradual return to normal; this may or may not be followed by fresh attacks. It may rise after a few hours to a high point.

When eclampsia occurs during pregnancy, labor usually takes place shortly afterward. In some cases the attack is coincident with the onset of definite pains. During the attacks uterine contractions continue and may be more intense and rapid. Labor sometimes proceeds very quickly. When marked tonic contractions affect the abdominal muscles, the fetus and uterus may be

markedly pushed downward. The uterus probably does not share in the convulsive contractions. The ordinary movements of the fetus are sometimes intensified.

**Condition of the Patient after an Attack.**—In some cases, where there are very slight muscular movements, the patient may never lose consciousness nor feel much disturbed. When a well-marked seizure occurs, consciousness and lucidity may sometimes return after a few seconds; ordinarily, however, there are lassitude and dulness. Headache may be marked. There may be more or less dimness of vision. Frequently there is a semi-comatose condition, during which the patient may lie quiet unless she be disturbed, when she may attempt to mumble incoherently or to move without purpose. In some cases there is profound coma; rarely this is followed by maniacal symptoms.

Occasionally after an attack the patient may sleep for some time, and on waking may not know what has happened, even though labor may have been completed. In some cases of recovery there may be a continuance of the above-mentioned disturbances for varying periods; sometimes loss of memory or mental derangement may continue indefinitely. Occasionally contractions or paralyses may continue as the result of damage to the central nervous system. Pneumonia, pleurisy, gangrene of the lung, or sepsis may follow eclampsia; chronic renal disorder may continue.

**Labor in Eclampsia.**—Some authors state that labor is always shortened by the eclamptic attacks; it is difficult to prove this. The disease does not, at least, appear to lead to a prolongation. Postpartum hemorrhage is frequent, mainly due to uterine inertia; this may be caused by excessive anesthesia, hurried delivery, or lacerations. Eclamptics are especially liable to septic infection, and the delivery must be conducted with the strictest regard to asepsis.

**Diagnosis.**—(a) **In the Pre-eclamptic Stage.**—The various premonitory phenomena already described may easily be misinterpreted, especially if very few are present or are not well pronounced. The warning significance of mental disturbance, headache, neuralgia, epigastric pain, anemia, etc., may thus be entirely overlooked.

(b) **During an Eclamptic Attack.**—The eclamptic seizure must be distinguished from various conditions. It may be mistaken for hysteria, but in this disease the patient is rarely unconscious and does not injure the tongue. There is often marked excitement. Convulsions are more irregular and disordered. There is an absence of well-marked clonic spasms. The patient often cries or laughs, and the attack is not followed by coma. Edema or albuminuria is not present, and frequently abundant clear urine is passed. There may be a history of previous similar attacks in the non-pregnant state.

Epilepsy is distinguished from eclampsia by a history of previous attacks and by the absence of the pre-eclamptic phenomena. There is often a distinct aura, which does not usually precede an eclamptic attack. The invasion stage is usually more severe and sudden in epilepsy; the patient usually falls suddenly and there is often an initial cry, whereas in eclampsia the latter is rare. In epilepsy the temperature is not raised at all or only slightly. Edema and albuminuria are not found save when due to some associated disease.

Meningitis may simulate eclampsia, but it is very rare. Delirium is apt to be present; fever precedes the convulsions, which are usually more localized than those of eclampsia and tend to get worse only gradually. The pulse is often slow when the temperature is elevated.

Brain tumor may also bear certain resemblances, but symptoms are usually preceded by a gradual history, and often there are local changes due to pressure—*c. g.*, optic neuritis—sufficient to establish a diagnosis.

Cerebral apoplexy may simulate eclampsia, but it is very rare in pregnancy; it usually begins suddenly, without prodromata. Convulsions are rare and paralysis is evident. It must be remembered that eclampsia may sometimes be complicated by cerebral hemorrhage, and the diagnosis is generally established when paralysis supervenes.

(*c*) **In the Stage of Coma.**—If a patient be first seen by the physician in the comatose condition following the convulsive stage, the case might be mistaken for one of alcoholism. It might be difficult to be certain unless the woman's breath indicated that she had been drinking. Albumin and casts would not likely be present in her urine if she were drunk.

Post-eclamptic stupor might easily be mistaken for cerebral concussion or cerebral hemorrhage. In the latter condition paralysis would probably be present and the temperature low if taken early in the hemorrhage; no changes would be expected in the urine. Post-epileptic stupor simulates post-eclamptic stupor, but is of short duration and marked by little or no rise of temperature, neither are there changes in the urine. In all cases of doubt careful examination of the urine should be made.

**Prognosis.**—Eclampsia is a very serious disease; the maternal mortality is variously estimated. Judging from statistics, it has not been so high in recent as in former years. Thus, Becquerel placed it at 50 per cent., Pajot at 46 per cent., and Brummerstadt at 37 per cent. In Tarnier's experience it was 30 per cent.; in Olshausen's, 25 per cent.; in Dührssen's, 21 per cent.; in Paupertoff's, 20.8 per cent.; in Löhlein's, 23.7 per cent.; in Leopold's, 24.7 per cent. If from these figures be deducted the cases in which death resulted from complications, the percentage would be

slightly reduced. Thus, Löhlein's rate would be diminished to 19.38 per cent.; Dührssen's to 19.8 per cent.; and Leopold's to 29 per cent.

The mortality is greater in multiparæ than in primiparæ. The following statistics are given:

| Observer.          | Multiparæ.     | Primiparæ.     |
|--------------------|----------------|----------------|
| Löhlein . . . . .  | 33.3 per cent. | 20.5 per cent. |
| Goldberg . . . . . | 45.4 "         | 21.4 "         |
| Dührssen . . . . . | 28 "           | 19 "           |

In Löhlein's 325 cases the mortality was distributed as follows:

|                        | Primiparæ. |                     | Multiparæ. |                     |
|------------------------|------------|---------------------|------------|---------------------|
|                        | Diseased.  | Died.               | Diseased.  | Died.               |
| In pregnancy . . . . . | 69         | 17 (24.3 per cent.) | 34         | 10 (29.4 per cent.) |
| In labor . . . . .     | 115        | 18 (15.7 " )        | 31         | 7 (22.6 " )         |
| After labor . . . . .  | 60         | 7 (11.6 " )         | 16         | 4 (25.6 " )         |

This table shows the highest death-rate to be among multiparæ in pregnancy, and the lowest to be among primiparæ during the puerperium. Tarnier found, however, that his mortality was 27 per cent. during labor, 31 per cent. during pregnancy, and 42 per cent. in the puerperium. In pregnancy the prognosis is worse the earlier the eclampsia develops. Of the cases occurring during parturition, the most favorable are probably those in which the attack develops when labor is well advanced.

As regards the relationships to the number of attacks, it appears that the more numerous they are, the greater the risk of death. Charpentier has published the following statistics:

| Number of attacks. | Mortality.   |
|--------------------|--------------|
| 1 to 10 . . . . .  | 25 per cent. |
| 10 to 20 . . . . . | 33 "         |
| 21 to 50 . . . . . | 50 "         |

Schauta's statistics are as follows:

| Number of attacks. | Cases. | Number of deaths. | Mortality.     |
|--------------------|--------|-------------------|----------------|
| 10 . . . . .       | 152    | 36                | 23.6 per cent. |
| 11 to 20 . . . . . | 62     | 17                | 27.4 "         |
| 21 to 30 . . . . . | 24     | 12                | 50 "           |
| 31 to 40 . . . . . | 17     | 13                | 76 "           |
| 41 to 50 . . . . . | 5      | 3                 | 60 "           |
| 51 to 60 . . . . . | 4      | 4                 | 100 "          |

Geuer observed in a study of 12 cases of death in a series of 50 cases of eclampsia that the greatest number of attacks was 50 and the smallest 4. Among the 38 cases which recovered the greatest number of attacks was 17 and the smallest 1. In some cases a very large number of fits may be observed. Charpentier, Depaul, and Critel are reported to have counted more than 150

attacks in different cases. Such cases are almost always fatal; very rarely recovery may follow, as in a case reported by Bailly and Pajot, in which there were more than 100 fits. Goldberg states that in Leopold's cases the attacks numbered from 8 to 24 in those who died. The average for all cases in primiparæ was 7, and in multiparæ 10 attacks.

The prognosis must indeed always be grave where 15 or more fits take place. It must, however, be remembered that death may take place when only one or a few attacks are noted. The more prolonged the fits, especially in the tonic stage, the more serious they are. Budin states that the prognosis becomes more grave the higher the temperature rises. The more profound the coma, the worse the outlook. Maniacal symptoms are very unfavorable. Improvement in the condition of the pulse between the attacks is a favorable sign. The outlook is bad when it continues small, wiry, and frequent or irregular; as long as it is full, hard, and regular, even though frequent, there is usually no immediate danger. Extreme dyspnea is unfavorable, especially if pulmonary edema be present. Anasarca does not warrant a bad prognosis unless it increases rapidly during and after the attacks.

The prognosis is unfavorable when the urine is diminishing rapidly, when the urea is very scanty, and when casts and albumin are abundant. Tarnier and Budin state that icterus with high temperature, scanty and blood-stained urine, and subcutaneous ecchymoses makes the prognosis serious, but that icterus without the other signs is not necessarily grave. Early profuse perspiration is a favorable sign. If the fetus dies early in the attacks, the prospects of recovery are greater.

The prognosis may be made worse by delay in treatment or by injudicious treatment. Thus, when the uterus is emptied excessive shock and marked loss of blood may exercise a bad influence on the case. Moreover, faulty technic is very liable to lead to septic infection. In many cases asphyxiation plays an important part, the oxygenation of the blood being diminished as a result of the interference with breathing caused by the fixing of the muscles of respiration. The asphyxiation is worse when pulmonary edema is present and when fat embolism occurs in the lung capillaries. The respiratory center is also probably affected by the toxic matters circulating in the blood, and it may be gradually paralyzed. The heart muscle may become paralyzed as a result of direct poisoning as well as of interference with the function of the lungs. Degeneration of the blood and destructive changes in various organs are important factors. Cerebral congestion and edema may tend to hasten a fatal issue in some cases, while in others cerebral hemorrhage is the determining cause. In some cases an acute or chronic septic infection may be fatal. Rarely pneumonia, gangrene of the lung, and other conditions may cause death.

**Fetal Mortality.**—The fetal death-rate is high, different statistics being given. Tarnier found in 304 cases a percentage of 60; Depaul, in 132 cases, 48 per cent.; Löhlein, in 325 cases, 56 per cent.; Olshausen, in 200 cases, 45 per cent. Schauta states that the mortality is higher in multiparæ than in primiparæ. Dührssen, in an analysis of fetal deaths in reference to the period of pregnancy, states that in the seventh month and earlier the mortality is 100 per cent. He found that in 14 cases in the eighth month it was 93 per cent.; in 13 cases in the ninth month it was 54 per cent.; in 90 cases at term, 37.8 per cent.

Rarely convulsions may appear in a child which survives labor, due to the influence of toxic material absorbed *in utero*. Kreuzmann has recently reported a case of albuminuria in a mother who developed no eclamptic phenomena; the child, however, had convulsions thirty-six hours after labor. He considered that the toxic agents had been absorbed from the colostrum that the child swallowed when suckling.

The causes of the fetal mortality are not absolutely determined; asphyxiation may be an important factor. During the periods in which the maternal blood is asphyxiated on account of the interference with respiration, there is a marked diminution in the amount of oxygen that passes from the maternal to the fetal blood. In some cases placental infarcts are abundant, and as a result many villi are rendered functionless; these may, therefore, greatly interfere with the oxygenation of the fetal blood. When there is a high maternal temperature, the vitality of the fetus is impaired. Prematurity of delivery exercises a bad influence in many cases. The poisons circulating in the maternal blood probably play a very important part in destroying the fetus. In some cases the method of treatment is responsible for death of the fetus.

**Pathology.**—A great many changes are found in cases of eclampsia. So numerous and variable are they that at the present time it is impossible to be certain as to the features that are to be considered as characteristic of the disease.

**Urinary System.**—The association of albuminuria and edema with eclampsia has been noted for many years. In recent times special attention has been given to the renal changes occurring in some cases of pregnancy and labor where eclampsia is absent, especially in primiparæ, leading to the use of the term "kidney of pregnancy." These changes and their relationship to nephritis have already been considered along with the various theories as to their causation. (See "Pathology of Pregnancy.") The occurrence of albuminuria and edema in pregnancy and labor, and even sometimes of uremic coma, apart from eclampsia, has also been described. The relationship of these conditions to eclampsia cannot be accurately estimated. They may be present, undoubtedly, with-

out eclampsia, but they occur in the circumstances in which the latter is most frequent, and are similar to the conditions found in eclampsia. Both may be produced by the same influences; only in eclampsia there is an uncertain additional factor that precipitates the convulsive seizures. Many variations are found in the urine in eclampsia. The total quantity is usually diminished. Albumin is frequently present in varying amounts. The specific gravity is generally high. Red and white blood-corpuscles, degenerated epithelium, and all kinds of casts may be present. The excretion of urea is less during the fits, as a rule, though the percentage may not vary.

In Dührssen's 196 cases in which the urine was examined the following conditions existed: Albuminuria in 189 cases (96 per cent.), abundant albumin in 174 cases (92 per cent.), formed elements (casts, epithelium, etc.) in 121 cases, hemoglobinuria in 4 cases, urobilin in 1 case. There were edema of the tissues in 113 cases and other evidences of kidney disturbance in 25 cases.

Sugar is sometimes found in the urine of eclamptics, but, as Fehling points out, this is probably milk-sugar in most cases, absorbed from the breasts. Acetone is sometimes found, and possibly may be associated with death of the fetus. Olshausen found albuminuria in 97 per cent. of cases, and it was abundant in 50 per cent. Leopold found it in 90.79 per cent., and edema in 50 per cent. Goldberg noted that the serious cases were associated with abundant albuminuria; of 20 which died, it was marked in 17. As regards the relation of edema to fatality, it is interesting to note Leopold's findings. This complication was present in 40 cases. It was severe in 10 cases, all of whom recovered; moderate in 17, of whom 5 died; slight in 13, of whom 5 died. Carstairs Douglas has suggested that possibly edema is a safety-valve for serous exudation, subcutaneous outpouring being less dangerous than intracranial, for example. It is interesting to note Bartel's statement regarding uremia in patients with Bright's disease. He states that it is more frequent, relatively and absolutely, among those who are not dropsical than among those who are.

The changes in the kidney structure are very variable; in some cases no alterations can be distinguished. In 37 cases Olshausen found acute and subacute processes in 22; in 73 cases Schmordl found changes in 72; in 368 cases Prutz found only 7 healthy kidneys. Cloudy swelling and fatty degeneration and necrosis of the epithelium were mostly observed, especially in the cortex. In a few cases there was interstitial nephritis, parenchymatous nephritis, or chronic interstitial changes. Renal hemorrhages were few. Fibrinous and hyaline thrombi were occasionally found in the glomeruli. In one of Olshausen's cases the right kidney was very small and cystic and its ureter very thin; in another the right ureter was somewhat dilated; in another ureteric dilatation

PLATE 10.



FIG. 1.—Kidney in eclampsia. The section is stained with neutral red and osmic acid, showing granular and fatty degeneration of the convoluted tubules (R. H. Bell).



FIG. 2.—The liver in eclampsia: *a*, Section showing degenerative changes—the spaces were mostly filled with fat; *b*, section through infarcted area (R. H. Bell).



was accompanied with some hydronephrosis; in another hydronephrosis alone was present. In Leopold's fatal cases 94 per cent. showed acute or chronic changes in the kidneys. Herzfeld, in 81 postmortem cases, found evidence of chronic nephritis in 38; in 25 cases he found parenchymatous degeneration of the tubules.

Prutz has made a careful study of the kidneys. In no instance did he find micro-organisms. The veins were congested in many. Fat droplets were obtained only in 3 cases in the glomeruli, vasa afferentia, intertubular capillaries, and other places. In 50 per cent. he found "Bürstenbesätzen"—*i. e.*, a peculiar fringed condition of the epithelial cells, mainly in the convoluted tubules and in the ascending and descending parts of Henle's loop. In many cases hyaline casts were present in the tubules, in whose epithelium cloudy swelling and pigmentation were present in many places. Occasionally blood-corpuscles were found in the tubules, and areas of small-cell infiltration were distinguished.

It is thus evident that a definite relationship cannot be established between eclampsia and renal changes. The latter may only be in a few cases an important causal factor. In many cases, in all probability, they are simply part of a series of widespread alterations produced by the underlying cause of all eclamptic phenomena, though other factors may sometimes assist in their production. The latter have already been referred to in describing the kidney of pregnancy. Nothing is more certain than that marked kidney disease may be accompanied by slight eclampsia, and that severe eclampsia may be associated with few renal changes, or with none in some cases. Regarding the ureters, only a few observations have been made. Distinct dilatation has been occasionally noted, one or both ureters being affected. It may be distended in its entire length or in its upper portion. Halbertsma claims to have found this change in a number of cases. Tarnier and Budin state that very slight dilatation of the upper part of the ureter is not infrequent.

Herzfeld, in examining 81 postmortem cases in the Pathologic Institute of Vienna, found compression of both ureters in 18 (22 per cent.). This bilateral change has been observed by him only in primiparæ, never in multiparæ, nor in primiparæ in whom the eclampsia began early in pregnancy or after labor. The ureters were compressed where they crossed the brim. Below this point they were normal; above, they were dilated to the size of a man's thumb, the renal pelvis being also dilated. Herzfeld points out that the ureters are somewhat protected at the brim by crossing the bifurcation of the common iliac. When the latter is abnormally high or low there is more risk of ureteric compression. Normally the right ureter is more liable to pressure than the left, as it crosses the external iliac at a lower level and enters the pelvis at more of an angle. It is interesting to note that in women who have

become pregnant after the loss of a kidney by operation no special tendency to eclampsia has been observed.

**Liver.**—Much attention has been given to the liver, Schmorl having been the first, in 1893, to describe fully changes in this organ. Stumpf has described changes compared by him to those found in acute yellow atrophy. The organ was diminished, the tissue yellow, with dark-red areas. In the center of these areas were granular and necrotic liver cells and red blood-corpuscles; many vessels were thrombosed. Leucin and tyrosin were frequently present. Others describe the liver as increased in size. Bar found in 17 cases that it weighed less than 1500 gm. in 2.



FIG. 146.—Naked-eye appearance of portion of liver removed from an eclamptic case postmortem. The dark area represents an infarcted portion in the degenerated liver (R. H. Bell).

Klebs described hemorrhages between hepatic cells, and noted embolism of branches of the portal vein, due to blocking with detached liver cells. Dührssen describes hepatic hypertrophy, hemorrhages, hepatitis parenchymatosa, and marked pallor. The liver is sometimes firm, sometimes friable; in some cases it may be very easily broken down. According to Jürgens, Schmorl, Pilliet, and others the most marked changes occur around branches of the portal vein, in many of which thrombosis often occurs.

The alterations found in the liver cannot be regarded as distinctive of eclampsia. They are characteristic of acute infectious disorders and of those in which severe toxemia is present. Their presence in eclampsia is strongly suggestive of circulating toxic matters capable of disintegrating the hepatic as well as other tissues. There is no doubt that the more the liver is disintegrated, the more powerful the influence of the circulating poisons, for undoubtedly the organ has the power of destroying the latter. In connection with the liver changes, reference may be made to icterus. Dührssen found it in 15.5 per cent. of his cases; Olshausen in 1 per cent. The former attributed it largely to the free use of chloroform, a drug little employed by Olshausen in eclampsia. Stumpf attributed it to bruising of the liver cells and injury of vessels. It must, however, be remembered that icterus may occur in pregnancy apart from marked

disease, and may be due to catarrh of the common bile-duct, to pressure, or to other unknown causes.

**Central Nervous System.**—Various changes have been found in the brain, but these are variable; in some cases nothing pathologic can be distinguished. Goldberg reported among Leopold's cases 4 with hemorrhages, 9 with edema, 4 with anemia, and 2 with hyperemia. Schauta, in 28 cases, found 25 with anemia and edema and 3 with apoplexy. Dührssen, in 42 cases, found 5 with apoplexy. In 30 of Olshausen's autopsies in which the head was carefully examined, edema of the brain substance, and often of the pia, was found in 16 cases. There were apoplexies in 5, and in 2 a large blood-clot in the pia; in 5 hyperemia of the brain, the membranes being also usually altered. Hyaline degeneration in the vessels of the meninges has been described by some. It is difficult to decide whether edema, anemia, or hyperemia is most frequent. Hemorrhages are infrequent, and likely are due to the effects of the convulsive attacks. Schmorl noted minute hemorrhages in the brain or membranes in 65 out of 73 cases. Pachymeningitis and leptomenigitis have occasionally been found, but are probably only a coincidence.

Klebs has described emboli of cells, which he thought to be hepatic in origin. (They were probably portions of fetal epiblast carried from the uterus.)

**Lungs.**—The most frequent change is edema, which may be due to various disturbances in the respiratory and circulatory systems or to drugs used in treatment; pleural effusion may be present at the same time. Sometimes blood-extravasations are found; sometimes fat emboli. Bronchopneumonia has frequently been reported as developing in eclampsia. Dührssen attributed it to the retention of the secretions containing germs and to the use of anesthetics. Schmorl described thrombi of multinucleated masses of protoplasm in the capillaries; these may frequently be found in normal women, being portions of fetal epiblast, mainly syncytium, that have been carried away by the veins from the uterus.

**Heart.**—Regarding the cardiac muscle, no definite changes have been determined. Fatty and granular degeneration and cloudy swelling are found in some cases; small hemorrhages may be noted. In 73 cases, Schmorl noted minute hemorrhages, and necrosis of muscle cells 42 times.

**Alimentary Canal.**—No definite changes are constant. Congestion of the mucosa is found with variations in the stomach and small intestine, especially the duodenum. In some cases small hemorrhages are present; in others erosions or ulcerations. Fatty changes have also been described. In some instances emboli of distant cells are found in capillaries, probably removed as the result of violent convulsions.

**Uterus.**—No characteristic change is found in the uterus in

eclampsia. In a number of cases excessive size of the organ is found—*i. e.*, twin pregnancy, hydramnios, and large fetus. In 325 cases of eclampsia analyzed by Löhlein there were 16 of twins and 1 of triplets, a proportion of 5 per cent. The same percentage was found in Dohrn's 40 cases; in Olshausen's 200 cases it was 8.7 per cent.; in Zweifel's 23 cases it was 21.7 per cent.; in Newell's 63 twin labors eclampsia occurred in 6 cases. There can be no doubt that there is a larger percentage of eclampsia in multiple than in single pregnancies, and the disease is probably more fatal in the former.

**Placenta.**—There are no distinctive placental lesions in eclampsia. It has long been taught that placental hemorrhages, described as infarcts, are common. There is no doubt that infarcts, varying in size and color, are frequently found in eclamptic cases, but they are also found in other diseased conditions, and frequently when the health is good. In some cases they may not be visible to the naked eye. I have already described these infarcts, and have shown that in the great majority of instances they are not due to blood-extravasation, but to the formation of blood-clots as the result of degenerative changes in the fetal tissue of the placenta. A real outpouring of blood is very rare. In every placenta from advanced pregnancy these changes are present and small fibrin-clots can be distinguished. The largest and most numerous "infarcts" are found in albuminuric women, in eclampsia, syphilis, and some other conditions. Favre's view that the infarct is due to the influence of a micrococcus has not been proved.

**Fetus.**—Comparatively little investigation has been made on the condition of the fetus in eclampsia. Prutz found casts, uric acid, infarcts, dilated veins, and unaltered epithelium in 1 case. Döderlein studied the blood bacteriologically in 5 cases and the urine in 3 with negative results. Albumin has sometimes been found in the urine. Cassaët and Chambrelent state that the hepatic veins are much dilated, and that small hemorrhages are found near the vessels or in the interior of the lobules. The liver cells may be somewhat compressed and occasionally degenerated. Schmorl has described necrotic foci. In the kidneys congestion is found, especially in the region of Henle's tubules, and in some parts blood-extravasation may be noted. Bar found in 1 case fatty degeneration in the tubules and considerable hemorrhage under the capsule of Glisson. Hemorrhages have been found in the brain and spinal cord. These vascular and hemorrhagic changes are not distinctive of eclampsia; they may be found in other cases in which the fetus dies in delivery. Bar, however, believes that cell-degeneration in the liver and kidney of the fetus is common in eclampsia. Sometimes the fetus is rigid at birth.

**Nature and Causation of Eclampsia.**—There has been

much discussion as to the nature and cause of eclampsia, and during the second half of the nineteenth century many views were advanced to explain its phenomena. When Rayer, of Paris, in 1840, and Lever, of London, in 1843, pointed out the frequency of albuminuria in eclampsia, the impression gradually gained ground that disturbed renal function associated with imperfect elimination of poisonous material caused the disease. It was held by some that urea was the noxious element.

In 1851 Frierichs pointed out the resemblance between the phenomena of eclampsia and those of the uremic convulsions of Bright's disease, and held that the conditions were identical. He was supported by Wieger and Braun, especially by the latter, whose text-book, published in 1857, did much to make this view popular. Frierichs believed that the cause of the poisoning was a decomposition product of urea—viz., ammonium carbonate. The uremic origin of eclampsia has been denied by many, and has been widely abandoned since it has been shown that eclamptic phenomena may occur without albuminuria; that in the great majority of cases there has been no previous renal disease; that the renal changes which may be found are not constant and definite, but very variable, and often very slight; that the albuminuria frequently appears after the convulsions begin; and that the clinical phenomena of eclampsia are not often found in cases of chronic Bright's disease.

As regards the influence of impaired urinary excretion, Cornil and Ranvier have pointed out the rarity of uremic convulsions in women suffering from uterine cancer that interferes with the ureters, even where the latter are dilated and hydronephrosis is present. Seyfert has reported over 70 cases of pregnancy in women with chronic Bright's disease, in which convulsions occurred in only 2. Hofmeier has reported 46 cases, in one-third of which there was eclampsia. Bamberger found 23 cases of eclamptic convulsions in 152 pregnant and puerperal women with chronic Bright's disease. As regards Frierichs's theory, it has been pointed out by several workers that ammonium carbonate cannot be found in the blood of eclamptics.

Traube advanced the view, modified by Rosenstein and supported by Munk, that cerebral anemia and edema were produced as the result of increased blood-pressure and hydremia of the blood, the former being aggravated by labor pains and the latter by the loss of albumin in the urine. Spiegelberg opposed this theory, stating that hydremia and increased pressure cannot cause cerebral anemia, and that hydremia is not a special feature of eclampsia. Johann Veit thought that these factors were probably the cause in cases of renal insufficiency, chlorosis also probably being a predisposing cause of eclampsia. Answering the criticism that cerebral edema has been rarely found in eclampsia, Veit

states that this condition may rapidly pass away. Bartels regards the cerebral edema as a result of eclampsia. Olshausen found cerebral hyperemia more frequently than anemia, and observed no edema in many cases. He noted a case in which death occurred after 104 convulsions, the brain being so dry that, on being cut, it appeared more like sclerosed than edematous tissue. He also emphasized the frequency of fits apart from labor, and, therefore, from the influence of increased blood-pressure caused by pains. Falk has experimented on animals, and has found it necessary to introduce enormous quantities of water (122 gm. per kilo of weight) in order to cause convulsions; in such cases the brain was usually congested and not edematous or anemic.

Angus Macdonald stated in 1878 that anemia of the brain substance was the essential cause of convulsions. In 2 fatal cases this was found, though the meninges were congested, the ventricles containing serum. He believed that the anemia was primarily due to excrementitious matter in the blood stimulating the vasomotor center or setting up a subacute inflammation about it, whereby contraction of the arteries was brought about. The poisonous matter in the blood he believed to be due to altered renal function. Spiegelberg held that eclampsia was due to cerebral anemia and to poisoning resulting from altered renal function. The latter he believed to depend mainly upon disturbances in the kidney circulation, which might in some cases rapidly disappear after death. He thought that the change might be of the nature of spasm of the smallest vessels, which interfered with excretion and might lead to destruction of the epithelium if it continued long enough. He suggested that the vasomotor irritation might also affect the cerebral vessels, the source of the irritation probably being the uterus, this irritability being greater in primiparæ and in cases where the uterus is much enlarged. In emphasizing the part played by peripheral irritation, he pointed out that convulsions might frequently be induced in eclamptics in the third stage by uterine manipulations, the peripheral irritation caused by the uterus in pregnancy being aggravated during labor. Those who believe in the importance of cerebral anemia point to such experiments as those of Kussmaul and Tenner, in which the carotids are tied or the animals bled from the neck, slight convulsions being produced.

In 1882 Halbertsma criticized the former views and stated that eclampsia is due to the influence of increased intra-abdominal pressure caused by the growing pregnant uterus interfering primarily with the ureters and secondarily with the kidneys. He held that the special tendency to the occurrence of eclampsia in primiparæ—hydramnios, multiple gestation, contracted pelvis—in all of which conditions there is excessive pressure, strengthens his view.

Ries, holding somewhat similar views, believes that in some cases compression of the ureters by the presenting part of the fetus is the most important factor. These views have not been accepted by most authorities. Halbertsma's statement that dilatation of the ureters is frequent in such cases has not been corroborated. Olshausen found dilatation only 7 times in 37 autopsies. He and Stadtfeld have pointed out that the ureters are sometimes dilated in non-eclamptic puerperal women. Thus, in 25 such cases 12 presented unilateral dilatation and 4 bilateral. I have already considered the anatomic relationships of the ureters in pregnancy, in connection with altered renal functions. It must be admitted that ureteric compression may in some cases be a factor in the determination of an eclamptic seizure, but there is no proof that it is the *fons et origo* of the disease in many cases.

Stumpf, in studying two eclamptic cases in 1886, commented on the resemblance of the liver changes to those found in acute yellow atrophy, which suggested to him the idea of acute poisoning by material circulating in the blood. As leucin and tyrosin were found in the liver and methemoglobin in the blood, Stumpf concluded that the poison was some non-nitrogenous body produced within the organism, and he was inclined to regard it as acetone or aceto-acetic acid, which he had detected in the expired air and urine of eclamptics. This poison, he stated, irritates the kidneys, decomposes hemoglobin, affects the liver, and causes convulsions and coma. Stumpf thought that the poison might be developed in the fetus, because the latter is sometimes in a state of *rigor mortis* in eclampsia, and because its death or removal often causes cessation of the convulsions. In reference to Stumpf's views, it is to be said that acetone is not always present in eclampsia nor the fetus in a state of *rigor mortis*. Moreover, the latter condition may be found apart from eclampsia. In cases in which the convulsions develop after labor the influence of the fetus is absent. Dührssen states that acetone is a result, not a cause, of eclampsia, and is due to blood-dissolution and anesthesia. Wiener holds that it may be formed from biliary products not excreted.

As to the part played by the living fetus, various other authorities also hold that it may be a source of the poison of eclampsia, that the convulsions may cease when it dies, and that albuminuria and edema may also disappear at the same time. There may, however, be no such disappearance. Further, several cases have been described in which eclamptic convulsions have ceased in pregnancy, the fetus remaining alive, the woman continuing normally afterward to full time.

Klebs advanced the suggestion that thrombi formed of liver cells displaced by pressure on the liver in pregnancy and labor might have something to do with eclampsia. The thrombi described by Klebs are probably the same as those noted by Schmorl

and others, who state that these may be primary or embolic, being found both in the veins and in the arteries. He thinks that the toxic agent that causes the coagulation probably induces eclampsia, and suggested that it is a ferment, possibly related to the placenta. There is little doubt that the cell-emboli noted by these observers are derived from the fetal chorionic epiblast (syncytium and Langhans's layer). It is known that they pass into the circulation normally in pregnancy, but there is no proof that they exercise any deleterious effect save when they occur in the malignant condition known as *deciduoma malignum*. Lubarsch, while admitting that these emboli may generally be placental in origin, states that in some cases they arise from the liver.

Within recent years the view has gradually gained ground that the most important factor in the production of eclampsia is auto-intoxication, the poisons resulting from various sources within the maternal and fetal organisms. These poisons may be derived from the effete products of metabolism throughout the body, a marked increase in the latter occurring in pregnancy. In the alimentary canal they may be taken in food or drink and may enter from the bile-passages, but are mainly formed in the process of digestion and by intestinal decomposition. The emunctories continually get rid of these noxious products as they enter the circulation. The liver in particular exercises a destructive influence on them, especially on those which may enter from the alimentary canal by the portal vein. The thyroid and parathyroids are believed by many to counteract the influence of toxic material. The kidneys also exercise a very important part in elimination. When the function of the liver is interfered with, greater work is thrown on the kidneys.

Various efforts have been made to detect the most important poisons, but without success.

These views in recent times owe their inception to the speculations of Bouchard, first expressed in 1887 in his *Leçons sur les Auto-intoxications*. He stated that health depends on a proper adjustment between the production and excretion of toxic substances, increase of the former or diminution of the latter leading to toxemia or auto-intoxication. He considered that the excretions, especially the urine, might serve as an index to the toxicity of the blood and tissues. When toxic agents are freely eliminated a lower degree of blood-toxicity may be expected than when the excretion is low. Increased production of toxins might raise the toxicity both of the blood and urine even if the excretory functions be normal.

The attempts made by Bouchard and his followers to establish the truth of these theories by experiment have not been very satisfactory, and in some cases have been very faulty and misleading. Thus, in injecting urine into the circulation of rabbits, Bouchard took no precautions to obtain uncontaminated urine. In many instances it was allowed to become altered by micro-organisms. Moreover, the urine was injected much below the temperature of the animal's blood. Nor was sufficient importance given to the influence likely to be exerted by the fluids of one animal on those of

another class. The urotoxic coefficient, therefore, established by such experiments is absolutely unreliable.

Tarnier was the first to study pregnancy in the light of Bouchard's theories. In 1890 he stated that the urotoxic dose from the pregnant woman's urine is greater than the normal urotoxic dose of the healthy non-pregnant adult estimated by Bouchard; or, in other words, he found the toxicity of the urine to be diminished in pregnancy. Chambrelent and Démont, in 1892, made a similar statement; but their experiments revealed such variations as to make their findings quite unreliable. Gorla, in the same year, gave an account of cases studied during and after labor. He used warm, sterile, neutral urine, and found that its toxicity was very much lower than that mentioned by the other workers. As Eden points out, the diminution was probably largely due to his care in preparing the urine. Blanc, in 1893, studied a number of pregnant and puerperal women. He used warm, filtered urine, free from albumin and neutralized with soda, and found that its toxicity was higher than that obtained by Gorla. His urine was not sterilized, however, and this probably made some difference. Both Gorla and Blanc noted an increase in toxicity after labor was finished. In further experiments Blanc reached a different conclusion—viz., that the toxicity of the urine is not diminished in pregnancy.

Labadie-Lagrave made experiments and stated that the toxicity of the urine diminishes during the first three months, remaining stationary afterward. In 1895 Ludwig and Savor published an account of their experiments with the urine of normal and eclamptic pregnant women. The fluid was not sterilized, but was kept on ice until used. They found the toxicity a little lower than that described by Bouchard for the non-pregnant adult. In the eclamptics they found great variations, but stated that the average urotoxic dose was lowered during the convulsive stage and raised afterward. Tarnier and Chambrelent, in their experiments, found that the toxicity of the urine in eclampsia is extremely low, and accounted for this by supposing that there was an accumulation of toxic matters in the blood. The statements of these workers differ considerably from those of Ludwig and Savor.

Volhard, in 1897, found considerable differences in the toxicity of urine from pregnant women. He noted that the urotoxic dose was increased by boiling, probably due to the sterilization. He found differences according to the rate of injection into the animal's circulation. He found the urotoxic dose of urine from the non-pregnant adult considerably higher than that mentioned by Bouchard. In experimenting with urine from eclamptics he obtained results from which no conclusion could be derived.

Schumacher, in 1901, published an account of some careful experiments made in Fehling's clinic. He first showed that normal saline solution introduced into the jugular vein of the rabbit produced negative results. As the strength of the solution increased its toxicity increased. He found that the urine of women in the non-pregnant state, in pregnancy, and in labor, *possessing an equal density*, has the same toxicity; that albumin does not increase the toxicity; that if extreme toxicity is found in eclampsia or albuminuria, it is due to increased density of the fluid. He found that reduction of the density to that of normal urine practically reduced the toxicity correspondingly. He points out the difficulties of experimentation and draws attention to the factors likely to introduce error.

Stewart, in 1897, described a series of observations regarding the urine of pregnant and parturient women. He used sterile and non-sterile specimens and injected the fluid into the peritoneal cavity of animals, careful bacteriologic examinations being made. His conclusions were as follows:

1. Urine passed naturally contains a convulsive poison lethal to rabbits and mice.
2. Urine drawn by catheter under strict asepsis and boiled at once is harmless.
3. If stale, unboiled urine be used, the toxicity rises rapidly with the age of the specimen.
4. All specimens of fresh urine that caused death contained micro-organisms at the time of the injection.

When injected animals died, septic injection was the cause. Stewart's work greatly discredits the results of the experiments carried on by those who have failed to estimate the influence of micro-organisms contaminating the urine.

Various workers have tried to test the toxicity of the blood. Rummo and others have shown that normal blood is toxic for different animals when injected into the circulation, and have stated that it is more toxic in diseased conditions. Doléris and Butte, in 1886, separated from the blood of eclampsics a crystalline inorganic substance which, injected under the skin of various animals, caused death with convulsions.

Tarnier and Chambrelent, in 1890, used the blood-serum of eclampsics, obtained without care as to asepsis, and decided that it was more toxic than normal serum. Ludwig and Savor reached a similar conclusion. Charrion, about the same time, stated that he found it to be less toxic. Volhard's results were somewhat similar. In 1894 Noret and Bosc endeavored to establish the standard toxicity of normal serum, and concluded that intravenous injection is an unsuitable method. They found that removal of the coagulable elements greatly reduced the toxicity. Herter states that the percentage of urea in the blood is not necessarily increased during the fits, Butte, however, says that in bad cases it is increased owing to impairment of the liver.

Schumacher has also experimented with blood-serum, but has not been able to establish any difference in toxicity between the serum of normal parturient women and those with eclampsia or nephritis. He states that the degree of the disease has no effect on the degree of toxicity of the urine. The amniotic fluid and the serum of the fetus are not more toxic than in normal cases. Comparing the action of urine and blood-serum, he states that the former acts simply as a salt solution, its action varying according to its concentration. With blood-serum it is otherwise, for on adding distilled water its toxicity is reduced only according to the amount of dilution—*i. e.*, a dose of equal parts of serum and water equals in toxicity that produced by the amount of serum alone not diluted, whereas urine diluted in the same proportion has no effect at all. The serum acts by virtue of toxic material contained in it.

In reference to the various experiments with blood, Eden says that unless separate definite toxic bodies can be obtained from it, experimentation along the lines employed in the past is certain to be vitiated by sources of serious error. Indeed, the value of these experiments is very doubtful as a test of toxicity when it is found that the animals are often killed by coagula produced in the heart and blood-vessels, not by poisoning, whether normal or eclamptic blood-serum is used. They show in reality only a difference in the power of producing coagulation. When the serum is injected under the skin or into the peritoneum, much larger quantities are required to produce death. Thus, Far found that 20 c.c. per kilo could be injected subcutaneously into a rabbit without fatal results, when an intravenous dose of 3 c.c. would cause death.

Recently efforts have also been made to prove by experiments that

renal elimination is diminished in pregnancy, especially in eclampsia. Inert coloring-matter is introduced into the body, and the interval that elapses before it appears in the urine noted; also the rate and regularity with which elimination continues and is completed. The results are inconclusive.

In the endeavor to determine the nature of the toxic agents, experiments have been made with substances known to result from body metabolism. Thus, Landois induced convulsions and coma by exposing the anterior and lateral cerebral convolutions and applying kreatin, kreatinin, dried urinary sediment, sodium and potassium phosphates, and other bodies. Several workers have regarded the potassium salts as important toxic agents in uremia and eclampsia.

Since the publication by Döderlein of the results of bacteriologic examinations in cases of eclampsia, many authors have thought that this disease might be due to micro-organisms. Since May, 1898, Levinowitsch has made systematic bacteriologic examinations of the blood in eclampsia, with the following results: In fresh blood from 44 cases large regular cocci, of round and oval forms, were found, which showed extraordinary activity, the round forms being smaller than the oval ones; the cocci were often arranged in pairs, or as diplococci. In 28 cases the eclamptic blood was placed in bouillon, gelatin, and agar, and 25 times a complete culture was obtained; the micrococcus flourished at the normal body temperature, and on such media as placental tissue. In three or four days the culture showed large oval cocci, arranged in twos or fours, and exhibited extreme mobility. The micrococcus was stained by anilins; cilia were demonstrated. Old cultures showed curiously involuted forms, with many oval ones of considerable size. Some cocci had a central stained portion (spore?); one form had a long, thread-like attachment that moved like a tail; another variety was shaped like a dumb-bell. These cocci were mostly found in blood taken during the first seizure, but blood was also examined within two days after the last attack; in two days after the last attack the involuted forms with the central uncolored portion were found.

The micrococcus was pathologic to guinea-pigs. In twenty-eight to thirty days after subcutaneous injection of the clear culture acute anemia was produced, following hemorrhagic endometritis; in one case of injection of the clear culture in a bitch, transient convulsive attacks were observed in the muscles of the vagina. In one case the same coccus was found in the blood of the newborn child of an eclamptic mother; in two infants attacks of eclampsia were observed. In the blood, both of pregnant women and those at term who had no typical eclampsia, but had nevertheless suffered from headache, edema, vomiting, etc., the same micrococci were found in small numbers. The dumb-bell form appeared some-

times in the mononuclear and polynuclear leukocytes, where they may be distinctly seen when a fresh-blood specimen is examined.

H. Müller and Albert have advanced the view that eclampsia is a general intoxication, due to the action of bacteria within, and the resorption of their products from, the uterine cavity. In pregnancy the bacteria are believed to be latent during the early months, before the convulsions begin.

Stroganoff has urged the infective nature of the disease for the following reasons: It is a widespread infection, involving many organs; it develops acutely; the fever accompanying it, especially the postmortem thermic elevation, is peculiar to infective disease; one attack appears to confer immunity; the disease is more common in populous centers.

In conclusion it must be admitted that while many observations have been made in eclampsia, very little has followed the attempts to analyze these and to arrange them in their proper relationship to the disease. No certain cause has been definitely established. It is probable that different etiologic factors are associated in the production of the fits. In some cases many of these may be combined; in others few. Sometimes one factor may be very prominent and the others of little account. No scientific classification of the various combinations can be made. The factors may be referred to generally as follows:

Of great importance are toxic agents circulating in the blood, derived from sources already mentioned. They are probably most active in the gravest cases of eclampsia. They affect various tissues differently in different cases, and are probably responsible for most of the degenerations found in the liver and kidneys. Impaired action of the excretories, especially of the kidneys, plays a rôle in some cases by interfering with the elimination of circulating toxic agents; therefore pressure on the ureters and kidneys, the kidney of pregnancy, nephritis, and reflexly induced renal anemia may occasionally play a part. Faulty elimination of the bowel is probably not infrequently a cause of retention of toxic matter. Another factor is nervous and psychic irritability or excitability. In some cases this may determine the onset of an attack. Some authors think there is a special type of nervous organization in which there is a particular liability to disturbance. It is widely believed that in eclamptic cases in which the kidney or liver changes are slight the attacks are due to the influence of circulating poisons on abnormally irritable cortical psychomotor centers and sub-cortical ganglia. Von Herff thinks that there is little difference between the phenomena of epileptic, uremic, and eclamptic attacks, and that all are due to the influence of different causes acting on these centers.

Recently Nicholson, of Edinburgh, has suggested that some cases of eclampsia might be related to inadequacy of the thyroid and parathyroid

glands. He refers to Lange's 25 cases of pregnancy in which the normal hypertrophy of the thyroid did not occur, and in which albuminuria, and sometimes eclampsia, developed. Others have also noted that the thyroid is frequently small in eclampsia.

The thyroid is one of the organs closely related to metabolism, iodothylin being an essential to the organism. In cases of absent or small thyroid there are faulty metabolism and impaired excretion. Iodothylin administration stimulates metabolism and increases the excretion of urea. Nicholson regards eclampsia as the result of some failure in the process of proteid metabolism, associated with a deficiency of iodothylin, or to impaired activity of the secretion, though the liver and other "defence organs" may also be at fault. He points out that the phenomena of an eclamptic attack resemble those following experimental removal of the whole thyroid system in animals. He thinks that the thyroid may be given a primary rôle in the causation of eclampsia.

Spasm of the renal vessels tends to occur when the influence of the thyroid is diminished (perhaps aided by the action of the suprarenal secretion, which contracts the arteries). He urges the use of fresh iodothylin or thyroid extract both in the pre-eclamptic and in the eclamptic condition, even to the point of causing thyroidism, in which state vessels are fully relaxed. Activity of the skin and kidneys is thereby promoted, though with considerable variations in different cases. Thyroid extract may have some specific action in rendering certain toxic substances harmless. It is stated, for example, that the parathyroids normally render enterotoxins innocuous. Morphin is regarded by Nicholson as a valuable adjunct to the thyroid extract.

**Treatment.**—There is considerable difference of opinion regarding the treatment of eclampsia, which is to a great extent empiric in nature. That this is the case is not surprising in view of the many speculations current regarding the nature of the disease.

**Preventive Treatment.**—When a pregnant woman exhibits any of the signs or symptoms that have been described as premonitory to eclampsia,—*i. e.*, albuminuria, edema, deficiency of urine or of total solids, alimentary disturbances, headache, lassitude, rapidity and high tension of pulse,—she should be placed on a restricted diet. Jacoud and Tarnier have been strong advocates of milk. This should be administered in the forms most palatable to the patient—warm, cold, hot, boiled, mixed with hot water, Vichy, or other table waters. A pinch of salt or of sodium bicarbonate often renders milk more easily digestible. It should always be sipped slowly. Two or three liters or even more should be taken daily. After each meal it is advisable to rinse the mouth with a solution of sodium borate or listerin. All exposure to cold or dampness should be avoided. Flannel should be worn next the skin and daily warm baths taken. Vigorous massage and shampooing of the skin are very advantageous unless there is some contraindication, and moderate exercise may be taken. The patient must avoid all worry and excitement. Sexual intercourse should be prohibited. If the premonitory signs and symptoms

are marked, the patient should be kept quiet in her room or even in bed. The bowels must be kept regularly open, various well-known medicines being used for this purpose. To increase the activity of the kidneys the author has employed the following modified Semmola's mixture: Sodium iodid, 15 gr.; sodium phosphate, 30 gr.; sodium chlorid, 90 gr.; water, 36 oz. Several glasses may be taken daily alone or with milk. Diuretin, digitalis, and other diuretics may be used. In threatening cases high bowel injections of normal saline solution may be given—a pint two or three times daily; its diuretic action is increased if 30 to 60 gr. of sodium acetate be added, as Jardine has pointed out. Diuretin and glonoin are also valuable diuretics. Pilocarpin should not be used because of the risk of edema of the lungs and glottis. Nicholson advocates full doses of fresh iodothyryn or thyroid extract, for reasons already given. When there is much nervous excitability, chloral or sodium bromid may be given.

Morphin is used by many for this purpose only as a last resort, on the ground that if the kidneys be much affected, this drug is eliminated with difficulty, its accumulation tending, therefore, to produce toxic symptoms. It is, however, urged by several that the risk of dangerous cumulative effects of morphin, when the renal activity is impaired, is much exaggerated and unwarranted. Nicholson strongly urges the use of morphin, pointing out that it causes relaxation of the vessels and so promotes diuresis; that it inhibits metabolism temporarily and so causes less toxic matter to be produced, and that it counteracts the nervous phenomena of eclampsia.

Stroganoff has strongly advocated the combined use of morphin and chloral, the former for its influence on the sensory centers and the latter to control convulsions. The number of the attacks is reduced and the chances of recovery are greatly increased, according to this authority. Newell states that this method is better in postpartum than in antepartum eclampsia.

Venesection may be employed when symptoms are very unfavorable, especially when renal activity is much impaired and the blood-pressure high. In grave, threatening conditions, particularly after the employment of the measures already described, it is justifiable to empty the uterus prematurely; or, if the woman be already in labor, delivery may be hastened by dilatation of the cervix, delivering by forceps, or turning. Chloroform anesthesia should be used. Antiseptics whose absorption may be deleterious—*i. e.*, corrosive sublimate—should not be employed. Several of these procedures have been strongly opposed by a number of authorities. While the indiscriminate indication of premature labor in all cases in which premonitory symptoms of eclampsia occur cannot be too strongly condemned, its employment in certain selected cases is to be recommended.

Labor may be induced by dilating the cervix and introducing a Barnes or a Champetier de Ribes bag, which is left in the canal in order to stimulate the uterus to contractions. In urgent cases it may not be advisable to allow nature to empty the uterus, but to dilate and deliver artificially.

**During an Attack.**—The patient should be placed in bed and constantly watched. The hot-air bath or hot pack may be used to promote diaphoresis, the pulse being closely observed. During the convulsions it may be necessary to control her during excessive movements. To prevent biting of the tongue a rolled towel or a piece of wood or rubber should be placed between her teeth. When the seizures are violent, they may be controlled by chloroform inhalations. This drug has been used in various ways, continuously or intermittently. Its influence in causing fatty degeneration in the heart, liver, kidneys, etc., should always be remembered, and it should, therefore, be used to modify only very severe convulsions. It should be administered when the latter threaten, in order to produce narcosis, being withheld after the fits. Rectal administration of chloral is used by many authorities in addition to chloroform. It is usually freely eliminated from the body and does not tend to accumulate in poisonous doses.

Veratrum viride is highly praised by many, especially in America. It should be used only when the patient is strong and the pulse full and regular; when the latter is weak and irregular, the drug is contraindicated. It should be given only when the patient is lying down. It causes a reduction in the pulse-rate, and is believed to promote renal and skin activity, lower the temperature, and relax the cervix. An initial dose of 15 to 20 minims of the fluid extract should be given hypodermically. This should be followed every thirty minutes by a dose of 10 minims until the pulse remains below 60 a minute, eclamptic convulsions being rare with a pulse of this low rate. Should collapse and vomiting occur, the drug must be discontinued, the patient kept recumbent, and alcoholic stimulants given. Morphin is used by many authorities in preference to the drugs described. Nicholson has noted the beneficial influence of thyroid extract on the vomiting. Ice-bags applied to the back of the head and neck seem in some cases to modify the convulsions.

Inhalation of oxygen has been highly praised by some authorities. It may be of benefit when the patient is asphyxiated. If the bowels have not been recently freely moved, a strong purgative should be given by the mouth. When the patient is unconscious, a few drops of croton oil mixed with a little olive oil should be placed on the back of the tongue in order that they may be swallowed reflexly.

Recently the practice of administering normal saline solution subcutaneously or by the rectum has been recommended by

several authorities. The rectal route should be chosen if several injections are to be given, on account of the greater convenience and freedom from risk of septic infection, the fluid being rapidly enough absorbed into the system. The value of the saline solution is stated to consist in the promotion of diuresis and diaphoresis and in the dilution of poisons circulating in the blood. It undoubtedly leads to a dilatation of the arteries in the kidneys and elsewhere.

Venesection has been considerably recommended and may be helpful when the patient is robust, the pulse full and of high tension, and cyanosis marked. If the view as to the circulation of poisons be correct, it is logical to remove some of the poisoned blood, as well as to dilute what is left in the vessels by the introduction of saline solution into the system in the manner described. At least 300 gm. of blood may be withdrawn from the arm or neck. Venesection helps to reduce blood-pressure.

It has been frequently noted in cases of eclampsia that improvement has followed the birth of the fetus. Consequently the practice has become prevalent in many schools of inducing labor immediately or of hastening it if it has already begun. There has been much dispute as to the advisability and limitations of this procedure. Some authorities—*i. e.*, Charpentier and Winckel—hold that the uterus should not be interfered with save after complete dilatation of the cervix, as they believe that the disturbance caused by artificial dilatation induces convulsive seizures. Others hold that delivery should be carried out as quickly as is possible without serious damage to the patient, whether or not labor has begun, for the reason that the fits usually cease afterward. Several authorities hold that this reason has been exaggerated. Herman has recently collected a series of 2142 cases of eclampsia, in 905 of which the convulsions ceased after delivery, while in 816 they continued. He holds, therefore, that operative delivery is not urgently required.

Among those who believe in carrying out artificial delivery there is a difference of opinion as to the best means of performing the operation. When the cervix is fully dilated, forceps may be used; or if the child be dead, embryulcia may be carried out, if the operator deems it safer and more expeditious. In undilated or partly dilated conditions of the cervix various procedures may be employed. (These are described in the section dealing with methods of inducing labor.) If a physician be present when a pregnant woman carrying a viable fetus dies of eclampsia, it is his duty to advise immediate postmortem Cæsarean section, in the hope of saving the infant. Bauer has recently collected reports of 8 such cases in which 4 infants were saved.

**In the Post eclamptic State of Stupor.**—In this state the hot-air bath or hot pack may be used to favor diaphoresis, the pulse

being carefully watched. Croton oil may be given as above described, or a large dose of a saline purgative may be administered by a stomach-tube. Normal saline injections containing sodium acetate should be given by the bowel (1 pint every five or six hours). Venesection may be carried out where there is asphyxia, if not previously employed. Oxygen inhalation may be used. Alcohol and strychnin may be given if there are collapse and evidence of failing heart.

As the patient recovers and is able to take nourishment the diet should at first consist of milk, plasmon, cocoa plasmon, barley and rice soups, toast, and gruel.

Eclampsics should not be allowed to nurse their infants.

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## CHAPTER XV.

### ECTOPIC PREGNANCY.

**Definition.**—By an ectopic pregnancy is meant one that develops outside of the uterine cavity. By many this term is considered as synonymous with extra-uterine. The latter, however, cannot be strictly held to include interstitial gestations, and is, therefore, abandoned by the author for the former expression, which was first employed by Robert Barnes in 1873.

**Etiology.**—For a long time it has been held that an ovum fertilized at the fimbriated end of the tube might develop anywhere on the tubal mucosa, normal or abnormal, if it were prevented from passing into the uterus by various mechanical forces—*i. e.*, tumors of the tube-wall or of neighboring structures pressing upon it, polypi in the lumen, constriction of the tube by adhesions, displacement of diverticula of the tube-lumen, interference with the peristaltic action of the tube as the result of thickness or adhesions, and destruction of the cilia in the tube by inflammation. Various other causes have been assigned, such as falls, fright, mental excitement, etc.

In 1895 the author pointed out that these views were largely speculative. He showed that while frequently these mechanical factors might be associated with ectopic pregnancy, there was no proof that they were the ultimate factors in its causation. He demonstrated the existence of the decidual reaction in the tubal mucosa in all cases of tubal pregnancy, and advanced the view that the fertilized ovum could develop only on tissue capable of undergoing the genetic reaction. Normally in the human female this reaction, occurring as the result of fertilization, takes place in the body of the uterus. Its occasional occurrence in other por-

tions derived from the Müllerian tract—*i. e.*, Fallopian tube—is to be regarded as a reversion in these tissues to an earlier mammalian type, either in structure or in reaction tendency.

The fertilized ovum, coming in contact with any portion of the Müllerian tract capable of establishing with it that relationship that is necessary to its development, may become attached and grow just as readily as if it were lodged in the uterine cavity. Since the great majority of ectopic gestations occur within the tube-lumen, it is very easy to understand why all mechanical conditions that interfere with the transit of the ovum through the tube might play a part in determining the site of its attachment. It is, however, an unjustifiable assumption to hold that the ovum, if simply obstructed in its downward movement, may develop in a tubal mucosa that is perfectly normal or altered by inflammation.

When the phylogeny of the Müllerian tract is borne in mind, it is not surprising that there should be found occasionally in the human subject a condition of tubal mucosa in which characteristics normally limited to the uterine mucosa may be found. The evolution of the single uterus of the human female from the bicornute condition of the lower animals, in which more than one ovum normally develops, has been accompanied by a differentiation in structure and function, the upper portion of the Müllerian tract on either side—*viz.*, the Fallopian tube—acting as an egg carrier; the lower portion—*viz.*, the uterus—serving as the egg holder. The author strongly holds that there is no proof whatever that ectopic pregnancy begins its development on any other than Müllerian tissue. Primary development on the peritoneum has never yet been established. A few cases described as ovarian pregnancy, in which it is claimed that the ovum has developed in ovarian tissue, are probably only instances of growth of the ovum on portions of the Müllerian tract in close relationship with the ovary.

**Classification.**—Almost all ectopic pregnancies begin to develop in contact with some portion of the tubal mucosa. They may, therefore, be considered for purposes of study in the following groups:

I. **Ampullar**, in which the gestation begins in the ampulla or middle portion of the tube. This includes the majority of cases.

II. **Interstitial**, in which the ovum develops in that portion of the tube situated in the wall of the uterus.

III. **Infundibular**, in which the gestation develops in the outer end of the tube-lumen or among the fimbriæ.

IV. **Anomalous Varieties.**—Among these may be placed gestations that develop in accessory fimbriated extremities or in tubal diverticula. Here also should be included those which develop on the ovarian fimbria or in detached portions of Müllerian tissue

—*i. e.*, those attached to or embedded in the ovary. In the latter category should be placed some recently described cases of ovarian pregnancy.

V. **Cornual pregnancy**, in which the ovum develops in the undeveloped horn of a bicornute uterus, though not strictly speaking ectopic, is usually considered in this connection.

**Varieties Studied in Detail.**—1. **Ampullar.**—1. *Persistent.*

—Very few cases have been recorded where pregnancy has reached an advanced stage without rupture. As the tube enlarges it may occupy various positions in the pelvis; in late stages it may sometimes be found entirely above the brim, though it generally partially occupies the pelvic cavity. It may be somewhat pedunculated, though its mobility is usually early impaired by the formation of adhesions to surrounding structures.

2. *Cases which Rupture into the Broad Ligament.*—(a) *Persistent.*—Some cases after rupture continue their development. These have been variously denominated as "extraperitoneal," "tuboligamentous," "subperitoneopelvic," and "broad-ligament." When the gestation develops upward in the abdominal cavity without opening into the peritoneal cavity, the term "subperitoneo-abdominal" has been used to describe it. The rupture takes place usually between the eighth and fourteenth weeks; sometimes at an earlier or later period. It is due to a gradual thinning and stretching of the lower part of the tube-wall within the layers of the broad ligament. The ovum may rapidly or gradually extend through the opening, the broad ligament gradually becoming distended by it. The gestation then tends to increase in all directions and may descend to a very low level in the pelvic floor, displacing the uterus, bladder, and rectum, and stripping the peritoneum from these structures and from the pelvic wall.

In some cases the uterus may be pushed against one side of the pelvis, or it may be pushed markedly toward the front when the gestation burrows under the peritoneum behind it. As the extension occurs upward into the abdomen the peritoneum is stripped from the abdominal parietes and from portions of the viscera. The position of the placenta varies in different cases. When it is situated mainly lowermost in the tube, it may gradually extend between the layers of the broad ligament, being found chiefly within the pelvis, even if gestation should reach an advanced stage. When it is mainly uppermost in the tube, it may be greatly elevated upward into the abdomen behind the peritoneum, and through the adhesions that form on the outer surface of the tube it may lie in close relationship to the parietes or to the viscera.

(b) *Rupture of the Extraperitoneal Variety into the Peritoneal Cavity.*—After the escape of a tubal pregnancy into the broad ligament there may be a secondary rupture into the peritoneal

cavity. This may take place immediately or at various periods afterward. The site of rupture is most frequently the upper posterior part of the sac-wall.

(c) *Termination of the Gestation.*—Instead of continuing its development after rupture into the broad ligament, the gestation may come to an end in various ways. Blood-extravasation may take place to such an extent that the placenta is detached or greatly torn, a hematoma being produced, in which are scattered

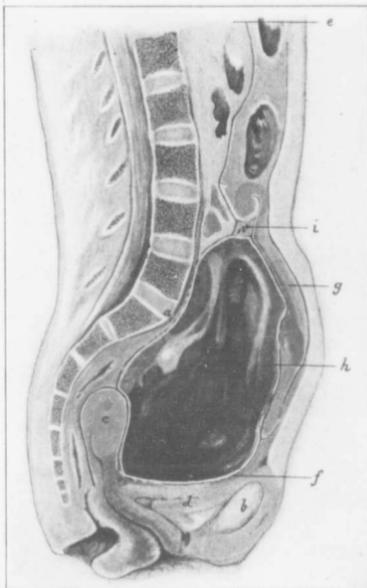


FIG. 147.—Vertical mesial section of a woman who died after removal of a fetus from amniotic cavity of a full-time tuboperitoneal ectopic gestation: *a*, Promontory; *b*, symphysis; *c*, uterus; *d*, bladder; *e*, upper end of sac lined by amnion, in which lay the fetus; *f*, lower end of sac lined by amnion; *g*, great omentum, altered in character, being dense and fibrous in its inner part, which formed the anterior wall of the sac lined by the amnion; *h*, wall of primary tubal gestation sac, within which are the placenta and blood-clot; *i*, umbilical cord.

the various portions of the ovum. The blood may spread in various directions from the original site of the hemorrhage—in some cases the mass may increase greatly in size owing to successive outpourings of blood. In course of time the hematoma may gradually become absorbed.

In some cases infection occurs, suppuration taking place in the broad ligament, forming a pelvic abscess that may burrow in various directions, and may escape through the bowels, bladder, vagina, abdominal wall, perineum, buttock, or groin; in the majority of cases opening takes place into the bowel, especially the rectum or sigmoid flexure. The discharge may continue for a short or long time; in some cases it may last for many years. Infection in these cases almost always arises from the bowel, being due to the slipping upward of the peritoneum and to the close relationship that is established between the gestation sac and the wall of the bowel.

In some cases mummification of the fetus may occur, though sometimes it may be transformed into adipocere or a lithopedion.

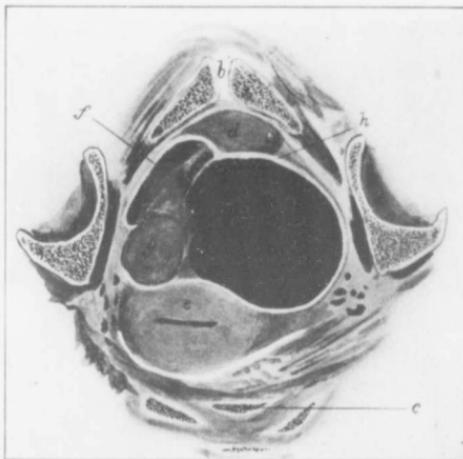


FIG. 148.—Transverse section across pelvis in case of tuboperitoneal gestation illustrated in Fig. 147: *a*, Right acetabulum; *b*, symphysis; *c*, third sacral vertebra; *d*, upper end of bladder above its cavity; *e*, uterus displaced backward and to the left; *f*, placenta and blood within primary tubal sac; *g*, fibrin; *h*, peritoneal cavity lined with amnion.

3. *Cases which Rupture into the Peritoneal Cavity.*—(a) *Tuboperitoneal Gestation.*—In this form the fetus escapes in its membranes into the peritoneal cavity, the placenta remaining in the tube, the pregnancy continuing to progress. This variety was first definitely established by me in 1892. I described in detail a case in which pregnancy had advanced to term; the fetus lay in the amniotic sac, which was attached to the peritoneum behind the stomach, transverse colon, and great omentum. The

umbilical cord passed into the greatly enlarged left Fallopian tube, which lay in front of the uterus, extending from the utero-vesical pouch to the level of the fourth lumbar vertebra, being to a large extent adherent to surrounding structures. The placenta was considerably altered by blood-extravasation.

(b) *Termination of Gestation.*—In the majority of cases in which rupture occurs into the peritoneal cavity the life of the fetus comes to an end, and the mother's life is endangered by the outpouring of blood that occurs.

As regards the most favorable time for rupture, statistics show that it is in the second, third, and fourth months of gestation.



FIG. 149.—Rupture into the peritoneal cavity of an early tubal pregnancy (Martin and Orthmann).

The factors that lead to rupture are thinness of the tube-wall, accompanied by separation of its muscle bundles; increase in the size of the vessels in the wall; sudden changes in blood-pressure; sudden changes in intra-abdominal pressure, such as are produced by blows, falls, strains, etc.; hemorrhage in the substance of the tube-wall or within its lumen. The nature and extent of the rupture vary greatly in different cases. It may be of considerable size or very small, and may be round, linear, or irregular. It may be found in the non-placental or in the placental part of the wall or may involve both portions. The whole ovum or part of it may escape through the rent. Sometimes it is arrested as it attempts to pass through, thus blocking the opening and checking the hem-

orrhage. Sometimes the internal hemorrhage may be so great that the woman dies within a few hours. Parry reports 113 cases, of which 39 died within ten, 81 within twenty-four, and 98 within forty-eight, hours. Sometimes the primary hemorrhage may cease and may be followed by others at later periods, forming a large hematocoele, and may lead to the death of the woman. In a few cases recovery occurs spontaneously, the blood and tissues of the ovum being gradually absorbed. Sometimes there may be considerable peritonitis in connection with this process. Occasionally pus formation occurs in connection with a hematocoele.

4. *The Gestation may be Destroyed in the Tube.*—(a) *By the Occurrence of the so-called Tubal Abortion.*—This consists in the detachment of the ovum, complete or partial, from the tube-wall, accompanied by hemorrhage, the mass gradually escaping through the fimbriated end of the tube into the peritoneal cavity. Sometimes only blood escapes, the destroyed ovum remaining in the tube; in some cases part of it may escape with the blood.

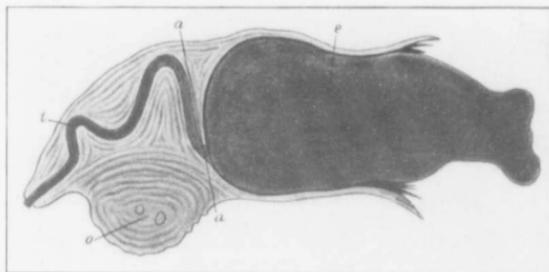


FIG. 150.—Early tubal abortion. The tube is cut longitudinally (Orthmann): *e*, Ovum and blood-clot escaping from outer end of tube; *t*, lumen of tube near uterus; *a, a*, tube-lumen near ovum; *o*, ovary.

Abortion is most likely to occur during the first two months of pregnancy, while the outer end of the tube is patent, though it may also occur after adhesions have closed the fimbriae. The results to the mother are practically the same as when rupture of the tube-wall occurs, though the risk to her life is not at all so great, the escape of blood being usually much less marked. In 19 cases reported by Cullingworth in which escape took place through the end of the tube, a free effusion of blood occurred in only one instance; in the majority of cases a localized pelvic hematocoele was formed.

(b) *By the Formation of a Hematosalpinx.*—The tube may be distended with blood, the ovum being more or less broken up and diffused throughout it.

(c) *By the Formation of a Mole.*—In some cases hemorrhage occurs in the placenta, leading to death of the ovum and forming a mass that is known as a *mole*, which is sometimes expelled into the peritoneal cavity, but may remain for a considerable time in the tube, slowly shrinking in size.

(d) *By Suppuration.*—The contents of the tube may sometimes become infected, leading to the formation of a pyosalpinx.

(e) *In Cases in which Pregnancy is Considerably Advanced.*—Mummification or transformation into adipocere or a lithopedion may result.

II. **Interstitial.**—It is rare that an ovum develops in that portion of the tube which is situated in the uterine wall. In early specimens the whole uterus appears to be enlarged, though irregu-



FIG. 151.—Right interstitial tubal gestation ruptured into the peritoneal cavity. The gestation sac and uterine cavity are opened from behind (Hennig).

larly. The gestation grows internal to the round ligament on the side to which it belongs—as does a cornual pregnancy. As the sac enlarges it pushes the uterine cavity toward the opposite side; it may also extend outward between the layers of the broad ligament, or upward toward the abdomen. Sometimes the gestation may extend into the uterine cavity. As development continues some part of the uterine musculature surrounding the gestation becomes very thin.

Rarely may an interstitial pregnancy continue to full time; rupture usually occurs. When this is intraperitoneal, the results

are fatal, being due to hemorrhage. Rupture between the layers of the broad ligament is rare. Sometimes it may take place into the uterine cavity, or into both peritoneal and uterine cavities. Very rarely the fetus may die in advanced gestation, the ovum remaining *in situ*.

III. **Infundibular.**—An ovum may develop in the outer end of the Fallopian tube, though not frequently. Cases have been described as "tubo-ovarian" and "tubo-abdominal." Owing to the mobility of the outer end of the tube, such gestations are likely to be found in various positions, and adhesion may form between the fimbriae and the ovary, broad ligament, parietes, bowel, blad-

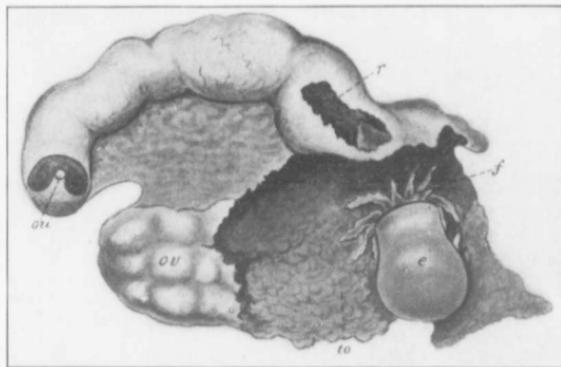


FIG. 152.—Tubo-ovarian ectopic gestation rupture. Second month (Martin and Orthmann): *ut*, Uterine end of tube; *r*, site of rupture in tube-wall; *f*, fimbriae; *o*, blood-clot; *ov*, ovary; *to*, tubo-ovarian cavity opened.

der, etc. The gestation sac may easily rupture and the ovum may pass into the peritoneal cavity or elsewhere. Sometimes it may extend into an ovarian sac of peritoneum behind the broad ligament; sometimes into a corpus luteum cavity or other cyst of the ovary.

IV. **Anomalous Varieties.**—Under this heading may be included some very rare forms of gestation whose development is not yet well ascertained. It has been shown that an ovum may become attached to and grow in an accessory tube, an accessory fimbriated extremity, and in a tubal diverticulum. It may also develop on the ovarian fimbria near the tube or near the ovary. In this category must be placed those cases described as "ovarian pregnancy." It is now incontestable that a gestation may be found entirely within the substance of the ovary. The most thoroughly described specimens are those of Van Tussenbroek<sup>1</sup>

<sup>1</sup> *Ann. de Gynec. et d'Obst.*, Dec., 1899.

and J. F. Thompson.<sup>1</sup> Regarding the original place of embedding of the ovum in these cases we are, however, in doubt. *A priori*, there is a strong presumption in favor of believing that the fertilized ovum in the human female can begin its development only in tissue derived from the Müllerian tract. This view is not weakened by the rare finding of an early gestation in the ovary, for it is known that portions of tissue derived from the Müllerian tract may be on the surface of the ovary or in its substance. It cannot, therefore, be disproved that the ovum may begin its development on such portions, thereafter extending into a Graafian follicle, a cyst in the ovary or the ovarian stroma, just as an early tubal pregnancy may extend into the broad ligament and develop in its tissues.

In the past many specimens have wrongly been described as examples of ovarian pregnancy because of incomplete examination. Thus, an ovarian hematoma has sometimes been so termed. Pregnancy in an accessory tube, in an accessory fimbriated end, or in a tubal diverticulum may easily be mistaken for an ovarian gestation when it is intimately blended with the ovary or when the ovary is congenitally absent on the side of the gestation. In the same way error may easily arise when the ovum develops on a fimbria near the ovary. A broad-ligament gestation may become so related to the ovary that the latter appears to be part of the gestation sac, being thinner and adherent, so that it cannot be found as an independent structure. If in such a condition the outline of the tube be distinguishable, the mistake may be made of describing the gestation as "ovarian."

V. **Cornual Pregnancy.**—Though not ectopic, a cornual pregnancy is best considered in this connection on account of the close resemblances between them. When, owing to maldevelopment of the Müllerian tracts, a single uterus is not formed, various conditions of the bicornute condition may be produced. To one of these only is it necessary to refer here—viz., that in which one horn is more or less rudimentary. This imperfect horn may become the seat of a pregnancy whether its lumen be continuous with that of the well-formed horn or whether there be no connection between them. In the latter case the ovum must have been fertilized by spermatozoa that passed upward along the healthy horn. Such cases of cornual pregnancy are rare, and are apt to end fatally by rupture into the peritoneal cavity, generally after the third month. In a few instances the ovum has ceased to grow without the occurrence of rupture.

**General Considerations.**—**Changes in the Ovum after Death when it is Retained in situ and not Absorbed nor Altered by Suppuration.**—*Mummification* is a change that leads to the shrinkage of the tissues of the ovum by the absorption of fluid

<sup>1</sup> *Amer. Gynec.*, July, 1902.

from them. The membranes and placenta become shriveled and fibrous, closely enveloping the fetus, which is also much shrunken. Sometimes this process is accompanied by calcareous deposition.

*Adipocere transformation* consists in an alteration of the tissues of the fetus into a soap-like substance with a golden-yellow tinge. The bones may or may not be altered. Sometimes the change is accompanied by calcareous deposits.

*Calcification* of the ovum has frequently been described; the membranous placenta and the maternal tissues external to it may alone be affected. In some cases also the fetus may be calcified, the salt being usually deposited superficially, though sometimes it may be scattered throughout the fetal tissue. Occasionally the fetus alone may be the seat of the calcareous change—lithopedion proper. Sometimes the tissue may be so hard as to resemble bone.

*Alleged Growth of the Placenta after Death of the Fetus.*—It has been held by many that the placenta may continue to grow after fetal death; this view is erroneous. There may be an increase in size, due to extravasation of the maternal blood into its substance from time to time, but the villi of the chorion show only degenerative changes.

*Repeated Ectopic Gestation.*—It is believed that ectopic pregnancy may occur more than once in the same tube; certainly it is well established that having occurred in one tube it may take place at a later period in the other. Cases have been reported in which the second gestation has taken place while remains of the first have been present in the tube.

*Plural Ectopic Gestation.*—Rarely the gestation may occur in each tube at the same time, or two ova may develop at the same time in different parts of the same tube, or a twin pregnancy may develop in one tube.

*Concurrent Ectopic and Uterine Gestation.*—Sometimes ectopic and uterine gestation may take place concurrently. There is no evidence that a pregnancy may develop in the uterus after an ectopic pregnancy has started to develop, or as long as its development continues. After an ectopic gestation has ceased to develop, however, whether the ovum has been absorbed or not, pregnancy may take place in the uterus.

**Developmental Changes.**—*Muscular Part of the Tube-wall.*—There is little doubt that the development of a gestation in the tube induces changes in its musculature similar to those that take place in the uterus during normal pregnancy, hypertrophy and hyperplasia of its fibers occurring. These changes are chiefly marked through the first two or three months, but very slightly afterward, the muscle after an early period being unable to respond to the rapid development of the ovum as does that of the normal fruit-holder—the uterus; the connective tissue, however, increases

considerably. The muscle bundles become thinned, stretched, separated, and irregularly distributed. After the early months large portions of the wall may be found in which no muscle is distinguishable.

*Mucous Membrane.*—Different opinions are held in regard to the changes in the tubal mucosa. It has been stated by some that no decidual transformation takes place; this view is erroneous. Careful study will usually reveal the presence of decidual cells, though they may frequently be scanty or irregularly distributed. They are best studied in the early months of ampullar tubal gestation. In advanced stages, after the mucosa has been greatly stretched and thinned, the decidual cells are relatively few and scattered, though in parts they may be abundant. When the tube bursts and the ovum develops in the broad ligament, decidual cells are not usually found in non-tubal tissues, even though they be in relation to the placenta. When the ovum develops on a fimbria or other small portion of the Müllerian tract, there must necessarily be very little decidual tissue; and if the pregnancy develops in the midst of the ovary, no decidual cells may be found after an early period. The decidual reaction, as it usually occurs in tubal gestation, may be described as analogous to that which occurs in the uterus in the formation of a decidua vera. The resemblance to the arrangement of the uterine vera may sometimes be very close. There is, however, no uniformity in its production. Sometimes an extensive portion of the mucosa may be altered; sometimes only a limited portion arranged circularly or on one side. In some cases a superficial compact and deep spongy layer may be distinguished. This arrangement may be due to a blending of adjacent portions of the original mucosal fringes near the tube-lumen, the spaces between them resembling the gland spaces of the normal uterine mucosa. Sometimes the tubal mucosa, especially near the uterus, may considerably resemble the uterine mucosa; in such a condition there will be resemblances after decidual transformation. As the decidual changes progress the lining epithelium becomes flattened, broken, and degenerated. Many connective-tissue cells are transformed into large decidual cells somewhat similar to those found in the uterus, the most marked development taking place nearest the tube-lumen. The epithelium covering the mucosal folds near the musculature tends to become disintegrated and cast off. The blood-vessels increase in size, the capillaries here and there dilating to form small sinuses.

*Decidua Scrotina.*—That part of the mucosa to which the ovum becomes attached may be termed the decidua scrotina. Its condition at the time of the embedding of the ovum has not been described. No tubal pregnancy has been described as early as the uterine pregnancy described by Hubert Peters. In the earliest

specimens described changes are found somewhat similar to those noted in the uterus in normal pregnancy. The blood-vessels are dilated, the capillaries being distended to form large sinuses in the superficial portion of the decidua. The connective tissue shows hypertrophy and hyperplasia of the cells, leading to the formation of characteristic decidual cells, which is most advanced near the surface.

As pregnancy continues the cells tend to lie with their long axes parallel to the surface, due probably to the increasing pressure of the growing ovum. Degeneration also takes place in the cell-substance and nucleus. In many parts their outlines may become very indefinite. A form of coagulation-necrosis occurs, areas of the tissue having a fibrinous or hyaline appearance under the microscope. Of special interest is the occasional proliferation of the endothelium in some of the large sinuses, forming a layer of several thicknesses of cells, which in some instances may extend somewhat into the surrounding decidual tissue. This has not been observed in uterine pregnancy, but has been observed in the hedge-hog by Hubrecht.

The arteries and veins present appearances similar to those found in the decidua of uterine pregnancy.

*Decidua Reflexa.*—There has been much dispute as to the formation of a reflexa in tubal pregnancy. Some deny its existence; others, while admitting that it may be present, express different views as regards its formation. Owing to the smallness of the tube it is probable that in some cases a distinct reflexa may never be able to form, the gap formed in the mucosa by the embedding of the ovum being closed by the opposite side of the tube; in some cases a reflexa may be partially formed, blending immediately with the adjacent mucosa lining the tube. That the complete reflexa may be formed cannot be denied, for specimens have been described. It has a structure similar to that of the neighboring serotina. Degeneration takes place in it very rapidly, and there is a great tendency to rupture of blood-vessels in its substance.

When the ovum is not early destroyed, the reflexa becomes stretched and thinned and pressed against the surrounding portion of the wall of the tube, gradually disappearing.

*Relations between Ovum and Decidua.*—The relationships between the ovum and decidua in tubal pregnancy have not been described at such an early date as in the case of uterine pregnancy, but the information given by many preparations within the first month of gestation and later suggests strongly that in the beginning the conditions are similar to those found in uterine gestation. The surface of the serotina next to the ovum, forming the maternal boundary of the intervillous spaces, is somewhat irregular. By the end of the first month a thin layer of hyaline degeneration is

usually present near the surface. Masses of syncytium, varying in shape and size, are attached to the surface; in some parts the syncytium forms a distinct layer. Below the surface portions extend in various directions, even into the musculature of the tube-wall. They may also extend into the blood-sinuses in the decidua, and portions may be carried away in the veins.

The maternal blood-sinuses communicate with the intervillous space by openings of various sizes, and occasionally syncytium is seen in the process of absorbing the decidual tissue between the sinus and the surface of the decidua.

*Chorion.*—A detailed description of the chorion is unnecessary, since it is identical with that which has already been given in the description of uterine pregnancy. The villi are attached to the serotina and the reflexa in the same manner. Great variations are found as regards the extent of degenerative changes in the early villi, leading to atrophy and disappearance. In some cases these correspond to the changes found in uterine pregnancy, for the chorion may become differentiated into a placental and a non-placental portion; and in such cases the placenta may have a typical discoid shape. Much more frequently there is irregularity of chorionic development. Sometimes the greater part of the villi may remain functional, forming a placenta that in the early pregnancy fills almost the entire cavity in which the ovum develops. Sometimes the placenta may have an irregular, ring-shaped character.

*Amnion.*—The amnion is the same as that found in uterine gestation.

*Tubal Mucosa Outside of the Sac containing the Ovum.*—Great variations are found in this part of the mucosa. Decidual cells may be present in more or less of its extent, though as pregnancy advances they tend to disappear.

Blood is frequently found in this part of the lumen, and may cause considerable flattening of the mucosal folds against the wall or may mass them in irregular heaps. As the gestation increases more of the tube is occupied, and the mucosal folds external to the sac become greatly altered, the epithelium becoming somewhat flattened and frequently cast off.

**Symptoms and Signs.**—**Those Due to the Pregnancy per se.**—Sometimes they may be the same as those of normal pregnancy, the ectopic gestation reaching an advanced stage, being regarded as a normal uterine pregnancy both by the woman and her physician. Such cases are, however, very rare. In the great majority of instances there are variations, both in signs and symptoms, which are suggestive of an abnormal condition, though there are no subjective symptoms of such marked character as may indicate to the woman the peculiar nature of her condition. With regard to physical examination, it may be said that there are very

few cases in which a thorough study should not enable the physician to suspect, if not to establish, the character of the gestation. The constitutional and sympathetic changes occur with great variations. While these may be as well marked as in normal labor, they are frequently less distinct. The breasts, for example, in ectopic pregnancy may at the fourth month present very little pigmentation, enlargement, or colostrum formation. The discoloration of the vagina is frequently slightly marked. It must be remembered, however, that such peculiarities may occasionally be found in uterine pregnancy.

**Menstruation.**—Great variations are found as regards the menstrual function. It may cease entirely in a number of cases throughout pregnancy; it may take place regularly for the first few months and not afterward; it may be regular at first and then irregular; or it may occur at irregular intervals throughout pregnancy. The amount of blood also varies greatly; sometimes the flow may consist of only a few drops; sometimes it may last for one or more weeks. In some cases there is considerable pain in the region of the uterus in connection with the periods, but in other cases there may be little or no suffering.

**Periodic Colicky Pains.**—Such pains are frequently experienced, especially after the second month, though in some cases they are entirely absent. The intervals between them vary considerably. Each attack consists of irregular, intermittent pains, felt in the region of the gestation or in the lower abdomen. The explanation of these pains has been a matter of some difference of opinion. They are believed to be due to contractions of the gestation sac or of the uterus. It is probable that they cannot be caused by the former after the early months, because of the relatively small amount of muscular tissue in the wall. Hemorrhage in the wall of the tube or in the lumen probably explains the pain in many cases. In other instances it is possible that inflammatory changes cause the disturbance.

With regard to the uterus, there can be no doubt that contractions in its musculature are frequently present. Sometimes they are marked, and indicate the efforts of the organ to expel the decidua that lines it.

**Discharge of the Uterine Decidua.**—Very frequently portions of the lining of the uterine mucosa are expelled with more or less blood during the course of an ectopic pregnancy, often with much uterine pain. Sometimes a complete cast of the uterine cavity may be shed. This tissue presents characteristic changes similar to those found in the decidua vera in normal uterine pregnancy.

**Changes in the Breasts.**—Mammary changes, while similar to those found in normal pregnancy, are, as a rule, not so pronounced. If the gestation comes to an end, retrogressive alterations occur, though sometimes, when cases reach full term and

undergo a spurious labor accompanied by the death of the fetus, increased secretion of milk may occur.

**Abdominal Enlargement.**—In uterine gestation, after the third month, there is a fairly constant progressive rate and form of increase in the size of the abdomen; in ectopic gestation there is less uniformity. The more advanced the gestation, the more do the abdominal swellings in the different ectopic varieties tend to resemble one another, and the shape of the abdomen may resemble considerably that found in normal cases. In the majority of instances, however, the increase of the abdomen, especially during the first five or six months, is mainly one-sided. Frequently a tubal pregnancy growing in one side and not falling below the pelvic brim may, within the first three months, form a swelling in the iliac region, noticeable to the woman or to others. Many cases, however, form no apparent swelling above the brim until they have developed to a great extent below it. Those cases which rupture into the broad ligament and develop upward are particularly liable to be noticed as irregular lateral swellings.

**Fetal Movements.**—Fetal movements are felt by the mother first usually between the fourth and fifth months, as in normal pregnancy, variations being found; in a number of cases they may be felt earlier and more distinctly than in normal uterine pregnancy, probably owing to the greater thinness of the gestation sac. Frequently the movements are felt first on one side. In early ectopic sacs that lie close to the abdominal wall they may frequently be detected by auscultation before the mother feels them, and more readily than in uterine pregnancy. After midterm they may often be felt and heard with very great distinctness if the intestines do not intervene between the gestation sac and the anterior abdominal wall. When fetal heart-sounds are heard, they may appear unusually distinct, though there are great variations, according to the health of the fetus, its position, and other factors.

**Maternal Souffle.**—The souffle may frequently be heard in one or both iliac regions, great variations being found. It may be absent, faint, or very loud. It is most pronounced close to the gestation sac.

**Changes in the Vagina.**—The walls of the vagina become soft, lax, and dark in color, as in normal pregnancy, though these changes are not usually so pronounced.

**Changes in the Uterus.**—The cervix becomes somewhat softened and darker in color, though not usually to the extent found in uterine pregnancy. The whole organ enlarges, the extent varying in different cases. It retains the non-pregnant shape, and the body does not become rounded as in normal pregnancy, nor does any special softening occur above the cervix. The latter frequently becomes patulous, especially during the periods of contractions in the organ. Bandl has stated that uterine enlarge-

ment is greater the nearer to the organ the ovum is developed. In the majority of cases it is between 4 and 5 in. in length; sometimes, however, it may be as much as 7 or 8 in. The mucosa shows marked alterations similar to those found in the decidua vera of normal uterine pregnancy. These changes are constant; sometimes, however, on examining the interior of the uterus, no decidual tissue may be found, owing to its previous expulsion.

**Phenomena Noted at Full Time.**—When an ectopic gestation advances to full term there usually occurs what has been termed a spurious labor, characterized by the occurrence of a series of pains resembling those of normal labor. A number of cases are on record where the patient has been attended under such circumstances in the belief that normal labor was taking place. Sometimes these pains develop prematurely during the seventh or eighth month. The duration of the spurious labor varies: it may last hours or even days. When the pains once cease, there is usually no return, though sometimes there may be. There has been some difference of opinion as regards the cause of these pains. There can be little doubt but that they are due to uterine contractions. The gestation sac can take no part in their production except in the case of an interstitial pregnancy or possibly a cornual pregnancy.

The pains are accompanied by dilatation of the cervix, by expulsion of mucus, and frequently blood and decidual tissue.

The fetus probably always dies at the time of spurious labor, though it is possible it may occasionally live to a later period. Voluntary straining-efforts are frequently made by the patient during the pains, and this may cause separation of the placenta, leading to death of the fetus. After the death of the fetus the abdomen usually diminishes somewhat in size, the liquor amnii becoming absorbed. If the fetus is not removed, it may become enveloped in placenta and membranes, and may undergo one or other of the changes that have already been described. In some cases the amniotic fluid slowly diminishes, but it may occasionally increase.

**Symptoms and Signs due to Complications.**—**Pressure Effects.**—Displacement of the bladder may take place in various directions and the various well-known disturbances of micturition may result.

In the early months there is trouble when the gestation sac falls on the bladder or behind the uterus; in the latter position its growth leads to pressure of the former against the pelves. In extraperitoneal development the ovum may come into close relationship with the bladder-wall. The ureters may also be interfered with and the renal functions thereby altered. Pressure on the rectum is apt to lead to constipation; diarrhea may also be caused. Interference with vessels may lead to edema or varicosity

of the external genitals or of the extremities. Pressure on nerves may also lead to pain in the pelvis, lower extremities, and muscles.

**Peritonitis.**—Acute peritonitis is very rare in ectopic pregnancy. It may sometimes follow rupture of the tube into the abdomen, or may follow septic changes in the gestation sac with invasion of the peritoneum. Chronic peritonitis is frequently found, causing changes in the wall of the gestation sac and leading to adhesions between it and the surrounding structures. In the majority of cases this is merely the continuance of an inflammatory process that existed before the pregnancy.

**Pain.**—Various forms of pain are found in ectopic pregnancy. Those of a somewhat labor-like character that occur at intervals have already been described. Suffering may also occur from mechanical pressure of the gestation sac on nerves in the pelvis and abdomen, and may also be caused by vigorous movements of the fetus in the advanced months. Reference has already been made to pains that occur in connection with spurious labor. Peritonitis may in some cases lead to suffering, but in many cases it is not marked by any pain whatever. Rupture of the gestation sac into the broad ligament or into the peritoneal cavity may often be associated with pain, though in some cases it is slight or absent. Hemorrhage into the gestation sac may also cause distress.

**Phenomena Accompanying Hemorrhage.**—The symptoms of hemorrhage in connection with ectopic pregnancy vary greatly, depending upon the size and site of the hemorrhage. In cases of great loss of blood there are symptoms of shock and acute anemia. Pain may be present, varying greatly in various cases. When a hematocele or hematoma is formed, various pressure effects may follow—*i. e.*, interference with the functions of the rectum, ureters, bladder, etc.

**Infection.**—When septic micro-organisms invade an ectopic pregnancy, various changes may be produced that are found in septic processes occurring apart from pregnancy. Suppuration, leading to the formation of a collection of pus, runs the same course as in other pelvic or abdominal abscesses.

**Interference with the Digestive Tract.**—Pressure on the rectum has already been described. As a result of chronic peritonitis, leading to adhesions among the intestines, there may be the ordinary disturbances associated with that complication when pregnancy is not present. When the gestation reaches an advanced period, the most marked alimentary disturbances are likely to be found, though they occur with many variations; in some instances there may be very little disturbance in connection with either the stomach or the intestines.

**Rupture of the Gestation Sac.**—The symptoms and signs following rupture of the gestation sac vary greatly. They depend mainly upon the nature of the rupture, the site of the

rupture and the amount of blood lost, the complication of infection, etc.

At the time of spurious labor the sac may sometimes burst. Rarely does this take place so that the fetus escapes into some part of the peritoneal cavity or into the vagina. Sometimes it may enter the large intestine. An interstitial pregnancy may burst into the uterine cavity. When suppuration occurs, the fetal tissues may escape by the bowel, bladder, vagina, or parietes.

**Changes Following Death of the Fetus.**—If the maternal souffle has been present, it gradually disappears. Labor-like pains, may occur; sometimes also at later periods. Menstruation usually returns, though not in any definite or regular manner. The abdomen usually diminishes in size, though in some cases it may not change much. If no suppuration occurs, the mass may be carried for many years and cause little or no trouble to the woman.

**Diagnosis.**—The difficulty of establishing an accurate diagnosis in ectopic gestation is largely due to the great variations in the signs and symptoms that may be present. In studying any given case it is necessary to prove that the uterus is not gravid, that an abnormal swelling exists, and that it is due to the ectopic development of an ovum. The most important factor in establishing the diagnosis is the physical examination of the pelvis and abdomen, especially by abdominorectovaginal bimanual method.

An anesthetic should always be employed when there is uncertainty. The great difference between uterine and ectopic pregnancy is that the physical changes in the abdomen and pelvis occur fairly uniformly in the former and with great variability in the latter.

Relaxation, softening, and discoloration of the walls of the vagina, though usually present, are often not very well marked. They are most developed in cases of advanced pregnancy. Increased pulsation of vessels as found in vaginal examination occurs with great variability. The shape and position of the vagina are altered in different ways. Sometimes there is little change; sometimes there is marked shortening, especially when the uterus is pushed downward by the gestation sac. There may be marked displacement forward, backward, or laterally. The position of the uterus is likewise subject to many alterations. In the early months it may not be much changed; later it is frequently pushed upward and forward or displaced laterally; occasionally it is pushed directly downward, or may be retroposed or retroverted. It may occasionally be considerably rotated. Changes in its size have already been noted, though frequently it is impossible to measure the organ owing to the impossibility of outlining its upper end. A sound must never be used when there are doubts as regards the existence of uterine gestation. When the uterus can be entirely palpated, it does not present the alteration found in normal pregnancy.

It is firmer and does not become especially soft above the cervix. In some cases it may be felt to be distinct from the gestation sac; in others it is so related to it that it appears to be only a firm portion of its wall. In other cases it is so incorporated that it cannot be felt in any way distinct from it. In some cases when bimanual examination is employed fluctuation may be obtained in the liquor amnii, ballottement may be found, and the fetal movements may be felt. In other cases it is impossible to determine these points, owing to the thickness of the placenta and the presence of extravasated blood or other complications.

Various conditions must be considered in establishing the diagnosis of ectopic pregnancy.

1. **Uterine Pregnancy.**—In the early weeks of normal pregnancy a pelvic swelling lying alongside the uterus may be regarded as an ectopic sac, the enlargement of the uterus being attributed to the influence of the former. If the uterus had formerly been hardened by chronic metritis, the mistake is more liable to be made, but it is especially when there is some irregularity in the ordinary signs and symptoms—*i. e.*, a discharge of blood from the uterus—that the risk of making a mistake is greatest.

In advanced uterine pregnancy error may be made, especially when the wall of the uterus is thin and the liquor amnii scanty, allowing the fetal parts to be easily palpated. Error may also be made when the uterus is displaced markedly to one side by old adhesions, by a tumor, or by a loaded portion of bowel. It may also occur when there is a fibroid tumor in the wall of the uterus.

Ectopic gestation may also be mistaken for uterine pregnancy, especially in the advanced months, though an interstitial gestation might be mistaken during any month. In some cases error may be made even after the most careful examination.

2. **Retroversion of the Gravid Uterus.**—Ectopic pregnancy has often been mistaken for this condition, chiefly in the early months. The error should rarely be made if a thorough anesthetic examination is carried out. Similarly, retroversion of the pregnant uterus has been mistaken for ectopic pregnancy. It is important to note the following symptoms and signs resulting from pressure of the displaced gravid uterus—*viz.*, difficulty in micturition, retention of urine, overdistention of the bladder, constipation, and pains in the pelvis and thighs. If the bladder be overdistended, it is felt as a round or oval tumor above the symphysis. The cervix uteri is generally close behind the latter. The body of the uterus is felt as a soft cystic swelling in the pouch of Douglas, continuous with the cervix.

3. **Sacculatation of the Uterus.**—When sacculatation of the anterior or posterior wall of the uterus occurs, with displacement of the cervix, the condition may exactly resemble an ectopic gestation.

4. **Tumor of the Ovary.**—This may be mistaken for ectopic pregnancy under various circumstances. A small tumor developing in the pelvis or burrowing beneath the broad ligament, displacing the uterus, may simulate the condition. When there is a large tumor, error may be made if the uterus be adherent to it, especially if there be a history of irregular menstruation, accompanied by some of the minor signs and symptoms of pregnancy. Torsion of the pedicle may result in many of the signs and symptoms associated with rupture of blood-vessels in an ectopic sac. When uterine pregnancy is complicated with an ovarian tumor, an error in diagnosis is very apt to arise. A tumor associated with a uterus from which an incomplete early abortion has passed may be difficult to diagnose from ectopic gestation.

5. What has been said of ovarian cysts applies to other pelvic swellings—*i. e.*, those arising in the tube or broad ligaments.

6. **Fibromyomatous or Fibrocystic Tumors.**—Ordinary fibroid tumors are generally easily distinguished from ectopic pregnancy. Sometimes an intramural growth may simulate markedly an interstitial gestation. A large irregular fibroid mass may sometimes be mistaken for an ectopic gestation that has reached an advanced period. Death of the fetus then occurs, followed by absorption of the liquor amnii. Occasionally the occurrence of a local peritonitis in connection with a fibroid uterus may simulate an ectopic pregnancy in which rupture has occurred.

7. **Pelvic Hematocele and Hematoma.**—The occurrence of an outpouring of blood in the peritoneal cavity or the cellular tissue of the pelvis apart from ectopic pregnancy may be very difficult to diagnose from the latter condition. In this connection it should always be remembered that the most frequent cause of such hemorrhage is undoubtedly ectopic gestation.

It is necessary that the case should be studied with the greatest care, because of the risks to the life of the patient that follow the rupture of ectopic gestation sacs.

8. **Inflammatory Swellings in the Pelvis.**—Various swellings that may be produced in the pelvis as the result of inflammation must be diagnosed from ectopic pregnancy. The risk of making an error is greater when the uterus has been recently pregnant or when the inflammation complicates actual normal pregnancy.

9. **Malignant swellings** occasionally cause error in diagnosis. In most cases the error has been due to the formation of a malignant swelling resembling somewhat the shape of the fetus in its gestation sac. Sometimes such a condition may be very perplexing when it is found at the time of the menopause, especially if menstrual irregularities and some of the minor changes usually found in pregnancy be present.

10. **Gestation in the Rudimentary Horn of a Malformed Uterus.**—This condition can be definitely diagnosed from ectopic

pregnancy only if the shape of the malformed horn can be accurately outlined. This is rarely done, but for practical purposes accuracy is not necessary, since both conditions demand the same treatment.

11. **Gestation in a well-formed Bicornute Uterus.**—When one half of a bicornute uterus is pregnant, the condition may strongly resemble an ectopic gestation. In the former case the finger may usually feel the fetus in advanced pregnancy if the cervix be patulous.

12. **Spurious Pregnancy.**—This condition may be mistaken for ectopic pregnancy. The menses may cease for several months or may be irregular. There may be changes in the breasts and various other manifestations of pregnancy. When the uterus is found empty on bimanual examination, it may be thought that an ectopic gestation is present, especially if there be a swelling of any kind in the abdomen or pelvis. In such cases an anesthetic examination should always be made.

13. Various other conditions may simulate rupture of a gestation sac—*i. e.*, acute intestinal obstruction, perforation of the intestines, rupture of an aneurysm, renal and biliary colic, torsion of the pedicle of a tumor, etc.

**Treatment.**—(a) **When the Gestation is Confined to its Original Site in the Ampullar or Infundibular Portion of the Tube or in the Ovary.**—As soon as the diagnosis is established the patient should be kept at rest, in order to avoid any form of exertion that might bring about rupture of the gestation sac. Abdominal section should be carried out and the gestation removed, the procedure being the same as in the case of the removal of a tube much altered by disease.

In such conditions the chief difficulty arises when the gestation sac is impacted in the pelvis or is extensively adherent to surrounding structures. If the sac be ruptured during operation, considerable hemorrhage may result. It is, therefore, always advisable before removal to ligate the ovarian artery on the affected side. When the gestation sac occupies a considerable portion of the abdomen and is so adherent that its removal is impossible without dangerous loss of blood, it may be advisable to carry out a procedure similar to that described in connection with subperitoneo-abdominal cases.

(b) **Interstitial Tubal Pregnancy.**—Several cases have been reported in which the cervix has been dilated and the septum between the uterine cavity and the gestation sac divided so as to allow the removal of the ovum. This procedure should be undertaken only in the early months, when there is considerable probability that it may be satisfactorily accomplished or when there is some contraindication to abdominal section. The chief risk is that the outer wall of the gestation sac may be ruptured, leading

to extra-uterine hemorrhage. This is most likely to occur in separating the placenta manually. After removal of the pregnant mass the cavity should be packed with gauze for several days.

In a great majority of these cases, however, abdominal section is the safest procedure; if the gestation be not too far advanced, it may be possible to remove the pregnant portion of the uterus, closing the cavity as after a myomectomy. When the gestation is advanced, however, it is advisable to remove the whole uterus, as in the operation of hysterectomy for a large fibroid.

(c) **When the Gestation Sac has Ruptured into the Peritoneal Cavity.**—When rupture is accompanied with acute symptoms of loss of blood, abdominal section is indicated. All precautions should be taken to counteract the influence of the blood-loss before and during the operative procedure,—*i. e.*, the introduction of normal saline solution into the system,—and the latter should be quickly carried out. In opening the abdomen it is imperative first of all to find the place of rupture, in order that the bleeding vessels may be controlled. Also the ovarian vessels on the side of the gestation should be early clamped or ligated. If the tear be large or irregular, it may be impossible to do this quickly, or attempts at compression may increase the size of the tear. In such cases the assistants should compress both broad ligaments while the operator carries out his manipulations.

The gestation sac should be removed as would be an inflammatory swelling, and complications should be treated in the ordinary manner.

In cases of rupture in which dangerous loss of blood has not at once occurred, but a succession of small hemorrhages, abdominal section is also advisable. Cases seen after hemorrhage has ceased may be treated expectantly, in order that the hemocele may have a chance to absorb. If this does not take place with reasonable rapidity, operation should be carried out, the blood-clots removed, and the gestation sac taken away, if possible. Abdominal or vaginal drainage may be necessary afterward.

The gestation sac being removed, the operation is very likely to be complicated in such conditions by the presence of numerous adhesions and by blood-clots in all stages of formation. The most careful technic must be observed, the clots being carefully removed, and the abdominal cavity being flushed out with normal saline solution.

In the rare cases in which after the rupture of the primary sac the fetus escapes in its membranes and continues to grow in the peritoneal cavity, abdominal section should also be carried out. The secondary sac should be opened first of all, the fetus and amniotic fluid being removed. Thereafter, if the primary sac is movable and the adhesions surrounding it are easily divided, the

mass containing the placenta should be taken away. As much of the amnion as is loosely attached may be stripped away. It should not be forcibly torn off, however, because of the danger of injuring the viscera. When the primary sac is too firmly embedded in the pelvis or in adhesions to allow of its safe removal, the ovarian artery of the affected side should, at least, be ligated. The umbilical cord should be brought to the lower end of the abdominal incision and a gauze tampon inserted from the latter down to the placenta.

After four or five days the patient should be anesthetized, the packing removed, and an effort made to detach the placenta. Sometimes only a portion of it may be taken away at this time. The cavity should be again packed, and the rest of the placenta be removed several days later. The cavity is afterward allowed to close gradually.

(d) **When the Primary Gestation Ruptures into the Broad Ligament.**—At the time of primary rupture the patient should be placed at rest in bed, a simple light diet being administered, and an ice-coil or ice-bag should be placed over the lower abdominal region, ergot being administered internally. The pelvis should be examined from time to time, in order to determine if the mass tends to increase in size. If the ovum be destroyed, no further treatment may be necessary, in some cases the swelling in the broad ligament gradually disappearing. If the disappearance takes place very slowly or pressure symptoms are present, it is wise to make a vaginal incision into the mass, remove blood-clots, and pack the cavity with antiseptic gauze.

In cases in which after rupture the ovum continues to develop, so that the swelling reaches upward into the abdomen, it is sometimes possible to carry out vaginal operation. This should be done when the amniotic cavity is felt to bulge downward behind the uterus, the placenta being above the level of the fornix. By incising the gestation sac the liquor amnii and fetus may be removed. An antiseptic gauze tampon may then be inserted into the sac, which gradually shrinks. After four or five days the gauze may be removed and an effort made to take away part or all of the placenta. The cavity should be again packed, and should afterward be treated as a pelvic abscess cavity.

When the placenta is situated low in the pelvis or the gestation sac has advanced several inches above the brim of the pelvis, the abdominal route should be selected and a mesial or lateral incision made, the sac opened, the fetus and liquor amnii extracted, and the cavity packed with antiseptic gauze, the umbilical cord being carried into the abdominal wound. The edges of the gestation sac should be stitched to the edges of the abdominal incision. This method of treatment may be greatly complicated if the abdominal incision is made through the placental area, as the

loss of blood may be very rapid. To lessen this risk the cavity should be packed with the greatest rapidity.

After four or five days the gauze should be removed and the placenta entirely or partially taken away. No force should be employed in this procedure. Thereafter the cavity may be packed every few days until it gradually shrinks and closes. Removal of the placenta at the time of primary operation is not advisable on account of the danger of hemorrhage. In cases in which infection of the cavity may follow this procedure the healing-process is delayed. It may be greatly hastened if a vaginal incision can be safely made into the sac, so that downward drainage may be carried out.

**(e) When, after Rupture of the Primary Gestation Sac into the Broad Ligament, Rupture takes place into the Peritoneal Cavity.**—

When secondary rupture occurs soon after the primary rupture, abdominal section must be carried out and the case treated on the lines laid down for the management of primary rupture of the gestation sac into the peritoneal cavity. When the rupture occurs after the ovum has been developing extraperitoneally for some time, the abdominal cavity should be opened, the vessels in the edges of the tear closed, and the latter stitched to the edge of the abdominal incision if near enough.

If the rent be too far from the abdominal wall, it should be closed with catgut, the peritoneal cavity flushed out with normal saline solution, and the sac opened anteriorly, being treated in the manner already described.

**(f) When the Case has Reached the Advanced Months of Pregnancy.**—

Abdominal section is always indicated. There should be no delay unless at the express desire of the parents, in order to take chances of securing a more developed fetus. Such a course is, however, unwise; waiting adds to the risks and discomforts of the mother. As regards the fetus there is great uncertainty.

In the case of ectopic pregnancy the fetus is less robust than in the case of uterine pregnancy, and there is great liability to death at or near full term. When the operation is carried out after there has been a spurious labor, followed by death of the child, the risks of hemorrhage are much reduced and the chance of removing the placenta considerable.

When the fetus has been long dead and it has been mummified, transformed into adipocere or a lithopedion, removal by abdominal section is always indicated. The fetus should be taken out, and its membranes or sac with it, if they be easily detachable.

**(g) When Suppuration has taken place in an Old or Recent Gestation.**—In these conditions the procedure usually adopted for pelvic or abdominal abscesses should be employed. The vaginal incision should always be chosen if possible. If the

abdominal route be selected, care should be taken not to infect the peritoneal cavity. In cases of spontaneous rupture of the infected sac there may be great delay in the healing if the fetus has been so far advanced that its skeleton has been well formed. Its bones pass out very slowly and may greatly impede the escape of pus. It may be necessary to remove the contents by hands or instruments, and an incision may be required.

(h) **When there is a Combination of Ectopic and Normal Uterine Pregnancy.**—When the gestation is of old standing, as in the case of a lithopedion, a uterine gestation may sometimes progress normally and be delivered satisfactorily. Sometimes premature emptying of the uterus may result from the interference caused by the old gestation mass. In other cases full time may be reached, but labor may be obstructed and artificial delivery may be necessary. When an ectopic gestation is in the condition of active growth, the complication is very serious. Rarely a uterine pregnancy may go to full term and delivery occur without rupture of the ectopic sac; the latter occurrence is, however, likely to occur. Usually in such a condition it is advisable to carry out abdominal section, removing the ectopic gestation and allowing the uterine pregnancy to continue. Sometimes it may be necessary to terminate the latter also, though such a procedure greatly increases the risk to the mother.

(i) **Rudimentary-horn Gestation.**—This condition is a grave one, and is to be treated according to the rules laid down for the management of tubal pregnancy.

PART V.  
THE PATHOLOGY OF LABOR.

IN considering the different complications of labor which make that process difficult or dangerous it is convenient to consider them in three groups: 1. Those relating to the powers. 2. Those relating to the passages. 3. Those relating to the passenger.

CHAPTER I.

ANOMALIES OF THE EXPELLANT POWERS.

(a) **Excess; Precipitate Labor.**—**Excessive Uterine Contractions.**—Excessive activity of the uterus may be manifested by increased frequency, intensity, or duration of the pains. In some cases all these features may be combined. Sometimes they may be present from the beginning of labor; sometimes they may develop in the course of the first or second stage. When intense pains succeed one another rapidly, the patient becomes distressed and restless and the pulse-rate rises. Frequently in the first stage she may make involuntary straining-efforts. Sometimes these are so violent as to cause fracture of the ribs, emphysema of the throat and chest, and hemorrhages in the trachea and bronchi.

If there be obstruction to the passage of the fetus, the results may be very serious, both to the mother and child. When there is no obstruction, delivery may be very rapid. Frequently after rupture of the membranes the fetus may be expelled in a few seconds or minutes.

Precipitate labor is most apt to occur in multiparæ, especially in biparæ, though in a considerable number of cases it is noted in primiparæ. It is favored by a small fetus, large pelvis, and by an inclination of the pelvis that establishes the most direct continuity between the axis of the uterus and that of the upper part of the pelvic cavity. Bayer has collected 808 cases; in these the labor occurred in 273 standing, in 67 walking, and in 234 sitting or

squatting. Previous precipitate labors exercise a predisposing influence.

In some cases excessive action of the voluntary muscles may be an important factor in hastening the delivery. Sometimes sudden births are those in which the head has reached the pelvic floor by a painless descent, the expulsion occurring thereafter by a few strong contractions.

Precipitate labors are frequently associated with complications—*i. e.*, laceration of the soft parts, hemorrhage, separation of the placenta, inversion of the uterus, and rupture of the cord. Winckel states that lacerations are three times as frequent as in normal labors in multiparæ. The risks are greater when the woman happens to be sitting or standing; the labor is likely to be more precipitate than it is when the woman is lying down. The fetus may be injured when it is forcibly expelled; fractures may be caused, or the fetus may so fall on its face as to be prevented from breathing. Sometimes, when the woman is unattended, the infant may die before it is cared for. After these labors there are apt to be uterine inertia and postpartum hemorrhage; there is also greater risk of infection than in normal cases, chiefly on account of the lacerations.

Asphyxiation of the fetus follows excessive compression of the placenta; intracranial hemorrhage or fracture of the skull may sometimes be produced by violent uterine contractions.

*Treatment.*—When there is a history of a previous precipitate labor, the woman should be advised not to go far from her house during the last week or two of her pregnancy and to avoid straining at stool. When excessive activity of the uterus is noted in labor, the woman should be placed in bed and not allowed to walk about, especially if there is a history of a former precipitate labor. She should be urged not to strain during the pains in the first stage. To moderate their intensity, chloral may be given or a little chloroform may be inhaled at the beginning of a pain. Morphine should be used only when absolutely necessary, on account of the risk of affecting the fetus. When dilatation of the cervix causes intense suffering, it is recommended by some to apply cocaine solution (4 to 10 per cent.) to the cervix. In the second stage the perineum must be carefully guarded and the head not allowed to pass too quickly. In the third stage the body of the uterus must be controlled by a hand placed on the abdomen. Precautions must be taken to prevent postpartum hemorrhage.

(*b*) **Delayed Labor; Inertia Uteri.—Defective Uterine Contractions.**—Labor may be delayed from weak, short, or infrequent uterine contractions. Weakness must be regarded as relative, for pains that might be sufficient to bring about delivery in some cases, might be ineffectual if there be increased resistance. In some cases the pains may cease entirely.

*Etiology.*—The following causes may be enumerated: Debilitated constitution, exhausting disease; uterus weakened because of congenital malformation, inflammation, or too frequent child-bearing; adhesions to neighboring structures; tumors of the uterus or of neighboring tissues; distention of the bladder or intestine; displacement of the uterus; premature escape of the liquor amnii; pregnancy in an old primipara; hydramnios; twin pregnancy; fright or mental emotion. Usually in the early stage of labor in cases of placenta prævia there is some uterine inertia. Strong pains may be succeeded by weak contractions in cases of obstructed labor due to various causes—*i. e.*, strong and adherent membranes, contracted hard or soft parts, large fetus, malpresentations, malpositions, etc.

*Symptoms.*—In the first stage the membranes do not get very tense or bulge down during contractions and may be easily pushed up. The cervix dilates slowly or not at all. If the membranes are ruptured, the fetus makes little or no advance. In cases of long delay—*i. e.*, more than twenty-four hours—the woman usually shows evidence of fatigue. She may be anxious and restless, the skin gets dry, the pulse rapid and small in volume, and the temperature elevated. In extreme cases the patient becomes much reduced, the tongue furred and dry, nausea and vomiting supervene, the face becomes swollen, and delirium and coma may follow. The vagina and vulva frequently become dry, congested, edematous, and tender, and there may be pains in the pelvis, abdomen, and thighs. Death may result if the woman is not delivered early enough. The life of the fetus is endangered; its movements may become violent, its heart-beat increasing and then becoming slowed, and it may finally die from asphyxiation, especially when the membranes have been ruptured. During the third stage in such cases there may be inertia, retention of the placenta, and hemorrhage. Afterward there may be uterine relaxation, hemorrhage, and accumulation of clots *in utero*.

*Prognosis.*—The risk to the fetus is very great if the membranes have ruptured prematurely. Great variations are, however, found, and it is impossible to state an exact limit beyond which death of the fetus takes place. Change in rhythm of the fetal heart is a danger sign; also passage of meconium in a breech presentation. Increase in pulse, temperature, and respiration in the mother and swelling of the soft passage indicate a serious condition. The longer the delay, the worse is the prognosis.

*Treatment.*—Remedial measures vary according to the cause of weak contractions, their extent, and the stage of labor. The mere fact that labor is prolonged does not always imply the necessity of terminating it. The condition of the mother and fetus determines the indication. If there be general weakness, stimulants may be necessary. If the bladder or bowel be distended, it

should be emptied. In the first stage, if the patient be tired, if the membranes are intact, it is advisable to administer opium, morphin, or chloral, or a combination of morphin and chloral, in order that the patient may have a rest and a sleep; at the same time some light food may be given. Often after such a spell she may awake refreshed and go through her labor satisfactorily. If the patient be not exhausted, quinin should be administered (the hydrobromate is least apt to disturb the system), in order to strengthen the pains. Fifteen grains may be given within thirty minutes. In large doses this drug does not tend to cause tetanic contraction of the uterus. Massage of the uterus should be carried out through the abdominal wall.

If hydramnios is present, it is advisable to withdraw the liquor amnii slowly. Hot vaginal douches (105° to 110° F.) given every hour are sometimes helpful. A rubber bag distended in the vagina may often stimulate the uterus. In cases in which the membranes are ruptured, a Champetier de Ribes bag placed in the lower part of the uterus and distended may cause labor to proceed satisfactorily. When the weak pains occur in the second stage, quinin may be administered and the uterine body massaged. The method of expression recommended by Kristeller in 1867 may be tried. The fundus should be grasped anteroposteriorly between the fingers and thumbs of the hands placed side by side on the abdominal wall, care being taken not to include the intestine in the grasp, if possible. Downward pressure is made in the axis of the pelvic inlet, at first gradually, then with more force, ten or fifteen seconds, then gradually relaxing. This manipulation is repeated at intervals of one to five minutes, preferably during pains. When the patient is very sensitive, an anesthetic may be given. If the uterus lies laterally, it should be moved so as to lie mesially. Kristeller's manipulations may succeed in bringing about descent of the fetus as well as stimulating the uterus. Hofmeier recommends that the head alone be pressed down, the hands of the obstetrician being placed on the abdomen, above the brim, one over the occiput, the other over the face. It may also be necessary to apply forceps in head presentations, or to carry out manual traction along with pressure from above if the breech presents. These measures may be adopted if the second stage has lasted three and a half hours in primiparæ or two and a half hours in multiparæ.

**Irregular Uterine Contractions.**—The uterine contractions may be irregular as regards their occurrence or as regards the amount of uterine wall involved. They may be very painful but ineffective. The pain is usually localized when part of the uterus only is active. In some cases the activity may be localized to the region of the retraction ring. In some cases a tetanic condition of the uterine body is produced. The causes of these irregularities

are not definitely known. They are sometimes present in prolonged or difficult labors, especially when there is some definite obstruction; sometimes after premature rupture of the membranes. They are apt to follow the administration of ergot during labor, especially the tetanic variety.

In examining the uterus during partial contraction, one portion of the wall may be felt to harden while another remains uncontracted. No bulging of the membranes or dilatation of the cervix may be present during the pain. When the retraction ring is affected, it may be felt hard and firmly pressed against the fetus. In the tetanic condition the whole uterus remains firm and is moulded on the fetus if the liquor amnii has escaped.

*Prognosis.*—In irregular contractions the labor is delayed and the woman becomes restless and wearied. The tetanic condition may lead to uterine rupture, may cause fracture of the head of the fetus, and is apt to cause its asphyxiation by compression of the placenta or cord.

*Treatment.*—In mild cases chloral or morphin may be given; hot vaginal douches may be helpful. In severe cases chloroform may be necessary. Sometimes artificial delivery is advisable, the cervix being dilated if necessary. In the tetanic condition it may sometimes be impossible to remove the fetus except by embryotomy. In some cases Cæsarean section may be advisable. In the third stage there may be difficulty in connection with the delivery of the placenta.

**Anomalies of the Accessory Muscles.**—Ordinarily the accessory muscles become active after the first stage, the patient straining during the uterine contractions. Occasionally they may act during the first stage, especially when the uterine pains are intense. Sometimes the woman may inhibit them from fear. In heart and lung conditions associated with dyspnea it may be impossible to use them. In general debility or emaciation the muscles may be weak. Their action may be largely ineffectual when there has been marked separation of the recti abdominis, especially when there has been a pendulous belly during pregnancy. Excessive obesity is said to weaken them. In lesions of the spinal cord they may be inactive. When the lower limbs are diseased or amputated, they cannot act as effectively as in normal cases, because the pelvis cannot be fixed during straining. Distended intestines, ascites, and abdominal tumors interfere with the efficiency. As a rule, weakness, absence, or inefficiency of contractions of the accessory muscles delays labor. Sometimes, however, this is not the case, the uterus being able to expel the fetus.

The **treatment**, as a rule, consists in artificial delivery if labor tends to be unduly delayed. Kristeller's manipulation may be tried during the second stage. When the linea alba is much stretched, an abdominal binder may be of some assistance.

## CHAPTER II.

## ANOMALIES OF THE PASSAGES.

## SOFT PARTS.

**Malformations of the Uterus.**—Labor may take place satisfactorily when a unicornute uterus is pregnant. Owing to the inclination of the long uterine axis to the pelvic brim there may be malpresentations and malpositions, though these are not as frequent as might be expected, since the enlarged uterus at the end of pregnancy tends to lie more symmetrically in the abdomen than in the non-pregnant state. When one horn of a bicornute uterus is pregnant, the condition is much the same as in the preceding case. Obstruction to the passage of the fetus may sometimes be caused by the non-pregnant horn. Rarely both horns are pregnant, and when labor occurs, each may obstruct the other. (Pregnancy in a rudimentary horn is considered in connection with Ectopic Gestation.) When one half of a septate uterus is pregnant, labor may be obstructed by the septum or by the empty part of the uterus.

In all these conditions labor may be prolonged and the uterine contractions weak, irregular, inefficient, and sometimes very painful. Rupture of the uterus may take place. The placenta may be retained and there may be postpartum hemorrhage.

**Treatment.**—In some cases the management is the same as under normal conditions; sometimes forceps may be necessary. Version should be employed as little as possible, owing to the risk of rupturing the uterus in such cases. When a septum is an obstruction, it should be divided, if possible. Embryoclia or Cæsarean section is sometimes required.

**Malpositions of the Uterus.—Obliquity of the Uterus.**—The long axis of the uterus may be inclined so much to one or the other side or to the front as to cause trouble in labor. When the fundus is displaced anteriorly, the condition is often termed anteversion, being due to weakness of the anterior abdominal wall, resulting from separation of the recti abdominis muscles. Marked tilting to one side may be due to adhesions or the presence of a tumor. When these obliquities are present during labor, much of the force of uterine contractions is inefficient because the long axis of the uterus is not in line with the axis of the inlet. Moreover, malpresentations and malpositions are apt to be produced.

**Treatment.**—The obliquity should be corrected as much as possible and a binder applied to the abdomen, the patient being kept in bed on her back as much as possible. Version may sometimes be necessary on account of a malpresentation or malposition that may be caused by the obliquity.

**Hernia.**—Rarely the pregnant uterus may form part or the whole of an umbilical, ventral, inguinal, or femoral hernia. The uterus may be normal, unicornute, or part of a bicornute organ. The hernia may be congenital or may develop before or during pregnancy. The uterus may sometimes be drawn into the sac by adhesions to intestines or may be secondary to an ovarian hernia.

*Treatment.*—Reduction of the hernia should be attempted. If this be impossible, the uterus should be opened and emptied, hysterectomy being carried out if a conservative operation cannot be safely performed.

**Prolapsus Uteri.**—Partial prolapse of the pregnant uterus is occasionally found, but it is extremely rare that any considerable portion of the uterus lies outside of the vulva at full term. In the minor degrees the lower part of the uterus may be elevated after uterine contractions have been active for a time. Sometimes this does not take place, especially if the cervix be rigid or hypertrophied, and it may become edematous and obstruct the passage of the head.

*Treatment.*—When the cervix does not dilate readily, it may be necessary to employ artificial means. Vaginal Caesarean section is advisable if dilatation is impossible without excessive tearing. When the cervix tends to be pushed down before the head, artificial dilatation should be carried out, and its descent should be prevented as much as possible by the hands. When labor is tedious, it is advisable to apply forceps if the cervix be sufficiently dilated.

**Sacculation.**—This term is applied to the condition in which the uterine wall does not distend uniformly during pregnancy, but in which one wall enlarges to a much greater extent than the other. Either the anterior or the posterior wall may be affected. In retroversion of the gravid uterus the lower portion of the posterior wall may develop and form a diverticulum behind the cervix, bulging the posterior vaginal wall downward and forward, the cervix itself being elevated. This sometimes occurs in placenta prævia. It may also take place when tumors of the uterus or neighboring parts interfere with the normal upward development of the pregnant uterus. It may be found when the organ is held by adhesions, and when it is prevented from rising by a markedly contracted brim. Sacculation of the posterior wall may also take place when pregnancy occurs in a uterus that has been rendered immobile in an anteverted position by vaginal fixation or ventrofixation. The anterior wall remains as a thick, unexpanded mass above the bladder, while the thin, expanded posterior wall rises in the abdomen, containing the fetus. Sacculation of the anterior wall is rare, and may extend upward when the uterus is retroverted and fixed by adhesions. Downward sacculation of the anterior wall may also occur when the uterus is anteverted, the

cervix being much displaced backward. In these cases, as the cervix is generally displaced upward, normal labor is usually impossible, artificial delivery being necessary. Abdominal Caesarean section is probably the most satisfactory treatment, though sometimes vaginal incision of the sacculated wall might be employed for removal of the uterine contents.

**Labor after Hysteropexy.**—The various disturbances that may follow operations that have been carried out in the treatment of uterine displacements have previously been described. I have already described the serious complications that are apt to follow vaginal fixation and ventrofixation, procedures that greatly limit the normal movements of the uterus (p. 337). In cases that reach full term there may be malpresentations and malpositions, uterine inertia, non-engagement of the presenting part, deviation of the cervix backward or upward, delayed labor, and rupture of the uterus. Interference is necessary in these complications—*i. e.*, dilatation of the cervix, forceps, version, embryulcia, and Caesarean section.

**Pregnancy and Labor in Old Primiparæ.**—First pregnancies in women over thirty years of age are more frequently abnormal than those occurring in the preceding decade. Abortion, renal disorder, and eclampsia are relatively frequent. De Koninck states that in such women who have been married several years the first gestation is frequently twin or ectopic. Labor is very apt to be delayed, often continuing for forty or fifty hours, and sometimes longer, uterine contractions being usually feeble. Mental and physical exhaustion is very common. Delay also frequently occurs when the head reaches the perineum. Artificial delivery is frequently necessary. It is held by some that the percentage of male children is relatively large in the first labors of old primiparæ.

**Pregnancy and Labor in Young Primiparæ.**—Spitta has reviewed the histories of 260 labors in primiparæ of eighteen and under, as observed in the Marburg Maternity. He states that the general health is not worse than the average among other pregnant women. Labor before the fortieth week was relatively frequent. Labor is often prolonged and the pains weak. Flooding is common, as are lacerations of the soft parts. Artificial delivery is often necessary. The proportion of male births increases with the age of the mother. The maternal and fetal mortalities are not excessively high.

**Tumors of the Uterus.—Fibromyoma.**—The relationship of fibroids to pregnancy has already been considered. Various complications may arise in labor, in association with submucous, subperitoneal, and interstitial tumors. Those situated near the cervix are likely to cause the most serious disturbance. There may occur displacement of the cervix, malpresentations

and malpositions, hemorrhage during delivery, prolapse of the cord, placenta prævia, adherent placenta, and postpartum hemorrhage. Uterine contractions may be very weak or irregular, sometimes tetanic; uterine rupture may occur; the fetal head may be contused and fractured. Delivery may be impossible by natural means. In the puerperium hemorrhage may occur. There is increased liability to septic infection. Sometimes a fibroid may become necrosed and slough; rarely one may be expelled from the uterus.

*Diagnosis.*—The condition is usually easily ascertained, save when the tumors are situated on the posterior uterine wall or project mainly into the uterus. In some cases a fibroid may be

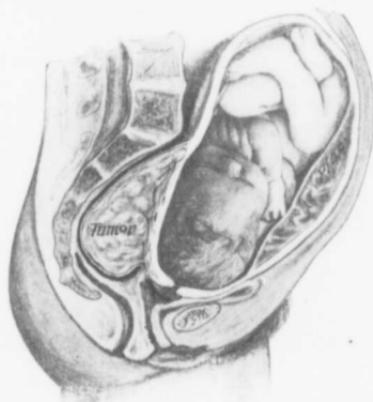


FIG. 153.—Small fibroid past which the child was extracted. The tumor became gangrenous and the woman died (Simpson).

mistaken for parts of a fetus, for twins, for fecal masses, or for portions of the placenta.

*Treatment.*—Some cases may go through labor normally, especially those in which there are small subperitoneal fibroids situated high on the uterus. In other cases, in which the tumors are not low enough to obstruct the passage, labor may be prolonged as the result of inefficient pains. In these cases forceps or version may be necessary if the cervix is dilated; if dilatation takes place slowly, artificial means may be necessary.

When a small subperitoneal fibroid lies in the pelvis, an attempt may be made under anesthesia to push it above the brim. If this be impossible, the child may be delivered by forceps or version if the obstruction caused by the tumor be slight. When it is more

marked, embryulia or Cæsarean section is indicated. When a large fibroid or several of small size cause much obstruction, Porro-Cæsarean section is advisable. Pedunculated cervical fibroids may be removed during labor, and non-pedunculated tumors may sometimes be enucleated in order to remove obstruction. In every instance in which labor takes place the patient must be watched carefully. After the birth of the child it is advisable to separate the placenta manually, in order to avoid the risk of partial or complete non-separation and hemorrhage. The uterine cavity should be packed with sterile or antiseptic gauze, which may be left *in situ* three days and renewed if necessary, ergot being administered in large doses. If a submucous fibroid tends to become expelled, it should be taken away early, in order to lessen the risk of infection and necrosis. Sometimes fibroids get smaller after labor, and are believed by many to disappear occasionally.

**Anomalies of the Cervix.—Displacement.**—When the cervix is much displaced, it may be a source of trouble in labor. Usually this anomaly is associated with a displacement of the body, which may itself be the cause of a complicated labor. Sometimes, however, the cervix is markedly drawn toward one or the other part of the fornix vaginae, though the body may be normally placed in the abdomen. Rarely, when the cervix is drawn far back in the pelvis, there may be a downward sacculation of the lower part of the anterior uterine wall. Similarly, when the cervix is displaced forward, there may or may not be a sacculation of the posterior uterine wall. On vaginal examination the findings are different, according to whether or not there is sacculation of the uterine wall. If this be present, the bulging is felt below the level of the os, and the latter may be distinguished with difficulty. Sometimes it is not felt, and the projecting sacculated portion may be diagnosed as occluded cervix and lower uterine segment. Sometimes, when the head fills the sacculated portion, which is thinned and stretched over it, the diagnosis of fully dilated cervix may be made, the thin uterine wall being mistaken for the scalp. The bulging portion may also be mistaken for a tumor. An anæsthetic examination may be necessary in order to establish a diagnosis. Slight deviations of the cervix cause no trouble in labor. In marked cases dilatation takes place slowly; the lower uterine segment may become greatly thinned and rupture threaten. Malpresentations and malpositions of the fetus may occur.

**Treatment.**—In many cases artificial dilatation of the cervix may be carried out. In extreme degrees, especially when marked sacculation exists, vaginal or abdominal Cæsarean section may be necessary.

**Occlusion of the Os Externum.**—Atresia of the cervix occa-

sionally complicates labor. It may be partial or complete, the latter variety being very rare. The affection is almost entirely limited to the os externum. It may result from cicatricial contraction following operations on the cervix, sloughing, and the application of escharotics. The site of the occluded os is generally marked by a dimple, through which a probe may be passed when the occlusion is not complete. Sometimes the vaginal portion of the cervix is a slight elevation, smooth or irregular, in which no opening can be found. In such a case, if labor pains have been in progress, the condition may be wrongly diagnosed as displacement of the cervix with sacciform bulging of one uterine wall or closure of the vaginal fornix. If there be a head presentation, the lower segment and cervix may be regarded as the scalp, the cervix being thought to be fully dilated. Labor is greatly delayed by such a condition. Sometimes the cervix may be opened without interference. There is, however, always risk of rupture of the uterus. The fetus is likely to be asphyxiated.

*Treatment* should be carried out when the diagnosis is made. The os should be reopened with a sound or with a bistoury; sometimes the finger-tip suffices. Dilatation should then be carried out to a certain extent with metal dilators or the fingers. If nature cannot complete dilatation, this should be done artificially, though if this is difficult and tends to cause marked laceration, vaginal Caesarean section should be performed.

**Rigidity of the Cervix.**—This condition causes difficulty in dilatation of the cervix. It may arise from peculiarities in its structure, from pathologic changes, or from functional peculiarities.

Functional or spasmodic rigidity or retraction is believed to be due to abnormal activity in the cervical musculature, especially in the upper or lower sphincter or in both. This condition may be intermittent or continuous. The cervix remains small, or may contract during contractions of the body instead of relaxing, and does not relax between the pains. Its causes are not definitely known. It may be due to some nervous disturbance, and may be found in very nervous women or in those who have been much disturbed by examinations. It may occur in cases in which labor is prolonged by some obstruction—*e. g.*, malpresentation and contracted pelvis. Ergot may also be a cause. It may some-



FIG. 154.—Partial prolapse of womb and hypertrophy of cervix (Favre).

times be associated with irregular contractions of the uterine body.

*Constitutional Rigidity.*—In this variety the cervix is tough and dilates with great difficulty. It is found in elderly primiparæ and in cases of premature labor.

*Pathologic or organic rigidity* is due to various changes in the cervix, inflammatory cicatrization and thickening being most common. These may result from previous labors, operations, or the application of escharotics. Occasionally syphilis is a cause, either the induration of primary chancre or changes induced by the secondary or tertiary stages of the disease. The condition of hypertrophic elongation of the cervix is sometimes a cause. (New growths of the cervix are considered separately.) Rigidity of the cervix, from whatever cause, leads to prolongation of labor, with increase of suffering to the woman. Rectal and vesical tenesmus may be induced, as well as nausea and vomiting. After much delay dilatation may be accomplished in many cases. Sometimes the woman may become greatly exhausted. The cervix may be pushed far down in the vagina and it may become congested and edematous. Sometimes the cervix may rupture; rarely a circular portion may be torn away. In some cases the uterus may rupture above the cervix.

*Treatment.*—In the spasmodic, constitutional, and inflammatory forms hot douches frequently given are often serviceable; also chloral, morphin, or opium in full doses. If the patient be exhausted, chloroform may be administered, while one of these drugs is given in hypodermic injection or by suppository. In cases in which the contractions of the uterus are weak or irregular appropriate measures should be employed. Often artificial dilatation is necessary, rubber dilators and the fingers being employed. Recently Bossi's metallic dilator has been recommended. Frequently dilatation may be more rapidly performed and with less risk that the liquor amnii will escape if the membranes be detached a short distance above the cervix.

When dilatation cannot be carried out satisfactorily, or when it is apt to cause much laceration, delivery should be accomplished by vaginal Cæsarean section if the fetus be alive. If it be dead, embryotomy through the dilated cervix may be satisfactory. The method of making cervical incisions as recommended by Dührssen should not be adopted, on account of the risk of serious rupture of the uterus and hemorrhage.

**Impaction of the Cervix.**—The anterior lip of the cervix may be compressed between the fetal head and the pubes in some cases, or the posterior lip between the head and the promontory, resulting in edema and congestion of the lower portion; as a result, a swelling of considerable size may be produced, causing delay in the labor. It may be pushed downward by the head, and

sometimes torn away. In some cases it is badly lacerated, vertically, obliquely, or transversely. Blood may be effused in its substance, forming a clot. After labor sloughing sometimes occurs. Occasionally the cervix may become very edematous before labor begins, and in some cases the edema does not appear to be associated with pressure. The swelling forms a dark-red tumor, which may project from the vulva. It may be mistaken for a fibroid, prolapsed uterus, inverted vagina, or placenta.

*Treatment.*—The patient should be placed in the dorsal position, with the hips higher than the head. During pains the swollen lip should be prevented from being forced downward, and between the pains it should be pushed upward. Sometimes this may be expedited by dilating the cervix, so as to allow the head to descend more rapidly. Sometimes it is necessary to puncture the edematous lip, so that its size may be reduced. If the labor has been long delayed, it is advisable to extract the head with forceps, the lip being protected and pushed up during delivery. Rarely incision or amputation is necessary in order to permit extraction.

**Cancer of the Cervix.**—This disease has already been described as a complication of pregnancy. It may sometimes be noticed first at the time of labor. If the disease be early and localized, dilatation may take place, though slowly, and labor proceed satisfactorily, but the woman must be watched with great care lest hemorrhage, laceration, or exhaustion occur. If the carcinoma be advanced, labor should not be allowed to take place. If possible, vaginal Cæsarean section should be carried out, the uterus being removed after its contents are taken away. The fetus is extracted in this operation by version or forceps; but if it be dead, embryulcia may be performed. When the vaginal operation is not feasible, the carcinoma should be scraped away, the surface cauterized, and abdominal Porro-Cæsarean section carried out.

**Anomalies of the Vulva and Vagina.—Malformations.**

—Congenital atresia or septal remains may obstruct labor. Septa should be divided. Atresic portions may be dilated if not too extensive, but sometimes incisions may be required. Delivery by forceps, embryulcia, or Cæsarean section may be necessary.

**Rigidity.**—The tissues of the vulva and vagina may be rigid and less distensible than normal in young or old primiparæ and in cicatricial contraction following previous injury. The hymen may sometimes be a marked cause of resistance to the passage of the head.

In very powerful women the well-developed musculature of the pelvic floor may narrow the genital passage, the levatores ani being the most important factor. They may easily be felt to contract spasmodically or continuously by the examining fingers. Such conditions may delay labor many hours. In some cases the

resistance may be overcome at the expense of the tissue, lacerations of the vulva and vagina being produced. When there is marked contraction of the outlet, as in the case of a rigid hymen, central rupture of the perineum may occur. Laceration of the vulva or vaginal wall may extend into the bladder, rectum, cervix, peritoneum, or cellular tissue. Marked hemorrhage may be produced in these cases.

*Treatment.*—Hot douches and hot fomentations may serve somewhat to soften the parts, but dilatation under anesthesia is often advisable. This procedure may be carried out with rubber bags or with the hands. When the hymen is at fault, it may be necessary to make multiple incision in it or to excise it. In the case of a rigid perineum it must always be remembered that the employment of Walcher's position helps to relax it. When this is not sufficient, episiotomy should be performed. When the vagina is so cicatrized that satisfactory dilatation cannot be carried out, Cæsarean section is necessary.

**Hematoma.**—A localized accumulation of blood may be found in any part of the vulva or vaginal wall, and, though it is generally found after labor, it may be present before the birth of the fetus. Rarely it may develop between the delivery of the first and the second child in the case of twins. When the swelling is large enough to interfere with labor, it should be incised, the clots being removed. After delivery firm pressure may be applied to it by means of a tampon placed in the vagina or against the vulva. Sometimes it is necessary to pack the blood-cavity or to apply sutures to check the hemorrhage. In cases of this kind it is advisable to deliver the fetus with forceps unless it is advancing quickly by the natural powers.

**Edema.**—This condition is usually found in heart or kidney disease, in delayed labors, and in marked distention of the abdomen. The swollen tissues may obstruct labor, and may easily suffer as a result of pressure; they may afterward become infected or gangrenous. Puncture or incision may be necessary to diminish the swelling, though these procedures increase the risk of septic infection. Strict asepsis is necessary. Episiotomy is sometimes indicated in order that rupture may be avoided.

**Varicose Veins.**—This condition is rarely extensive enough to prevent the passage of the fetus. Rupture may occasionally take place, or bruising, which may be followed by sloughing. It may sometimes be necessary to use forceps, and in all cases appliances must be at hand to check hemorrhage should rupture occur.

**Abscess.**—Suppuration in the vulva usually starts in a Bartholinian gland. It is a serious complication because of the risk of infection. If it be large enough to obstruct labor, it should be excised, if possible; otherwise it should be opened, scraped, cauterized, and packed with antiseptic gauze for two or three days

and then renewed, in order to diminish the chance for the upward extension of infection. Moist antiseptic applications should be applied constantly to the vulva.

**Solid Tumors.**—Fibroma and fibromyoma of the vulva or vagina are very rare. They may prevent the birth of the fetus. When they are much bruised, sloughing may afterward follow. If removal or enucleation seems feasible, it should be carried out under anesthesia. If not, the fetus may be delivered with forceps if sufficient room can be obtained for their safe employment. Rarely embryulcia or Cæsarean section is indicated.

**Cystic Swellings.**—These may obstruct labor, but the trouble is easily overcome by puncture. Removal should not be performed during labor save when the cyst is pedunculated.

**Bowel Complications.—Enterocoele.**—Vaginal enterocoele may be anterior or posterior, the latter being more frequent. Labor may be obstructed, especially when there is gas or feces in the bowel. Pressure on the sac may rupture it or cause bruising of the intestine. An attempt should be made to reduce the hernia by placing the patient in the genupectoral or elevated lithotomy position. The latter may be very conveniently arranged in hospitals by using a Boldt operating-table with shoulder supports. The fetus should then be extracted with forceps before the hernia can descend again. If the mass cannot be reduced owing to adhesions or to the low position of the fetus, forceps delivery may be carried out if the enterocoele be small. If it be large, Cæsarean section is advisable.

**Distended Rectum or Colon.**—Fecal accumulation may directly obstruct the pelvic cavity and delay labor, or may interfere with the action of the powers. Sometimes rectal distention is found in cases in which the anus is situated abnormally far forward (*anus vaginalis*). The bowel must be flushed out. Rarely impacted feces must be scooped out.

**Cancer of the rectum**, if advanced, may cause such an obstruction as to necessitate embryulcia or Cæsarean section.

**Affections of the Bladder.—Distention.**—Accumulation of urine in the bladder frequently delays labor. The condition is very apt to be overlooked, especially when frequent dribbling occurs. The bladder should be emptied with a long curved gum-elastic or metal catheter. A soft-rubber catheter may fail to reach the urine, while a glass instrument may easily be broken.

**Cystocoele.**—Prolapse of the bladder and anterior vaginal wall may obstruct labor. The condition may be mistaken for an impacted and swollen anterior lip of the cervix, the bag of membranes, caput succedaneum, or cyst of the vaginal wall.

In labor special care should be taken to keep the bladder empty. In the second stage the prolapsing part should be prevented from descending, and if possible should be gradually pushed

upward as the head descends. When labor proceeds slowly, it is best to deliver the fetus with forceps.

**Stone in the Bladder.**—A small calculus may not obstruct labor, but if it be pushed against the pubes by the advancing head, it may injure the bladder-wall. Several calculi, or one of some



FIG. 155.—Ovarian tumor incarcerated in pelvis during labor.



FIG. 156.—Cystocele obstructing labor.

size, may be an obstruction. When this is likely to take place, the stone should be removed through the dilated urethra or through an opening made in the base of the bladder and anterior vaginal wall. After labor the fistula may be closed.

**Affections of Neighboring Parts.—Ovarian Tumors.**—These have already been fully considered in connection with pregnancy (p. 338). They may complicate labor by interfering with the normal action of the powers and by obstructing the birth passage. They cause malpresentations and malpositions. When a small tumor lies in the pelvis it may absolutely prevent delivery; it may be much compressed and injured or may rupture. The pedicle may become twisted and obstruction of the bowel be produced. Peritonitis or hemorrhage may follow. The obstruction may sometimes cause rupture of the uterus, vagina, or bowel.

The *diagnosis* may be difficult. The tumor may be mistaken for a fibroid, inflammatory or blood-accumulation, ectopic pregnancy, or fecal mass. When the abdomen is much distended, hydramnios or twin pregnancy may be thought to exist. It is important to note that no intermittent contractions can be felt in the tumor.

*Treatment.*—If the tumor be small and situated below the pelvic brim, or large and above the brim, Cæsarean section should be performed and the tumor removed at the same time. Hitherto it has been recommended that small tumors below the brim should be pushed above it, or, failing this, to deliver the fetus with forceps

or by embryulcia, the tumor being punctured *per vaginam* if necessary to secure room. Such a procedure should be employed only where abdominal section cannot be safely carried out. It has been demonstrated to be more risky for the woman than is the latter procedure. Compression of a tumor lying in the pelvis may lead to rupture, hemorrhage, peritonitis, and gangrene. A tumor situated above the brim may become changed in position, its pedicle twisting and leading to edema, hemorrhage, gangrene, and peritonitis. If adhesions are present, they may be ruptured. Moreover, a tumor in the abdomen may interfere with the uterus after labor, preventing it from sinking as it normally does, and may cause postpartum hemorrhage.

**Other Pelvic Swellings.**—Tumors, collections of blood, pus, or serum in the tubes, broad ligaments, or other tissues, sufficient to obstruct labor seriously, are indications of Cæsarean section when it is certain that evacuation cannot be carried out by the vagina without exposing the woman to the risk of hemorrhage or infection.

**Inguinal and Femoral Herniæ.**—A hernia may be forced down during the straining connected with labor and may be a cause of much pain; sometimes strangulation results. The hernia should be held up during the pains. In such cases it is advisable to anesthetize the woman and deliver the fetus by version or forceps as soon as the cervix is dilated.

**Hepatic and other Abdominal Swellings.**—Hydatid cysts, malignant tumors, and enlarged spleen may obstruct or delay labor. Forceps, version, embryulcia, or Cæsarean section may be necessary.

**Displaced Kidney.**—A normal or enlarged kidney may sometimes be displaced downward so as to obstruct the birth passage at the pelvic brim or in the cavity. The displacement may be congenital or may be due to a floating condition. In the former case the kidney is not movable and has a short ureter. According to Morris, a pelvic kidney (apart from pregnancy) is found once in 800 cases, floating kidney being more common on the right side and congenital pelvic kidney on the left. Only a few cases of labor complicated by the misplaced kidney have been recorded. Very great pain may be caused in these cases. Rupture of the uterus has resulted from the obstruction. The kidney may be much damaged by pressure. Anesthesia and forceps delivery have been recommended, though this procedure may lead to injury of the kidney. Abdominal section has also been performed; this is probably the most satisfactory procedure. The kidney might be raised out of the pelvis, the abdomen closed, and the fetus delivered by version or forceps.

If the kidney be wedged in the pelvis or adherent, Cæsarean section is necessary. Vaginal nephrectomy has been performed in this condition, but such a step seems unwarranted.

## CHAPTER III.

## ANOMALIES OF THE BONY PELVIS.

**Pelvic Deformities.**—Many variations from the normal type of pelvis are found, the most important of which, as regards their influence on labor, are contractions. These complicate labor in various ways and may make it a difficult or dangerous process, both for the mother and child, very often necessitating artificial interference.

During pregnancy various irregularities may occur; thus, in the early months marked anteroposterior contraction of the pelvic brim may cause the growing uterus to be deflected backward, so that a retroverted condition of the organ is brought about, and as pregnancy advances the uterus may become incarcerated in the pelvic cavity. In the advanced months the uterus does not sink as low as in normal cases, so that the abdomen becomes abnormally prominent. When the fundus remains abnormally high, the round ligaments are tenser than usual. If the abdominal parietes be lax, marked displacement of the body of the uterus anteriorly or laterally may result. At full time malpresentations and malpositions are three times as frequent as in normal cases, the proportion being greater in multiparæ than in primiparæ, owing to the greater relaxation of the abdominal walls.

Franke's researches indicate that in cases of contracted pelves more primiparæ than multiparæ are delivered spontaneously, excluding all causes of delay not directly due to the pelvic contraction, which are undoubtedly more apt to be found in multiparous labors. This is probably due to greater strength of the pains, the tendency to early engagement of the head, the absence of uterine deviations, the smaller size of the fetus, and, possibly, the less advanced ossification in primiparæ.

In the first stage of labor in cases of marked contraction various anomalies may be found: the cervix is higher than normal, the diminished pelvic inlet may not allow the presenting part of the fetus to descend well into the lower uterine segment, and the cervix may thus be made to hang somewhat loosely at or above the brim. This anomaly is most marked when some malpresentation is present—*e. g.*, transverse. There may be weak and irregular pains for hours, or even days, before the cervix begins to dilate.

As the pains continue dilatation of the cervix may be very slow, the normal distention of the lower uterine segment by the bag of membranes may be absent, and the latter may be forced through the cervix as an elongated pouch.

Not infrequently the membranes rupture prematurely, leading to great prolongation of the first stage and retraction of the uterus on the fetus, increasing the risk both to the mother and fetus. The cord frequently prolapses into the lower uterine segment or through the cervix—occurring four times as frequently in flat as in normal pelvis.

In such cases, if the labor be allowed to continue long enough and the pelvic contraction be not too great, the fetus may be expelled dead, the head being much altered by moulding and softening, fractures of its bones being sometimes present. If the contraction be too great to allow the fetus to pass, there is great risk of rupture of the uterus or of exhaustion of the mother. The lower uterine segment thins and the retraction ring tends to rise.

Apart from rupture, the maternal soft parts may be injured by prolonged pressure, and this may be followed by necrosis of the tissues. The risk of infection in such conditions is also considerable.

The risks to the fetus are great, owing to compression of the prolapsed cord, retraction of the uterus on the fetus causing interference with the circulation in the cord or placenta, as well as to difficulties associated with the various methods of artificial delivery which may be adopted.

Pinard has stated that the average weight of infants born to women with contracted pelvis is greater than in the case of women with normal pelvis.

**Frequency.**—It is difficult to form an accurate idea of the frequency of pelvic deformities, owing to the imperfect methods of examination adopted in ordinary practice, and also to the difference of opinion among experts as to what constitutes a pelvic deformity. Some observers include in the classification slight anomalies that others exclude. Many tabulate only alterations that cause serious trouble in labor. It is usually believed that deformities are much more common in the Old World than in America. As the result of the recent observations of Williams and Dobbin, these views must be considerably modified. These observers state that pelvic deformities are rarer in America only because they are not sought for by careful examination of pregnant and parturient women.

In 1000 cases studied by them, 13.10 per cent. of the pelvis were contracted, and of these contracted pelvis, 35.11 per cent. were affected to such an extent as to require artificial delivery. They have also shown that the statistics of Reynolds, of Boston, are not reliable as regards the determination of the frequency of deformed pelvis, since this observer made measurements only in the cases in which artificial delivery was carried out. They showed that such a method of inquiry is certain to result in the non-recognition of a considerable percentage of deformities.

In their comparison of white and negro women they found

that contractions are much more frequent among the latter, though the proportion of difficult labors among negroes is small on account of the smaller and easily moulded fetal head.

E. P. Davis, in studying 1224 women, found that 25 per cent. had contracted pelves. Edgar found in 1200 cases 3.66 per cent. of contracted pelves. In 2.5 per cent. the contraction was just-minor, and in 1.16 per cent. flat.

As regards the statistics of other countries, great variations are found. Winckel states that contracted pelves occur in 12 or 15 per cent. of child-bearing German women, but that in only 5 per cent. is the contraction important enough to attract attention.

As regards the percentage of artificial interference in deformed pelves, different statements are also made. Knapp puts it at 61 per cent., Heinsius at 56.84 per cent., Ludvig and Savor at 45.6 per cent., Bosmann at 24.5 per cent., and Franke at 20.5 per cent. The largest percentage given in America is that of Flint, who puts it at 46 per cent. In Davis's cases operations were performed in 20 per cent. of patients with abnormal pelves.

**Classification.**—Various methods of classifying deformed pelves are found. The following will be found satisfactory in teaching:

- I. Pelves normal in proportion but abnormal in size.
  1. Uniformly contracted—*æquabiliter justo-minor*.
  2. Uniformly enlarged—*æquabiliter justo-major*.
- II. Pelves with anomalies of size, shape, and inclination, or combinations of these.
  1. Those with minor developmental peculiarities—*i. e.*, shallow, deep, funnel-shaped, or masculine.
  2. Contraction in the anteroposterior diameter. (a) Flat non-rachitic. (b) Flat rachitic. (c) Spondylolisthetic.
  3. Contraction in an oblique diameter. (a) As a result of loss of one leg, or impaired use of one leg in early life. (b) As a result of imperfect development of one sacral ala (Nægele pelvis).
  4. Contraction in the transverse diameter. As a result of imperfect development of both sacral alae (Robert pelvis).
  5. Generally compressed pelves. (a) Malacosteon. (b) Pseudo-malacosteon-rachitic.
  6. Contraction associated with deformities of the spinal column. (a) Kyphosis. (b) Scoliosis. (c) Kyphoscoliosis. (d) Lordosis.
  7. Alterations of the pelvis resulting from tumors, injury, and disease.

The contractions that most frequently give rise to difficulty in labor are the following: the justo-minor and flat pelves; less frequent are the alterations produced by spinal deformities, and those presenting developmental peculiarities—*i. e.*, masculine and funnel-shaped.

**Diagnosis.**—In attempting to determine the condition of a

woman's bony pelvis it is necessary to investigate the previous health of the patient, to gain accurate information regarding her previous pregnancies and labors, and to make a thorough physical examination of the pelvis, accurate measurements being taken.

If the woman be in labor, a study of the mechanism of delivery may give important information, while after the birth of the child the moulding of its head as well as the relation of the uterus to the bony canal may give additional facts.

In determining the previous history the health during infancy and childhood should be inquired into. If she had been affected with rickets, the history might be obtained from the patient's mother of digestive disorders, peevishness, late dentition, restlessness and sweating during sleep, and late closure of the anterior fontanel; in such cases various changes in the bones may have been noted—*e. g.*, bending of the long bones, enlargement of their

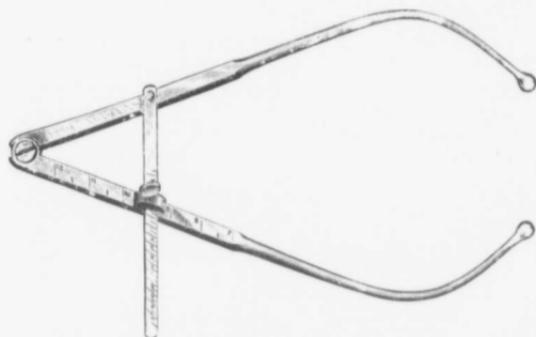


FIG. 157.—Schultze's pelvimeter.

ends, deformity of the spinal column, small stature, square head, pigeon-breast, rosary-ribs, etc.

If a history of tuberculosis is given, it is important to find out whether the spine, joints of the pelvis, or lower extremities have been affected, since these lesions may secondarily induce pelvic deformities. Investigation should also be made as to accidents causing shortening, dislocation, long disuse or loss of the lower extremities; rarely accident is the cause of dislocation of the lumbar vertebrae from the sacrum. Occasionally deformities are associated with congenital anomalies—*e. g.*, congenital dislocation of one or both hips. Rarely the patient may have suffered from osteomalacia, the history in such a case being one of poverty, hard work, imperfect nutrition, and exposure, the disease having developed during pregnancy or nursing. In a number of cases pelvic contraction is found in women who may have had no dis-

tinct disease during early life, but who have been weak, inactive, and slow of growth.

**Pelvimetry.**—In determining the size of the pelvis, some information may be obtained by the use of the eyes and hands, but to get exact measurements instruments are necessary. Efforts have been made to use the *x*-rays in pelvimetry, but without very satisfactory results.

(a) **External Measurements.**—In measuring the pelvis ex-

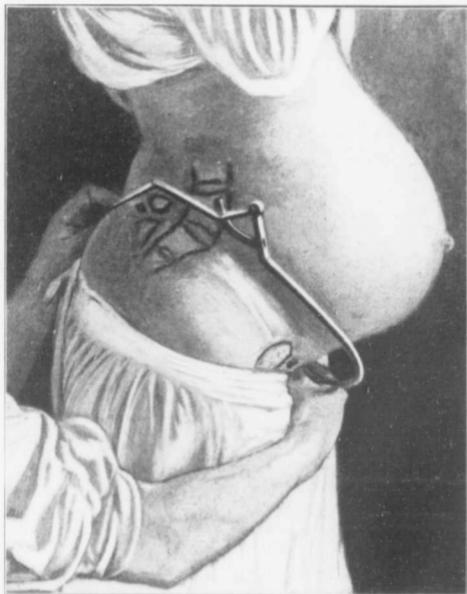


FIG. 158.—Measuring external conjugate diameter upon living female (Dickinson).

ternally a measuring-tape may be used, but it is of very limited value. A pair of calipers is necessary. Baudelocque, in 1775, first recommended this instrument, which has been termed a pelvimeter. Several varieties have been introduced, but that introduced by Baudelocque is as satisfactory as any.

1. *External Conjugate, Anteroposterior.*—Baudelocque first called attention to the importance of estimating the size of the pelvic cavity by making an anteroposterior measurement on the

living person in the plane of the pelvic brim. This has since been known as the external conjugate or diameter of Baudelocque. He believed that by subtracting from this diameter that which represents the thickness of bones and soft tissues, an exact idea of the length of the conjugata vera, or anteroposterior diameter of the pelvic inlet, might be obtained. His measurement was made between the depression below the spine of the last lumbar vertebra and the top of the symphysis pubis, and he estimated the thickness of bones and soft tissues to be subtracted at 8 to 8.5 cm.

To obtain Baudelocque's diameter the patient is placed on her side, the hips being exposed. The physician stands behind her, facing her head, the pelvimeter in his hands so that the tip of each index-finger is on the end of each rod; he places the latter points in the anatomic positions above indicated. He then reads off on the scale attached to the instrument the length of the measurements. If no scale is attached to the instrument, an

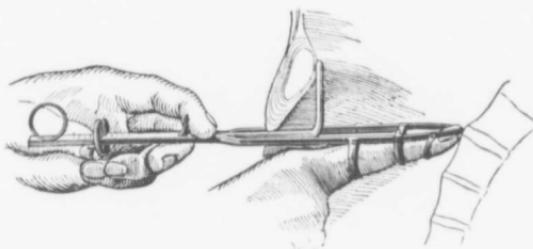


FIG. 159.—Faraboeuf's method of measuring the conjugata vera.

assistant may be employed to fix the rods in position, so that the pelvimeter may be removed and the distance between the ends of the rods measured. If the last lumbar spine cannot be easily felt, an endeavor should be made to find the lateral angles of the lozenge of Michaelis (posterosuperior iliac spines). A line should be drawn between these and a point measured 3 to 4 cm. vertically above, in the middle line. This corresponds to the depression below the last lumbar spine. Cr ede suggested that in cases where the posterior markings are absent, an imaginary line should be drawn through the highest points of the iliac crests, the depression below the spine of the last lumbar vertebra being 2 to 3 cm. below this line.

The value of this measurement as a means of determining the brim conjugate is not now highly considered. The external conjugate and the conjugata vera do not lie in the same plane. The former crosses the other, passing posteriorly, not through

the promontory, but through the body of the first sacral vertebra. The thickness of bones and soft tissues varies so greatly that it cannot be carefully estimated in any given case. Litzmann measured the pelvis in 30 cases before and after death and found an average difference between the true and external conjugates of 9.5 cm. ( $3\frac{3}{4}$  in.); in the whole series the range was from 7 cm. ( $2\frac{3}{4}$  in.) to 12.5 cm. ( $4\frac{1}{2}$  in.).

Undoubtedly in some cases the conjugate of Baudelocque may indicate positively pelvic contraction, and in other cases equally positively the absence of contraction. In many cases, however, no accurate information as to the size of the conjugata vera can be derived from it. Jewett says that the pelvis is invariably contracted when the external conjugate is at or below 15.2 cm. (6

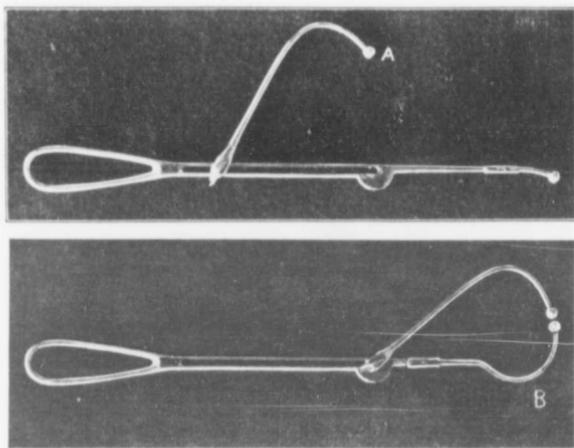


FIG. 160.—Hirst's pelvimeter: A, For measuring true conjugate plus thickness of symphysis; B, with extra tip added for measuring thickness of symphysis.

in.), or even below 15.8 cm. ( $6\frac{1}{4}$  in.); at or above 20.3 cm. (8 in.) the pelvis is surely ample; between  $6\frac{1}{4}$  and 8 in. the length of the conjugata vera is uncertain and must be determined by other measurements. The conjugata vera may be estimated by external measurements in another manner in a thin woman who is not pregnant, or whose pregnant uterus may not rise above the brim. When she lies on her back, the examiner's hand is placed flat above the pubes, the abdominal wall being pressed back against the promontory by the finger-tips. The distance between the

latter and the symphysis pubis is thus measured, and the thickness of the abdominal wall and other soft tissues deducted.

2. *Anteroposterior Conjugate of the Outlet*.—The distance from the lower edge of the symphysis to the lower end of the sacral or coccygeal vertebrae may be made with a pelvimeter, a slight deduction being made for the thickness of soft tissues.

This measurement may also be made by vaginal examination with the extended fingers.

3. *Transverse*.—The following measurements are usually made and are important:

(a) *Interspinous, anterior*—between the anterosuperior iliac spines.

(b) *Intercristal*—between the widest parts of the summits of the iliac crests.

(c) *Interspinous, posterior*—between the posterosuperior iliac spines (lateral angles of Michaelis's lozenge).

(d) *Intertrochanteric*—between the skin surfaces external to the great trochanters. This measurement is not reliable, owing to variations in the size of the head, neck, and trochanter of the femur. If, however, it be less than  $11\frac{1}{2}$  in., there is probably transverse contraction of the pelvis.

(e) *Transverse of the Outlet*.—The distance between the tuberosities may be measured with a pelvimeter; or the examiner may place two fingers on the inner edges, the distance between being measured with a rule or piece of tape by an assistant.

4. *Oblique*.—The various measurements made to determine oblique diameters of the pelvis are given in the section describing the Oblique Pelvis.

5. *Lozenge of Michaelis*.—The shape and size of this area should always be noted, as variations from the normal are produced by many abnormalities and deformities of the bony pelvis. (In the average normal Caucasian woman the four sides and angles are nearly equal.) The transverse diameter is slightly longer than the vertical, and measures about 9.8 cm. ( $3\frac{7}{8}$  in.).

(b) **Internal Measurements**.—Digital examination may give a fairly correct idea of the size of the pelvic cavity and outlet, the height of the symphysis, the mobility of the coccyx, etc. Certain specific measurements must also be made.

1. *Conjugata Diagonalis*.—The diagonal conjugate is measured from the promontory to the subpubic ligament. In determining this the patient should be placed in the dorsal position with the legs separated. The examiner passes the first two fingers of one hand, extended, into the vagina until the tip of the second finger touches the promontory. The radial side of the hand is placed against the subpubic ligament, and a mark is made at this point with the free hand. The fingers are then withdrawn, being kept in the same position in which they were in the vagina, and the

distance between the tip of the second finger and the point that touched the subpubic ligament measured with a pelvimeter by an assistant. This measurement represents the length of the diagonal conjugate. In obtaining it there may be difficulty in touching the promontory if the patient strains, if the soft parts are rigid, if the pelvis is deep, or the promontory high or far back. When the condition of double promontory exists, due to an abnormal projection of the junction of the first and second sacral vertebrae, the

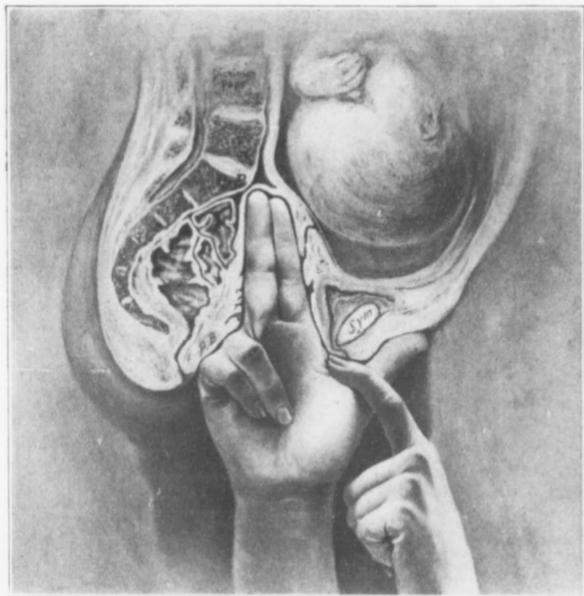


FIG. 161.—Manual method of measuring diagonal conjugate: *P.* Promontory; *PB.* perineal body displaced backward (Dickinson).

latter may be mistaken for the true promontory. In some cases, however, it is nearer the symphysis than the true promontory, and the obstetric conjugate must be measured in reference to it. Sometimes the patient must be anesthetized before the examination can be satisfactorily made.

It is important to remember that the length of the conjugata vera as well as that of the conjugata diagonalis varies according to the position of the patient. Each is greatest in the Walcher

posture, and least when the thighs are well flexed on the abdomen.

The transverse diameter cannot be directly measured in the living woman *per vaginam*, but Sandstein has shown that in all



FIG. 162.—Measuring true conjugate, plus thickness of symphysis, with Hirst's pelvimeter.

classes of pelves it equals half the length of the intercrystal diameter. He states that for practical purposes deviations from this relationship may be disregarded. The relationship does not exist in the fetus.

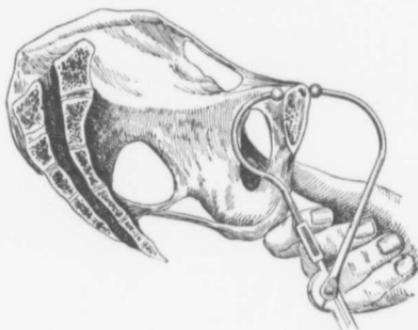


FIG. 163.—Measuring thickness of symphysis with Hirst's pelvimeter.

2. *Löhlein's Measurement*; from the Subpubic Ligament to the Upper Anterior Angle of the Great Sacrosiatic Notch.—This is stated to be normally 2 cm. ( $\frac{3}{4}$  in.) less than the transverse diameter of the brim.

3. *Hirst's Measurement; from the Promontory to the Skin in Front of the Upper Part of the Symphysis.*—This is made with a special pelvimeter, consisting of a long straight rod that is introduced into the vagina and pressed against the promontory, and a short curved rod that touches the front of the symphysis. When the rods are in position, they are fixed by a screw; the instrument is then withdrawn and the distance between the ends of the rods ascertained. The thickness of the upper part of the symphysis and soft tissues in front of it is then measured with small curved rods adjusted on the same instrument, and is subtracted from the first measurement to give the length of the conjugata vera. This diameter can be most satisfactorily measured by this method.

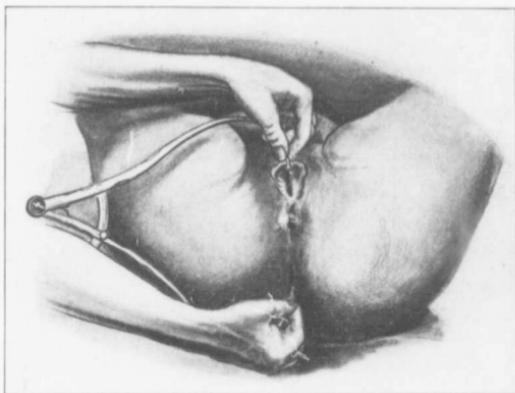


FIG. 164.—Measurement of anteroposterior diameter of outlet (Bumm).

The anteroposterior and transverse diameters of the outlet may be measured with fingers or instruments.

**Detailed Study of Individual Pelves.**—I. **Pelves Normal in Proportion but Abnormal in Size.**—1. *Normally Contracted (Æquabiliter Justo-minor).*—These pelves differ from the normal female pelvis only in the matter of size. In the variety most frequently met with there is simply a general reduction in the diameters, the diminution being proportionate. The vertical concavity of the sacrum is usually less marked than that of the normal pelvis, the axis of the cavity being consequently less curved than that of the normal. This form of pelvis may be found in women who are of slight build, but may also occur in those of normal size, and occasionally even in large women. Other varieties of justo-minor pelvis are described by some

PLATE II.

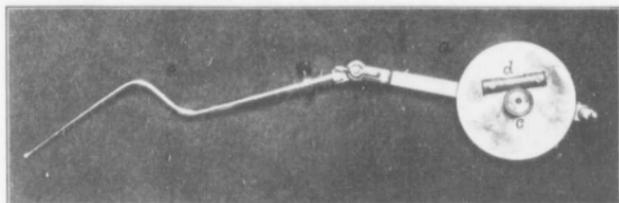


FIG. 1.—Pelvigraph: *a*, Registering portion; *b*, marker; *c*, thumb-screw; *d*, spirit-level; *e*, exploring rod.

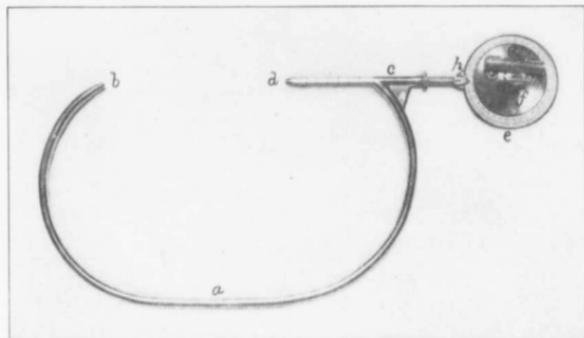


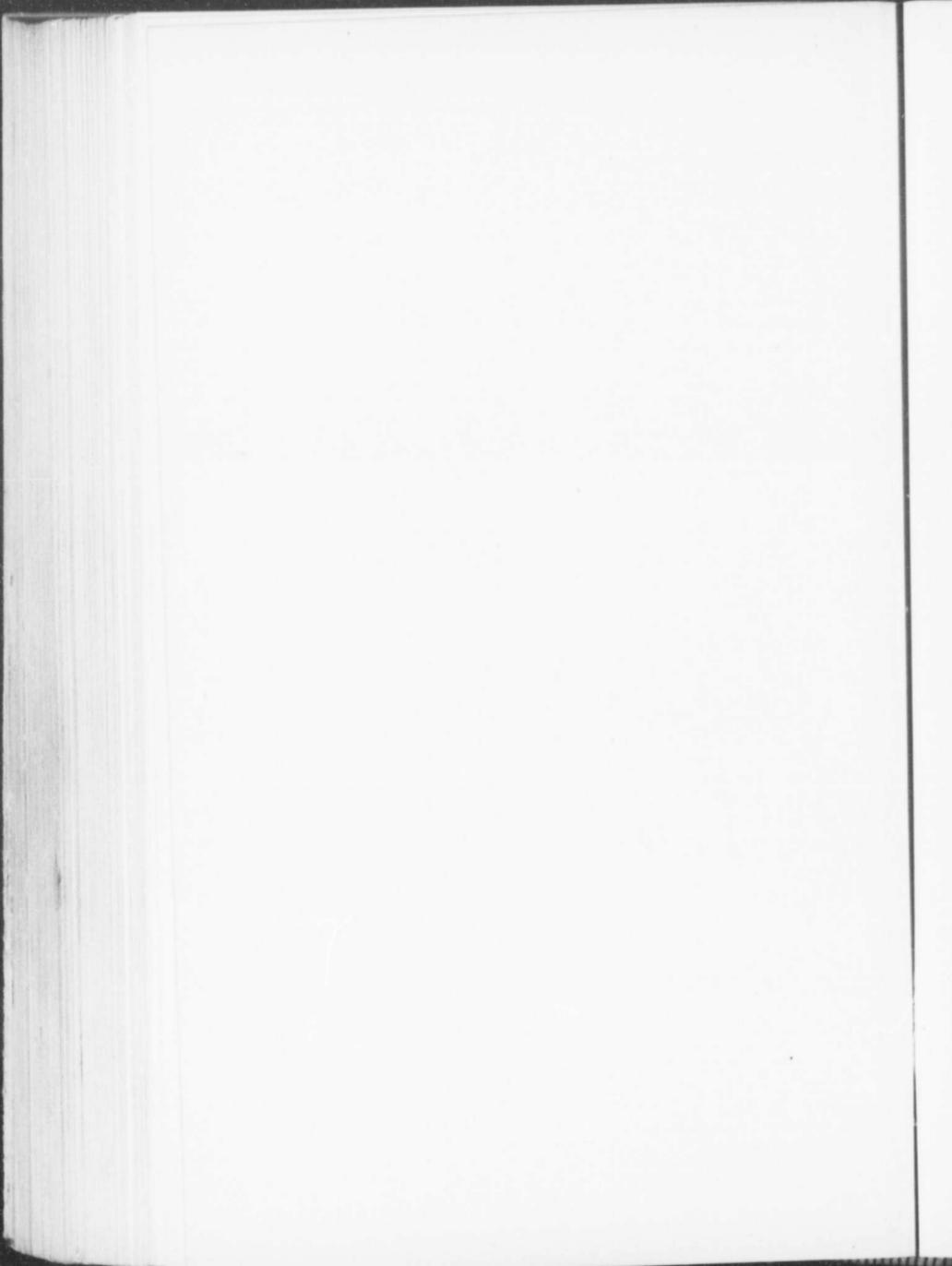
FIG. 2.—Klisometer: *a*, Rigid arch; *b*, knob at end of arch; *c*, cylindrical carrier; *d*, end of rod which moves through the carrier; *f*, thumb-screw; *g*, spirit-level; *h*, pointer.

Ehrenfest and Neumann have recently devised two instruments, termed respectively the "pelvigraph" (Plate II, Fig. 1) and the "klisometer" (Plate II, Fig. 2), for the purpose of determining the internal dimensions, the configuration, and the inclination of the pelvis. Satisfactory results may be obtained if the pelvis admits of manual exploration, if the woman can be kept absolutely quiet, and if the instruments be used by two skilled obstetricians who have been trained to work together. The pelvigraph consists of an exploring rod and a registering arm attached to a marker. When the woman lies on her back with the feet elevated, the exploring rod is introduced into the vagina. In determining the true conjugate, for example, the end of the rod is brought into contact with the upper edge of the posterior surface of the symphysis. The registering arm, with its marker, is manipulated by an assistant, a point being made on a sheet of paper representing that portion of the symphysis touched by the exploring rod. The latter is withdrawn and another rod is attached, suitable for application to the promontory. When the latter is touched, a corresponding mark is made on the paper, and the distance between the two marks represents the length of the true conjugate.

By the simple mechanical contrivance of a movable spirit-level attached to the registering arm, the distances between the points indicated by the marker can be made to represent exactly those touched by the exploring rods.

In using the klisometer to determine the inclination of the pelvis, the woman stands erect, the toes and heels being close together.

A complete account of these instruments and of the method of using them is given by Ehrenfest in the *American Journal of Obstetrics*, vol. xlvii., No. 5, 1903.



authors, but are rarely found. They are the infantile form, in which some of the characteristics of the pelvis of the child are retained, and a dwarf form, in which the bones are light and fragile, the cartilaginous junctions being retained between the pubes, ischium, and ilium.

*Etiology.*—In some cases—*i. e.*, dwarfs—the diminished size of the pelvis is part of a general non-development. In the majority of cases, however, it is impossible to establish any such associa-

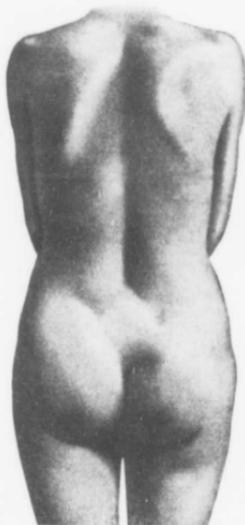


FIG. 165.—Posterior aspect of woman with normal pelvis. The lozenge of Michaelis is well shown (Bumm).

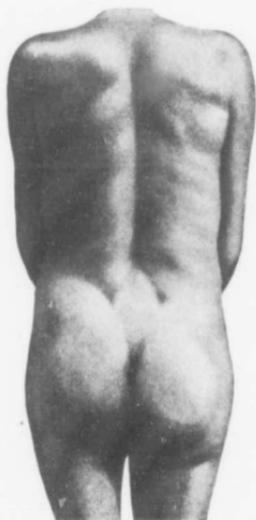


FIG. 166.—Posterior aspect of woman with justo-minor pelvis. The small lozenge of Michaelis is shown (Bumm).

tion; it is by some attributed to impairment of health from any condition in early life.

*Diagnosis.*—The nature of the pelvis may sometimes be suspected upon inspecting the body of an undersized woman, but the exact condition can be determined only by exact pelvimetry. Michaelis's lozenge is narrower than in the normal woman. The various measurements are proportionately less than normal. Usually the promontory is accessible and the linea pectinata more or less easily palpable. In a primipara, palpation of this line on each side almost certainly indicates transverse contraction

of the pelvis. In normal primiparæ it cannot be outlined *per vaginam*, and only exceptionally in multiparæ.

In advanced pregnancy it may be associated with abnormal prominence of the belly. Malpresentations and malpositions, prolapse of the cord, etc., such as have been described as occurring with contracted pelvis in general, are scarcely more frequent in justo-minor pelvis than in those that are normal.

*Relation to Labor.*—When too great a disproportion does not exist between the fetal head and the pelvis, delivery may take place, but is much prolonged. Frequently the mother may become greatly exhausted and the pain cease for a time during the process. As the head descends into the pelvis there is apt to be much greater suffering than in normal cases, and there is an increased risk of bruising and lacerating the maternal soft parts. The mechanism of labor in such cases resembles that found in normal women, except that flexion is more marked. The shorter

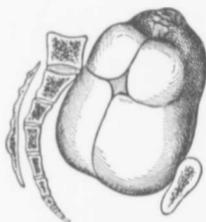


FIG. 167.—Extreme flexion of head in labor in a justo-minor pelvis.

suboccipitobregmatic plane is brought into relation with the brim; as a result, very early in the second stage the upper part of the occiput may lie in the axis of the pelvic canal. It has been already pointed out that in the normal mechanism the suboccipitobregmatic plane that enters into relation with the brim is one that passes through the center or anterior part of the bregma. In justo-minor cases the plane is one that passes through the posterior end. Internal rotation, extension, and external rotation occur as in normal cases, but take place much more slowly.

Sometimes delay may occur after partial rotation. The shoulders also are apt to cause delay.

When the pelvis is too small to allow the head to pass, labor pains continue until the uterus becomes exhausted, the fetus dies, and the mother's life may become endangered unless artificial delivery is carried out.

*Moulding of the Head.*—The appearance of the head after delivery differs markedly from that presented in the case of normal labor. The swelling of the soft tissues forming the caput succedaneum is found as a conical projection over the upper part of the occiput. The skull is markedly compressed in the suboccipitobregmatic diameter and elongated in the occipitomenal. In profile the head has thus the appearance of an ant hill or an old-fashioned sugar loaf.

*Management.*—In all forms of justo-minor pelvis labor must be watched with the greatest care, especially if during the last

weeks of pregnancy the patient has complained of edema of the lower extremities, external genitals, or lower abdominal wall, weakness of the lower extremities or marked distress in the pelvis and abdomen, or if there has been any impairment of the function of the kidneys. The tendency to the occurrence of eclampsia in women with contracted pelvis must always be remembered.

If there be no malposition or malpresentation of the head, and the disproportion between the latter and the bony canal be not marked, labor may be allowed to continue normally. When delay occurs either at the brim or within the cavity axis-traction forceps should be employed, the patient being placed in Walcher's position. In this way a head of normal size may be delivered through a brim whose conjugate measures  $3\frac{1}{2}$  inches.

In slight degrees of obstruction the head may sometimes be made to advance by Kristeller's manipulation. Occasionally in thin women, when the head is above the brim, it may be possible to adopt Hofmeier's procedure of exercising pressure on the head through the abdominal wall, a towel being used to protect the latter. Version should not be employed in a justo-minor pelvis, since the head is certain to be extended when it reaches the brim, increasing the difficulty of delivery; moreover, pressure on the cord is likely to occur, causing asphyxiation.

Symphysiotomy is recommended by many in cases in which the conjugata vera measures 3 to  $3\frac{1}{2}$  in. Owing to the great reduction of the mortality of Caesarean section during recent years, this operation is to be recommended when the fetus is alive and cannot be safely extracted by forceps, both when the difficulty in labor is due to the pelvic contraction and also when the head is larger than normal. When the fetus is dead, embryulcia is the safest method to deliver. This procedure is also adopted by many authors when the child is alive and cannot be delivered by means of the forceps, though undoubtedly there is a growing tendency to displace this destructive operation under such circumstances by symphysiotomy or Caesarean section.

2. *Uniformly Enlarged Pelvis (Æquibilter Justo-major).*—In very large women the pelvis usually shares in the general increase in the size of the body, the enlargement being characterized by a proportionate increase in all the diameters above the normal.

During the last months of pregnancy the uterus usually lies



FIG. 168.—Extreme moulding of the head by delivering through a justo-minor pelvis (Barbour).

at a lower level than in normal cases, the fetal head being found more or less within the pelvic cavity. There is less resistance to the passage of the child than in normal pelvis, and consequently in some cases labor may be precipitate. Ahlfeld has noted in a number of cases delay of the head in the pelvic cavity, the sagittal suture remaining transverse.

After the third stage there is a greater tendency to hemorrhage, especially if the cervix has been torn, because, as I have demonstrated, the normal compression of the extra-uterine tissues against the upper part of the bony pelvis by the retracted uterus is wanting, a freer flow of blood being thereby allowed through the pelvic vessels.

**II. Pelves with Abnormalities of Size, Shape, and Inclination, or Combinations of These.**—1. *Those with Minor Developmental Peculiarities.*—(a) *Funnel-shaped Pelvis.*—Occasionally a female pelvis may present an abnormal degree of contraction of the bony

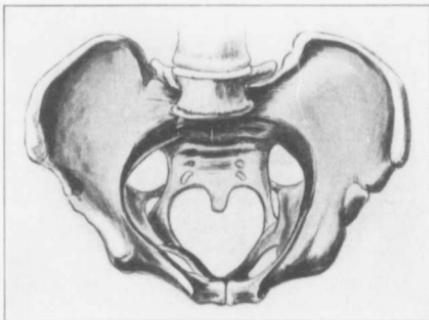


FIG. 169.—Funnel-shaped pelvis (Winckel).

canal toward its lower portion, the shape being roughly compared to a funnel. The alteration is mainly due to the altered slope of the lateral portion of the wall, though the sacrum and coccyx may also aid in its formation.

The canal may somewhat resemble that of the normal male pelvis, and by some authors male and funnel-shaped are used synonymously. This usage is not accurate, because the funnel-shaped pelvis may be female in every other characteristic. It is more accurate to say that the typical funnel pelvis is one that retains many of the infantile features. The sacrum is straighter and more elongated than in the normal adult pelvis. The deformity is very rare.

*Relation to Labor.*—When the head enters the pelvis its advance is slow, the rate of progress depending upon the extent

of pelvic contraction and the size of the head. Each of the movements of the normal mechanism may be more or less interfered with; the maternal soft parts are apt to be unduly pressed against the bony wall, and may be badly bruised or lacerated. There is also an increased risk of rupture of the perineum as the head passes through the outlet.

*Management.*—In slight degrees of contraction labor may take place spontaneously and satisfactorily. When there is delay, artificial delivery should be carried out, the procedure depending upon the conditions present. In slight cases Kristeller's manipulation may sometimes be of value, but the forceps is usually necessary. Forceps should never be used, however, if sufficient force must be employed to injure the wall of the bony canal or soft parts. In marked cases symphysiotomy, embryulcia, or Caesarean section may be carried out. The latter, however, should be employed only if the case be diagnosed during pregnancy or before the head has entered the brim in labor.

(b) *Masculine Pelvis.*—In rare cases a woman's pelvis may be masculine in type and may possess most of the characteristics of the male pelvis. Owing to the diminution of the transverse diameter of the brim, the head is very apt to be delayed when it attempts to enter the latter. This may also occur when the head descends toward the outlet of the pelvis. In such cases the axis-traction forceps proves satisfactory in effecting delivery; but when the difficulty is extreme, recourse must be had to some of the other methods of artificial delivery.

(c) *Shallow Pelvis.*—A pelvis is said to be shallow when the distance between the inlet and outlet is relatively less than that in the normal pelvis. The condition has no special importance in relation to labor, though it probably offers less resistance to the passage of the head than does the normal pelvis.

(d) *Deep Pelvis.*—A deep pelvis is one in which the distance between the outlet and inlet is relatively considerably greater than in the normal pelvis. The condition may increase the difficulty of labor owing to the greater length of bony canal to be traversed by the fetus. When labor is delayed, the axis-traction forceps should be tried.

2. *Pelves Contracted in an Anteroposterior Diameter.*—*Flat Pelvis.*—The term flat has long been applied to pelvis whose anteroposterior bony measurement is relatively less than that of the normal pelvis.

(a) *The Non-rachitic or Simple Flat Pelvis.*—In this variety of deformity the bones may present all the ordinary female characteristics, there being no evidence of previous rickets. The conjugata vera is usually larger than 3 in., though it is considerably below the normal. The transverse diameter of the pelvis is relatively increased. The sacrum is usually smaller than normal.

Sometimes the whole pelvis is smaller than normal as well as flattened. In some cases there is a double promontory.

*Etiology.*—The etiology of this formation is not definitely known. It is mostly found in women who have been sick or

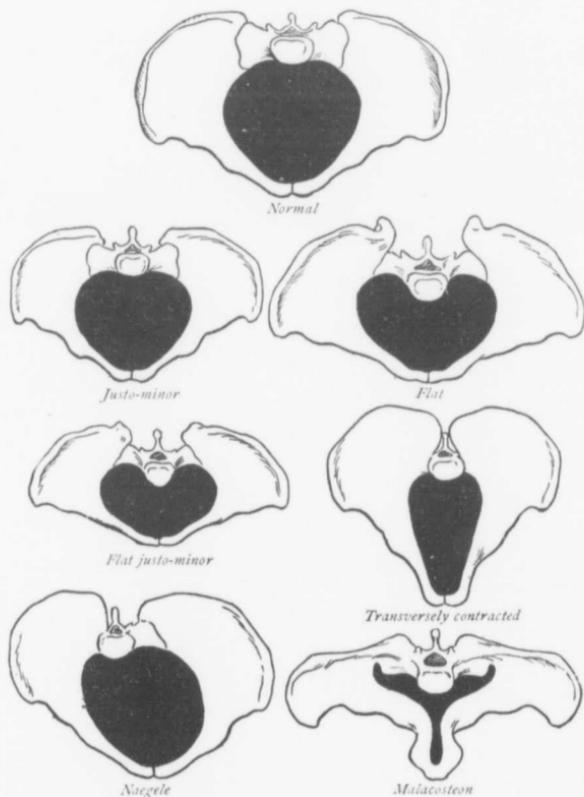


FIG. 170.—Various forms of pelves, showing the shape of the inlet or brim (Bumm).

poorly nourished in early life, especially if they have engaged in hard work or excessive walking or lifting, the deformity being easily explained by the approximation of the sacrum and pubes

as a result of weakening in the bony structure. It may be found both in large and small women.

*Diagnosis.*—Ordinarily there is nothing whatever in the woman's external appearance to suggest the deformity, all outward signs of rickets being absent. In carrying out careful pelvimetry, shortening of the external and diagonal conjugates and the altered relationships between the interspinous and intercrystal diameters may be determined; in slight degrees of deformity the latter may be little changed from the normal. Some shortening in the vertical diameter of Michaelis's lozenge may be detected.

(b) *Rickety Flat Pelvis.*—This deformity is a very important one and must be described in detail. The bones of the pelvis in general differ somewhat from those of the normal pelvis, being

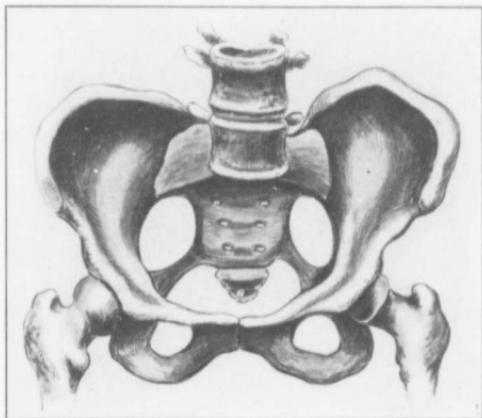


FIG. 171.—Flat non-rachitic pelvis (Kleinwächter).

thicker, coarser, and less expanded than those of the latter. These alterations are due to the disturbances in ossification caused by the disease. The crests of the ilium are less sinuous than normal and tend to be directed more outward than in normal cases, great variations being found. Thus, while in normal pelvis the intercrystal is on the average an inch wider than the interspinous, in the rickety pelvis the interspinous diameter approaches, equals, or exceeds the intercrystal measurement. The altered curve of the iliac crest is partly due to defective development, the normal curve being determined after the period during which rickets is common. The iliac wings are less expanded than in normal cases, flattening in the bones being considerably due to the dragging of the sacro-iliac ligaments and to the influence of the glutei

and sartorii muscles. The iliac fossæ look more directly forward; the iliac wings in general have a more dwarfed appearance than in the normal pelvis.

The pelvic inlet differs from that of the normal pelvis in being somewhat kidney-shaped, the anteroposterior diameter being less than the normal conjugate, the transverse diameter being both relatively and absolutely increased. The cavity of the pelvis is roomier in its lowest portion than in the normal pelvis, owing to the separation of the lateral bony walls. The anterior surface of the sacrum is somewhat flattened from side to side, and may even



FIG. 172.—Pregnant rachitic dwarf. Weight 45 pounds. Fifty-four fractures of bones had occurred (W. G. Willard).

be convex, owing to the bulging of the bodies of its component vertebrae. The outlet may not be very much altered from the normal in its anteroposterior diameter, though this may be somewhat increased. The transverse is decidedly enlarged, owing to the separation of the ischial tuberosities. The subpubic angle is larger than normal, and the acetabula are directed more forward in the erect position of the body.

On vertical mesial section the sacrum is less concave from above downward than in the normal pelvis. Its lower end with

the coccyx is frequently bent forward at a sharp angle at the level of the fourth vertebra. The vertical axis of the upper part of the sacrum is not parallel with that of the symphysis, as in the normal pelvis, but converges toward it if prolonged above the brim. The vertical measurement of the symphysis is greater than in normal cases. Owing to the greater height of the pubes, as well as to the divergence forward of the lower end of this bone, the diagonal conjugate exceeds the conjugata vera by an amount that is relatively greater than in the case of the normal pelvis. In the latter the average difference between these diameters is  $\frac{1}{4}$  in.; in a well-marked rickety pelvis it is  $\frac{3}{4}$  in. or more. Sometimes osteophytic growths may be present in rachitic pelvises.

*Explanation of the Changes in the Rickety Pelvis.*—The main

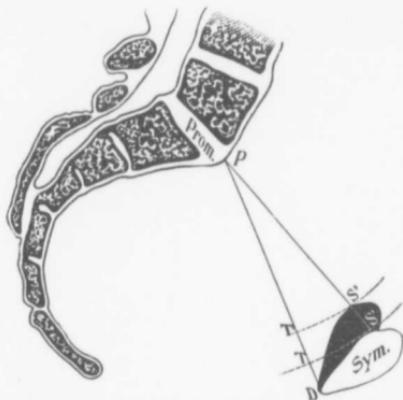


FIG. 173.—Effect of lessened slant outward of symphysis in a rachitic pelvis upon relationship between the true and the conjugate diameter (Ribemont-Dessaignes).

features of the rickety pelvis are explained by the following factors: During the active stage of the disease the bones are softer than normal, and changes are produced because of their unfitness to sustain the weight of the body. The weight of the latter, transmitted through the attachment of the sacral and iliac bones, tends to cause the promontory to sink toward the pubes, bringing about a rotation of the sacrum on a transverse axis passing through the sacro-iliac joints. The lower end of the sacrum with the coccyx tends to move upward, but is restrained by the strong ligaments attached to it, and there results usually a sharp bend at the lower end of the sacrum.

The action of various muscles attached to the pelvis may also assist in altering its shape; thus, the adductor and rotator muscles

of the thigh are believed to play a part in separating the tuberosities of the ischii, though the latter change is also brought about as a result of sitting. Alterations in the shape of bones in the condition of intra-uterine fetal rickets are believed to be mainly due to the action of muscles attached to them. In the great majority of cases, however, rickets is an affection of early childhood, and the changes produced by it vary greatly and depend upon a number of factors, such as the age and habits of the child, the intensity of the affection, etc.

*Varieties of Rachitic Pelvis.*—In some cases the pelvis, as

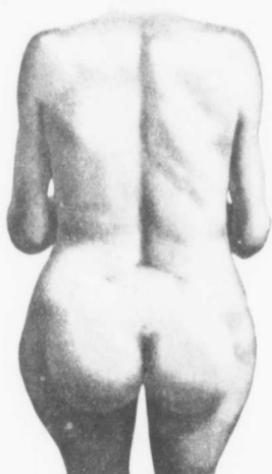


FIG. 174.—View of pelvis from behind in a rachitic woman. Michaelis's lozenge is almost a triangle (Bumm).

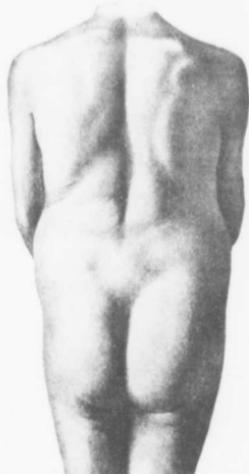


FIG. 175.—Posterior aspect of a woman with a transverse contracted pelvis. Michaelis's lozenge is narrowed (Bumm).

well as being rachitic, is smaller than normal, its development having been markedly interfered with, this form being known as the rachitic generally contracted pelvis. In other cases evidences of rickets may be associated with features that are peculiarly infantile. Occasionally the pubes is somewhat indented toward the promontory, giving to the brim a somewhat figure-of-8 shape.

When rickets is associated with marked lateral curvature of the spine, the pelvis is known as the scoliorachitic obliquely contracted form. Rarely there is indentation of the pelvis at both acetabula, giving rise to the variety known as rachitic rostrate or

pseudomalacosteon; the pubes projects forward in a kind of beak, as in the malacosteon pelvis, the inlet having a somewhat triradiate shape like that of the latter.

*Diagnosis.*—In diagnosing the rachitic pelvis it is necessary to obtain the previous history of the woman's health, to examine her frame, and to measure the pelvis. Frequently a history may be obtained of rickets in childhood; she may be stunted in growth, may present a square head, pigeon-breast, curved long bones

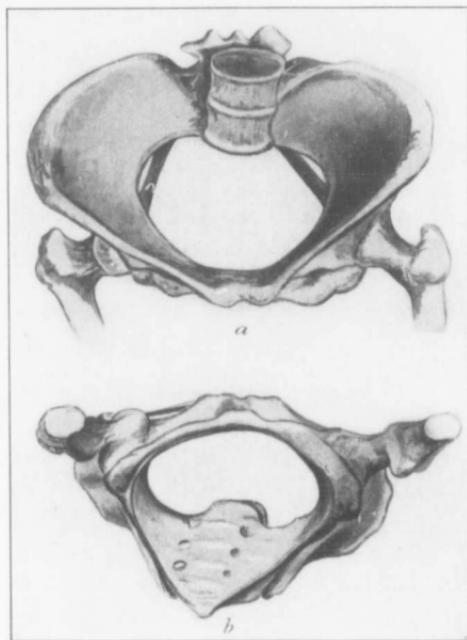


FIG. 176.—Flat rachitic pelvis: *a*, viewed from above; *b*, viewed from below.

with thickened ends, etc. When she lies on a flat surface there may be well-marked lumbar lordosis. The vertical diameter of the lozenge of Michaelis is shortened, owing to sinking of the promontory and the lumbar vertebræ. In extreme degrees of deformity the upper angle of the lozenge (spine of last lumbar vertebra) may be almost in the line that joins the lateral angles, the lozenge consequently approximating to a triangle in outline.

On measuring the pelvis with the pelvimeter changes in the

relationships of the interspinous and intercrystal diameters may be found. The external and diagonal conjugates are lessened, the difference between the diagonal and true conjugates being greater



FIG. 177.—Rachitic deformity in pelvis of a child.

than in the normal pelvis. The ischial tuberosities are found to be wider than normal and the subpubic angle greater.

Sometimes, owing to the projection of the joints of the first



FIG. 178.—Overlapping of cranial bones in a futile attempt to engage in superior strait of a rachitic pelvis (Smellie).

and second sacral vertebræ, a prominence may be formed that may easily be mistaken for the true promontory, and indeed for obstetric purposes it may sometimes take the place of the true

promontory. In measuring such a pelvis the available brim conjugate should be measured from the projection that is nearer the pubes. When marked lordosis is present, a point on the lower lumbar vertebra may be nearer the symphysis than the actual promontory.

*Relation to Pregnancy.*—This has already been detailed.

*Relation to Labor.*—When the pelvis is not too much contracted to prevent the passage of the fetus, the mechanism of labor usually takes place as follows: At the beginning the long diameter of the head usually lies in the transverse of the brim, not in the oblique, as is common in normal vertex cases. The sinciput tends to lie at a lower level—*i. e.*, the head is somewhat extended; the sagittal suture is usually nearer the posterior wall of the pelvis—the so-called "anterior parietal-bone presentation." Very



FIG. 179.—Spoon-shaped depression on head after spontaneous delivery in a flat pelvis (Bumm).

rarely the sagittal suture is nearer the pubes—the so-called "posterior parietal-bone presentation." In other words, the head possesses the Naegele obliquity well marked. These relationships of the head are well established at the beginning of the second stage of labor.

Considerable variations are found in the descriptions of the head movements as given by different authorities. The following are probably most frequently observed: In cases of anterior parietal presentation, as descent proceeds, the characteristic change is extension of the head or dipping of the sinciput (the Michaelis obliquity), the occiput remaining at the side of the pelvis in relation to the lower part of the iliac fossa, the whole head being pushed toward that side, the shortest transverse

diameter of the head, the bitemporal, entering into relation with the shortest diameter of the brim, the anteroposterior or conjugate. Along with this process of extension there is a movement of the head known as the rounding of the promontory. This consists in the rotation of the head on the anteroposterior axis, so

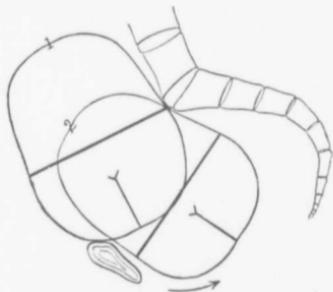


FIG. 180.—Diagram illustrating one method by which the head rounds the promontory in a flat pelvis when at the beginning of labor the sagittal suture lies nearest the pubes: 1, First position of the head; 2, second position of the head.

that the sagittal suture, from being directed toward the back of the pelvis, is moved first toward the middle of the pelvis and afterward again to the back, though when the latter position is reached the head is at a lower level, having rounded the promontory.

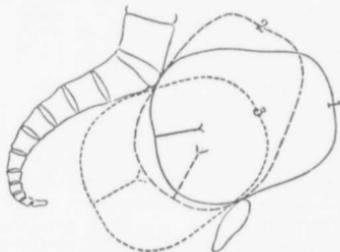


FIG. 181.—Diagram illustrating the usual method by which the head rounds the promontory in a flat pelvis when at the beginning of labor the sagittal suture lies nearest the promontory: 1, First position of the head; 2, second position of the head; 3, third position of the head.

After the passage of the inlet there is usually little trouble. The occiput may rotate to the front and the rest of the labor go on as in the normal pelvis, the occiput turning to the front, the

other movements following. Sometimes when the labor pains are strong the head may be pushed through the outlet with little or no attempt at mechanism. Occasionally there may be delay when the head is within the pelvic cavity.

In some cases early marked extension of the head may bring about a brow or face presentation, the labor being thereby increasingly complicated. In cases of posterior parietal presentation the sinciput dips, the side of the head above the brow descends, rounding the promontory, and the head as a whole becomes pushed to the side of the pelvis in relation to which the occiput lies. When labor is delayed the head may be found in any of the relationships that occur in connection with these various mechanisms. In pelves that are very small, such as the generally contracted rachitic, the head may attempt to pass the brim as if the case were a pure justminor—viz., in a markedly flexed attitude,

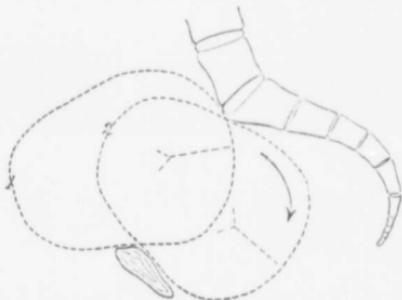


FIG. 182.—Diagram illustrating one method by which the head rounds the promontory in a flat pelvis when at the beginning of labor the sagittal suture lies nearest the promontory: 1, First position of the head; 2, second position of the head.

the type of mechanism being undoubtedly dependent upon the predominant feature of the deformity.

It is in connection with labor in rachitic pelves that those complications are apt to arise that have been described on page 440—*i. e.*, pouching of the bag of membranes, premature rupture of the membranes, prolapse of the cord, malpresentations and malpositions, etc. Localized pressure of the maternal soft parts against the promontory or pubes may result in their necrosis.

*Moulding of the Head.*—The characteristic marking on the fetal head is a groove or series of depressions in the skull, caused by the promontory. These vary in situation in different cases. They are usually in the anterior parietal or lateral frontal region, and sometimes may be found on the cheek. The posterior parietal bone is usually depressed below the anterior. The posterior region of the skull may be somewhat flattened.

*Pelvic Presentations in Flat Pelvis.*—Unless the pelvic deformity be very marked, there is usually no interference with the passage of the body of the fetus through the brim; the arms, however, are very apt to be displaced upward, and the head is frequently extended, whether the arms are displaced or not. In slight contraction of the brim the head usually passes in a flexed attitude. The more marked the contraction, the more apt the head is to extend upward; this is apt to be a serious cause of delayed labor.

*Treatment.*—In cases of slight deformity labor may take place spontaneously without being much longer than the average normal case. Very close attention should be given to it throughout, frequent examinations being made to determine the progress of the head, its changed relationships to the brim, and to detect



FIG. 183.—Marks made by promontory on child's head and face (Dickinson).

abnormalities, such as prolapse of the cord, inefficiency of the bag of membranes, and development of malpresentations and malpositions, etc. When delay tends to occur at the brim in minor cases it is advisable to place the patient in the Walcher position as much as possible, in order to gain a little more room at the inlet by the increase in length of the conjugata vera. When this is ineffective or when the contraction is quite marked, artificial interference is necessary before the woman has remained too long in labor.

Engagement of the head may sometimes be brought about by the Kristeller manipulation or by Hofmeier's procedure of pushing the head downward through the abdominal wall. In trying these methods the patient should be placed in Walcher's position.

For many years most authorities have recommended that the fetus be delivered by version—*i. e.*, podalic version. Since the axis-traction forceps has come into use it has been satisfactorily employed by several obstetricians in a number of these cases. This method of treatment is largely due to the advocacy of Milne Murray, of Edinburgh, who holds that the employment of axis-traction forceps is as favorable to the child as version, and no more dangerous to the mother. For many years an important objection to the use of forceps was the statement that the antero-posterior grasp of the head usually obtained in these cases not only tended to injure the fetal parts, but to produce a telescoping of the cranial bones, whereby increased bulging of the head took



FIG. 134.—Pressure of promontory upon head in a contracted pelvis (Smellie).

place in the transverse diameter, thereby increasing the narrow bitemporal diameter that should pass through the brim in relation to the narrow conjugate. Milne Murray showed experimentally that this compensatory transverse bulging does not ordinarily occur, but that it takes place in a vertical direction on the head, a change that cannot materially delay the passage of the head through the pelvic brim. Recently he has advised a slight modification of the ordinary axis-traction forceps, by which it is possible to exercise traction with greater efficiency, the axis of the pelvis being followed more nearly than is possible by the ordinary instrument.

It cannot be too strongly emphasized that only axis-traction for-

ceps should be employed in instrumental delivery in these cases. The ordinary long forceps must never be used, because in carrying out traction with it the head is compressed and is very apt to be injured. Moreover, much of the force applied is lost. (See chapter on Forceps.) Murray has reported one case where he extracted the head successfully with axis-traction forceps, in which the conjugata of the brim measured 2.57 in. The author has

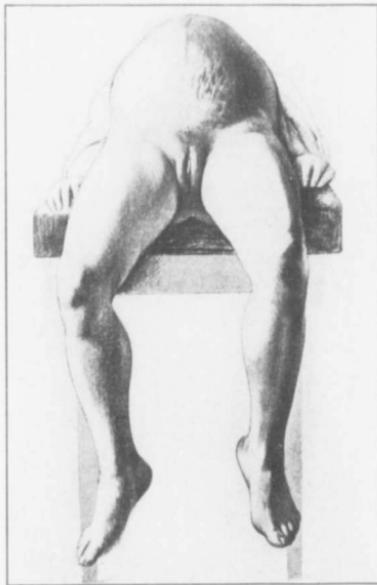


FIG. 185.—Walcher position.

brought about safe delivery a number of times in pelvis whose conjugates varied from  $3\frac{1}{4}$  to  $3\frac{1}{2}$  in. When the forceps is used in such cases, the patient should always be placed in Walcher's position, in order that the greatest amount of room may be gained at the inlet; though the increase may be slight in most cases, it may make all the difference between failure and success. The head should be steadied by the hands of an assistant, applied to the abdominal wall.

It is the custom of many, when the head has passed through the brim, to elevate the limbs of the mother, flexing them on the

abdomen, in order to obtain an increase in the conjugate of the outlet. This procedure is unnecessary, because there is usually abundant room in the transverse diameter of the outlet, and the gain in the anteroposterior is only theoretic and not worthy of consideration. It is best to continue the delivery with the limbs of the woman extended or in Walcher's position, in order to obtain the greatest degree of relaxation of the soft parts and thereby diminish the risk of lacerating the perineum.

Summing up the relative merits and demerits of version and forceps delivery, it may be stated against version that the procedure is always risky or impossible after the membranes have been ruptured for a time and the uterus retracted on the fetus; that complications are apt to arise by extension upward of the head or upper extremities, or from injury to the neck or limbs of the fetus; that the fetus may become asphyxiated by interference with the cord circulation. Version should be the operation of election when the arm, leg, or cord is prolapsed and cannot be

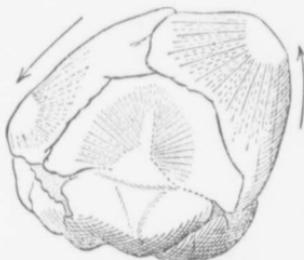


FIG. 186.—Asymmetry of head often found after delivery through a flat pelvis. The head is viewed from behind; one parietal bone (that which was anterior in the pelvis) is more curved and prominent than the other (Tarnier and Budin).

replaced; when the head rests on the *linea pectinata*, or when the *Naegele obliquity* is extremely marked, providing rupture of the uterus does not threaten.

When forceps is used, the various risks associated with breech deliveries are absent; delivery may be affected long after dilatation of the cervix and rupture of the membranes; the fetus may be extracted as nearly as possible in the proper axis of the pelvis without unnecessary waste of power; the anteroposterior grip of the head is not necessarily injurious to the fetus nor liable to cause such an amount of transverse bulging as will increase the difficulty of the passage of the head. It must be distinctly understood that the forceps is not to be used to overcome bony resistance. When careful traction fails to move the head after a fair trial, the instrument should be removed.

In cases in which these methods are considered inadvisable,

various other procedures are recommended—*e. g.*, embryulcia, Cæsarean section, symphysiotomy, and premature labor.

In some countries symphysiotomy has been popular with or without the combined use of forceps, care being taken that the pelvic contraction is not too excessive. This operation is likely to displace premature labor, for the living child delivered at full time by means of symphysiotomy, assisted if necessary by the axis-traction forceps, is better than a premature delivery with the risks of obtaining a dead child, a weak one, or one difficult to rear.

As regards embryulcia, the tendency is now growing to employ it only when the fetus is dead or when circumstances do not permit the adoption of a conservative surgical procedure.

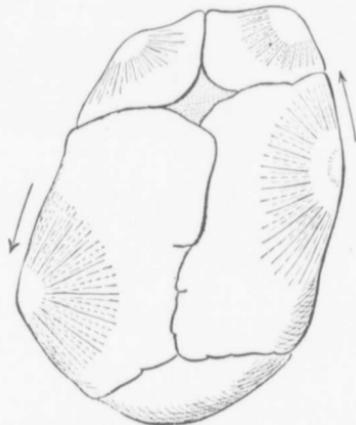


FIG. 187.—Asymmetry of head sometimes found after delivery through a flat pelvis. The head is viewed from above. In addition to the changes shown in Fig. 186, the right and left halves are asymmetrically disposed (Tarnier and Budin).

A further consideration of the relative values of these methods of treatment will be given when the latter are considered in detail.

*Spondylolisthesis.*—This deformity is a very rare one. It consists of bulging of the lower lumbar vertebræ downward into the true pelvis, the sacrum being also pushed downward and backward, and the anterior part of the pelvis being somewhat elevated. The anteroposterior diameter of the upper part of the pelvis is diminished, variations occurring according to the amount of dislocation of the vertebræ. The outlet of the pelvis is contracted in its measurements.

*Etiology.*—The explanation of this deformity is not certain in all cases. It has been attributed to disease or faulty development or ossification in the bones. These may be predisposing conditions in some cases, but it is certain that the change may be brought about in healthy women following falls or the carrying of heavy weights. Lane has shown that stretching of the ligaments, atrophy, and severance of bones may take place.

*Physical Signs.*—The woman is somewhat stunted, the abdomen tending to be somewhat pendulous. The ribs are close to the iliac bones, and the flanks are prominent. The outlines of the iliac crests are very prominent when the woman is viewed from behind; the posterior processes of the upper sacral vertebrae are usually easily distinguished beneath the skin, a deep depression



FIG. 188.—Ahlfeld's case of spondylolisthesis.

being seen over the base of the sacrum. The distance between the posterior iliac spines is greater than normal. The pubes is higher than in normal cases, the vulvar region being further forward. The inclination of the brim is greatly diminished, and the external conjugate of Baudelocque is less than normal. On vaginal examination the characteristic contractions already described may be easily distinguished. The lumbar vertebrae are readily palpated, and with them the lower end of the aorta with its iliac divisions may be felt.

In determining the available conjugate of the brim, measurement is made from the symphysis to the nearest portion of the lumbar projection. There is no fixed relationship between the diagonal and true conjugates, owing to the variations that are

found in the extent of deformity and the inclination of the pelvis. When the woman walks she carries her shoulders well back, and her feet are usually inclined directly forward, the toes not turning out. In some cases a grating feeling (crepitus) is noted in the region of the hips during locomotion.

*Influence on Pregnancy.*—The most characteristic disturbances of pregnancy may be found with spondylolisthesis. Owing to the

vertical shortening of the abdomen, the uterus finds scanty room for its upward development, and in the advanced months is deflected markedly forward, though it may be displaced in other directions; malpresentations and malpositions of the fetus occur as a result.

*Influence on Labor.*—The pelvic deformity may be compared to that found in rickets as regards the general alteration presented at the brim, the characteristic change being flattening. In cases in which the contraction is not too great to prevent the passage of the fetus, the latter passes through the pelvis by a mechanism similar to that found in rickety women. In addition to the delay at the brim there may be delay at the outlet, owing to its con-



FIG. 189.—Spondylolisthesis, well marked (Schauta).

tracted condition. In a considerable percentage of the cases of deformity the fetus cannot be delivered by the natural passage unless embryulcia or Caesarean section be carried out.

*Treatment.*—Cases of labor are conducted on lines similar to those observed in rachitic women. Delay or difficulty may necessitate version, force, Caesarean section, or embryulcia, according to the degree of the deformity.

3. *Pelves Contracted in an Oblique Diameter.*—(a) *As a Result of Loss of One Leg or Impaired Use of One Leg in Early Life.*—When the use of one limb is abolished or impaired during early life, owing to disease or injury of bones or joints, so that the weight of the body is transmitted for some time entirely through the sound extremity, that part of the pelvic wall in relation to the

sound thigh tends to be approximated to the promontory, producing an oblique contraction in the pelvic cavity, varying in degree in different cases. Along with the contraction there is usually some compensatory bulging outward of the pelvic wall on the side of the inactive limb.

(b) *As a Result of Imperfect Development of One Side of the Pelvis (Naegle Pelvis).*—When an ala of the sacrum is partly or

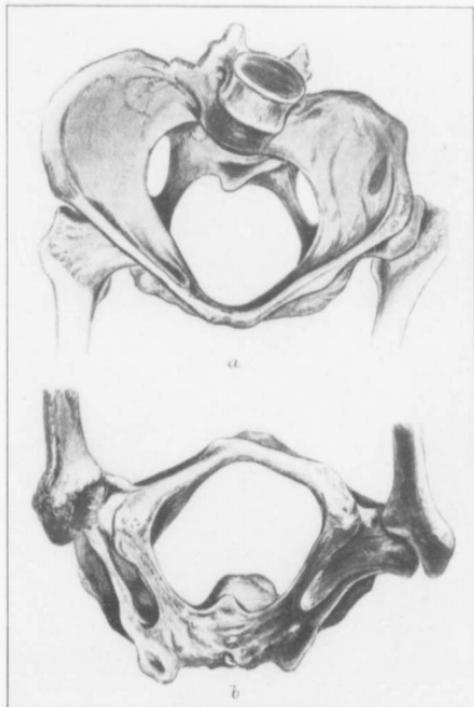


FIG. 190.—Pelvis obliquely contracted by congenital dislocation of one femur: *a*, Viewed from above; *b*, viewed from below.

entirely deficient, an oblique contraction of the pelvis is produced, the os innominatum on the affected side lying nearer the vertebral column than that of the healthy side. The sacrum is narrowed and is slightly rotated, so that its anterior surface is turned somewhat toward the diseased side. The os innominatum, as well as being moved nearer the middle line of the spine, is tilted a little

upward and backward, its ischial tuberosity lying at a little higher level than that of the healthy side, its ischial spine projecting more distinctly into the pelvic cavity. Its iliopectineal line is often less curved than normal, and its acetabulum is directed more laterally. The subpubic angle is not symmetric, being directed more toward the affected side of the pelvis. The shape of the brim is characteristic, though it varies according to the deformity of the sacrum. It has a somewhat ovoid shape, the small end of the ovoid being at the sacro-iliac joint on the affected side. The pelvic diameter, which is shortened, is that denominated by the healthy sacro-iliac joint—*i. e.*, if the sacrum is affected on the right side, the shortened oblique diameter of the brim is the left. There is usually ankylosis of the sacro-iliac joint on the diseased side.

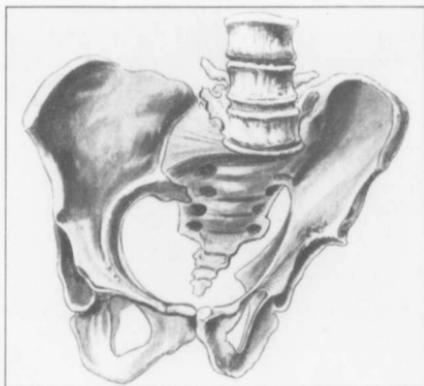


FIG. 101.—Singly obliquely contracted or Naegele pelvis (Winckel).

Michaelis's lozenge is usually asymmetric, the lateral angle being higher on one side than on the other, and the transverse diameter slightly diminished.

*Etiology.*—It is not possible to decide in any given case as to the cause that has led to the defect in the wing of the sacrum. In some cases it may be congenital, the normal bone development having been interfered with, or there may have been some diseased condition in early years. The ankylosis of the joint, which usually though not always takes place, is secondary to the changes in the sacrum. The displacement of the os innominatum is probably mainly brought about after the child begins to walk.

*Diagnosis.*—Slight degrees of deformity may be easily overlooked during life, and even extreme degrees may only be ascer-

tained after careful examination. The following measurements should always be made with the pelvimeter:

1. From the posterosuperior spine of one side to the antero-superior spine of the other.
2. From the posterosuperior spine of one side to the ischial tuberosity of the other.
3. From the posterosuperior spine of one side to the tip of the great trochanter of the other side.
4. From each posterosuperior spine to the spine of the last lumbar vertebra.
5. From each posterosuperior spine to the lower edge of the symphysis.
6. From each posterosuperior spine to a fixed point on the middle of the dorsal region of the spine.

On the normal pelvis these right and left measurements in each set are equal or nearly equal. On a well-marked Naegele pelvis there is usually a difference of a half-inch or more between them.

Careful internal examination of the pelvis should also be made, in order to determine the relationships of the ischial spines and tuberosities to the sacrum on each side. If the promontory can be palpated, the hollow on each side is felt to be distinctly narrower on the affected side. The promontory also appears to be slightly turned toward the latter.

*Relation to Labor.*—In slight deformity delivery may occur spontaneously with little delay. In more marked contraction there may be considerable interference with the passage of the fetus, and the mechanism by which the head attempts to move through the pelvis is the same as that described in the case of the universally contracted pelvis—*i. e.*, there is an extreme degree of flexion, the shortest possible suboccipitobregmatic circumference entering into relationship with the pelvic brim. Though the head may successfully enter the pelvic cavity, delay may be caused when the shoulders come into relationship with the brim, and the further movements of the head may consequently be more or less interfered with.

*Treatment.*—The conduct of labor is the same as that recommended in considering justo-minor cases. When artificial delivery is indicated, the axis-traction forceps should be tried. Version is not usually advisable because of the special risk of upward extension of the head and upper extremities at the brim. If it be carried out, that leg should be brought down which will cause the occiput to be turned toward the front, with the sagittal suture in the larger oblique.

In marked cases Cæsarean section may be necessary, or embryulcia if the fetus be dead. Premature labor may sometimes be employed if the deformity is recognized in early pregnancy.

Symphiotomy should not be tried, owing to the possibility of the existence of sacro-iliac ankylosis.

4. *Contraction in the Transverse Diameter of the Pelvis.*—(a) *As a Result of Pressure or in the Absence of Both Sacral Ala (Robert Pelvis).*—Very rarely a deformity of the pelvis may result from changes in each wing of the sacrum, similar to those already described as occurring in the Naegele pelvis. By some it has been termed the double Naegele deformity or the double oblique contracted pelvis. The wings of the sacrum may be considerably altered, or the deficiency may be greater on one side than on the other. Slight variations may, therefore, be found in the characteristics presented by the Robert pelvis. The ossa innominata are moved backward, inward, and a little upward, the characteristic alteration in the pelvis being a diminution in all the transverse

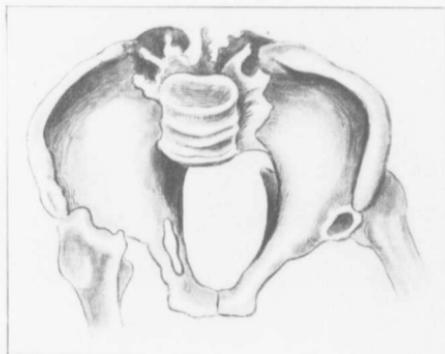


FIG. 192.—Transversely contracted or Robert pelvis, viewed from above (E. Martin).

measurements of the pelvis. The ilia project more posteriorly than in normal pelvis. The promontory lies a little nearer the symphysis, so that there is slight diminution in the conjugate of the brim; the sacrum, as well as being narrowed, is somewhat straightened vertically. Both the sacro-iliac joints may be ankylosed. The transverse diameter of the lozenge of Michaelis is greatly narrowed.

*Relation to Labor.*—Labor is impossible in these pelvis, and Cæsarean section is always necessary if pregnancy advances beyond the early months.

(b) *As a Result of Spinal Kyphosis.*—(See description of Kyphotic Pelvis.)

5. *Generally Compressed Pelvis.*—(a) *Malacosteon.*—In a well-marked malacosteon pelvis the following are the characteristic

peculiarities: The iliac wings are bent from before backward, so that the normal relationship between the interspinous and intercrystal diameters are markedly altered. The anterosuperior spines are turned inward, and the iliac fossæ, instead of being saucer-like as in the normal pelvis, are more scoop shaped. The brim has a



FIG. 193.—Malacosteon pelvis, viewed from above (Winckel).

somewhat stellate or triradiate shape, owing to the approximation of the promontory and the iliopectineal eminences. The pubic bones lie close together behind the symphysis, forming a beak-shaped or rostrate projection, and the available conjugate of the brim is measured from the promontory to the posterior portion of

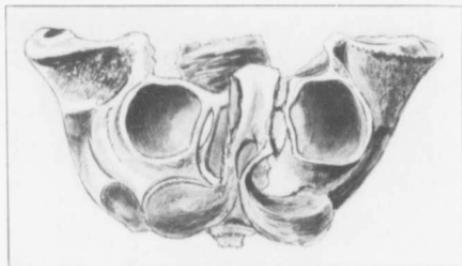


FIG. 194.—Malacosteon pelvis, viewed from the front (Winckel).

this projection. The descending rami of the pubes are approximated and may be twisted; the subpubic angle is, therefore, very narrow. The tuberosities of the ischii are usually nearer together than normally, and one or both may be variously twisted. The

lower part of the sacrum with the coccyx is curved upward and inward, greatly interfering with the cavity of the pelvis.

*Etiology.*—The pelvic deformity is brought about by the effects of pressure at a time when the pelvis is softened as a result of the disease known as osteomalacia or mollities ossium.

It will be readily understood that in the altered condition of the bones the weight of the body in a sitting posture, in standing, and in walking may result in such a distortion of the pelvis as has already been described.

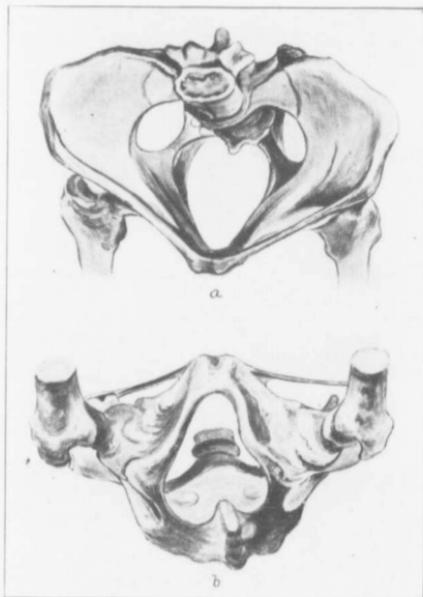


FIG. 105.—Pelvis deformed slightly by osteomalacia: *a*, Viewed from above; *b*, viewed from below.

*Diagnosis.*—The condition is usually readily made out by physical examination, and a history of osteomalacia is generally obtained. The height of the woman is diminished. The gait is peculiar, rotation of the body usually taking place as one foot is advanced in front of the other; abduction of the limbs is difficult or impossible.

*Relation to Labor.*—During the active progress of osteomalacia

labor may result in the birth of the child spontaneously or with assistance, the dangers to the mother, however, being considerable. Litzmann has collected the reports of 85 cases, with a maternal mortality of 47. In pelves in which the bones are hard and the deformity fixed, natural delivery is almost always impossible.

*Treatment.*—Owing to the marked maternal mortality associated with delivery through pelves softened by osteomalacia, it is doubtful if any procedure except Cæsarean section is justifiable, though in the past version and forceps have been employed. The abdominal operation is particularly indicated in view of the researches of Curatulo and others, who have demonstrated the curative influence that the removal of the ovaries usually exerts on the disease. This procedure should, therefore, be carried out in conjunction with the conservative operation or with removal

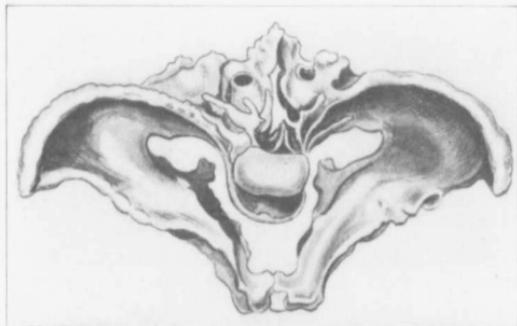


FIG. 196.—Pseudomalacosteon rachitic pelvis (Schroeder).

of the uterus. In the hardened osteomalacic pelvis embryulcia may rarely be carried out; in the great majority of cases Cæsarean section is necessary.

(b) *Pseudomalacosteon Rachitic Pelvis.*—This deformity has already been described in connection with rickets. In it there is an approximation of the acetabula and the promontory, the pubic bones being somewhat approximated behind the symphysis, forming a kind of beak. The pelvis differs from the typical malacosteon, however, in that the iliac wings are not compressed, but are found to be markedly everted anteriorly, so that the interspinous diameter is very much greater than the intercrystal. The pubic beak is not so pronounced or narrow as in the malacosteon pelvis, the descending rami of the pubes and the ischial tuberosities are not twisted, and the lower part of the sacrum does not curve markedly upward into the pelvic cavity.

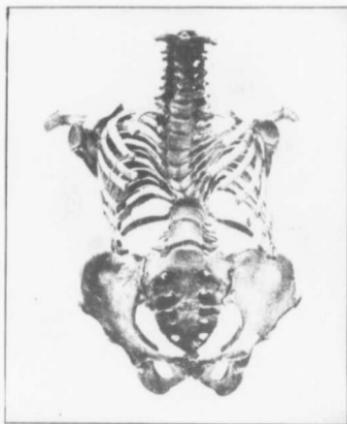
6. *Contraction Associated with Deformity of the Spinal Cord.*—

FIG. 197.—Kyphotic pelvis and spine (Barbour).

(a) *Kyphosis*.—Anteroposterior bending of the spine, resulting in the formation of a posterior hump, is usually associated with



FIG. 198.—Kyphotic pelvis (Kleinwachter).

more or less deformity in the pelvis, the alteration being most marked when the hump is pronounced and low in the back. The

most frequent site of the kyphosis is the junction of the dorsal and lumbar regions.

As a result of the alteration in the spine, the center of gravity of the part of the trunk above the curvature is thrown forward when the individual stands or sits. To counteract this some degree of lordosis develops above the hump, but this is insufficient to keep the center of gravity in its proper vertical plane; consequently changes are induced in the pelvis whereby the sacrum is

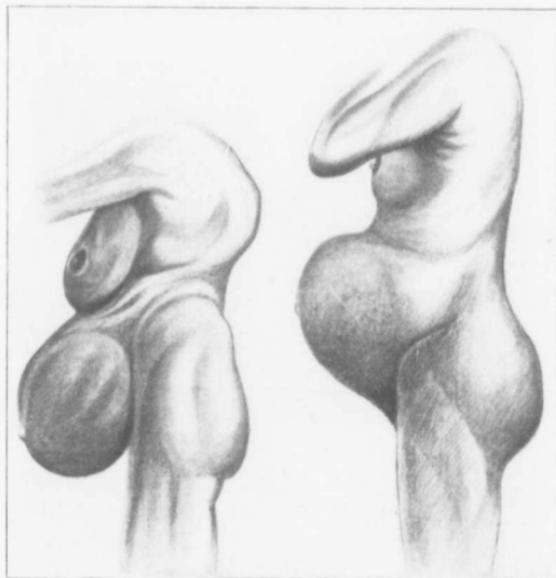


Fig. 199.

Fig. 200.

FIG. 199.—Advanced pregnancy in a kyphotic woman with a justo-minor pelvis. The belly is pendulous, the uterus having been unable to develop normally upward into the constricted abdominal cavity (Bumm).

FIG. 200.—Pregnancy in a woman with a justo-minor pelvis. The belly is unduly prominent (Bumm).

gradually forced backward and downward in its upper part. At the same time the lower end of the bone is moved somewhat forward. The ossa innominata are also moved at the same time and may be regarded as rotating in a transverse axis, their upper portions moving downward and backward. In the most marked cases the pelvis has the following characteristics: The inclination of the brim is very much diminished, the posterior portion being at a relatively lower level than in the normal pelvis; the outline is

somewhat oval in shape, the longest diameter being the antero-posterior. There may be no sign whatever of a projecting promontory. The shape is, therefore, exactly that of the brim of the newborn child. In addition to the relative diminution in the length of the transverse diameter there may be some actual shortening, owing to the diminished width of the sacrum that is frequently found in these cases. Indeed, the latter bone may be considerably altered from the normal, being not only narrowed, but also elongated and somewhat straightened. The pelvic cavity becomes funnel-shaped, owing to the approximation of the ischia, sacrum, and coccyx, many different degrees of approximation being found. In extreme cases the ischial tuberosities may be less than 2 in. apart.

In the false pelvis the anterosuperior spines are usually moved somewhat apart, while the posterior spines are drawn nearer together.

When the last lumbar or upper sacral vertebrae are affected with the disease that has caused the spinal curvature, there may be some thickening of the bone, interfering with the shape of the brim.

When the curvature is very marked and very low in the back, that part of the spine projecting forward above the hump may

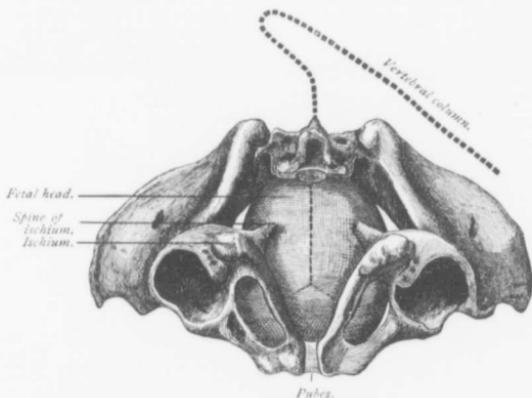


FIG. 201.—Head arrested by spines of ischia in a kyphotic pelvis (Budin).

encroach considerably upon the brim, so that it may seriously interfere with the uterus and fetus in advanced pregnancy—the so-called *pelvis obiecta* of Fehling.

*Diagnosis.*—The deformity of the spine is easily recognized on

examination, and careful pelvimetry may determine the condition of the bony pelvis; when the deformity is at all marked, it is usually impossible to reach the promontory on vaginal examination. It is especially necessary to examine the lower part of the pelvic cavity and the outlet and to note the relationship of the upper limb of the spinal curvature to the pelvic brim.

*Relationship to Pregnancy and Labor.*—Kyphosis chiefly affects the pregnant woman by interference with the abdominal cavity in advanced gestation. This interference is most marked when the spinal disease is near the pelvis and when the upper limb of the curvature projects markedly forward.

The growing uterus projects further forward than in the normal



FIG. 202.—Posterior view of a woman with kyphoscoliosis. The lozenge of Michaelis is obliquely distorted (Bumm).

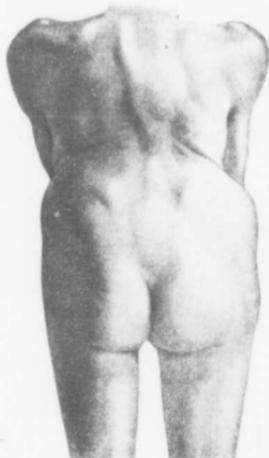


FIG. 203.—Posterior view of a woman with a kyphotic pelvis. The posterosuperior iliac spines are very prominent (Bumm).

cases, and a condition of well-marked pendulous belly may be produced. As a result of this displacement of the uterus, malpresentations and malpositions may be found at the beginning of labor. When these are not present, however, no difficulty is met with until the head descends to the lower part of the pelvic cavity. In some cases this descent may take place very rapidly. When there is delay, the degree depends upon the nature of the contraction in the lower portion of the pelvic cavity; in slight cases there may be little prolongation of labor. The occiput frequently

tends to rotate to the back. In most extreme conditions passage of the fetus is impossible.

After the third stage there is special danger of postpartum hemorrhage, owing to the imperfect filling of the enlarged upper part of the pelvis by the retracted and contracted uterus.

*Treatment.*—In cases of slight contraction labor may proceed naturally, no interference being necessary. When it is necessary to use artificial means for the purpose of delivering the head de-



FIG. 204.—Diagram illustrating the effect of well-marked kyphosis on a pregnant uterus in the late months. Extreme anteversion of the organ is produced, the fundus being pushed downward and forward (Tarnier and Budin).

laid at the lower part of the pelvis, forceps may be used, provided the degree of contraction be not too great to prevent its safe application. In worse cases embryulcia or Cæsarean section is indicated, though, of course, premature labor must always be regarded as an appropriate measure in certain cases.

*Scoliosis.*—The effects of lateral curvature of the spinal column depend on its situation and extent. Slight degrees of curvature situated high in the spine may not lead to any changes in the

pelvis. When situated near the latter, the effects on the pelvis are usually more or less marked.

Most cases of extreme scoliosis are due to rachitis, and consequently the pelvic bones present the features that have already been described in connection with that disease. In this connection it is only necessary to refer to the pelvic alterations resulting from the spinal deformity.

The center of gravity of the body is displaced toward that side of the pelvis over which the convexity of the spinal curvature projects. There is, therefore, a tendency to oblique compression of the pelvis, which is aggravated especially during sitting and walking. The acetabulum corresponding to the limb that receives the greatest share of the body-weight is forced somewhat upward and inward toward the sacrum and the overhanging spinal con-



FIG. 205.—Grooves on head of fetus, caused by pressure against the ischial spines as it passed through a kyphotic pelvis (Lelievre).

vexity. At the same time there is some rotation of the lumbar vertebrae toward the side of the convexity.

The shortest diameter of the pelvic inlet thus becomes the sacrocotyloid—*i. e.*, the distance between the promontory and the iliopectineal eminence; in some cases, however, this diameter must be drawn, not from the promontory, but from the nearest point on the projecting lumbar convexity. The lozenge of Michaelis is somewhat asymmetric.

*Relationship to Labor.*—In very slight degrees of scoliosis there may be no interference with the normal mechanism of labor. In other cases trouble arises in proportion to the degree of curvature and the pelvic changes associated with rachitis. In some cases the latter are predominant and naturally influence the nature of the delivery. When the sacrocotyloid diameter is much short-

ened, a considerable part of the pelvic inlet may be of no avail for the passage of the head, which may attempt to pass a large portion of the brim by a mechanism similar to that which takes place in the generally contracted pelvis. In such cases, however, only an unusually small fetus may succeed in entering the pelvic cavity. In all cases in which artificial delivery is necessary the indications

are practically the same as those described in connection with rachitic flat pelvis.

*Kyphoscoliosis.*—As a result of marked rachitic changes, kyphosis and scoliosis may be present at the same time. When the lower part of the spine is affected, the pelvis may be somewhat altered to correspond with both forms of curvature. As a rule, in these cases the kyphosis is situated in the dorsal region, so that the pelvis may not be markedly affected by it.

*Lordosis.*—Marked antero-posterior curvature of the spine, producing a forward convexity, is extremely rare as a primary disease. It is usually found compensatory to other spinal or pelvic deformitory. If it is situated low in the lumbar region, it may interfere with the normal relationship of the uterus to the pelvic brim in pregnancy and with the normal entrance of the fetus into the pelvis during labor.

7. *Alterations of the Pelvis Resulting from Tumors, Injuries, and Disease.*—All tumors that grow from bone—

*i. e.*, fibroma, sarcoma, carcinoma, etc.—may be found in the pelvis, and by diminishing the size of the brim or the cavity, may interfere with labor. Exostoses are occasionally found, especially in the region of the various joints, and may produce swellings sufficient to interfere seriously with the passage of the fetus, as well as being the source of injury to the maternal soft parts and the fetal tissues.

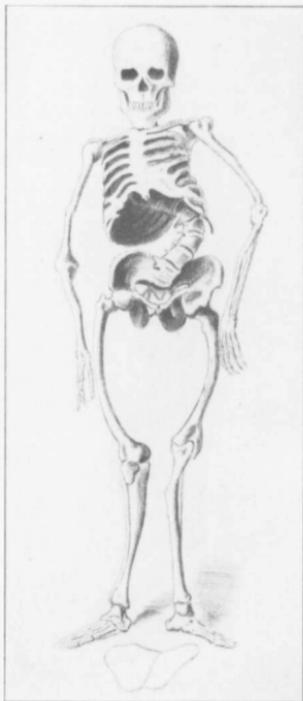


FIG. 206.—Kyphoscoliosis (Leopold).

They are most frequent in rachitic pelvis. Double dislocation backward of the thigh bones, usually congenital, is a rare condition. It produces rotation forward of the upper part of the sacrum and a widening of the lower part of the pelvic cavity, the ischial tuberosities being moved somewhat outward, upward, and backward.

Fractures of the pelvis are also rare, but may result in pelvic deformity as a result of faulty union of the bones, callous formation,

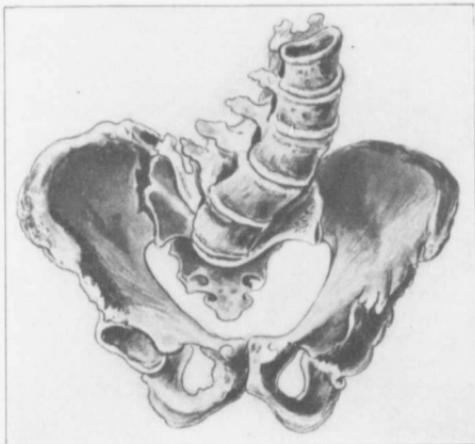


FIG. 207.—Kyphoscoliotic rachitic pelvis (Ahlfeld).

and ossification of joints near the fracture. Ankylosis of one or more pelvic joints may occasionally be found; when the coccygeal joints are affected, there may be considerable interference with the passage of the fetus through the outlet. Fracture may result, and this may be followed by faulty union, necessitating later removal.

When the symphysis pubis is ankylosed, the difficulty of performing symphysiotomy is increased. When the sacro-iliac joints are affected in early life, the condition is chiefly of importance in relation to the development of the adjacent portions of the sacrum and ilium, a deficiency in these causing an oblique contraction of the pelvis.

*Relationship to Labor.*—It is very evident that labor may be interfered with in various degrees according to the alteration produced in the bony passage. In some cases delivery may only be prolonged; in other cases it may be impossible.

All the well-recognized methods of artificial delivery may be necessary in these conditions.

8. *Deformities of the Pelvis in Relation to the Postpartum Uterus.*—In the author's work on the normal postpartum state he has pointed out that immediately after the third stage the retracted and contracted body of the uterus acts as a "ball-plug," filling the greater portion of the pelvic cavity and compressing the extra-uterine tissues laterally against the bony wall, while inferiorly,



FIG. 208.—Luxation and paralysis of right lower limb (Winckel).

owing to the softened and relaxed state of the pelvic floor, there is very much less compression of the extra-uterine tissues. As a result of this relationship the circulation of the blood external to the uterus is considerably interfered with in the upper part of the pelvis, while in the lower part the vessels are less interfered with, the various tissues being more or less congested, like the adjacent cervix; while the tissues in the upper part of the pelvis are more or less anemic, like the body of the uterus. This condition re-

mains practically unaltered during the first four days of the puerperium, and undoubtedly, owing to this compression of vessels as well as to the retraction and contraction of the uterine body, the risk of hemorrhage from the inner surface of the uterus is reduced to a minimum.

The condition of the tissues in the lower part of the pelvis makes it easy to understand why, after delivery, bleeding is likely to result from tears in the cervix, vagina, or neighboring tissues. Careful observations regarding the postpartum state in women with contracted pelves make it evident that hemorrhage is apt to

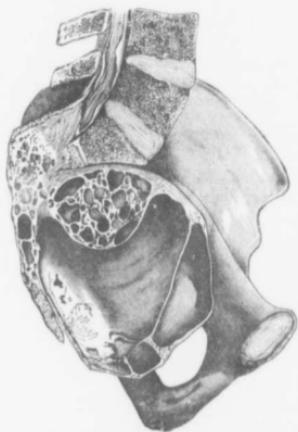


FIG. 209.—Cystic enchondroma (Zweifel).

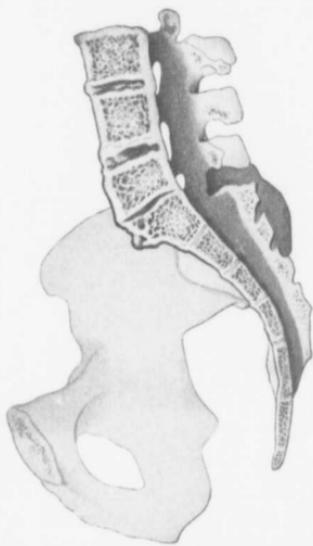


FIG. 210.—Button-like exostosis on promontory (Schauta).

be more marked than in women with normal pelves, the reason being that the uterus cannot sink within the pelvic cavity if the contraction be marked, and that consequently the normal plugging of the cavity is absent. Stratz has published sections of a woman with a well-marked rickety pelvis who died of postpartum hemorrhage half an hour after labor. The uterus remained almost entirely above the brim, the various tissues of the pelvis being thereby allowed to become greatly congested.

On the other hand, in kyphotic pelves and abnormally large pelves the risk of postpartum bleeding is increased, for though the uterus may sink within the pelvis, it cannot act as a plug in

the enlarged cavity, the extra-uterine tissues, therefore, remaining abnormally congested. Barbour, of Edinburgh, has published a case of a woman with a kyphotic pelvis who died of postpartum hemorrhage one and a half hours after delivery, and his sections demonstrate the condition that has just been described.

*Prevention of Dystocia.*—In the nineteenth century various attempts were made to diminish the size of the fetus by measures carried out during pregnancy, in order that labor might be made less difficult in cases in which there had previously been dystocia.

These methods consisted of bleeding or purging the woman or in reducing her diet.

In 1841 Rowbotham, a London chemist, published an account of the dietetic measures that he had employed with satisfaction in the case of his own wife. His aim was to exclude those mineral ingredients that enter into the structure of bone. This diet was composed largely of substances containing vegetable acids (apples, grapes, lemons, and oranges), which were intended to prevent the deposit of earthy salts. Small quantities of bread, rice, and potatoes were allowed, and scarcely any animal food.

Though his work attracted some attention among the public, little notice was paid it by the medical profession. In 1889 Prochownick published an account of several cases in which dietetic restrictions appeared to produce satisfactory results.

Florshütz, Hoffmann, Reijenga, Haspels, von Swiecicki, and others have made similar statements within recent years. Prochownick and his followers believe that it is possible, by diminishing the diet in pregnancy, to produce a

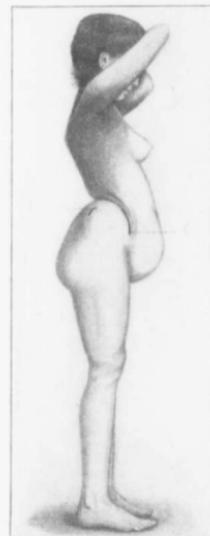


FIG. 211.—Congenital luxation of both femora: C, Crest of ilium; F, trochanter of femur (Henry).

smaller fetus, with an increased capacity for head-moulding. In a series of 48 cases, representing 62 confinements, in which the conjugate of the brim varied from  $3\frac{1}{2}$  to 4 in., he found that labor occurred normally at full term, whereas previously instrumental delivery or the induction of premature labor had been employed. He advises it with a conjugata vera of not less than 8 cm.

The diet recommended during the last two or three months of pregnancy is as follows:

*Breakfast.*—Small cup of coffee and 25 gm. of toast or Zwieback with butter.

*Dinner.*—Any kind of meat, an egg, fish with sauce, some green vegetables prepared in fat, salad, and cheese.

*Supper.*—The same as dinner, with the addition of 40 to 50 gm. of bread; butter as desired.

The total quantity of fluids taken is not to exceed 500 c.c., of which 300 to 400 c.c. may be red wine or Moselle.

Slight changes are permitted to suit individual tastes, such as the substitution of the same quantity of milk or water for the alcohol, along with some fresh fruit. Also a small cup of coffee or tea with 15 to 20 gm. of bread or one egg might be taken in the

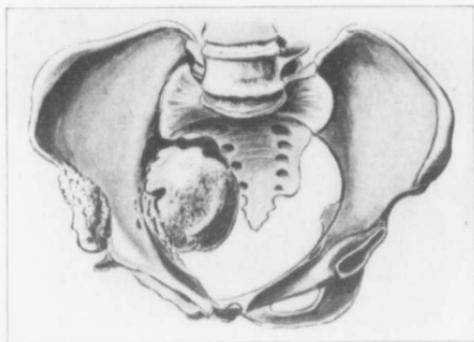


FIG. 212.—Bony tumor of pelvis (Winckel).

afternoon. Soups, potatoes, cereals, sugar, beer, and water in quantities are to be entirely avoided.

It is interesting to note in this connection the recent experiments of Noel Paton, who found in the case of well-fed pregnant guinea-pigs that each gram of the mother's weight produced from 0.35 to 0.4 gm. of fetus; while in the case of an underfed animal each gram of the mother produced only 0.22 gm. of fetus.

#### CHAPTER IV.

##### ANOMALIES OF THE PASSENGER.

**Malpositions of the Head.**—Various malpositions of the head may be found in cases of deformed pelvis, tumors, and other conditions. These will be considered in other sections. Here attention need be given only to the consideration of

occipitoposterior positions of the head, all other conditions being normal.

#### OCCIPITOPOSTERIOR CASES.

It has been already stated that in cases of vertex presentations the long axis of the head at the beginning of labor lies in an oblique diameter of the pelvis. Those cases in which the occiput is anterior have already been described. (See Normal Labor.) Rarely the occiput is posterior: occipitodextra posterior (O. D. P.), most frequent; occipitolava posterior (O. L. P.).

**Nature of the Labor.**—Labor is usually longer than in occipito-anterior cases, because as the head advances flexion tends to be less well preserved, owing to the resistance of the posterior bony pelvic wall against the occipital end of the head, and because in the movement of internal rotation the occiput traverses a greater distance. The pains are often irregular. The membranes frequently rupture prematurely.

**Diagnosis.**—On palpating the abdomen at the beginning of labor the back of the fetus is not usually felt. Sometimes it may be partly felt between the iliac crest and the last rib. If the wall be thin or lax, the irregular projections of its limbs may easily be distinguished through the anterior abdominal wall. If the head be above the pelvic brim, the rounded occiput is not felt anteriorly. The anterior shoulder may be felt 3 or 4 in. from the middle line. Sometimes the sharp chin may be felt anteriorly. The fetal heart may be heard in the lumbar region, well around toward the back, between the ribs and iliac crest; frequently, however, the dorsal surface of the fetus is too posterior to allow the heart to be heard. On vaginal examination the vertex is palpated through the fornix. When there is some dilatation of the cervix, the sagittal suture may be distinguished in the oblique diameter. The posterior fontanel may be felt near the sacro-iliac joint, though sometimes it cannot be touched early in labor. The anterior fontanel may be found near the iliopectineal eminence.

**Mechanism.**—As the head descends the posterior fontanel tends to leave the girdle of contact and to move downward and inward toward the axis of the canal. This is generally described as flexion, and has always been thought to be due to a bending of the chin on the sternum. There is, however, no proof that this occurs. If the head undergoes any such movement, the body probably undergoes a corresponding change on its long axis. This dipping of the occiput takes place more slowly than in occipito-anterior cases, because there is more resistance to the descent of the occiput than in anterior vertex cases, the broad biparietal end of the head being in relation to the narrowed part of the brim external to the promontory. As the posterior end of the head reaches the sacral segment of the pelvic floor, the

movement of internal rotation begins in accordance with Berry Hart's law, the occiput being shunted forward until it lies in the middle line behind the symphysis. The labor thereafter proceeds as in an occipito-anterior case, extension and external rotation of the head occurring.

**Abnormal Occipitoposterior Cases.**—Occasionally there is a divergence from the normal mechanism just described.

(1) When the pelvis is very roomy or the fetal head is small, the latter enters the pelvis less flexed than normally and descends more rapidly. In such a case the sinciput may reach the sacral segment of the pelvic floor anteriorly before the occiput reaches it behind, and in accordance with Hart's law is rotated to the front, the posterior part of the head moving toward the hollow of the sacrum. Clinically this change is usually described as a backward rotation of the occiput, though in reality the essential feature is anterior rotation of the anterior part of the head. After this



FIG. 213.—Occipitoposterior position, with the head beginning to distend the pelvic floor (Smellie).

malrotation there may be much delay, the case being termed "persistent occipitoposterior" or "face to pubes." When labor continues, the occiput descends over the perineum, the face passing under the symphysis. It is the more satisfactorily accomplished when the pains are strong, the head very small, and the maternal tissue soft and relaxed. The head flexes markedly as it passes through the outlet. After the head is born the body usually rotates so as to deliver the shoulders anteroposteriorly (described as external rotation of the head). The perineum is greatly stretched and is usually badly torn. The moulding of the head in such cases consists in shortening of the occipitomental and occipitofrontal diameters and in lengthening of the suboccipito-bregmatic.

(2) In some cases the occiput early in labor meets with great resistance at the pelvic brim, so that the normal flexion is undone, the presentation being changed to that of a face or brow.

(3) In other cases the movement of internal rotation may be checked when the long diameter of the head lies in the transverse diameter of the pelvis. This may be due to inefficiency in the pains, but may also be found as a result of partial extension of the head.

**Management of Labor.**—The case must be closely watched, frequent vaginal examinations being made to determine whether or not the head enters the pelvis properly flexed. When the progress is satisfactory, the management is the same as in occipito-anterior cases.

When extension tends to take place, the sinciput should be pushed up with the fingers during the pains. If this be not successful after several attempts, various procedures are recom-



FIG. 214.—Expulsion of head in persistently posterior positions of occiput; mechanism of face-to-pubes delivery.

mended. Some advise that the patient should be deeply anesthetized while a hand is passed through the dilated cervix, pressing up the sinciput, while the fetus is pushed downward through the abdomen. If flexion is brought about in this way, the anesthesia is discontinued, and the fetus is pressed downward until pains return, in order that the head may be kept in its new position.

Some recommend grasping the head and rotating it until the occiput is anterior, the sinciput being pushed upward in order to flex the head, the body being also turned correspondingly by manipulations through the abdomen. Labor may then be allowed to continue normally or forceps may be applied. Others prefer to apply forceps to the head early when the occiput lies posteriorly. Many advise delivery by version in all cases in which extension

tends to take place at the end of the first stage. When the head is partially rotated or malrotated within the pelvis, it is sometimes possible, by the introduction of a hand into the vagina, to rotate the occiput to the front, the body undergoing a corresponding change.

**Application of Forceps.**—When the forceps is used in a high occipitoposterior case, the blades are applied in the usual manner—*i. e.*, right and left, as regards the pelvis. The head is usually grasped obliquely. As descent occurs rotation tends to take place. This results in damage to the maternal tissues from the ends of the blades, since the latter are turned so as to be ill adapted to the pelvic curve. The instrument should, therefore, be removed before rotation reaches the danger-point. It should be reapplied to the head in its new position. As the occiput is well rotated toward the front the case may be left to nature, or the forceps may be removed and again applied.

When the forceps is applied in a low occipitoposterior case, the grasp of the head varies according to the position of the head. When the latter has rotated slightly or not at all, the blades are held it obliquely; when the long diameter lies transversely, it is grasped over the face and occiput; in such cases rotation occurs as traction is made. If this is marked, the instrument should be removed and reapplied. Between tractions the handles should be separated, in order to give the occiput an opportunity to turn to the front, as it sometimes does spontaneously. When the instrument is applied to the head whose occiput has rotated into the sacral hollow, a safe transverse grasp is obtained. The sinciput should be pushed up as much as possible before the blades are introduced. As the head is delivered the patient should be placed in Walcher's position, in order to relax the perineum. Episiotomy should be carried out if necessary to prevent a central rupture. In all conditions axis-traction forceps must be used. Recently Milne Murray has designed a special axis-traction forceps for use in occipitoposterior cases. The chief modification consists in a lessening of the pelvic curve, in order that when rotation of the head occurs extraction may be continued, removal and reapplication of the instrument not being necessary, since the ends of the blades do not project so as to injure the maternal tissues.

#### FACE PRESENTATIONS.

Cases of labor in which the fetus presents by its face are very rare. Their frequency is variously estimated, and might be placed between 1 in 175 and 1 in 250.

**Positions.**—The chin is used to denominate face positions, which are described as follows, in order of frequency: Mentodextra posterior (M. D. P.), mentolæva anterior (M. L. A.),

mentolava posterior (M. L. P.), mentodextra anterior (M. D. A.). By some writers it is stated that left mento-anterior positions are more frequent than right mentoposterior. Some authors state that in face and brow cases the long diameter of the head always lies transversely.

**Etiology.**—Face presentations are best regarded as vertex presentations in which extension of the head has occurred. They may exist before labor begins, but, as a rule, develop during labor. The following causes may be mentioned: 1. New growths or other enlargements of the neck and chest; tonic contraction of the neck muscles. 2. Displacement of the arms under the chin. 3. Coiling of the cord several times around the neck. 4. Smallness or mobility of the fetus. 5. Hydramnios; amniotic bands. 6. Sudden escape of the amniotic fluid. 7. Displacement of the long axis of the uterus. 8. Contractions of the pelvic brim. 9. Certain occipitoposterior cases in which there is much resistance to the descent of the occiput.

Some authors state that an elongated or dolichocephalic head causes face presentations, owing

to the increased resistance of the posterior half of the head against the brim of the pelvis, but it is very doubtful if this shape of head is ever sufficiently marked *in utero* to cause the malpresentation. This type of head is usually found after delivery in face cases, but the shape must be regarded as due to the moulding resulting from the peculiar mechanism of labor.

By several authors face presentations have been stated to be more frequent in primiparæ than in multiparæ. The researches of Winckel and Pinard, however, show that they are more common among the latter.

**Diagnosis.**—On examining the mother's abdomen early in labor the conditions presented differ somewhat from those found in corresponding vertex cases. In mentoposterior cases, if the abdominal wall be lax, it is usually possible to feel the high occiput and the depression between the occiput and the back of the fetus resulting from the extension of the head above Poupart's ligament; in mento-anterior cases it may rarely be felt in the flanks. The chin may frequently be distinctly felt. The fetal limbs, the heart, and the least accessible part of the head are



FIG. 215.—Presentation of face at pelvic brim.

found on the same side, the heart sounds being transmitted through the ventral side of the chest. The head is well above the brim. On vaginal examination in the beginning of labor the fornix is higher than in normal cases and is irregularly flattened transversely, the normal rounded bulging found in vertex cases being absent.

When the cervix is dilated, the fingers may distinguish various portions of the face—*i. e.*, nose, malar processes, supra-orbital ridges, and cavity of the mouth. When the soft tissues are much swollen and altered, it is more difficult to distinguish these parts, and the face may be mistaken for the breech, the mouth being regarded as the anus, the nose as the coccyx, the malar processes as the ischial tuberosities, and the cheeks as the nates. In making a digital examination the eyes may easily be injured if too much force be employed. Ordinarily the plane of the face is parallel to the plane of the brim, but occasionally it may be obliquely placed, so that much more of one side may be palpated than of the other.

**Prognosis.**—Labor is delayed both in the first and second stages. The face does not fit the lower uterine segment as accurately as does the vertex, and does not allow of the formation of so satisfactory a bag of membranes. The latter may pouch downward abnormally and may rupture prematurely. Mento-posterior cases are usually slower than mento-anterior. In the former malrotation of the chin into the hollow of the sacrum is apt to occur, producing a serious complication that generally demands interference. The risk to the mother in face cases is slightly greater than in vertex cases; the fetus is in much greater danger, the percentage of risk being computed as 13 to 5. Laceration of the perineum is very common.

**Mechanism of Labor.**—A normal mechanism may be described in face cases.

(a) **Mento-anterior Cases.**—As the head enters the pelvis the fronto-mental diameter tends to lie somewhat in the transverse. As descent continues extension continues, owing to the marked resistance offered to the downward movement of the occiput by the pelvic wall. That part of the presenting part that first reaches the sacral segment of the pelvic floor is the chin, and in accordance with Hart's law it is rotated to the middle line anteriorly. In the most common anterior case (M. L. A.), therefore, the chin, reaching the anterior portion of the left half of the sacral segment, is moved around to the symphysis. Flexion of the head then gradually takes place, the mouth, nose, and forehead appearing successively under the pubes, while the vertex sweeps over the perineum, followed by the occiput. Afterward external rotation occurs, being a movement of the shoulders, whereby they are made to lie in the anteroposterior diameter of the outlet. They are then delivered, followed by the rest of the body.

(*b*) **Mentoposterior Cases.**—Here extension of the head as descent continues causes the chin to reach the posterior part of the sacral segment of the floor and to be rotated around to the front, the extent of internal rotation being much greater than in mento-anterior cases. The rest of the delivery is the same as in mento-anterior cases.

**Abnormal Cases.**—(*a*) In mentoposterior cases rotation of the head may occur so that the chin is turned into the hollow of the sacrum. According to Hart, this takes place when the pelvis is abnormally large or the head small. Extension of the head is less marked than in a normal face case. The chin does not first reach the sacral segment of the pelvic floor, but the sinciput reaches the opposite segment and is rotated to the front. In other words, that which we describe clinically as a movement of the chin to the back is in reality a forward rotation of the sinciput. When this complication occurs natural delivery rarely takes place, except after great delay and danger both to mother and fetus.



FIG. 216.—Posterior position of face deeply engaged in pelvis (Smellie).

The reason of this is simple. The end of the chin is pressed firmly into the hollow of the sacrum, and if the head be normal in size or somewhat enlarged, it is evident that birth can occur only by excessive stretching of the sacrosciatic ligaments and perineum, bending of the coccyx, and compression of the cranial vault of the fetal head. The malrotated condition is usually described as a "persistent mentoposterior" case.

(*b*) Very rarely when the pelvis is unusually large or the head small, the fetus may be forced through the birth canal without any special mechanism.

**Moulding of the Head.**—After a face delivery the occipitofrontal, occipitomenal, and transverse diameters of the head are increased and the suboccipitobregmatic lessened. The vault of the head is flattened, the frontals more bulged, and the occipital bone pushed somewhat backward. The face is swollen by the caput succedaneum. The latter varies in position according to

the nature of the case. In mento-anterior positions it is placed in the region of the angle of the mouth (thus, in M. L. A. cases, on the left side of the face). In mentoposterior positions it is situated in the upper malar region and orbit (in M. D. P. cases, on the right side of the face). In other words, the caput forms over that part of the face situated anteriorly in relation to that portion of the pelvis where there is the least pressure against it. There may be marked discoloration of the skin from blood-extravasation; the eye may remain closed several days after birth, and the mouth may be so swollen as to prevent the child from nursing. The attitude tends to be that of opisthotonos for some days.

#### Management of Labor.—

Face cases must be watched carefully throughout labor. The bag of membranes must be preserved as long as possible, since the face acts as a poor dilator. In a multipara with a roomy pelvis and soft, dilatable tissues the case may be left to nature, especially when the chin is anterior. The patient should be made to lie mainly on the side toward which the chin is directed. If internal rotation is slow, it may be assisted by pressing the chin forward with the fingers during pains.

In mentoposterior cases some form of interference is usually advisable. Some authors recommend that the patient should be anesthetized when the diagnosis is made, and an effort be made to change the face to a vertex presentation by combined external and internal manipulations. In a mento-anterior case this should not be done, because an occipitoposterior position would be produced, and this might not be more favorable to satisfactory delivery.

Schatz recommends the following method: The head must be mobile and not impacted in the brim, and no condition must be present calling for rapid delivery. The patient lying on her back, the operator stands on the side toward which the occiput is directed. Between pains the anterior shoulder is grasped by the hand corresponding to it, and the breech by the other. Pressure is exerted on the shoulder in the direction of the occiput and somewhat upward, the breech being pressed upward and toward the anterior surface of the fetus. The hands at first press at a right angle to each other, then parallel in opposite directions, and afterward the breech is pushed downward and laterally. When pains come on, the head is steadied. When the head is in

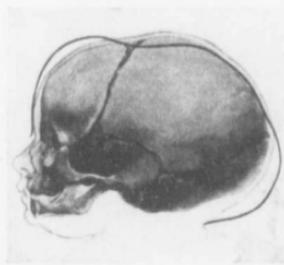


FIG. 217.—Configuration of fetal head after its delivery as a face presentation.

proper position, the patient may be placed on her side corresponding to the anterior surface of the fetus, or the membranes may be ruptured to prevent the head from moving.

Baudelocque recommended two procedures. In carrying out one the operator stands on the side corresponding to the fetal occiput and introduces the hand corresponding to the fetal face into the genital passage, the cervix being dilated, and grasps the face or upper jaw, forcing it in the direction of the chin—*i. e.*, flexes the head; at the same time the outer hand presses the occiput down into the pelvic inlet.

In his second procedure the operator stands on the side toward which the chin and breast lie, and, introducing his hand into the uterus, grasps the occiput and pulls it down, while with the outer hand he pushes the chest of the fetus upward and to the opposite side.

Humphrey advocates the genupectoral posture in carrying out this method. These internal manipulations are most difficult when the pelvis is contracted. There is considerable risk of rupturing the cervix and lower uterine segment. The greatest caution must, therefore, be employed.

Ziegenspeck, in employing Baudelocque's first procedure, used an assistant to push the child aside from without, according to Schatz's method.

If a vertex presentation can be satisfactorily brought about, the case may be left to nature, or forceps may be used if the head does not tend to engage well, provided that the cervix is sufficiently well dilated. If it is not possible or advisable to bring about a vertex presentation, delivery by version may be employed. But if this be inadvisable, the axis-traction forceps may be applied when the chin is anterior. Forceps application, however, is a difficult and dangerous procedure, and is to be undertaken only as a last resort when a living child is greatly desired. The blades must be applied right and left as regards the pelvis, no matter how the face is placed. It is very evident that their grip of the fetus is bad and that they are so wide apart that they are very apt to injure the maternal soft parts. In mentoposterior cases forceps should not be applied, because if the head descends, it is practically certain that the chin will pass into the hollow of the sacrum. Owing to the progress made in the operation of symphysiotomy, it is recommended by various authorities that this operation should be carried out in mentoposterior cases when delay has occurred before an attempt is made to use forceps. When the fetus is dead, it is always advisable to perform embryulcia. If the head has entered the pelvis and labor is delayed, in spite of the efforts to promote extension and internal rotation, the child's life is always endangered by the stretching of the vessels and nerves of the neck and by the pressure against them.

In such cases labor must be artificially terminated, either by forceps application, with or without symphysiotomy, or by embryulcia. It is very dangerous to the fetus to use forceps in such conditions, because the blades are apt to press on the tissues of the neck.

When labor is delayed by rotation of the chin into the hollow of the sacrum, the patient should be anesthetized and an effort made to rotate the head by the hand introduced into the vagina. If this is impossible and the child be alive, forceps delivery may be recommended, though the risk to the fetus and to the maternal tissues is very great. The patient should always be placed in Walcher's position when the instrument is used, in order to diminish the risk of lacerating the perineum extensively. Symphysiotomy is also justifiable when this complication exists. If the child is dead, however, embryulcia may be carried out.

#### BROW PRESENTATIONS.

Presentations of the brow are much rarer than those of the face. In 24,582 labors at Guy's Hospital there were 14 (1 in 1756). They may be regarded as halfway stages in the transformation of vertex to face presentations by extension of the head. The most frequent position is that in which an O. L. A. vertex has been altered; the next most frequent that in which an O. D. P. has been changed. It is not necessary to give special denominations, however, to these different brow positions. Some authors hold that in most cases the long axis of the head lies transversely at the beginning of labor.

**Etiology.**—The causes of head extension are the same as those described in connection with face presentations.

**Diagnosis.**—On abdominal examination at the beginning of labor the conditions are somewhat different from those found in corresponding vertex cases, but an exact diagnosis may be very difficult by this method. The head is high, the occiput and chin being on the same level and easily palpated. The heart is usually heard through the back of the fetus.

After the cervix is dilated, digital examination may find the root of the nose, the supra-orbital ridges, the forehead, and sometimes the anterior fontanel. When marked swelling of the soft tissues of the forehead occurs, it is very difficult to feel the bony parts satisfactorily.

**Mechanism of Labor.**—1. A normal mechanism may be described, but it is very rare and occurs only when there is not too great a disproportion between the head and the pelvis. This process is very lengthy. As the head descends through the inlet the occipitomenal diameter is diminished. The brow reaches the sacral segment of the floor and is rotated anteriorly to the middle line below the pubes, the face lying behind the latter, the occiput being in the hollow of the sacrum. Flexion then takes place, the

vertex sweeping over the perineum, then the nose, mouth, and chin passing under the pubes. External rotation then occurs, the shoulders being born, followed by the body, as in a vertex case.

2. When the child is very small or the pelvis very roomy, the former may be pushed through without any special mechanism.

3. Sometimes a brow presentation may be changed to a vertex or a face early in labor and may have the mechanism of either of these.

**Moulding of the Head.**—When the fetus is born after the normal mechanism just described, there is a characteristic alteration of the head. The caput succedaneum extends from the nose to the top of the forehead, the latter being somewhat flattened vertically; from the forehead the vertex slopes downward and

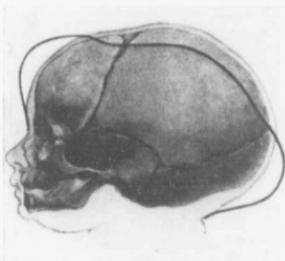


FIG. 218.—Configuration of fetal head after its delivery as a brow presentation.

backward to the occipital region. On profile the head has a somewhat triangular shape, the forehead being much elongated vertically. When a case has commenced as a brow and ended as a face, the head is dolichocephalic, with a caput succedaneum on the forehead as well as on the face.

**Management.**—If a brow presentation be diagnosed early in labor, it should never be allowed to continue unchanged. An effort should be made to change it to a vertex, pressure being made on the sinciput with the fingers during pains, or the methods of Schatz, Baudelocque, and others, as used in face cases, may be employed. The case may then be left to nature or forceps may be applied. If a vertex presentation cannot be brought about, it is advisable to perform version if the condition of the uterus is favorable. Some recommend that a face presentation should be brought about. This is not advisable if a mentoposterior is produced. If a mento-anterior be produced, there is less objection to bringing about a face presentation. Transformation to a face presentation should, however, be considered only if the vertex cannot be substituted or if version is impossible. When these procedures cannot be carried out it is advisable to employ forceps if the cervix be dilated, though this method of treatment is unfavorable for the child and is apt to injure the maternal soft parts. If the child be alive, symphysiotomy is justifiable previous to forceps application. If the child be dead, embryulcia should be performed. When the head has entered the pelvis and labor is delayed, the forceps may be used, though this method is very

unsatisfactory, especially when the chin is posterior. It is advisable to treat this condition as that of a face case delayed in the pelvis.

#### PELVIC PRESENTATIONS.

**Frequency.**—Different statistics are given as to the frequency of pelvic presentations. Pinard states that they occur once in every 30 labors; though if miscarriages and premature births be excluded, the percentage is 1 in 60. Generally the breech presents; occasionally one or both knees or feet may be lowermost. In order of frequency the positions are: Sacrolæva anterior (S. L. A.), sacrodextra posterior (S. D. P.), sacrodextra anterior (S. D. A.), sacrolæva posterior (S. L. P.).

It is thus evident that the positions are denominated by the sacrum. Berry Hart, however, objects to this nomenclature. The sacrum is unimportant in the study of the mechanism of labor, and he urges that the hip should be employed in the denomination of positions, since it is the movement of that part which is chiefly studied in the mechanism of labor.

**Etiology.**—The cause of pelvic presentations is not always evident. It is undoubtedly favored by a number of conditions—*e. g.*, hydramnios, laxity of the uterine and abdominal walls, displacement of the long axis of the uterus, multiparity, multiple pregnancy, monstrosity, death or prematurity of delivery, placenta prævia, contracted pelvis, and tumors of the uterus or other tissues.

**Diagnosis.**—On abdominal examination, unless the parietes be too thick or tense or the uterus be abnormally distended with amniotic fluid, the head may be palpated in the upper part of the uterus. The breech may be felt in the lower portion; it is not found within the pelvis before labor begins. It forms a mass that is not so firm as the head, is more variable in consistence, and has a less distinct outline. The breech can be moved only along with the body, there being no independent movement as there is to a certain extent in the case of the head. Along with the lower limbs it has usually a somewhat irregular conformation; the latter are more in evidence when the back is posterior. When they are moved by the hands, the point about which movement occurs is at a lower level than the free moving parts. The fetal heart-sounds are heard above the middle of a vertical line joining the fundus and the pubes, where, as in head presentations, they are heard below this point.

On examining the vagina early in labor the normal bulging of the hard fetal head is absent, though in some cases it may be very difficult to state that the projection is not the head. The head of an anencephalic monster may closely resemble a breech. After the cervix has dilated somewhat the various structures of

the breech may be distinguished—*e. g.*, the coccyx, ischial tuberosities, the feet if they present, or the knees; the foot must be distinguished from the hand by its length, the presence of a projecting os calcis, the parallel toes, and the absence of an opposable thumb. When both feet are down, they usually lie together. The knee may be mistaken for the elbow, but is larger and lacks the short olecranon. The anus is usually felt as a dimple below the level of the skin. When the child is dead, however, the anus may be gaping and project as an eminence. If the child be a male, the penis and scrotum may be distinguished. The latter may be mistaken for the bag of membranes, especially if it be much swollen by the presence of a caput succedaneum. In the case of a female the anus may be mistaken for the cervix. Holmes and



FIG. 219.—Full-time pregnancy. Breech presentation. Reconstruction from frozen sections (Waldeyer).

others have reported instances in which it has been wrongly dilated. If the finger be passed between the thigh and the abdomen, the groin may be mistaken for the axilla, but it is distinguished from it by the absence of ribs. Meconium may be found in the vaginal discharge. It has a tarry consistence and may be abundant. In describing face cases it has been pointed out that presentation of the latter may be mistaken for a breech, especially when the caput succedaneum has been formed over it.

**Prognosis.**—In uncomplicated cases the risks to the mother are not greater than in vertex cases. Dangers arise chiefly from methods of interference that may be employed. Frequently in-

ertia of the uterus is produced by too rapid extraction. Separation of the placenta, loss of blood, and laceration of the cervix and pelvic floor may be brought about.

The risks to the child are considerable, the fetal mortality being high. Hegar had a mortality of 35, Ramsbotham of 18.7, and Pinard of 19.5 per cent. The cord is often prolapsed and pressed upon; the liquor amnii is apt to escape early, because the breech does not fit so well into the lower uterine segment as does the head, and, the forewaters being not completely shut off from the rest of the liquor amnii, the membranes are apt to be ruptured by the force of the uterine contractions. Separation of the placenta may occur in hurried delivery or prolonged compression of the cord may take place, and thus the fetus may die from asphyxia



FIG. 220.—Passage of buttocks through vulva in a breech case (A. R. Simpson).

slowly or rapidly. It may make attempts at respiration and draw fluids into its lungs. Fractures and dislocations of the long bones may be produced by manipulations. Koettwitz states that wry-neck and hematoma of the sternomastoid muscle occur more frequently in breech cases than in any other. Other muscles may be the seat of hemorrhages. Internal ruptures and hemorrhages may be produced. The brachial plexus may be injured by traction on the shoulders.

**Mechanism of Labor.**—A normal mechanism of labor in breech cases may be described as follows: As descent occurs the hips may descend on the same level or the anterior hip may be a little lower than the posterior. The former reaches the sacral segment of the floor and is rotated to the middle line anteriorly.

It then remains for a time just behind the lower margin of the symphysis, while the rest of the pelvis is pushed downward, the posterior hip moving forward over the perineum; the anterior hip then gradually moves downward and forward, followed by the rest of the trunk and extremities, the latter being usually flexed on the anterior part of the body. The lower limbs may not be bent at the knees, or may be straightened out over the anterior surface of the body. This attitude is apt to produce some delay in labor, as Tarnier has pointed out, because the straight legs act as splints, interfering with the normal flexion of the trunk and its accommodation to the pelvic curve. In some cases only one leg is straight-

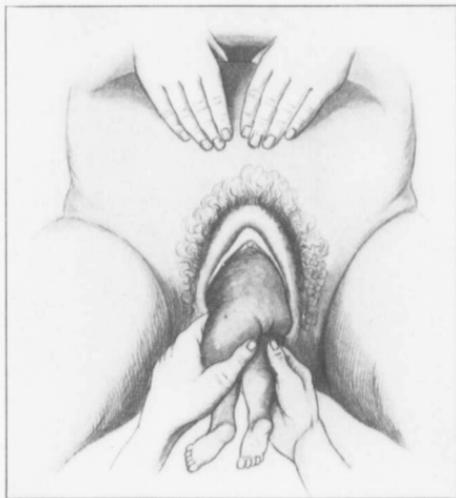


FIG. 221.—Delivery of fetus in a breech case by pressure on the fundus uteri and by traction on the lower limbs (A. R. Simpson).

ened, the other being in its normal attitude of flexion. As the shoulders reach the outlet they rotate so that their long diameter changes from the transverse to the anteroposterior of the pelvis. The head is born flexed, its anteroposterior diameter passing the brim in the oblique or transverse diameter. As it descends in the cavity it rotates so that the occiput lies behind the pubes, the face being in the hollow of the sacrum. The face then descends over the perineum, followed by the rest of the head.

**Moulding of the Fetus.**—The breech is usually swollen by a caput succedaneum and there may be much discoloration. The

swelling is mainly over the hip that has been anterior in labor, but may spread to the rest of the breech, and in the case of a male fetus may markedly affect the scrotum. If the knees or feet present, they also may be swollen.

**Variations in the Mechanism.**—1. In some cases the breech may be delayed at the brim, especially when it is very large or when the latter is somewhat contracted.

2. Delay may occur after the breech has entered the bony pelvis, due to smallness of the latter, large size of the fetus, contraction of the cervix, or extension of the lower limbs of the fetus on its anterior surface.

3. Frequently the arms are displaced upward. This may be caused by contraction of the cervix on the body of the fetus as it descends, but it also results from too hurried emptying of the uterus when artificial delivery is carried out. Displacements of the upper and lower extremities are frequently combined. One or both arms may be displaced upward and may be found in various positions in relation to the head—in front, behind, or at the sides. This complication delays labor and usually demands immediate interference, because the life of the child is endangered, owing to the extra pressure likely to be exerted on the umbilical cord.

4. Impaction of the head may take place above the brim or within the cavity of the pelvis. This is usually due to extension from too rapid delivery, though it may be caused by a large head or by contraction of the pelvis. In some cases rotation of the anterior hip of the fetus does not occur and the body passes directly through the brim, the shoulders being in relation to the transverse diameter. As the head descends anterior rotation of the occiput may not occur, and it may lie at the side of the pelvis or may turn to the back. Within the pelvis also the head may only partially rotate and may become jammed in the transverse diameter. In other cases, owing to extension of the head, the chin may get fixed in the hollow of the sacrum.

**General Management.**—Breech cases must be carefully watched from the beginning. As long as the normal conditions exist no interference should be carried out, though recently some authors have advocated external version for the purpose of changing the breech to a vertex presentation. The case may often continue throughout with a satisfactory termination. When dilatation of the cervix is very slow, especially if there is premature rupture of the membranes or artificial pouching downward of them so that they are inefficient, it is advisable to assist dilatation by the use of Barnes's bag or that of Champetier de Ribes, nature being allowed to complete the delivery after dilatation is ended. When the umbilicus appears, a loop of the cord should be examined, in order to determine the condition of the circulation. If the latter be satisfactory, labor may be allowed

to proceed by natural means. The exposed portion of the fetus may be covered with a warm cloth and supported. As the hands appear at the vulva they may be withdrawn. The cord should again be examined, and if its pulsations are weak or have ceased, delivery should be hastened. Sometimes spasms of the body of the child are present, indicating that respiratory efforts are being made; they always indicate that there must be no delay. In order to hasten labor it is advisable to use suprapubic pressure through the fundus uteri as well as to employ traction from below. In practice much too great prominence is given to the latter factor, the former being frequently forgotten. This neglect is very apt to lead to some of the accidents that have already been described. The child should be withdrawn from the pelvis in the



FIG. 222.—Examining umbilical cord during course of a breech delivery (A. R. Simpson).

proper axis of the outlet. When it is found that a loop of the cord lies between the thighs of the fetus, an effort should be made to pull it down and slip it up over the posterior thigh. If this be impossible, or if the cord be wound tightly around the body, it should be tied in two places and divided, delivery being thereafter hastened.

In carrying out manipulations in a breech case it is advisable that the patient should be placed at the edge of the bed or on a table.

**Management in Complications.—1. Non-engagement at the Brim.**—When the breech does not enter the inlet, Kristeller's manipulation may be employed if the cervix be well dilated.

If this fails, a lower limb should be drawn down, provided the cervix or the bony canal be large enough to admit this. Gentle traction accompanied with downward pressure against the fundus of the uterus may be made for a short time, and then nature may be allowed to continue the delivery; but if the patient has been long in labor and is tired, or if the life of the fetus be threatened, continued artificial delivery must be employed. An assistant should press down the fetus through the abdominal wall, and the foot should gradually be drawn down, the limb enveloped in a sterile cloth, being held as close to the vulva of the mother as



FIG. 223.—Delivery of fetus in a breech case by traction made with fingers placed in groin (A. R. Simpson).

possible. Traction should be made intermittently and pressure against the pubic arch should be avoided as much as possible. When the breech descends to the perineum, it should be directed somewhat forward in the axis of the outlet. As the abdomen is delivered the other limb usually drops down. The rest of the labor may be carried out as in normal cases.

2. **Impaction of the Breech.**—When the breech is delayed after having entered the pelvic cavity, labor may be hastened in various ways. Kristeller's manipulation may be tried. If this

fail, the index-finger may be placed in an accessible groin of the fetus, preferably the anterior, in order to pull it down. Instead of the fingers a sterile gauze fillet may be used. The fillet may be passed with the fingers, or with a gum-elastic catheter threaded with a loop of string. A blunt hook is used by some for the purpose of extraction, but it may injure the tissues. The direction of traction should be toward the fetal pelvis, in order that injury of the thigh may be avoided. When these measures fail, forceps may be applied to the breech, but this method may be attended with risk to the fetal tissues. It is necessary to compress them to



FIG. 224.—Method of freeing the posterior arm displaced upward in a breech delivery (A. R. Simpson).

a certain extent with the blades. When all other means fail, it is necessary to perform symphysiotomy or embryulcia. In the latter case the pelvis may be perforated with a cranioclast in order to obtain a good grip; sometimes crushing with a cephalotribe is necessary. As the head is drawn down it should also be perforated, to render its passage more easy and to insure death of the fetus.

3. **Upward Displacement of the Arms.**—(a) *When the Head is still Above the Brim.*—When labor is delayed owing to dis-



FIG. 225.—Method of freeing the anterior arm displaced upward in a breech delivery (A. R. Simpson).

placement of the arms above the brim, jamming usually occurs when that part of the thorax which is normally at the lower ends of the scapulae lies at the level of the vulva. In order to free the



FIG. 226.—Diagrams illustrating the method of withdrawing an arm that has been displaced upward during a breech delivery (Budín and Crouzat).

arms the body of the fetus should be pushed a little upward, to lessen the pressure at the brim, and the trunk should be rotated so that the back lies toward one or the other side of the

mother. It should then be pressed well forward against the pubes, in order that the arm which is situated posteriorly should be first freed. In bringing this about a hand is passed into the vagina behind the fetus, and the first two fingers are pushed up behind the neck of the fetus as far as the elbow of the posterior arm. The latter is then carried down over the face of the fetus until it comes to lie in the pelvic cavity, traction being made only in the hollow of the elbow. The fetus is then pushed backward against the perineum and the anterior arm freed by a similar maneuver. When the latter procedure is impossible on account of the lack of space in which to work, the body of the fetus may be rotated by both hands placed on the thorax, the latter being first pushed upward in order to diminish the risk of dislocating the neck. If the child be satisfactorily turned, the anterior arm is made to lie posteriorly and may then be more easily drawn down.

(b) *When the Head is Below the Brim.*—In this position the arms are more easily drawn down than when the head is above the brim, unless the pelvis be small or the fetus abnormally large. The posterior arm is usually withdrawn first, but if the anterior arm is most accessible, it may be first released. In carrying out these manipulations there is always a risk of dislocating the humerus, of separating the upper epiphysis of the humerus, of fracturing the humerus, clavicle, or scapula, or of injuring nerves. When it is impossible to release the arms, cleidotomy (division of the clavicle) may be performed, in order to diminish the size of the shoulder-girdle.

4. **Constriction of the Fetus by the Uterus.**—The cervix may sometimes retract firmly on the neck or the retraction ring may grasp the head of the fetus. Either complication endangers the life of the fetus by compressing the cord, and immediate delivery is necessary. Under deep anesthesia traction must be made on the shoulders and mouth, accompanied by suprapubic pressure, or forceps must be applied to the after-coming head if the soft parts can be sufficiently dilated to permit its safe application.

5. **Impaction of the Head.**—The head may become impacted at the inlet or within the cavity of the pelvis. In such cases delivery may be accomplished by the following methods:

(1) *Manual Extraction.*—(a) *By the Smellie Grasp.*—The body of the fetus is placed on the anterior aspect of the physician's forearm, its legs hanging down, one on each side. The fingers of this hand are introduced into the vagina and placed on each side of the nose. The fingers of the other hand are passed upward over the back as far as the base of the skull. Flexion of the head is brought about by pulling down with the fingers that are on the face and pushing up with those resting against

the occiput. The body of the fetus is then raised gradually over the pubes as the head is drawn down, the face sweeping over the perineum.

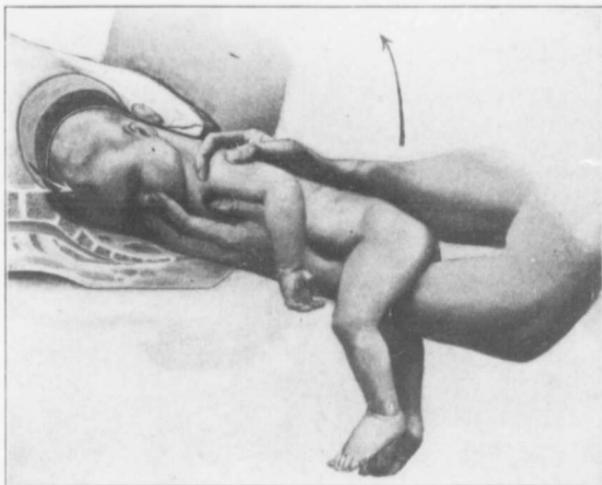


FIG. 227.—Delivery of after-coming head by combined traction on head and shoulders.

(b) *By the Prague Grasp.*—The feet are grasped in one hand, so that the trunk can be drawn well back over the mother's perineum. The fingers of the other hand are then placed over

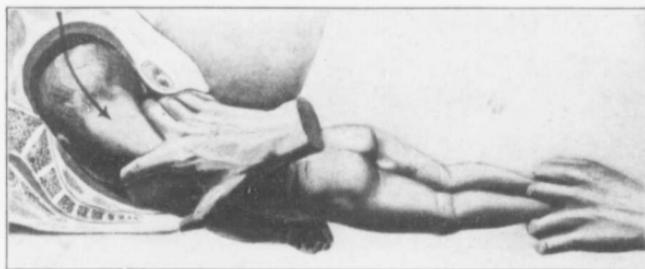


FIG. 228.—Prague method of extracting after-coming head, superior strait.

the shoulders, traction being made downward by both hands, the body being carried forward gradually as the face is drawn over the perineum.

(c) *Mauriccan or Smellie-Veit Grasp*.—Two fingers of one hand are placed in the mouth of the fetus, while those of the other hand grasp the shoulders. The fetus is drawn downward at first and the body afterward carried gradually toward the pubes. Too much force must not be exercised in pulling on the lower jaw, lest fracture or dislocation result.

(d) *Wigand-Martin Method*.—The body of the fetus is placed astride the anterior aspect of the arm, while the fingers are placed



FIG. 229.—Delivery of after-coming head by flexion through seizure of lower jaw, and extrusion by means of pressure in axis of brim.

over the face or in the mouth of the fetus, the other hand pressing downward on the head through the abdominal wall above the pubes.

(B) *Forceps Extraction*.—The head may also be delivered by means of forceps when it is delayed within the pelvic cavity. In introducing the blades the body of the fetus is directed forward toward the pubes.

(C) *Embryulcia*.—When the above methods fail to deliver the head, it is necessary to reduce the size of the latter. This may be done in various ways. The skull may be perforated either through the roof of the mouth or through the base of the occiput. After the escape of the gray matter the head may usually be drawn down.

6. **Malrotation of the Head.**—When the head lies in the pelvis so that the occiput is in the hollow of the sacrum, or its long diameter in the transverse of the pelvis, it is best to grasp the head and trunk and to rotate them so that the occiput is turned to the front, delivery being then continued in the manner already described. Sometimes it is impossible to bring about rotation.

In cases of breech delivery it is always advisable to have a skilled assistant at hand to give help during delivery and to restore the child, which is so frequently asphyxiated.

#### TRANSVERSE PRESENTATIONS.

**Frequency.**—Transverse presentations occur in less than 0.5 per cent. of all cases of labor.

**Causes.**—These malpresentations may be found in the fol-

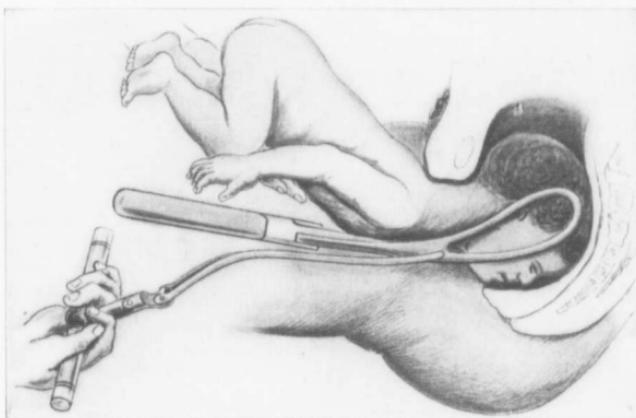


FIG. 230.—Axis-traction forceps applied to after-coming head (A. R. Simpson).

lowing conditions: Hydramnios, premature labor, death of the fetus, hydrocephalus, malformations and monstrosities, multiple pregnancy, malformations of the uterus, tumors of the uterus, irregular contractions of the uterus, pelvic and abdominal tumors, and placenta prævia.

**Varieties.**—Any portion of the trunk of the fetus may present; usually the shoulder is lowermost, and this variety need alone be considered. Sometimes the arm is prolapsed below the shoulder, the elbow or the hand being lowermost. The long axis of the trunk is very rarely exactly transverse; it is usually placed

obliquely in relation to the long axis of the uterus, and may be more or less bent.

**Positions.**—Various methods are employed to denominate shoulder presentations, the acromion process being used by some as the denominator, the spine of the scapula by others. The Ninth International Medical Congress adopted a nomenclature



FIG. 231.—Diagram illustrating the effect of a malpresentation (shoulder) on the wall of the uterus in labor: *A, A'*, Retraction ring, greatly elevated, especially on the left side; *a*, lower uterine segment, greatly thinned and stretched over the head of the fetus. The upper uterine segment is firmly retracted on the body of the fetus (Tarnier and Budin).

as follows: Scapula laeva anterior, scapula dextra anterior, scapula dextra posterior, scapula laeva posterior.

The following classification is also employed:

Dorso-anterior: Head on the right side; head on the left

side. Dorsoposterior: Head on the right side; head on the left side.

Of these the dorso-anterior position, in which the head lies on the left side of the mother, is the most frequent. The mechanism of labor will be described in relation to this variety.

**Diagnosis.**—The shape of the abdomen differs from that found in the vertex or breech presentations. The regular pyriform contour of the uterus is absent, the latter being moulded irregularly on the fetus. The head usually lies in an iliac fossa, sometimes in the flank; the breech may lie in the opposite fossa or at a higher level. If the back of the fetus be anterior, it is felt

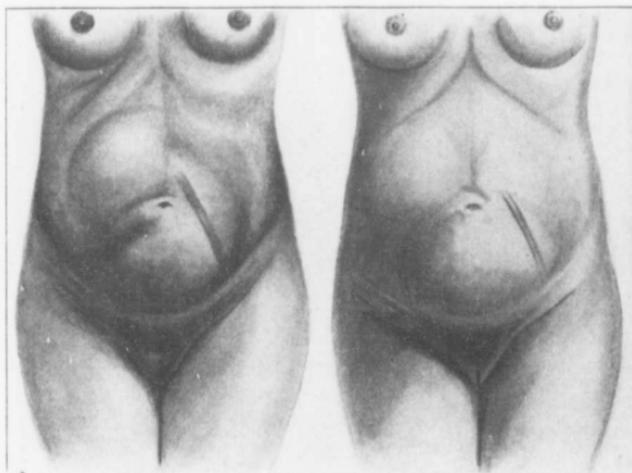


Fig. 232.

Fig. 233.

FIG. 232.—Overdistention of the lower uterine segment with threatened uterine rupture in a case of obstructed labor where the brow presents. The retraction ring is near the umbilicus. The left round ligament is tense and easily palpable (Bumm).

FIG. 233.—Overdistention of the lower uterine segment in a case of obstructed labor where there is a transverse presentation. The retraction ring is placed obliquely at the level of the umbilicus. Both round ligaments are tense and easily palpable (Bumm).

as a firm mass above the pubes of the mother, and if Budin's maneuver of approximating the fetal poles be carried out, the back is bulged forward more prominently. If it be posterior, the lower portion of the abdomen is more irregular, owing to the irregularities of the limbs of the fetus. When fetal heart sounds are heard in a dorso-anterior case, they are found below the level of the umbilicus. When labor has been in progress for a considerable time, abnormal stretching and thinning of the lower uterine seg-

ment occur, so that the fetus may be palpated with great distinctness above the pubes, while at an abnormal elevation above the latter the junction of the upper and lower uterine segments or retraction ridge may be felt.

On vaginal examination in the first stage of labor the fornix lacks the normal bulging found in vertex or breech cases. The cervix may be considerably elevated and the lower uterine segment imperfectly filled. As labor continues the membranes may be pushed downward into the vagina in the form of a pouch and the cord may prolapse inside of it. When the fingers can be passed within the cervix, the presenting part may be palpated. When the shoulder presents, the clavicle, humerus, and spine of the scapula should be found converging toward the tip of the shoulder. If the finger be passed into the axilla, the ribs may be felt, thus distinguishing that space from the groin. When the elbow or hand is prolapsed, it may easily be distinguished, care being taken not to mistake these parts for the knee or foot.

**Prognosis.**—Transverse cases allowed to run a natural course are very dangerous for both the mother and the child. Artificial delivery should always be carried out. This introduces certain risks, but they are much less serious than those attendant upon natural delivery. The greater the length of time allowed to elapse before interference, the graver are the risks. The chief dangers are exhaustion of the mother, rupture of the uterus and other soft tissues, and sepsis.

**Varieties of Spontaneous Delivery.**—The following processes have been observed occasionally in transverse cases left to themselves :

1. **Spontaneous Version.**—A transverse presentation may change to that of a head or breech spontaneously, delivery afterward taking place according to the new presentation. This is most likely to take place in multiparæ with lax uterine walls when the child is small and living. A soft, dead fetus is not likely thus to change its presentation. Version may take place before as well as after rupture of the membranes. In the latter case retraction of the uterus on the fetus must be absent, and it must not be pressed down into the inlet of the pelvis. The process results from intermittent uterine contractions pressing the fetus downward against a partly dilated cervix, whose resistance causes a displacement of the presenting part until the fetus is partly or completely turned. (Very rarely a complete rotation may occur, one transverse presentation being substituted for another. This can probably take place only when the fetus is small and the liquor amnii abundant.)

2. **Spontaneous Evolution.**—This term is applied to cases in which the fetus is delivered without transformation to a vertex or breech presentation. Two varieties are described :

(a) *Most Frequent* (Douglas).—Uterine contractions force the fetus well into the brim, the presenting shoulder being pushed downward to the sacral segment of the pelvic floor and then rotated forward until it reaches the subpubic angle, the corresponding arm descending outside of the vulva. The body of the fetus at this time is bent upon itself somewhat laterally, the head usually lying alongside the breech, above the pelvic brim, the breech being posterior. The thorax is gradually pushed downward over the perineum, followed by the abdomen and lower extremities, the presenting shoulder during this process resting under the pubes. The head then enters the pelvic cavity and is delivered,

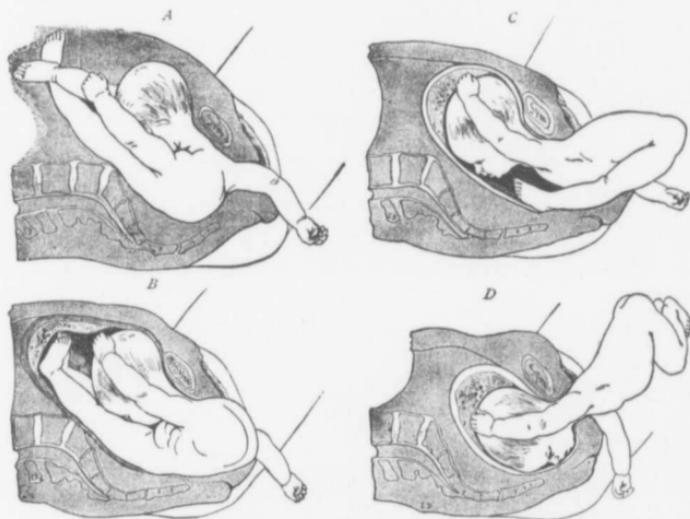


FIG. 234.—A, B, C, D. The four stages of spontaneous evolution, first form of mechanism.

the occiput usually passing under the symphysis. This method of delivery can take place only where the pelvis is roomy, the fetus small, and the pains strong.

(b) *Rare (Evolutio Conduplicato Corpore)* (Röderer, Kleinwächter).—The fetus is driven into the pelvis doubled up, and in this position is forced through the vulva. It is thus evident that a roomy pelvis and a small and easily compressible fetus are essential to its occurrence, though it may more readily occur when the fetus is small and dead. As the shoulder passes the outlet the head is crowded into the pelvis, alongside the body and upper arm. The head and chest are born after the presenting shoulder

and lower arm, being followed by the breech and lower extremities.

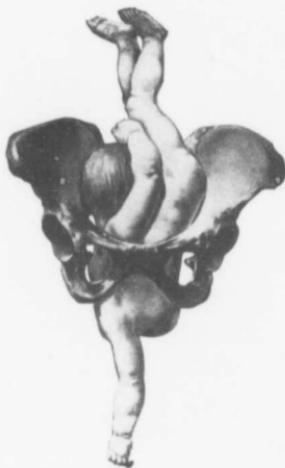


FIG. 235.—Spontaneous evolution, second and rare form of mechanism, known as birth with double body (one-sixth natural size, redrawn from Küstner).

sion employed. The latter procedure should be attempted only after the cervix is fully dilated, and dilatation should be accomplished artificially.

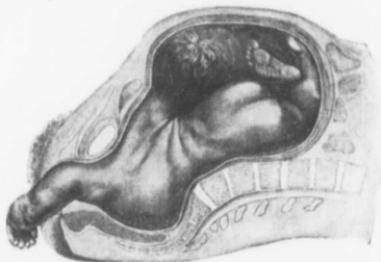


FIG. 236.—Frozen section of shoulder presentation (Chiari). The distortion and the elongation of the neck are noteworthy.

It is important to bear in mind that in impacted transverse cases version may be a very dangerous operation if it be too long de-

**Management.**—Transverse cases should not be left to themselves, artificial interference being necessary. When the diagnosis is established at the end of pregnancy or early in labor, previous to rupture of the membranes or before the presenting part is impacted in the brim, external version should be attempted. If this fail, the bipolar or Braxton-Hicks method may be tried, in order to bring about a vertex or breech presentation. If the pelvis be normal and the shoulder presents, it should be changed to a vertex, if possible. The labor may then be allowed to continue naturally. If any other part of the body than the shoulder presents, or if the pelvis be flat, it is best to bring about a pelvic presentation. If the Braxton-Hicks method be not successful, the membranes should be ruptured and internal or podalic ver-

layed, the risk of rupturing the greatly stretched and thinned lower uterine segment being considerable. It is impossible, however, to state how long after the escape of the amniotic fluid it is safe to carry out version in any given case. The procedure is easier and safer the nearer the time of the rupture and the less the uterus has retracted on the fetus. The operation should never be carried out when the retraction ridge is abnormally elevated—*i. e.*, is 3 in. or more above the level of the symphysis. In carrying out version the patient should be deeply anesthetized. When turning is impracticable in transverse cases, it is necessary to reduce the size of the fetus by decapitation, evisceration, or spondylotomy. These methods will be described in another chapter. (See "Embryotomy.")

#### PROLAPSE OF THE ARMS AND LEGS.

Prolapse of the limbs may occur before or during labor. In the latter condition it may take place before or after rupture of the membranes. In some cases the displacement occurs without evident cause. Usually it is associated with small fetus, hydramnios, deformed pelvis, sudden escape of the liquor amnii, and attempts at version. The umbilical cord may also prolapse in such cases.

**In Pelvic Presentations.**—One or both feet may sometimes present below the breech in pelvic cases and may be born first. Occasionally a hand may also lie down close to the breech. This complication does not interfere with the delivery. It may remain in that position throughout labor, or may gradually be pushed upward as the body of the fetus descends.

**In Head Presentations.**—One or both arms may sometimes lie in front, behind, or at the side of the head when it presents in labor. The most serious condition is the folding of the arm across the back of the neck. Most frequently the arm lies at the side of the head. As a result of the prolapse the head may be pushed aside, so that a malpresentation is produced. When the head and arm are jammed in the brim the former may sometimes be indented; the latter becomes swollen in its lower part.

When this complication is diagnosed early in labor, an effort should be made to push the limbs upward, after the cervix is fully dilated. This may be more expeditiously managed if the patient be placed in the genupectoral or elevated lithotomy position. If the membranes be intact and the head not impacted, irritation of the arm through the os may sometimes cause it to be drawn upward into the uterus. If the attempt be not successful, it is advisable to effect delivery by version, because labor may be much delayed if the arm be allowed to descend alongside of the head, and there is always risk that nerves may be damaged. If turning is impossible, forceps should be used.

When the diagnosis is established in the second stage of labor, after the head has descended well into the brim, it is usually impossible to push up the arm without danger of breaking it. In such a case it is advisable to deliver the fetus by means of forceps.

Very rarely a foot may descend alongside of the head when the latter presents. The line of treatment is much the same as that described in the case of prolapse of an arm. Sometimes symphysiotomy or embryulcia is necessary in cases in which delivery is impossible with forceps, when the head and prolapsed limb are impacted in the pelvis.

**In Transverse Presentations.**—Prolapse of a foot in transverse cases must be regarded as favorable, for it allows version to be carried out easily. When an arm descends in a shoulder presentation, it may sometimes interfere with the operation of turning. In such a case it is possible sometimes to push it above the brim, out of the way, and some authorities recommend that a piece of tape be tied around the prolapsed wrist, in order that the limb may be prevented from ascending too high during the performance of version.

#### FETAL ANOMALIES AND DISEASES.

**Short Umbilical Cord.**—The cord is rarely naturally short, but may sometimes be only a few inches in length. Most frequently shortness is accidental, being due to the coiling around the neck, body, or limbs of the fetus. The number of coils made by the cord varies. In rare instances as many as 6, 7, 8, and even 9 have been noted; ordinarily they are much fewer. There are different opinions as to the length of free cord necessary for safety. Probably it should be between 9 and 10 in. Smellie reported a case where coilings prevented version until he uncoiled the cord. As a result of shortening, detachment of the placenta may occur in labor, the cord may rupture, or the uterus may be inverted. The navel of the fetus may be made to pouch considerably. When it is coiled around the fetus, it may be easily compressed, and so lead to death of the fetus. Rupture of the cord very rarely occurs. As regards the amount of strain that the cord will bear, different statements are made; most break with a weight of  $8\frac{1}{2}$  pounds. Some, however, will not bear as much as this, while occasionally one may be found that will resist as much as 14 or 15 pounds. Shortness of the cord is not often diagnosed early in labor. Sometimes there is pain over the placental area during uterine contractions, and the area may be depressed. Labor is delayed, the heart-sounds of the fetus may become irregular, and unusual recession of the head may be noticed between the pains. If separation of the placenta takes place, bleeding may be present. In some cases there is inertia uteri. Brickner states that there is

increased desire to urinate during the early part of the second stage. King has observed a special desire on the part of the patient to sit up. When the condition is diagnosed, an attempt should be made at the first feasible opportunity to free the coils from around the fetus, or to divide the cord and promote delivery with forceps. If the cord cannot be ligated, it may be cut between two artery forceps applied to it. When the cord cannot be reached, the fetus should be pressed downward. If the breech presents, the labor should be hastened by one of the methods described in connection with that complication.

**Large Size of the Fetus.**—The causes of abnormally large children are not definitely known. As regards the influence of heredity, it is believed that the paternal is a more important factor than the maternal. They are usually males and are especially found in multiparæ. Occasionally they are found in cases in which there is abnormal prolongation of the period of pregnancy.

Labor is delayed, especially in the second stage. The head usually becomes markedly moulded, the type of the change being similar to that produced by the passage of a normal head through a justo-minor pelvis. The risk of rupture of maternal tissues is great. In cases in which the disproportion between the head and the pelvis is not too great, delivery by means of forceps may be carried out. In bad cases, however, this procedure is dangerous and may lead to great injury of the maternal parts. Symphysiotomy or embryulcia is then indicated.

**Smallness of the Fetus.**—An abnormally small fetus may sometimes cause trouble in labor. It may lead to malpresentation or prolapse of a limb or of the cord. Sometimes labor is so rapid that the perineum may be badly torn. Inertia of the uterus may be produced.

**Excessive Ossification of the Skull.**—When the bones of the head are abnormally hard on account of excessive ossification, moulding does not take place readily in labor and delay results. The head may be arrested either at the brim or in the pelvic cavity. Artificial interference is usually necessary, the procedure depending upon the degree of dystocia. Delivery by forceps, symphysiotomy, or embryulcia may be necessary.

In some cases the head of the fetus may be unusually large, apart from hydrocephalus, the body being only of average size.

**Dead Fetus.**—When the fetus dies in the uterus its tissues become lax. If the head or breech presents, there may be no peculiarity in the labor, though when the former is very soft, the ordinary movements may not take place, the head being pushed directly through the birth-canal. If there is a transverse presentation, spontaneous delivery may sometimes occur by one of the methods already described. When putrefactive changes take place in the fetal tissues, leading to distention of its body with gas, the

labor may be greatly delayed, and it is necessary in such a case to reduce the size of the body by means of puncture. Sometimes in cases of labor occurring soon after death of the fetus rigor mortis may be so marked as to delay delivery. (The possibility of the occurrence of rigor mortis *in utero* is not widely known.)

**Diseases of the Fetus Causing Enlargement.**—**Hydrocephalus.**—Enlargement of the head in hydrocephalus is chiefly due to the accumulation of serum in the ventricles of the brain, especially in the lateral ones. Great variations are found in the condition of the skull. In slight cases the bones, fontanels, and sutures may appear normal, the bones only being thinned, little alteration being produced in the brain structure. In more marked cases the brain tissue is thin, its convolutions being more or less flattened and its ventricles enlarged. The size of the forehead is increased relative to the face, the frontal bones and supra-orbital ridges being prominent, and the fontanels and sutures widened. In extreme cases the head is very large, the greater part of the skull being represented only by membrane, and the brain tissue is a mere sac, in which little or no trace of cerebrum can be determined. In some cases irregular centers of ossification are found in the membranous part of the skull. Sometimes the internal changes of hydrocephalus may be found without accompanying alterations in the skull. The latter may not be enlarged, though the ventricles may be much distended and the brain tissue much thinned. Occasionally hydrocephalus is complicated with an extension outward, at some point, of the skull contents, forming a hydroencephalocoele. Spina bifida or some other malformation may sometimes be associated with it. Hydramnios is not infrequent. The larger the head, the greater the tendency to breech presentations. In some cases the hydrocephalic head ruptures during pregnancy, the membranes shrinking and becoming attached to the remnants of cerebral tissue at the base of the skull (anencephalus or hemiccephalus).

**Diagnosis.**—In moderate cases hydrocephalus cannot be diagnosed during pregnancy. Marked enlargement of the head may frequently be palpated, especially when the breech presents. If, however, hydramnios be present, a large head may easily be overlooked. Sometimes indentation or crackling of the skull may be felt through the abdominal wall. In well-marked cases the head has an elastic consistence. When the head presents, the area of maximum intensity of the heart-sounds is higher than normal; when the breech presents, it is apt to be lower than in normal breech cases. When the breech presents, an enlarged head lying at the fundus may be more easily overlooked than when the latter presents. During labor, if the head presents, the cervix may be felt to be very high during the first stage, because the large size of the head does not allow it to descend below the brim. Dilatation of

the cervix may be considerably delayed. As the case proceeds marked bulging is felt above the pubes and the retraction ridge is elevated abnormally high. When the fingers can be introduced through the cervix, it may be possible to feel the wide fontanel, wide sutures, or the membranous character of the head, with or without areas of ossification. Thin bones may crackle under the finger like parchment, and during pains the membranous head becomes tense. In cases in which the fontanel and sutures are not abnormally widened nor the vertex less hard than normal, the condition of hydrocephalus may easily be overlooked unless the head enlargement be marked. It is necessary to diagnose the condition from enlargements of the abdomen due to hydramnion, twin pregnancy, and tumors; also from cases of pregnancy in which marked contraction of the pelvis exists, the uterus being abnormally high or prominent.

*Prognosis.*—The outlook for the mother depends upon the degree of enlargement of the fetal head and on the measures that are employed in delivery. She may become greatly exhausted from delay in labor and rupture of the uterus may readily take place, especially in the stretched and thin lower uterine segment. Keith collected 74 cases, in 16 of which the lower uterine segment ruptured; Poulet, 106 cases, in which it occurred in 17. Various parts of the soft passages may be injured by long-continued pressure. Sometimes labor is not much delayed when the skull is largely membranous and not tense, even though the head be of considerable size. This is also the case when the membranous cranial sac ruptures, as it sometimes does in labor, especially when the breech presents.

*Treatment.*—In every case in which marked enlargement of the head is a cause of danger to the mother in delivery, artificial interference should be carried out to effect delivery without concern for the life of the fetus. When the head presents, it should be perforated and extraction carried out by means of a cranioclast. In cases of breech presentation, after the body has been born as far as possible, either the spinal canal may be opened and the fluid evacuated by an elastic catheter passed into the skull through the spinal canal, or the head may be perforated at a convenient point if it can be easily reached. In cases in which the head is well ossified it may be necessary to reduce the size of the head by breaking the bones.

**Hydromeningocele.**—This condition is an enlargement produced by a bulging of the brain membranes through the skull, owing to an accumulation of serum, especially in the subarachnoid space.

**Enlargement of the Thorax.**—The thorax is sometimes enlarged by serous accumulation in the pleural cavities (hydrothorax) or by pericardial effusion. This may be associated with

ascites, anasarca, or other diseased conditions; sometimes a new growth may enlarge the chest. The enlargement may delay labor to a greater or less extent, and in marked cases it may be necessary to puncture the thorax or reduce its size in order to effect delivery.

**Distention of the Abdomen.**—Ascitic accumulation may cause marked enlargement of the abdomen, and is usually found with hydrothorax or hydropericardium. It is generally due to syphilis, but may be found with abdominal tumors. Sometimes a new growth may cause great increase in size. The degree of delay in

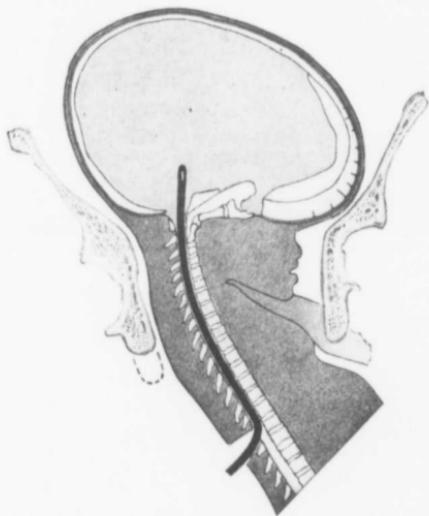


FIG. 237.—Tapping a hydrocephalus through spinal canal (Varnier).

labor varies considerably. In marked cases it is necessary to puncture the abdomen or to perform evisceration. Distention of the kidneys associated with obliteration or atresia of the lower urinary canal is a rare cause of abdominal enlargement. Dilatation of the bladder is sometimes found and may be associated with an imperforate urethra, though sometimes it is not. The distended viscus may be entirely within the abdomen, but occasionally may extend downward, bulging the floor of the pelvis as well as producing an abdominal enlargement. Tumors of the abdominal viscera are very rare. Distention of the uterus and vagina in con-

nection with atresia of the latter is very rarely large enough to distend the abdomen.

**General edema of the body of the fetus** is sometimes so marked as to produce great delay in labor.

**Umbilical or other herniæ** may produce a swelling sufficient to obstruct delivery.

**Exomphalos** may also be a cause of delay.

**Hydrorrhachis.**—This is an accumulation of serum in a sac composed of the spinal membranes and skin, situated usually in



FIG. 238.—Exomphalos (A. R. Simpson).

the lower region of the back, commonly associated with spina bifida. It varies in size in different cases, and may sometimes delay labor.

**External tumors**, simple and malignant, may also obstruct labor. They may be found in any part of the body, most frequently in the region of the sacrum and coccyx.

*General Considerations as to Treatment.*—In slight degrees of obstruction labor may be shortened by artificial assistance—*i. e.*, downward pressure through the fundus, aided by traction from below. When the swelling is too large to permit delivery in this way, it must be reduced in size by puncture, evisceration, or em-

bryulcia. When the head presents, it may be impossible to reach the swelling that is causing trouble without first reducing the head in size or removing it.

**Adhesion of Membranes.**—The causation of adherent membranes is not fully known. Most frequently it is due to a chronic endometritis that makes the inner portion of the mucosa tougher than normal, the attached chorion and amnion being also affected. It is possible that sometimes the disease may spread from the fetal membranes to the decidua.

When the membranes do not separate from the lower uterine segment in the beginning of labor, the first stage is more or less retarded. In some cases the pains may be very strong and yet little or no dilatation be produced. The woman may become much exhausted.

**Treatment.**—When the condition is recognized as a cause of delay in the first stage, an effort should be made to detach the membranes from the lower uterine segment for an inch or more above the cervix with a finger. If this cannot be satisfactorily accomplished, the cervix should be partially dilated artificially and another attempt made. If this be successful, labor may then be allowed to continue naturally. If the os be considerably dilated and the head be low in the pelvis, the membranes may be ruptured if they cannot be separated, and labor allowed to proceed. If the membranes are ruptured accidentally and the cervix be only slightly opened, it is advisable to dilate it somewhat artificially and then introduce a Champetier de Ribes bag, so that it may act as a dilator, labor being allowed to continue. Rapid complete dilatation and delivery by artificial means are necessary only when the patient is exhausted or some complication exists.

**Pouching of the Bag of Membranes.**—Occasionally in the first stage of labor the bag of membranes may pouch downward through the vagina to a greater or less extent, the amniotic fluid being forced into it by the pains. The dilating function of the bag is thereby greatly impaired and labor is consequently delayed. This condition is generally found when the presenting part does not fit well into the lower uterine segment, as a result of some complication on the part of the fetus, the bony canal, or the soft passages—*e. g.*, transverse presentations, flat pelvis, etc. It may develop soon after the cervix has begun to dilate or after a considerable degree of dilatation. The pouch may consist both of amnion and chorion, or of the former alone. The former is elastic, and sometimes is capable of much distention. The pouch is forced lower in the vagina as labor proceeds, and may actually appear at the vulva. By some authors the condition has been termed "hour-glass" constriction of the membranes. Rupture of the pouch may occur at any time before the cervix is fully dilated; rarely it may be preserved during the second stage. Sometimes the cord prolapses into it early in labor.

**Treatment.**—Recognition of a pouching bag of membranes should always be followed by a careful examination to determine the existence of some important associated cause of delay. The latter may thereupon require the chief attention. After well-marked pouching has taken place, the efficiency of the bag of membranes as a dilator may be practically disregarded. It may be necessary to dilate the cervix artificially, and the pouch need not be ruptured until this is completed.

**Toughness of the Membranes.**—It has already been noted that great variations are found as regards the amount of pressure under which the membranes normally burst. Occasionally they are excessively tough and do not rupture at the proper time—viz., when the cervix is well dilated. As a result of their persistence labor is somewhat delayed. In some cases rupture may not take place until the head has descended toward the outlet; in others, after a portion of the child is born. Rarely delivery may take place without rupture. Sometimes the membranes are adherent as well as tough.

**Treatment.**—Whenever the cervix is well dilated and the membranes do not break spontaneously, they should be ruptured during a pain by means of the finger-tip, a dressing-forceps, or some other suitable instrument.

**Rupture of the Umbilical Cord.**—Albert describes three varieties of this accident: (1) Rupture of individual vessels in the cord; (2) rupture of the whole cord; (3) avulsion of the cord from the placenta or from the abdomen of the fetus.

Rupture of individual vessels is very rare, and may be due to varix, a knot, or aberrant vascular arrangement associated with a velamentous insertion or with a succenturiate placenta. In most cases the rupture is incidental to rupture of the membranes.

Rupture of the cord may be caused by artificial delivery, especially instrumental. It may sometimes occur spontaneously. In a considerable proportion of cases it is due to delivery while the mother is standing.

Avulsion of the cord from the abdomen has been several times reported. Albert observed a case in which the cord was torn from the placenta during labor; it was coiled around the neck of the fetus, and so made very short.

**Prolapsus Funis.**—The umbilical cord sometimes descends below the presenting part of the fetus. This may take place before labor, but generally it occurs only after the first stage has well advanced. The two parts of the prolapsed cord may be close together, or may be separated by the head or other presenting part of the fetus. The prolapse usually occurs in the depression on either side of the promontory, rarely elsewhere. The condition is a serious one as regards the life of the fetus, pressure on the cord during labor interfering with the fetal circulation. Very

rarely may a living child be born when no interference is carried out.

**Frequency.**—Various statistics are given as regards the frequency of the condition. Churchill stated it to be 1 in 300 cases; Lachapelle, 1 in 380; Jacquemier, 1 in 170. Some authors have found it in more than 1 per cent. of cases—*i. e.*, Tarnier, Engelmann, and Michaelis.

**Etiology and Pathology.**—The most important factor associated with prolapse of the cord is a lack of accommodation between the lower uterine segment and the presenting part of the fetus. Normally these are related in such a manner as to make it impossible for the cord to fall between them so as to lie beneath the presenting part.

Various causes may bring about a want of proper accommodation: small fetus; face, breech, or transverse presentation; monstrosity or malformed fetus—*e. g.*, anencephalus; multiple pregnancy; presentation of the head with a limb; hydramnion, especially associated with undue mobility of the fetus; excessive length of the cord; velamentous insertion; low attachment of the placenta; pendulous belly and uterine displacement; premature rupture of the membranes and sudden escape of the amniotic fluid, especially if the woman be erect or partly erect. Multiparity is a favoring condition. Hecker reported 28 cases of prolapse of the cord, only 3 of which were in primiparæ. Deformities of the pelvis, especially anteroposterior contractions of the brim, are important favoring conditions. In primiparæ prolapse of the cord is almost always found in cases of flat pelvis. Litzmann states that prolapse is four to six times more frequent in deformed than in normal pelvis. A contracted brim opposes the early engagement of the presenting part of the fetus, favors malpresentations, and opposes the normal accommodation between the lower uterine segment and the fetus. An abnormally large pelvis may also favor prolapsus funis.

Tumors and swellings of the bones or soft parts of the pelvis act like deformed pelvis in favoring prolapse. Excessive movements of the mother may sometimes play a part. Interference on the part of the attendant may be responsible—*e. g.*, attempts at version or forceps application.

**Diagnosis.**—Prolapse of the cord is rarely recognized when the cervix is only partially dilated and the membranes unruptured. Yet this is sometimes possible if digital examination be made between pains, the finger being passed into the cervical canal outside of the membranes. Pulsation may be felt in the cord unless the fetus be dead or the cord be compressed. When the cervix is considerably dilated, it is much easier to detect the prolapsed cord; it is compressible and usually mobile. After rupture of the membranes the diagnosis is usually easy, for the characteristic

structure of the cord may be palpated or inspected. It may be found at various levels in the vagina. Sometimes the loop is not visible and may be caught between the fetus and some part of the bony pelvis above the level of the os externum. This may cause death of the fetus before the condition is recognized. Winckel states that growing feebleness of the fetal heart-sounds without apparent reason should always lead to the suspicion of prolapsus funis.

It is to be remembered that uterine pains may temporarily check the circulation in the cord. The latter should, therefore, be examined chiefly between pains. A prolapsed cord may sometimes be confounded with fetal toes or fingers. The latter, however, have a definite outline and may move when touched, while no pulsation can be felt in them.

When the cord has a velamentous insertion and the separated vessels run in the membranes near the cervix, the condition may be mistaken for prolapse of the cord.

The pulsation of maternal vessels in the fornix may be mistaken for that in the cord vessels. The former is, however, synchronous with the maternal pulse.

The prolapsed cord may be mistaken for intestine; the latter has a mesentery and no pulsation.

**Prognosis.**—Prolapsus funis in itself does not affect the mother. The treatment adopted for the condition may, however, considerably add to her risks, especially those due to hemorrhage and sepsis. The danger to the fetus is great, more than 50 per cent. dying from asphyxiation due to compression of the cord. The prognosis varies according to many conditions. When the head presents, there is more risk of early compression of the cord than when the breech or shoulder presents. The danger to the fetus is slighter when the membranes are unruptured than after their rupture, and when the cervix is only slightly dilated. Primiparity increases the risk. It is also greater when the prolapsed loop lies in relation to a part of the pelvic brim, where there is little space between it and the fetus.

**Treatment.**—When the fetus is dead no special treatment is necessary because of the prolapsed cord, though interference may be advisable for other reasons. When the fetus is alive, the following measures should be carried out:

*Before Rupture of the Membranes.*—While the membranes are intact the cord is to a great measure protected by the liquor amnii; therefore, care should be taken to preserve the membranes as long as possible. First of all postural methods should be employed. The patient should be placed in the genupectoral position as long as possible, in order to give the cord a chance to gravitate toward the upper part of the amniotic cavity. Frequently this maneuver is successful, the cord slipping out of the lower uterine segment, leaving the presenting part of the fetus to occupy it alone.

In hospitals it is perhaps more convenient to employ the extreme Trendelenburg position instead of the genupectoral. Unless, however, by it an inclination of more than 45 degrees can be obtained, the genupectoral posture should be employed.

When posture alone does not displace the cord, digital manipulations may be employed between the pains. These must be carried out very carefully, in order not to rupture the membranes, while the patient's pelvis is raised. Webster employs for this purpose, in his hospital work, a table that allows the patient to be placed in the elevated lithotomy position, her shoulders resting against padded steel supports. An inclination of 40 to 50 degrees may thus be obtained, and manipulations may be carried out very easily by the operator, who stands on a chair at the foot of the table. This method has given the greatest satisfaction.

When the cord has been replaced, the fetus should be pushed well down toward the cervix and held there for a short time. Sometimes the cord may be hooked above a limb of the fetus to prevent another prolapse. The patient should then be allowed to lie down on the side opposite to that on which the descent of the cord took place. The cervix should afterward be examined from time to time to determine whether or not the cord has again fallen. When these methods fail, various other plans may be tried.

The cervix may be dilated by digital manipulations or Barnes's bags, and the fetus delivered by version or forceps. It is advisable to carry out this procedure in the elevated lithotomy posture. Recently it has been recommended to introduce a Champetier de Ribes bag into the cervix without rupturing the membranes, allowing labor to continue spontaneously; it is claimed that the risk of compression of the cord before rupture of the membranes is very slight. When the bag is expelled and the cervix dilated, labor may be allowed to continue spontaneously if the cord be not beneath the fetus. If it be still prolapsed, version or forceps may be employed.

When the membranes are ruptured and the cord is prolapsed, an effort may be made to replace it by the postural methods referred to above, if the fetus be still alive. Usually, however, in this condition attempts are made to replace the cord by manipulations. These may be carried out by means of the fingers or by means of instruments. Of the latter, various forms have been used. The simplest is a rubber catheter, perforated on opposite sides near the tip. A piece of tape is made to encircle



FIG. 230.—Use of catheter as a porte-fillet.

the cord, and its free ends are passed through the perforations in the end of the catheter. A stilet is then inserted into the latter and pushed against the tape. The catheter and cord are then pushed upward into the uterus as far as possible, and the stilet withdrawn. The catheter is left to be expelled with the uterine contents. In carrying out either manual or instrumental reposition it is best to place the patient in the genupectoral or extreme elevated lithotomy posture, preferably the latter.

After reposition labor is usually allowed to continue spontaneously, though version or forceps might be employed if the cervix be well dilated; if it be partially dilated, a Champetier de Ribes bag may be introduced, labor being allowed to continue spontaneously; or rapid artificial dilatation may be carried out.

When reposition by these maneuvers is impossible and the fetus is alive, delivery should be carried out by podalic version if the conditions are favorable; otherwise forceps should be used, care being taken not to grasp the cord between the blades and the head.

If the cervix be not sufficiently dilated, artificial dilatation should be employed. When the fetus is dead, labor may continue spontaneously or may be hastened, according to other indications present.

**Multiple Pregnancy in Relation to Labor.**—**Twin Cases.**—Twin labors are normal in a considerable percentage of cases, the first child being born, followed after an interval, usually less than half an hour, by the second fetus. Sometimes the interval is much longer than half an hour, several cases having been reported in which it extended over one or two days: Kalnikoff has reported a case in which it lasted for three days, both fetuses surviving. As regards the birth of the placenta, differences are noted. In some cases the first child may be immediately followed by its own placenta, the other being delivered after the birth of the second child. Sometimes, however, the second placenta precedes the second fetus; usually the placenta are not delivered until both twins are expelled. In the case of a large single placenta a portion may be torn off and expelled with the first child, though usually it does not appear until after the birth of the second. Labor may be delayed in all its stages in twin cases, especially if hydramnion be present, the uterine contractions being weakened, owing to the stretching and thinning of the wall. With regard to hydramnion, it is interesting to note that while this may affect both amniotic cavities, in some cases only one may be affected. Spiegelberg gives the following data representing the varieties of presentations found: Both heads, 49 per cent.; head and breech, 31.7 per cent.; both breeches, 8.6 per cent.; head and transverse, 6.18 per cent.; breech and transverse, 4.14 per cent.; both transverse, 0.35 per cent.

*Prognosis.*—The maternal risks are considerably greater than in cases of single labors. Owing to the overdistention of the uterus, its contractions are less effective. If there be excessive liquor amnii, there is an additional cause of interference, both with uterine contractions and with the dilating action of the bag of membranes, the uterus being rendered too spheric. Protraction of labor may be found in all stages. When the pains are weak, labor is prolonged and the woman's strength becomes reduced. Albuminuria is frequent, and eclampsia is more common than in single labors; it may be necessary to interfere in order to deliver the fetuses. In the third stage inertia uteri may occur and may lead to postpartum hemorrhage. There is also greater danger of septic infection in the puerperium. If labor is completely obstructed, the patient may die of exhaustion or from rupture of the uterus. In 568 cases collected by Stephenson, 15 maternal deaths took place due to eclampsia, 4 to hemorrhage, 1 to exhaustion, and 7 to sepsis. He found that convulsions occurred in the proportion of 1 in 81 cases. Hemorrhage was five times more frequent than in single labors; it was twice as frequent during the third stage as postpartum, the placenta being adherent in a considerable number of the cases. Retained placenta was much more frequent than in single labors. Stephenson thinks that the hemorrhage in twin cases is largely due to irregular or unequal uterine retraction, due to inequality of pressure on the inner wall of the uterus. It is also due to placenta prævia, which is more frequent than in single pregnancies.

Fetal mortality is higher than in single labors; according to Stephenson, two and a half times greater. He states that the danger is greater in the case of the second fetus, especially when the interval following the birth of the first exceeds half an hour. He points out that the most dangerous presentation as regards the fetus is that of the head. In studying a series of cases he found that of the children lost about 90 per cent. presented by the head and about 9 per cent. by the breech. Among the footling and transverse presentations there was not a child lost which was alive when the treatment began. Thus, it appears that the more frequent occurrence of "abnormal" presentations diminishes the fetal mortality, the reverse of experience in single pregnancies. Delivery is often premature and the twins may be in an undeveloped condition. Malpresentations and malpositions are not infrequent, rendering artificial interference necessary, and thus increasing the risks.

*Diagnosis.*—In the majority of cases twins are diagnosed only after the birth of the first fetus in labor. In pregnancy the following conditions should be looked for: The abdomen is larger than normal, and it is more frequently irregular than in single pregnancy. Ballottement is usually impossible or imperfect. An

abnormal number of projections of fetal limbs may be felt. Two heads may be palpated. Two fetal hearts may be heard in different locations, not synchronously. Frequently, however, the two hearts may never be detected in pregnancy.

*Conduct of Labor.*—When the condition is diagnosed early in labor, the patient should be watched carefully throughout. The abdomen should be examined from time to time, in order to determine if one or the other twin becomes displaced so as to interfere with the passage of the lower fetus. The lower uterine segment should be palpated to determine whether abnormal

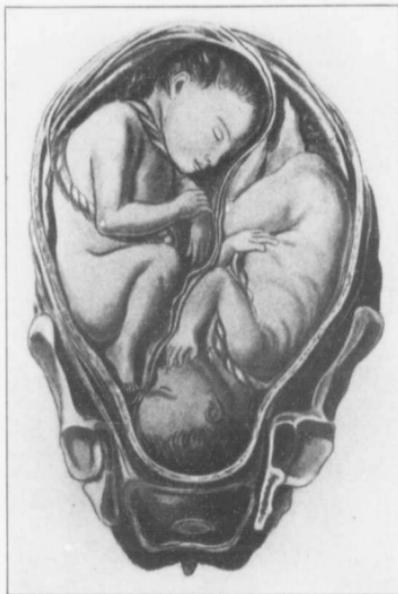


FIG. 240.—Twins—head and breech (modified from Hunter).

stretching and elevation of the retraction ridge take place. When labor proceeds satisfactorily, the cord should be tied in two places after the birth of the first child. The abdomen should be gently massaged during the interval between the expulsion of the first and the second fetus. If the second twin presents by the head or breech, the labor should be allowed to proceed naturally if the interval be not too long. There is a difference of opinion as to how long a period may be allowed to elapse between the birth of the first and that of the second twin. From Stephenson's re-

searches it is certain that it should not be extended beyond half an hour, for, though the mother may regain her strength, retraction of the cervix may occur, leading to trouble in connection with the birth of the second child. When the latter is transversely placed, it should be turned at once, by either external or internal manipulations, either the head or the breech being made to present, most authorities preferring to deliver by the breech at once. Following the birth of the second child, the fundus uteri should be massaged by an assistant until the third stage is completed. If there should be partial separation of the placenta and loss of blood, the uterus should be emptied by artificial means, massage being kept up afterward and other methods employed, if necessary, to counteract the tendency to inertia. In cases in which the birth of the first child is followed by much loss of blood or by the second placenta, it is advisable to interfere at once and deliver the second fetus by means of version.



FIG. 241.—Impaction of heads in twin labor.



FIG. 242.—Locking of heads in twin labor.

**Complex Cases.**—1. Labor is sometimes delayed when both bags of membranes bulge downward into the cervix. In such a case, when dilatation is completed, the bag of the leading fetus should be ruptured.

2. Both fetuses may tend to enter the pelvic brim together. In such a case it is necessary to push one up and allow the other to engage. If the head and breech together present, the latter should be pushed upward.

3. Locking of the twins. Both heads or a head and a breech may become jammed in the pelvis in cases where they present together. In such cases the lower presenting part should be delivered while the other part is pushed upward. Sometimes embryoclia of one fetus is necessary. In such an operation an

endeavor should be made to find out which fetus is alive; and the dead one should be destroyed, if possible. Of the two, the lowermost fetus is more likely to be dead, because of the increased risk of compression of its cord. Occasionally, where one child presents by the head and the other by the breech, the latter may be born as far as the neck and then become jammed against that of the second fetus. The heads may be related in different ways; thus, the chins may lock together, or the occipital regions, or the chin of one may be pressed against the occiput of the other. The head of the fetus whose body has been born usually lies above the pelvic brim in these cases. When this complication is found, an effort should be made to push the head of the highest fetus upward. If this is impossible, it is advisable to perform embryulcia on the head of the fetus which is partly born, since it is almost always dead, owing to compression of the cord, and then to deliver the other fetus by forceps.

4. Twisting of the umbilical cords. When both fetuses lie in one amniotic sac, the cords may be twisted around one another in various ways, sometimes even being knotted. When this occurs early in pregnancy, death of one or of both of the fetuses may occur, leading to premature emptying of the uterus. It may not take place, however, to a sufficient degree to destroy the circulation in one or both cords, and the case may proceed to full time. In labor the twisting of the cords may interfere with the free passage of the twins and may seriously endanger their lives. When the condition is discovered in labor, artificial delivery is necessary.

**Triplets.**—Triplets are very rare. The tendency to premature labor is great, and when this is the case, labor may be simple and uncomplicated. Even at term there may sometimes be no trouble. The difficulties that occur are similar to those found in connection with twin cases. In 458 triplet cases selected by Charbonnier the head presented in 254, the breech in 117, and the body in 57. This author has found that malpresentations and malpositions have given trouble in a very small number of cases. The labor must be very carefully attended, especially during the third stage, on account of the great liability to inertia uteri and postpartum hemorrhage. In the delivery the triplets may be born before the placenta, or each may be followed by its own; sometimes one is born with its placenta, followed by the other two with their placenta. Sometimes two are born, followed by one or two placenta, after which the third fetus is expelled, followed by its own placenta.

**Monsters.**—**Anencephalus or Hemicephalus.**—This monstrosity may cause difficulty in labor on account of the malformed head, which does not easily follow the normal mechanism, and being small, may allow other parts of the fetus to enter the pelvis along with it. Indeed, the head may be so small that the character of the labor may early be determined by the shoulders. If

the case be diagnosed early in labor, it is advisable to deliver by version. When delay occurs in the second stage, it is advisable to use a cranioclast in extracting the fetus.

**Double Monsters.**—These are found in various combinations, of which the following are the main types :

1. Those in which the heads are double.
2. Those in which the lower part of the body is double.
3. Those in which there are both a double head and a double body.

*Relation to Labor.*—Monstrosities are very rarely diagnosed before or during labor; they are most likely to be mistaken for twins. Usually they can be diagnosed only by the passage of the hand into the uterus. They may be delivered without much



FIG. 243.—Dicephalus.

trouble when small. In some cases they may become jammed or may cause a tedious labor. When artificial interference is necessary, it must be adapted to the conditions found. When there are two heads, it is sometimes possible to push one up while the other is allowed to engage. Version is sometimes necessary to delivery; occasionally the forceps may be applied with advantage to the advancing head. In some cases it is necessary to break up the monster. Indeed, some advise that craniotomy should be performed in all cases.

## CHAPTER V.

## COMPLEX LABOR.

## UTERINE HEMORRHAGE BEFORE THE EXPULSION OF THE CHILD, ASSOCIATED WITH THE SEPARATION OF A NORMALLY OR ABNORMALLY PLACED PLACENTA.

UTERINE hemorrhage in the early months of gestation has already been considered in connection with abortion. In the present connection the subject is considered both in regard to full-time labor and to advanced pregnancy.

## PLACENTA PRAEVIÆ.

By this term is meant the attachment of the placenta to that portion of the uterine wall which forms the lower uterine segment in labor. In describing the anatomy of pregnancy and labor I have pointed out that the lower uterine segment has no definite upper boundary in pregnancy, but that the latter is determined by the retraction ridge, which develops only after labor begins. The exact *anlage* of this ridge in the wall of the pregnant uterus is not accurately known, variations being found in its position. Moreover, while its distance above the os externum has been measured in Chiari's, Braune's, and Barbour and Webster's second-stage specimens in which the cervix is fully dilated, its distance above the os internum is not precisely known, since the latter cannot be accurately determined. The information afforded by the frozen sections of first-stage cases is not sufficient to establish the *anlage* of the retraction ring. It can be approximately placed at a distance  $1\frac{3}{4}$  to  $2\frac{1}{2}$  in. above the os internum, being longer posteriorly than anteriorly; it varies somewhat in position in different cases. In examining specimens of the pregnant uterus it may be impossible in some cases to state whether or not the placenta should be considered as prævia.

The hemorrhage that occurs as the result of placenta prævia was termed *unavoidable* by Rigby, and is so named at the present day. He employed it in distinction to the term *accidental*, applied to that form of hemorrhage which results from separation of a placenta normally situated—*i. e.*, above the retraction ridge.

**Frequency.**—Statistics as to the frequency of placenta prævia vary considerably. In so far as it causes hemorrhage in advanced pregnancy or labor, its frequency is generally stated to be on the average 1 in 1000 cases. Müller's statistics are 1 in 1078; Klein's, 1 in 760; Lomer's, 1 in 723; Veit's, 1 in 2000.

In maternities, where a larger percentage of these cases occur, Tarnier and Budin state that the frequency is less than 1 in 300.

In the Boston Lying-in Hospital in twenty years Townsend found it to be about 1 in 240. Boss reports it in Breslau as 1 in 130; Amadei and Ferri, 1 in 52.9, or 1.89 per cent.

If the number of instances in which placenta prævia causes abortion in early pregnancy be taken into consideration, as well as those slightly marked cases in which little or no bleeding takes place, the condition must be regarded as occurring more frequently than 1 in 1000 in ordinary practice; it is impossible, however, to give an accurate estimate. It is much more frequent in multiparæ than in primiparæ. This was first pointed out by Sir J. Y. Simpson, who collected 81 cases, of which 73 were multiparæ. Amadei and Ferri report 97 cases, of which 86 were multiparæ. Reed states that placenta prævia is three times as frequent after thirty as before.

**Varieties.**—The following classification is usually employed: *Complete* or *central*, when the os internum is completely covered



FIG. 244.—Partial placenta prævia, vertex presentation: the os beginning to dilate (Lusk).

by the placenta; *partial*, when the greater portion lies on one side of the os, the remainder covering the os; *marginal*, when the margin of the placenta crosses the os; *lateral*, when the lower part of the placenta lies in the lower uterine segment, being near the os only when dilatation occurs. These terms are often loosely employed, the os being considered as undilated, partially dilated, or fully dilated. It is evident that an individual case might be described as belonging to more than one variety, according to the condition of the cervix. The above classification implies an undilated cervix. Some authorities use only two terms, *complete* and *partial*. As regards the relative frequency of these variations, Lomer, in 136 cases of placenta prævia, found that only 26 were complete; Townsend, in 28 cases, found 5; Demelin, in 302 cases, found 28; Boss, in 133 cases, found 37; Amadei and Ferri found 1 in 24 cases.

From the developmental standpoint three varieties may be noted:

1. That in which the portion of the placenta in relation to the lower uterine segment is entirely serotinal.
2. That in which it is reflexal.

## 3. That in which it is both serotinal and reflexal.

**Etiology.**—The majority of the earliest obstetric writers—*i. e.*, Mauriceau, Astruc, Dionis, Daventer, Pugh, and others—held that the ovum in cases of placenta prævia had not developed from the beginning in the lowest part of the uterine cavity, but that it had originally been attached in the upper normal zone, from which it had become accidentally loosened, falling by its own weight to the lower zone, where it continued its development. Portal appears to have been the first who described placenta prævia as having arisen from the implantation of the ovum in the lower part of the uterus from the beginning. This view was held by several other authorities—*i. e.*, Roederer, Levret, and Smellie—and it was mainly due to the writings of the last of these that it became generally accepted.

In 1888 Hofmeier, at the German Gynecologic Congress in Halle, advanced the opinion that placenta prævia is due to the development of villi of the chorion læve, which are attached in the early stages of gestation to the decidua reflexa, and which normally atrophy. He believes that as the latter becomes absorbed or blended with the vera these villi remain functional, forming the lower portion of the placenta, continuous with the serotinal or true placenta. In 1890 Kaltenbach adopted the same view and proposed the definition that the placenta is prævia when attached over the lower pole of the reflexa. This view has been enthusiastically received in many quarters, and several specimens have been exhibited in recent years, clearly demonstrating the reflexal placenta. Such an one is that represented by me in Fig. 56.

That placenta prævia is always formed in this way cannot, however, be held. Another specimen, represented in Figs. 245 and 246, proves conclusively that the condition may arise from the development of a chorion frondosum developing normally in relation to a decidua serotina, situated from the beginning in the lower portion of the uterine body. Gottschalk, in 1897, described a specimen demonstrating the same fact. Kaltenbach has stated that a primary implantation of the ovum near the os internum is unlikely because of the nearness of the cervical canal, down which the ovum would probably pass. This speculation is of no value in view of the demonstration of such specimens as Gottschalk's and mine.

In some cases placenta prævia may be due to a combination of the conditions mentioned—*viz.*, primary low implantation of the ovum and persistent chorionic development on the reflexa. In my second specimen both conditions exist, though the amount of placental tissue attached to the reflexa is very small.

The explanation of primary low implantation of the ovum is a matter of pure speculation. Whether the ovum is carried down

by the action of the cilia on the cells of the uterine mucosa, by the movement of fluid in the cavity, or by mechanical displacement, we do not know. Nor are we able to say anything regarding the possibility that the ovum may have some power of movement in itself or exercise some selective function.

One simple yet feasible reason may be advanced to explain a low primary implantation of the ovum—viz., fertilization of an ovum by spermatozoa in the lower part of the uterine cavity. Of course, there is at the present time a widespread belief that this process generally takes place in the Fallopian tube, but no one can presume to say in what percentage of cases this is found, nor place any limit upon the range of its occurrence. It is not at all unlikely, therefore, that occasionally the ovum and spermatozoa may meet in the lower part of the uterus, followed by low implantation and development.

The explanation of placenta prævia resulting from a reflexal placental formation may be undertaken with more facts and less speculation. Hubert Peters has described the earliest stage in the formation of the human reflexa. He has shown that the young ovum, on becoming attached to the uterine mucosa, sinks rapidly into the compact layer, excavating laterally as well as deeply. The overhanging portion of the compacta forms the reflexa, the gap through which the ovum has entered being closed by the organization of blood-clot. The thickness of the reflexa must depend to a considerable extent upon the amount of excavation caused by the ovum, though it also varies according to the thickness of the mucosa at the site of embedding and according to the degree of decidual development taking place. The basal part of the reflexa is always the thickest part, and is similar to the neighboring compact layer of the serotina in early pregnancy. The layer thins toward the outer polar part, showing less vascularization and tending to undergo early degenerative changes. Blood-extravasation is frequent in the substance of the reflexa, coagulation-necrosis in the decidual tissue constantly occurs, and blood-channels become closed.

In the earliest changes that take place in the outer epiblastic covering of the ovum, no distinction can be traced between the portion related to the reflexa and that related to the serotina; neither is there any distinction between the villi during the first few weeks of gestation. Gradually differences are noted, the villi of the chorion læve (those in relation to the reflexa) showing less growth-tendency the farther they are from the serotina. As pregnancy advances retrogressive and degenerative changes occur, fibrin formation takes place in the maternal blood between the villi and on the inner surface of the reflexa.

There has been some difference of opinion as to the relationships between the degenerative changes in the reflexa and those

in the villi related to it. There can, however, be very little doubt that the degenerated condition of the reflexa is the occasion of retrogression in the villi attached to it. Of these villi, those nearest the serotina become most developed and are the last to degenerate. This is due to the fact that the basal reflexa to which they are attached is most developed and degenerates most slowly. In certain cases in which there are abnormal growth and continuance of a portion of the chorion læve forming the so-called reflexal placenta, continuous with the serotinal placenta, there seems to be an exceptional development of the decidua reflexa, especially near the serotina, the degenerative changes



FIG. 245.—Vertical mesial section of uterus at end of third month of pregnancy. Right half. The specimen is in the author's collection in Rush Medical College, Chicago. It is somewhat elongated vertically and narrowed transversely by its suspension in a jar. The lower part of the cervix has been cut away. The decidua reflexa is a thin membrane that has fallen somewhat inward and rests on the embryo. The placenta is situated on the anterior uterine wall, which it mostly covers. Its upper end is at the fundus; its lower end at the os internum, where it is attached for a length of 1.3 cm. to the reflexa. Blood lies between the reflexa and the os internum; *a*, Embryo; *b*, serotinal placenta; *c*, slight extension of placenta on decidua reflexa; *d*, decidua reflexa, which has fallen inward against the embryo; *e*, part of the cervix; *f*, wall of uterine body.

being much less marked than in ordinary cases. As a result of the gradual thinning of the reflexa, together with the intrinsic necrotic changes that I have described, rupture of its substance with consequent hemorrhage may easily be brought about. One

of my specimens (Fig. 246) illustrates this condition; the extravasated blood between the reflexa and the os internum is due to rupture of a small portion of the reflexa to which well-marked chorionic villi are attached.

If there be no disturbance of gestation in the early months, there may be in the later. These variations probably depend mainly upon the degree of preservation of that part of the reflexa to which the placenta is attached and the amount of blending with the vera that takes place. It has long been held that in normal

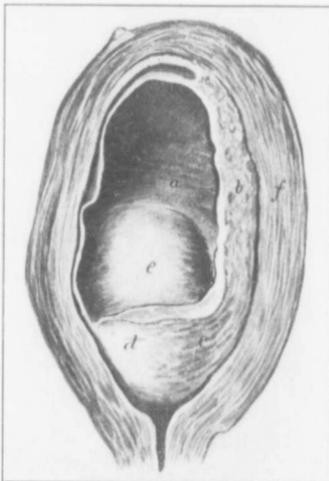


FIG. 246.—Left half of specimen described in Fig. 245. The inferior edge of the placenta (reflexal portion) and the neighboring decidua reflexa are considerably torn by blood-extravasation, which has formed an accumulation between the reflexa and vera on the left side, resembling a small hen's egg, somewhat flattened; *a*, Amniotic cavity; *b*, serotinal placenta; *c*, lower edge of placenta, torn by blood-extravasation; *d*, lower portion of blood-clot, lying between reflexa and vera; *e*, blood-clot bulging the reflexa and membranes inward; *f*, anterior uterine wall.

pregnancy the reflexa gradually merges with the vera, so that it forms the inner layer of the latter during the advanced months. The work of Minot, E. Fränkel, and myself has shown that blending occurs only to a partial extent and in varying degrees. During the fourth month I have sometimes found the reflexa partly distinguishable as a continuous thin hyaline membrane lying in contact with the vera, but more frequently as a broken layer, parts of it being absent, the remains of the degenerated chorion laeve at these intervals lying against the vera. During the fifth

month fewer traces of the reflexa are usually found. During the later months small portions may sometimes be noticed as patches of fibrin containing degenerated villi.

When there is no early interruption of gestation in the condition of reflexal placenta, the occurrence of hemorrhage in the later months is probably mainly determined by the state of that part of the reflexa to which the villi are attached and by the extent and nature of the union that may have taken place between it and the decidua vera. If there be firm union hemorrhage is less likely to occur during pregnancy than if it be absent. When a case progresses to the seventh or eighth month, hemorrhage then taking place, the explanation probably is that there has been an unusually thick or strong reflexa; that degeneration has taken place very slowly or to a slight extent, and that the mechanical stretching that the membrane normally undergoes has not been able to produce an earlier rupture of its substance. If a case of reflexal placenta continues to full term, it is probably one in which firm blending has taken place between the reflexa and vera. The great majority of cases of placenta prævia that go to term are probably those in which there has not been a reflexal placenta, but in which the ovum has been implanted low in the uterus from the beginning. In these cases hemorrhage need not be expected until canalization of the cervix and lower uterine segment has begun, producing that disproportion between the placenta and the area of its attachment on the uterus that inevitably results in the loss of blood.

Bayer and others have tried to explain the hemorrhage occurring in placenta prævia cases previous to full term by the old view that the upper portion of the cervix was taken up to form part of the lower uterine segment during the late months, in this way bringing about a separation between the uterus and placenta. This explanation no longer can claim attention, since anatomic investigations have abundantly proved that the cervix does not enter into the formation of the lower uterine segment during pregnancy.

Another explanation has been put forward to the effect that the diameter of the lower segment of the uterus increases during the later months of gestation, and that this increase in area leads to a separation of the placenta. Anatomic facts also disprove this view. The full capacity of the lower uterine segment is ordinarily attained by the fifth month. Thereafter the great increase in the uterus is almost entirely due to a development of the upper portion. Slight dilatation of the cervix may take place during the last weeks of gestation in multiparæ. This might, in a case of placenta prævia, cause some separation in the region of the os internum.

**Summary.**—1. Three different sets of conditions explain the occurrence of placenta prævia:

- (a) Low implantation of the ovum.  
 (b) Development of chorionic villi on the decidua reflexa, forming a reflexal placenta.  
 (c) Low implantation of the ovum together with a reflexal placenta.
2. Reflexal placenta prævia is probably a frequent (though generally unrecognized) cause of abortion and miscarriage, the

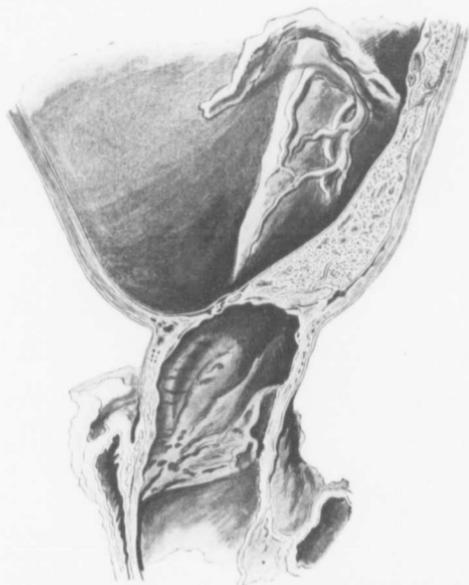


FIG. 247.—Partial placenta prævia (Ahlfeld).

degenerated reflexa becoming thinned and torn, leading to hemorrhage.

3. Cases of placenta prævia that reach full time are probably in most instances those in which a reflexal placenta has not been present, but in which the ovum has been implanted low in the uterus, the serotina thereby lying partly or entirely in the lower uterine segment.

4. Cases of reflexal placenta prævia in which the gestation is not interrupted until the end of pregnancy are probably those in which the late appearance of hemorrhage is due to unusual strength

and thickness of the reflexa and to the slow advance of degenerative changes in it. Persistence of a reflexal placenta prævia to full term is probably a very rare occurrence, and is explained by non-rupture of the reflexa because of the above-mentioned characteristics, or by firm blending of the reflexa with the vera. Hemorrhage occurring in the late months of pregnancy, when the placenta prævia is not reflexal in origin, is probably generally due to some degree of dilatation of the cervix that may or may not be the earliest sign of premature labor. The onset of labor, with consequent increasing dilatation of the cervix and lower uterine segment, necessitates further disproportion between the placenta and the site of its attachment, and increasing separation.

5. In all conditions of placenta prævia hemorrhage may result from various causes that are entirely independent of the position of the placenta, which may also be effective when the placenta is normally situated.

6. In a considerable proportion of cases in which uterine hemorrhage occurs in advanced pregnancy, where the diagnosis of "accidental hemorrhage" is made, placenta prævia of reflexal origin is probably present. Unless the placenta be within easy reach of the examining finger, a careless observer might easily conclude that its attachment is normal. A thorough study of the shed placenta and membranes is necessary to establish the true nature of these cases, though it may sometimes be inconclusive because of disturbed and altered relationships.

**Condition of the Placenta.**—The placenta is often abnormal. In all probability the most marked variations are found when it is largely reflexal in origin, the reason for which has already been given. It may be much spread out and thinned, sometimes covering a large area. Some parts may be well developed; others may be much degenerated, the villi being largely destroyed and surrounded with fibrin. Sometimes it may have a patchy appearance. Detached portions (*placenta succenturiata*) may be found. The outline may vary greatly, being round, oval, reniform, and lobed. The cord usually has an eccentric attachment. Sometimes it enters the placenta at the border or has a velamentous insertion. According to Kilian, the placenta is more frequently situated posteriorly than anteriorly. Müller states that when there is a partial placenta prævia, the lower edge extends toward the right more frequently than to the left. It is frequently adherent.

**Source of Bleeding.**—From what has been stated, it is evident that in some cases blood may escape from torn vessels in the decidua reflexa; in other cases from those in the serotina, owing to the separation of the placenta. As well, blood may pour from the intervillous space that may be opened, though such hemorrhage tends to be checked by a massing of the villi together

and by coagulation of the blood on their surface. The so-called circular sinus or sinus of Meckel is often noted as a source of bleeding, and it indeed may be, if it be torn. This blood-space should not, however, be termed a sinus, as it is merely the outer portion of the intervillous space at the edge of the placenta, where few



FIG. 248.—Central placenta previa, the os partly dilated (Hunter).

villi exist. It never exists as a continuous canal around the placenta, but is interrupted at irregular intervals by abundant villi.

**Symptoms.**—Placenta previa may exist for varying periods without causing any symptoms. In many cases these may develop in the early months, and are those described in connection with abortion, hemorrhage from the uterus being the first and

chief occurrence. After the early months hemorrhage may occur at any time. In the majority of cases in which the condition continues to an advanced period it usually takes place during the eighth or ninth month. It usually appears suddenly during the day or night, and the first flow may be abundant or scanty. It does not ordinarily follow any exciting cause, though sometimes it may be associated with some form of physical exertion, though the association may have nothing whatever to do with the hemorrhage. (Detachment of a placenta prævia may also be brought about by any of the conditions that may separate a placenta situated in the upper uterine segment.)

In some cases the hemorrhage may continue so excessive from the onset that the woman is reduced to a dangerous condition of anemia, exhibiting marked pallor, syncope, dimness of vision, jactitation, irregular sighing respirations, etc. Frequently after the first bleeding there is an interval of hours or days, followed by another discharge, and this may be repeated. As the case progresses the intervals become shorter. Rarely there is a continuous dribbling of blood. During labor the escape of blood from the opened sinuses is usually most marked as the pains pass away. During active uterine contractions the ovum compresses the placenta against the lower segment, and so tends to prevent further escape from the vessels. At the same time, blood that has been poured out is forced through the cervix by these pains. The common statement that in placenta prævia the hemorrhage occurs mainly during the pains is correct only as applied to a limited number of cases.

**Physical Signs.**—Rarely placenta prævia may be detected by abdominal palpation when it is situated anteriorly in the uterus. The maternal souffle may be heard over the lower portion of the uterus; the edge of the placenta may sometimes be felt as a ridge; the fetal parts are felt very indistinctly within the area of the placenta.

On vaginal examination, when the placenta covers the lower segment entirely, ballottement may not be obtained or only indistinctly, and the fetal parts cannot be palpated. The tissues palpated through the anterior fornix have a boggy feeling. When the placenta prævia is complete, the vaginal signs are similar though more extensive, being the same in the posterior as in the anterior fornix. When the placenta is situated on the posterior wall, its anterior edge being marginal, its presence is rarely detected on vaginal examination.

When the cervix is dilated sufficiently to admit a finger, the placenta may be felt as a stringy mass when it is complete. When it is lateral or marginal, the edge may usually be palpated. On rectal examination, when the lower uterine segment posteriorly is partly occupied by the placenta, its edge may be felt as a ridge.

When it is entirely occupied, a boggy thickness is made out, palpation of the fetus is indistinct, and ballottement is difficult or impossible.

It must be distinctly understood that this examination is rarely necessary. If it be employed as a routine, the practitioner is certain to add to the risks of infection, owing to carelessness in cleansing the fingers before using them again in the genital passage. When a rectal examination is made, it is always advisable to wear a rubber glove.

**Prognosis.**—Placenta prævia must be regarded as a serious complication of pregnancy and labor, for both the mother and the child. It is usually stated that the risks are greater the larger the area of the lower uterine segment covered by placenta. While this is true, it must be remembered that there may be very marked loss of blood and great danger in cases of partial implantation. The marginal is the most dangerous variety of partial implantation; complete placenta prævia is the most serious of all forms. Demetris mentions 39 complete insertions, with a mortality of 35.8 per cent.; Depaul, 25, with 56 per cent.

Weakness of uterine contractions are frequent during the first stage, probably due to the absence of pressure of the fetus against the cervix, and this inertia favors the escape of blood.

The cervix usually is soft and dilates easily in cases of placenta prævia. When the cervix tears badly, the hemorrhage may be very great; when it is firm, there is increased risk to the mother, because of the prolongation of the first stage from slow or difficult dilatation. Hence the condition of the cervix makes placenta prævia more serious in primiparæ than in multiparæ, other things being equal. Injudicious interference may cause rupture of the lower uterine segment. Malpresentations and malpositions of the fetus, prolapse and velamentous insertion of the cord, and placenta succenturiata are found more frequently in placenta prævia cases than in those with normally implanted placenta, and these add to the risks if labor goes on unaided or if artificial delivery is carried out. In 133 cases occurring in two hospitals in Breslau, between 1884 and 1894, Boss found that the presentations were as follows: Head, 66.2 per cent.; breech, 1.8 per cent.; footling, 8 per cent.; transverse, 24 per cent. The risks are greater to those who are encumbered by repeated hemorrhage previous to labor than to those who first lose blood during labor. The reaction of the woman to the loss of blood is an important factor. Great variations are found. One patient may suffer little as the result of a hemorrhage that might be very serious to another.

The fetus is in danger of asphyxiation from separation of the placenta and interference with the circulation of maternal blood in the intervillous space. It may also be endangered by premature or artificial delivery and by interference with the cord. In the

third stage trouble may be caused by adherent placenta, which, according to Müller, is found in 39 per cent. of cases. Sometimes a complete placenta prævia is delivered before the fetus. J. Y. Simpson collected statistics of 141 such cases, with a maternal mortality of 10 per cent. After labor there is increased risk of inertia uteri, hemorrhage, and septic infection; phlebitis is exceptionally frequent. Death is sometimes due to embolism from air entering open veins in the placental site. The patient may be very weak in the puerperium and may recover slowly. Involution of the uterus is retarded.

Before the seventh month of gestation the maternal risks in connection with hemorrhage and the expulsion of the ovum are very much less than in the last two or three months of pregnancy. Death has rarely been due to hemorrhage in the first six months.

Various statistics of mortality are found. Since the beginning of antiseptic technic there has been a reduction in the death rate, this being due both to cleanliness and to improved treatment. The following statistics of maternal mortality are given by old authorities—*i. e.*, J. Y. Simpson, 33.3 per cent.; Hugenberger, 38 per cent.; Depaul, 32 per cent.; Spiegelberg, 30 per cent.

In recent times Labusquière mentions 236 per cent. in 169 cases. It is interesting to note his analysis of these. In 109 labor occurred spontaneously and without fatality; in 60 cases, where interference was considered necessary, the death rate was 6.66 per cent. Of these 60 cases the membranes were simply ruptured in 36, labor taking place without fatality; in the remaining 24 other forms of interference were carried out and 4 deaths occurred—*i. e.*, the entire mortality belonged to those cases in which artificial manipulations other than rupturing the membranes were carried out. Tarnier and Budin give a rate of 21.05 per cent. in 62 cases, and Barnes, 8.8 per cent. in 67 cases. Winckel thinks that the maternal mortality should be between 5 and 10 per cent.

The fetal mortality is high. J. Y. Simpson estimated it at 67 per cent.; Depaul, at 62 per cent. When the placenta is born first the fetus almost always dies. In premature delivery the death rate is very high; and even if the fetus is alive at birth it is likely to die soon.

**Treatment.**—1. **Before the Fetus is Viable.**—The treatment of hemorrhage in the early months of pregnancy has already been considered in connection with abortion. When bleeding from placenta prævia occurs shortly before viability, many authorities hold that the question of palliative treatment must always be considered in the interests of the fetus, since maternal death is a very rare event before the end of the seventh month. If the hemorrhage be excessive at first or continuous, or if the fetus dies, it is generally held that the pregnancy should be terminated. When there is a slight loss of blood, which ceases, an effort may

be made to carry the patient along until the fetus is viable, provided that the conditions are such as ensure prompt attendance when medical attention is needed. Such a course can best be adopted by placing the patient in a well-equipped hospital. The woman should be put to bed during the waiting-period, the bodily functions being carefully regulated. In such cases the pulse and general condition must be carefully watched if there be a succession of slight hemorrhages, for these as well as a sudden excessive flow may in time reduce the woman. Interference should not, therefore, be delayed too long.

2. **After the Fetus is Viable.**—If palliative treatment has been carried out, labor should be induced after viability is certain, if the placenta praevia be central or marginal. If it be lateral, the pregnancy may be allowed to continue if there be no more bleeding. As already stated, the risks increase, especially during the last two months.

The method of interfering in placenta praevia to the best advantage of the mother, without reference to the preservation of the fetus, is one that is very generally in favor. Different procedures are recommended, each of which has its advocates. They should have in view the checking of hemorrhage, the dilatation of the cervix, and the delivery of the fetus. It is important that the procedure adopted should not have as its end one of the results at the expense of the others, though, of course, one must be chosen whose prime object is the checking of the hemorrhage.

In any condition of placenta praevia bleeding may be very often completely checked by a firm tamponade of the vagina, a long continuous strip (or several strips tied together) of wet aseptic or antiseptic gauze—*c. g.*, chinosol—being most convenient for the purpose. It is best introduced when the woman is in the genupectoral or elevated lithotomy posture, the vulva being opened with a spatular speculum. The external genitals should have been previously shaved and cleansed, and the bowels and bladder should be emptied. The vagina need not be washed out beforehand if manipulations have not been employed that may have introduced infecting organisms. In an emergency in a private house, strips of sheeting 3 in. wide, boiled in water containing soda for fifteen minutes, may be used instead of gauze.

The woman should then be kept quiet in bed and should be under the observation of the medical attendant or a skilled assistant. If there be no bleeding, the patient's pulse remaining satisfactory, many authorities leave the plug in position for six or eight hours. Frequently its presence induces labor pains, which lead to dilatation of the cervix. At the end of the time stated the tampon may be removed. If the cervix is dilating satisfactorily and little blood has been lost many recommend reinsertion

of the tampon, labor being allowed to proceed naturally. Between pains the fetus may be pressed downward through the fundus, in order to push the placenta against the lower segment and cervix; the uterus is also stimulated by this manipulation. When the cervix is well dilated the tampon may be removed and the bag of membranes ruptured; the consequent descent of the presenting part may completely or nearly check hemorrhage. Downward pressure of the fetus through the fundus between pains is a valuable adjunct. At the time of rupturing the membranes, correction of a faulty position or presentation may be made, and turning may be carried out if deemed advisable. If there be a cephalic presentation that is allowed to proceed normally, forceps may be used if there be delay after the head has entered the true pelvis.

This method of procedure is very frequently satisfactory to the mother (Winckel giving a maternal mortality of 5.2 per cent.) and offers good chances to the fetus. In the hands of those who are not accustomed to obstetric manipulations and who have not the facilities of a hospital at hand, it is perhaps the safest method to be employed. An objection to it is the delay and worry to which the patient may be subjected, especially when the first tamponade does not excite labor pains. The patient may get no sleep and may become worn and restless. The bowel and urethra may be so compressed that natural evacuations are impossible, and regular catheterization of the bladder may be required.

Many authorities employ the tampon for six or eight hours in order to obtain some degree of dilatation, but it is not always certain to bring this about. Others use it only to check hemorrhage until preparations can be made for other methods of procedure. When the patient can be attended at once, these may be carried out without previous tamponade. Instead of vaginal tamponade, plugging of the cervix may be employed. For this purpose a Barnes's bag distended with normal saline solution may be introduced without rupturing the membranes. It checks bleeding, dilates the cervix, and stimulates the uterine pains. The patient requires to be closely watched, however, as it may rupture or be forced into the vagina as the cervical canal enlarges, and fresh bleeding may occur.

Of greater service is the Champetier de Ribes bag introduced into the cervix, below or within the amniotic cavity (in a complete placenta prævia it should be placed within). It rarely bursts, presses against the lower uterine segment, dilates the cervix, and only passes through the cervix when the latter is dilated sufficiently to receive the head. After it is expelled constant downward pressure must be exerted on the fetus through the fundus in order to check hemorrhage, and the membranes should be ruptured if this has not already taken place. If bleed-

ing be not controlled in this way until the head has well entered the cervix, it is advisable to deliver by turning or by forceps; preferably by the latter method if the cervix be fully dilated, as the fetus probably has a better chance. The chief objection to the use of this bag is that it frequently displaces the fetus and may thus complicate the labor; thus, it may change a vertex to a transverse presentation. Such a change may usually be detected by careful abdominal palpation through the abdomen. The displacement must be corrected as soon as the bag is delivered through the cervix.

Among those who employ the above methods only for the temporary control of bleeding the following procedure is a favorite one, much practised at the present time: If the cervix will not admit two fingers its canal should be enlarged with metal dilators, fingers, or Barnes's bag until the fingers can be easily introduced. In the great majority of cases, owing to the abnormal softness of the cervix, the dilatation may be accomplished mainly by the fingers (perhaps being begun with the dilators), the bags being rarely needed. The bipolar or Braxton Hicks method of version is then performed, the membranes being preserved. When the placenta is marginal the fingers should be placed against the membranes near its edge.

If the placenta entirely cover the cervix the fingers must be pushed through the thickness of the villi but not through the amnion. Preservation of the amnion is essential to speedy and satisfactory turning of the fetus by this method. (See Version.) When the fetus lies transversely, turning is more quickly accomplished than when the head presents. When the breech presents, of course version is not necessary. When the breech is brought near the cervix, two fingers are pushed into the amniotic cavity in order to seize one or both feet, which are then drawn through the cervix; both being preferable if they are accessible and can be drawn down. The fetus now acts as an efficient compress against the lower uterine segment as well as a dilator of the cervix, and delivery may take place naturally without any more bleeding. Should any be noted, it may be checked by pressure of the fetus downward through the fundus, between pains, or by keeping up slight traction on the limb of the fetus. The case should never be left without a medical attendant.

Rarely it is advisable to interfere if the labor does not take place satisfactorily by the natural powers, or if the patient is exhausted. Dilatation of the cervix may be hastened by careful traction on the fetus, assisted by digital manipulations, steady pressure being exerted on the fundus as the fetus descends. When the body has passed through the cervix the latter tends to retract on the neck. If dilatation be not sufficient for the passage of the head, rupture of the cervix and lower segment may result, greatly

increasing the risk to the woman. If the fetus be dead, the simplest plan is the reduction of the size of the head by perforation through the base of the occiput (or sometimes the roof of the mouth). As the brain matter escapes the head may be extracted without more dilatation.

When, however, there is a chance of a living child the cervix must be dilated carefully with the fingers and the head delivered. After the birth of the child it is best to separate and remove the placenta by the introduction of the hand into the uterus. This is especially advisable on account of the frequency of adherent placenta. Thereafter the uterine body should be compressed and steadied by an assistant while a long gauze tampon is firmly packed from the fundus to the vulva. An assistant or nurse should sit by the patient for at least an hour after delivery, keeping a hand on the uterine body through the abdominal wall, and kneading it if relaxation occurs.

Immediately after labor, also, two pints of warm normal saline enema may be given by a high rectal tube. This may indeed be administered at any time in labor, except in the second stage, if considerable blood has been lost. If immediate addition of the solution is urgently needed at any time, it may be injected under the breasts. Transfusion into the blood is rarely necessary. The lower end of the bed should be elevated. In the early puerperium the patient must be kept exceptionally quiet. If much blood has been lost the foot of her bed may be elevated for a day or two. Ergot should be administered for a few days.

The chief disadvantage in the method of treatment just described is the large fetal mortality. Undue haste in delivery may cause bad rupture of the cervix and lower uterine segment, and this may lead to increased hemorrhage.

During ten years, 1889-99, 74 cases were treated in the Dublin Rotunda by turning, drawing a foot through the cervix, and leaving the rest to nature, except when bad hemorrhage continued. Of these cases only 28 occurred at full time. Nine only were complete. Four maternal deaths took place: 1 from pulmonary embolism on the eighteenth day, 2 from septic infection introduced before the patients were admitted to hospital, and 1 from hemorrhage following the application of forceps, which ruptured the uterus.

Some mention may be made of other methods of treatment.

**Rupture of the membranes** is advised by some as soon as the condition is diagnosed, especially in high lateral placenta prævia. This certainly is calculated to check the hemorrhage, but it leads to a very tedious labor and makes version difficult or impossible, and increases the risks to the mother and fetus; it is admissible only when the head or breech presents. In cases where the membranes have ruptured early it is advisable to introduce a Cham-

petier de Ribes bag in order to promote dilatation. Thereafter delivery may occur naturally, though forceps or embryulcia may be necessary; turning can rarely be safely carried out on account of uterine retraction.

**Separation of the lower part of the placenta** was advocated by Barnes in cases of partial implantation. It frequently checks hemorrhage and allows dilatation to take place more rapidly. It is not certain in its results, however, and the effect on the fetus is very bad.

**Separation of the whole placenta** was proposed by J. Y. Simpson on the ground that it does no harm, may diminish bleeding, and promote dilatation. It should not be employed if the fetus be alive or viable.

**Rapid manual dilatation of the cervix** may occasionally be safely carried out, but it is very risky. The chance of tearing the cervix and lower uterine segment and of increasing the hemorrhage is great. Moreover, if the woman has lost much blood, this procedure, followed by rapid delivery, may be too much of a shock to her system and may prove fatal. It is really admissible only when the cervix is nearly fully dilated and it is desirable to complete the labor by version or forceps.

**Cæsarean Section.**—Within the last few years abdominal Cæsarean section has been carried out in several cases of placenta prævia. It was first recommended by Lawson Tait. The procedure has been severely criticized by several authorities. Zinke has collected 6 cases of the conservative operation and 2 of Porro's operation, in which 5 mothers and 6 infants lived. This author holds that in central placenta prævia, when the patient is a primipara, the os closed, hemorrhage profuse, and separation of the placenta around the internal os difficult, the Cæsarean or Porro operation is legitimate and elective. Webster has reported the case of a young girl in which excessive hemorrhage, associated with a small vagina and pelvis and a transverse presentation of the fetus, necessitated Cæsarean section. (See Cæsarean Section.)

**HEMORRHAGE FROM PREMATURE DETACHMENT OF THE NORMALLY SITUATED PLACENTA (ABLATIO PLACENTAE; ACCIDENTAL HEMORRHAGE).**

Bleeding in early pregnancy, associated with separation of the normally placed placenta, has already been studied in connection with the subject of abortion. It now remains to consider the cases in which such hemorrhage occurs in advanced gestation. To it the name of "accidental" was given by Rigby, as opposed to "unavoidable," the term used in describing the hemorrhage of placenta prævia. Rudolph W. Holmes has recently proposed the term "ablatio placenta."

**Frequency.**—Accurate statistics cannot be given, as there is

little doubt that in literature many cases of accidental hemorrhage have been tabulated as placenta prævia. Moreover, slight placental detachments, accompanied by clotting in the area of separation and leading to no disturbance, are not infrequent, and these are not included in the statistics by most writers. Spiegelberg called special attention to these. Broadhead noted 57 instances in 5900 cases in the Sloane Maternity, visible antepartum hemorrhage having been present. In 1000 cases, 7 had putty-like gray clots.

Of the frequency of ablatio as a cause of serious disturbance from loss of blood externally or concealed, it is impossible to speak with accuracy. In 3000 labors occurring in the Chicago Lying-in Hospital and Dispensary, 6 cases were noted, in only 2 of which treatment was necessary. Tissier found that in six years' service at two large clinics in Paris the percentage was about 1 in 1000. The New York Lying-in Hospital reports 10,000 cases, with 1 accidental hemorrhage. Churchill reported 68,982 labors with 85.

**Etiology.**—There has been much speculation as to the causes of the separation of the placenta. It has long been held that the arrangement of the uterine circulation—viz., the enormous ramification of uterine sinuses, drained mainly by the ovarian and uterine veins—predisposes to blood-stasis, and that whatever causes excessive engorgement might tend to produce retroplacental hemorrhage, as Jacquemier first suggested.

Traumatism has long been considered an important factor, but it is probably less frequently a direct cause than is generally believed. There is no doubt that violent injury may cause immediate separation and hemorrhage, but in many cases in which the bleeding is attributed to some form of exertion or unimportant accident, the real cause is a diseased condition of the decidua or chorionic villi. Inflammation in the decidua serotina is indeed generally considered to be a frequent cause. Separation is more frequent in multiparæ than in primiparæ. Holmes has pointed out that in 156 cases, 19.2 per cent. were primiparæ. He also noted that in 17 per cent. of cases ablatio occurred in women between the ages of sixteen and twenty-five; in 53.7 per cent. in those between twenty-six and thirty-five; in 29.8 per cent. in those between thirty-six and forty-five. As to the period of gestation, ablatio was reported 6 times in the fifth month, 4 times in the sixth, 29 in the seventh, 62 in the eighth, and 52 in the ninth.

In a considerable number of instances congestion of the decidua is secondary to renal changes, as was first described by Blot, in 1849. It has also been noted in tuberculosis, heart disease, alcoholism, syphilis, and exophthalmos. Arterial degeneration may also be a cause. The acute infectious diseases sometimes lead to placental separation. Diseased conditions of the placenta

are usually mentioned, though little is known regarding them. It is evident that separation of a portion of the placenta might readily take place if the villi attached to the serotina be so degenerated as to be easily torn. It must here again be pointed out that the importance of the placenta as a causal factor has probably been exaggerated, from the frequency with which infarcts, so-called, have been noted in the placenta. In the past these have always been considered as resulting from hemorrhages, whereas recently they have clearly been demonstrated as localized formations of fibrin, caused by degenerative changes in the villi. (See p. 66.) Abnormalities in the ovum have been noted in association with ablatio in some cases—*i. g.*, malpositions and malpresentations, and shortness of the cord.

#### Pathologic Anatomy.

—In cases where a small hemorrhage occurs between the placenta and uterus, insufficient to produce any sign or symptom where it may be recognized, the clot usually organizes and forms a firm mass of fibrin. Sometimes it may give rise to a cystic formation. In cases in which distinct signs and symptoms are present, two varieties are usually described—*viz.*, apparent and concealed hemorrhage.

By the first is meant the passage of blood from the separated area downward between the membranes and through the cervical canal; by the second, the accumulation of blood between the placenta or placenta and membranes.

By the first is meant the passage of blood from the separated area downward between the membranes and through the cervical canal; by the second, the accumulation of blood between the placenta or placenta and membranes and the uterine wall, or in the amniotic cavity, rupture of the membranes having occurred, no escape through the cervix taking place. In some cases of apparent hemorrhage, most of the blood that is poured out escapes through the cervix, but in other cases only a small amount may appear externally, the greater part accumulating inside the uterus. Thus, the quantity of blood passing through the cervix may be no index whatever of the actual extent of the hemorrhage. Occasionally clotting takes place along the track

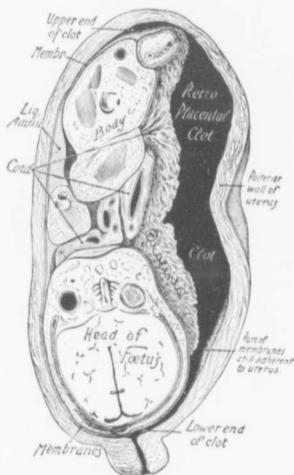


FIG. 249.—Accidental hemorrhage. Blood collected between placenta and part of membranes and the uterine wall (Pinard and Varnier).

of the escaping blood, so that a mass of fibrin is formed that may extend into the cervix; in these cases only the clear blood-serum may pass downward through the cervix. This process may gradually be followed by complete checking of the hemorrhage. Clotting also tends to occur at the primary seat of hemorrhage unless death or delivery takes place at an early stage. The clots are found in various stages, according to the period of their formation. In the concealed form, according to Goodell, the placenta may be detached everywhere except around the margin; it may also be detached at the margin, the adjacent membranes being adherent or separated for a distance, the blood collecting under them. In the latter condition the blood may be prevented from passing through the cervix by a clot near the os internum or by the pressure of the presenting part of the fetus. Holmes suggests that firm closure of the os internum may sometimes also prevent its escape. Very rarely the blood may burst into the amniotic cavity and mix with the amniotic fluid.

As the placenta is separated it is bulged toward the amniotic cavity. It may be pushed against and moulded by the fetus. The blood-mass may be somewhat regular or irregular, the placenta being separated with no uniformity. Very rarely detachment is accompanied with prolapse of the placenta; sometimes the separation may be complete and yet no blood escape from the uterus.

**Symptoms and Signs.**—Great variations are found. No symptoms whatever are produced when slight detachment and localized clotting occurs, the condition being discovered only after delivery of the placenta. In well-marked cases the symptoms and signs associated with loss of blood are present. These vary according to the suddenness and extent of the hemorrhage and to the strength and resistance of the patient. In the most serious acute cases, especially of the concealed type, there is

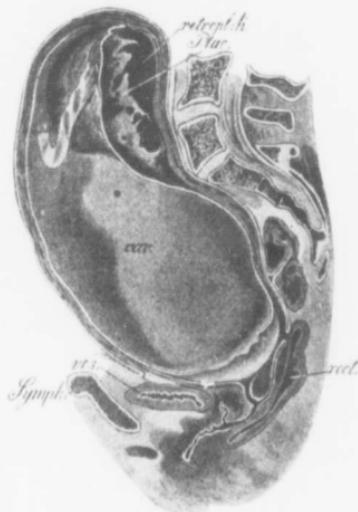


FIG. 250.—Premature detachment of the placenta occupying its normal site. Frozen section of an undelivered woman dead of eclampsia (after Dr. Winter). A blood-mass under the placenta.

sudden collapse, weakness, pallor, and sometimes syncope. The woman becomes restless and cold, presenting sighing respirations, her pulse being rapid and feeble. Frequently there is distress in the region of the uterus, variously described as pain, cramps, pressure, and stretching; the pain may sometimes be localized. Blood may soon escape through the cervix in these severe cases, though it is usually small in quantity and is often absent. It is of the greatest importance that the physician does not estimate the gravity of a case by the amount of visible blood. In these acute severe hemorrhages death may rapidly take place unless treatment be carried out. In another type of case the symptoms of anemia may develop slowly during the course of several hours, a considerable quantity of blood escaping through the cervix, little or no abdominal distress being felt. Rarely after the primary hemorrhage there may be an oozing of blood or serum, more or less continuous, for several days. In such cases the patient may become very anemic.

Labor may frequently be induced by accidental hemorrhage. During uterine contractions, though the uterine vessels may be completely closed, there is not necessarily any diminution in the amount of blood that may be escaping through the cervix. On the contrary, it may be increased by the action of the uterus in forcing downward blood that has accumulated in the uterus. On physical examination various conditions are found. In cases where the hemorrhage is not marked palpation of the uterus reveals nothing unusual. When much blood accumulates the uterus may be considerably enlarged, feeling boggy when contractions are not present; or it may be continuously more tense than normally. The enlargement may or may not be symmetrical. The woman may or may not complain of soreness over the whole organ. When the placenta is situated on the anterior wall or fundus the accumulated blood may cause a distinct bulging of the wall, which may be palpated, usually with the production of pain. The fetal parts may be very indistinctly felt; the fetal heart sounds may not be heard, or if heard are often slow, weak, and irregular. When the placenta is posterior the fetus may sometimes be pushed firmly against the anterior wall, so that its irregularities may be visible.

Frequently on vaginal examination nothing abnormal can be detected. Clots, fresh blood, or serum may be found in the passages when external hemorrhage takes place. Sometimes a blood-mass in the lower segment may cause the fornix vaginae to feel boggy. When the cervix is dilated recent blood-clot may or may not be felt. Occasionally, when a fibrinous clot has formed, it may be felt as a stringy, friable mass, which may be mistaken for the placenta. The placenta itself cannot be felt save in the rare cases where it is prolapsed. When the membranes rupture

the liquor amnii may be darkened by the admixture of blood; this is, however, a rare occurrence. Some authors believe that occasionally there may be a transudation of blood through unruptured membranes. In many cases the escaping amniotic fluid is tinged by the blood lying in the cervix and vagina. In labor, as the fetus or placenta is delivered, clots or fluid blood that has been concealed escapes.

**Differential Diagnosis.**—Difficulty may arise in establishing a diagnosis. Some of the general symptoms may resemble those found in certain forms of acute poisoning, in the rupture of an aneurism, or in pulmonary embolism, but in these the uterine changes are absent. Similar local and general signs and symptoms may be found in rupture associated with ectopic gestation.

Rupture of the uterus may simulate ablatio, but rarely is found apart from advanced labor. If the fetus has escaped through the uterus the latter is correspondingly reduced in size, unless relaxed, and labor pains cease. Acute hydramnios must also be noted; in this condition the anemia is wanting. Fainting in a pregnant woman from causes other than loss of blood may be mistaken for that due to hemorrhage.

Those cases in which external bleeding is present must be diagnosed from cases of pregnancy in which external hemorrhage is due to other causes—*e. g.*, endometritis, cervical polypi, and carcinoma. In the latter conditions physical examination usually establishes a diagnosis; in endometritis there is never a sudden development of anemia, but there may be a resemblance to those cases of ablatio in which there is no marked disturbance, the blood being lost gradually in small amounts only.

The greatest difficulty may sometimes be experienced in diagnosing ablatio placenta from placenta praevia. In the latter condition there is never any local pain or distress, such as is present in many cases of the former. The blood that escapes is generally bright red, whereas in ablatio it is frequently dark-colored. If the cervix be dilated digital exploration can detect no placenta in ablatio save in the very rare conditions in which it is detached and prolapsed. In some cases of lateral placenta praevia it may be impossible to feel the edge unless the cervix be greatly dilated. If the cervix be placed abnormally high or the vagina be not roomy the difficulty of establishing a diagnosis is increased. The uterus does not become distended in placenta praevia. Sometimes a mass of fibrin that has formed inside the cervix may feel very much like placental tissue; its exact nature can only be determined by microscopic examination. Sometimes the nature of a case may be determined only after the placenta is delivered. In ablatio the opening in the membranes through which the fetus is born is not near the placenta, but two or more inches from it. Old clots are frequently found in connection with the

latter, which may be moulded over them, near the margin or center.

**Prognosis.**—The prognosis depends upon the amount of hemorrhage, shock, the degree of dilatation of the os, and its dilatability. Much depends on the nature of the treatment employed. The previous condition of the patient is important. If her health be poor she is not able to bear a loss of blood that might not be dangerous if she were robust. The greater the hemorrhage the graver the risks. The concealed form is much more serious than the external, since treatment is apt to be delayed. The escape of blood usually calls immediate attention to the condition, medical aid being summoned, whereas in the concealed variety the patient may be moribund before she can be helped. When the patient does not die, her after-recovery is slow and she may be very weak for a long period. The danger of infection is greater in such cases.

As to statistics, Braxton Hicks, in 1860, reported a maternal mortality of 65.2 per cent. in 23 cases; Goodell, 50.9 per cent. in 106 cases; Tarnier, 7.4 per cent. in 27 cases; Forin, 35.8 per cent. in 111 cases; Holmes, 32.2 per cent. in 189 cases; von Weiss, 50 per cent. in 106 cases.

As to infant mortality, Goodell placed it at 94.4 per cent.; Winter, at 95 per cent.; Freudenberg, at 100 per cent.; Forin, at 81 per cent.; Holmes, at 70 to 85 per cent., according to the treatment employed.

**Treatment.**—When the hemorrhage is slight palliative measures should be adopted. The patient should be kept in bed on simple diet and an ice bag or ice coil applied to the abdomen. The pulse should be closely watched and the quantity of blood lost externally carefully estimated. It is useless to administer ergot for the purpose of checking the bleeding from the opened sinuses, since small doses are of no avail and large ones might introduce new dangers. It would be more rational to endeavor to bring about clotting in the effused blood, and for this purpose calcium chlorid should be given in large doses—*v. g.*, 30 gr. every three hours—by the mouth. By such treatment a case may usually be carried along safely, the bleeding gradually ceasing, owing to the formation of a clot, which may afterward shrink considerably.

If slight bleeding continues in spite of these measures the condition may become serious, owing to the increasing anemia. Pregnancy should then be ended; this may be carried out by the introduction of a Barnes's or Champetier de Ribes bag, labor pains being allowed to empty the uterus, their action being assisted by the administration of quinin, if they be not very strong. If the patient be weak or the bleeding increase, it is advisable to hasten delivery—*i. e.*, by promoting dilatation and performing version. Forceps may be used only if the cervix be fully dilated.

When a considerable hemorrhage has occurred, but not such as to place the woman in an immediately critical condition, she should be placed at absolute rest in bed, the lower end of which is elevated. One or two pints of warm normal saline solution should be injected into the rectum through a long tube. In order to increase the coagulability of the blood, in the hope of forming a clot in the effused blood, a subcutaneous injection of a sterilized solution of gelatin (10 gr. or more) in normal salt solution (2 to 10 per cent.) may be given if the mixture can be obtained. The cervix should then be dilated with metal dilators and fingers or by rubber bags. If this proceeds easily without much tearing of the cervix, no serious hemorrhage taking place, bipolar version should be performed as soon as the canal is large enough to permit of delivery. The membranes are then ruptured and the fetus slowly delivered. During extraction firm compression of the uterus through the abdominal wall must be kept up by an assistant. If the fetus be dead and the passage of the head through the cervix be difficult, it is best to perforate the basi-occipital and allow the brain matter to escape, so that the head is reduced in size. If it is certain that the fetus is dead, as the cervix is being dilated it may be more expeditious to perform craniotomy and extract rather than to turn the child. In regard to version, it should always be remembered that the manipulations necessary to carry it out may sometimes separate to a greater extent the already loosened placenta, and so may cause more hemorrhage. Occasionally when the fetus is alive sufficient dilatation may be obtained to permit safe delivery with forceps rather than by turning.

When in such cases the cervix is so firm as to make dilatation very slow and difficult, some authorities recommend that it be incised, according to Dührssen's method. This procedure is, however, uncertain in its results and not free from grave risks. Vaginal Cæsarean section is greatly to be preferred. The incisions necessary in this operation need cause little loss of blood if the uterine arteries and divided branches of the vaginal arteries be secured early, and if continual downward traction on the cervix be kept up, accompanied with pressure on the uterus from above. Abdominal Cæsarean section rather than the vaginal operation is recommended by some authorities. These operations, however, should be carried out only if the circumstances be suitable and an expert operator be at hand. (See Cæsarean Section.)

There should not be too much delay in attempting dilatation in such cases, in order that the patient's condition may not be too much reduced. Repeated saline injections may be necessary before the delivery is finished.

Finally, in cases of very profuse loss of blood and shock, it is difficult to decide which treatment is best. All methods are apt

to result in failure. Under most circumstances the best course is to rupture the membranes immediately with a finger or bougie. The uterus should then be massaged through the abdominal wall, in order to promote retraction on the fetus. A firm binder should then be fastened around the abdomen; bleeding may thus be checked. Efforts should then be made to combat the condition of anemia and shock by saline injections or transfusion of blood, elevation of the lower end of the bed, bandaging of the limbs, etc. Later, labor pains may supervene, but dilatation of the cervix should be promoted by artificial means. No thought need be given to the fetus, as it almost always dies in such bad cases. Perforation of the head may, therefore, be employed as soon as the canal is large enough to permit of extraction. In no case should ergot be administered while the fetus is in the uterus. Quinin may, however, be given. Early rupture of the membranes is widely employed in the treatment of *ablatio placenta*, but there is little doubt that the results following its application are not such as to justify its routine use. Holmes has examined a large number of case reports, and has found that in a considerable percentage hemorrhage was not at all checked or only partially. It cannot be relied upon with the certainty that exists in cases of *placenta prævia*.

The vaginal tampon has been considered by many to have no place in the treatment of *ablatio placenta*, but to be of much value in cases of *placenta prævia*. Attention, however, should be called to the reports of Smyly and Tweedy as to the value of vaginal plugging combined with firm bandaging of the abdomen and perineum. They do not recommend the method in concealed hemorrhage, nor after the membranes have ruptured. The vagina should be packed with a large number of sterile cotton-wool plugs. Colclough, in speaking of this method, advises that when the pains have been very vigorous for a time a few of the plugs should be removed from the vagina. At Dublin, in the Rotunda, this method is now the routine treatment for marked external accidental hemorrhage, especially in cases in which the pains are not vigorous and the os not well dilated. Colclough reports that hemorrhage was successfully controlled in 42 out of 43 cases.

In all cases after extraction of the fetus the placenta and membranes should be immediately removed by the introduction of the hand into the uterus. As the danger of postpartum hemorrhage is great, the uterus should be at once tamponed, and the organ should be massaged through the abdominal wall an hour or more. Large doses of ergot should be given with a hypodermic needle.

As regards the relative merits of expectant measures and artificial interference, von Weiss, from his study of 106 cases,

states that the former has a mortality of 74 per cent., and the latter one of 30 per cent.

(Caesarean section has been recommended by some in cases of extreme loss of blood. Such a procedure might be justifiable if the patient were in such a position as to be operated upon immediately, rapidly, and aseptically, but under no other circumstances.)

#### HEMORRHAGE DURING THE THIRD STAGE.

Normally in labor slight hemorrhage is frequent after the birth of the child, as a result of laceration of the perineum, vagina, or cervix. The amount varies greatly in different cases. Sometimes it is considerable; occasionally excessive. When the vagina is badly torn there may be an alarming flow, owing to the opening of enlarged veins in the paravaginal tissue. In other cases hemorrhage may proceed from the interior of the uterus, when the placenta is separated entirely or partly and not expelled, owing to uterine inertia, irregular contractions and retraction, or to adhesions between the placenta and uterus. Bleeding may also be due to rupture or inversion of the uterus, as well as to new growths in the genital tract. It is important that the source of the bleeding should be definitely located in each case. This can only be done by systematic examination. The signs found in the above-mentioned conditions are given where the latter are individually described, the appropriate treatment being also considered.

#### POSTPARTUM HEMORRHAGE.

Bleeding from any part of the genital tract may be included under the term postpartum hemorrhage. In the present connection it is restricted to the cases in which the blood flows from the cavity of the uterus, after the birth of the placenta, within the first six hours following labor. This complication of labor is frequently due to mismanagement on the part of the medical attendant. When the hemorrhage is excessive the results to the patient may be very serious. It always demands prompt and energetic treatment.

**Etiology.**—The most important alteration that is associated with postpartum hemorrhage is absence or diminution of the contraction and retraction that are normally present in the uterus after the expulsion of its contents, and which exercise an important influence in checking the flow of blood through the uterine wall, and consequently from the opened sinuses in the placental area.

All causes of uterine inertia or atony, therefore, favor postpartum hemorrhage. Thus, it may occur after prolonged, difficult, or rapid labors, or in cases in which there has been unusual

enlargement of the uterus—*c. g.*, multiple pregnancy or hydramnios. Prolonged anesthesia and certain constitutional conditions—*c. g.*, anemia, Bright's disease, heart disease, hemophilia, tuberculosis, obesity, and general weakness—favor hemorrhage. It occurs more frequently in multiparae than in primiparae, a rapid succession of labors being particularly favorable, owing to weakness of the uterine wall from overwork of the muscle and excess of connective tissue; sometimes paralysis of the placental part of the wall may be a cause. All conditions that prevent the uterus from sinking into the pelvis and acting as a ball-plug favor bleeding—*c. g.*, distended bladder or rectum and ovarian or other tumors. Uterine fibroids may prevent the uterus from sinking, but they may directly prevent proper uterine contraction and retraction. A contracted pelvis may not allow the normal descent and so may favor hemorrhage. In an enlarged pelvis the uterus may descend, but does not act as a plug, and, therefore, favors hemorrhage. Sudden emotional excitement may cause relaxation of the uterus. Hemorrhage may follow retention of part of the placenta, membranes, or blood-clots. It is favored by a low implantation of the placenta (*placenta praevia*).

**Diagnosis.**—Bleeding may take place slowly and gradually, the clothes around the patient becoming soaked, her attention being thus called to the condition. In some cases it is profuse and escapes in rapid gushes, with or without clots. Frequently, when the latter are formed in the uterus, its efforts to expel them cause pains in the abdomen, usually in the loins, and these may first attract attention to the hemorrhage. Generally, however, the patient's condition indicates the loss of blood. She grows paler, the skin becoming waxy in extreme cases, and sometimes cold and clammy. Respirations may be rapid and shallow, and yawning may be a noticeable feature. She may complain of faintness and indistinctness of vision. The pulse becomes rapid and feeble. These signs may be present though little external bleeding has occurred, hemorrhage taking place into the uterine cavity and vagina, or into the former only; in these cases a free escape of serum through the vulva may be noted. In other cases there may be considerable combined external and internal loss. In fatal cases convulsions and loss of consciousness supervene. The amount of blood that a woman can lose without danger varies according to a number of conditions, among which the general health is an important factor. Physiologists have stated that one-third of the blood may be lost, in a healthy woman, without risk of death.

On palpating the abdomen the body of the uterus may be felt enlarged as high as or higher than the umbilicus; in the worst cases of internal hemorrhage it may occupy a large area of the abdomen. Frequently its outline is indefinable, owing to the

softness of its wall. Indeed, it may be palpated only when it makes an effort at retraction or contraction. Some degree of hardening may be noted as a result of the stimulus of palpation.

In the majority of cases in which there is marked external hemorrhage along with internal accumulation, the uterus does not reach the size usually found when there is mainly internal bleeding. Very rarely uterine hemorrhage occurs with a considerable degree of retraction and contraction in the uterus. In such cases the blood chiefly comes from a torn cervix, or from that part of the lower uterine segment that has not undergone retraction and has been torn, or which has been the site of a placenta prævia.

Hemorrhage from the uterine cavity must be diagnosed from that due to the laceration of the cervix, vagina, or perineum, from a ruptured varicose vein, a new growth, or a ruptured hematoma. In these conditions the uterus should be retracted and contracted; the exact source of the bleeding may sometimes be determined only by careful examination of the lower genital tract.

**Prognosis.**—Marked loss of blood following labor must ever be considered as a grave occurrence. It is impossible to estimate the amount poured out in any case. But the seriousness of a case must be judged not by the actual quantity of blood lost, but by the woman's condition. As has been stated, that which may be a dangerous loss for one may scarcely affect another. The general health is an important consideration; thus, those who are already anemic, or weakened by previous disease or an exhausting labor, cannot afford to lose much blood. When death does not occur the patient may remain very weak, even months after labor. Septic infection may more readily take place. She may be too feeble to nurse her child.

**Treatment.**—**Prophylaxis.**—It cannot be too strongly emphasized that postpartum hemorrhage is almost always due to the careless or wrong conduct of labor on the part of the medical attendant. Remembering that uterine inertia is the most important factor in its production, all the conditions that may lead to this complication must be prevented.

Too prolonged a first stage in cases of slow and difficult dilatation, causing general exhaustion and uterine weakness, should not be permitted. Neither should there be too great delay in the second stage. When artificial delivery is carried out, extraction must not be too rapid; in these cases it is advisable that the hand of an assistant should be kept on the fundus of the uterus, causing it to follow the descending fetus.

In cases of hydramnios the liquor amnii should be slowly evacuated. In a twin labor, after the first child is born, there should not be too much hurry in the delivery of the second. At the end of the second stage a hand should be kept on the abdominal

wall over the fundus until the placenta is delivered, and sometime afterward. In this position the condition of the uterus may best be determined and deviations from the normal be corrected. In many cases no manipulations are necessary, the third stage being completed normally, the hand simply covering the fundus, ready to act when necessary. This stage must not be hurried. Early forcible compression of the uterus, while the placenta is still attached, for the purpose of hastening the delivery, is bad practice save where there is some distinct indication for its employment.

Undue relaxation of the uterus is checked by massage of the fundus, one or both hands grasping it anteroposteriorly. After the third stage is finished the fundus should be held twenty or twenty-five minutes in normal cases, and an hour or more in those in which there is a distinct possibility that uterine inertia might supervene; in the latter ergot may be administered. The placenta should be carefully examined as soon as expelled, and if any portion has been left in the uterus this should at once be removed. When the hand is removed from the fundus a firm abdominal binder should be applied. Additional stimulation of the uterus may be obtained if three folded towels be placed under the binder, above the fundus of the retracted and contracted organ.

**Active Treatment.**—Of great value in promoting retraction and contraction of the relaxed uterus is massage of the organ through the abdominal wall. It should be grasped anteroposteriorly with one or both hands and compressed or massaged. These manipulations are usually sufficient to expel blood and clots from the uterine cavity. Sometimes they fail to do this, and it is necessary to introduce a hand, carefully sterilized (a boiled rubber glove gives the best protection), for the purpose of removing the clots (and any retained portions of the placenta and membranes). The intra-uterine manipulations serve also as an additional stimulus to the uterus. Before the introduction of the hand the external genitals should be thoroughly cleansed. The organ should then be compressed externally and pushed well down into the pelvic cavity. Arendt has advised grasping the anterior and posterior lips of the cervix, in order to pull the latter well down toward the vulva; this traction helps to check the flow of blood through the uterine arteries. If employed alone, however, it is efficacious only for a very short time.

In addition to these measures, intra-uterine irrigation with hot sterile water (120° F.) through a large long-curved double catheter is widely recommended. If the temperature cannot be measured with a thermometer, it may be roughly estimated by pouring some of the water on the back of the hand, which should just be able to bear the heat. Care should be taken not to introduce too hot water, lest the tissue be damaged. If the fluid be not hot enough it does not stimulate the uterus to contract, but rather

favors bleeding. In beginning the injection air may easily be carried into the uterine cavity and give rise to air embolism. The water should, therefore, be allowed to run through the catheter before it is introduced. While the stream flows, there should be a good return current; if this be prevented the uterus may be distended by the fluid. According to Helme's experiments, the duration of the hot douche should not exceed two minutes; beyond this the effect is to raise the temperature of the uterine musculature, to enfeeble its contractions, and make them irregular.

The application of ice to the abdomen and vulva has long been practised in cases of hemorrhage, but its influence cannot be compared to that of the manipulations already described. Helme has studied the effects of the intra-uterine cold douche (40° to 50° F.), and points out that it produces an immediate, powerful, and prolonged tetanus-like contraction of the uterus, a marked influence being also exerted on the walls of the blood-vessels. If, however, the cold douche be too long continued, paralysis of the musculature may follow; the duration should not be longer than two or three minutes. Helme is of the opinion that the cold douche is better than one of hot water for the purpose of immediately checking postpartum hemorrhage. These views differ from those of Milne Murray, who has also worked experimentally at the subject. He holds that the hot douche is more desirable, producing greater rapidity of action and greater duration of contraction, while it warms and stimulates the patient and does not abstract heat from her tissues.

Packing of the uterine cavity is a very valuable method of checking hemorrhage, the uterine musculature being stimulated, while thrombosis in the open sinuses is favored. When the tampon is in position, external manipulations of the uterus through the abdominal wall may be more effectively employed. The best tampon is a long strip of sterile or antiseptic gauze. In my own practice I employ chinosol gauze, iodoform gauze not being desirable, on account of the risk of toxic phenomena from absorption of the drug. To introduce the tampon the patient should be placed in the lithotomy position, and the external genitals cleansed and protected by sterile coverings. The vagina should be opened with retractors and the cervix steadied with a volsella; at the same time the body of the uterus should be compressed and steadied through the abdominal wall by the hands of an assistant. The gauze should then be packed firmly in the uterus, the lower end passing through the cervix into the vagina. Rudolph Holmes has devised an instrument by which the introduction of the gauze is facilitated. It consists of a long tube, meant to enter the uterus, the gauze being pushed through it by a long steel rod, the tube being gradually withdrawn. In every case of marked hemorrhage the intra-uterine tampon should be employed. It may safely be

left in position for twenty-four hours. Several authors advise that in cases of marked hemorrhage absorbent gauze should not be used, because it acts as a drain for blood and serum. Schaeffer has recommended a non-absorbent gauze, prepared by impregnating it with gutta-percha.

Ergot is widely employed for the purpose of checking bleeding. Its effects on the uterus have been studied chiefly by Nikitin, Marckwald, and Helme. Marckwald showed that ergot is valuable in producing uterine contractions, but has very little influence in checking the flow of blood through the arteries. Of its two chief constituents, ergotinin has no effect on uterine contractions and increases the flow of blood through the arteries, sclerotic acid increasing uterine contractions and diminishing the flow through the arteries. The ergotinin and sclerotic acid, therefore, seem to antagonize each other as regards the influence on arteries, though the action of the latter is slightly greater than that of the former. Ergotinin alone is, therefore, of no value in checking hemorrhage. Helme has corroborated Marckwald's results. He points out that the larger the dose of ergot, the greater the intensity and duration of the individual contractions of the uterus, rhythmic action being preserved and no tendency to true tetanus being noted. In obstetric work hermetically sealed bulbs of aseptic ergot are reliable long after they are prepared. In ordinary bottles the ergot decomposes in a short time. Chloral has been used as a preservative, but Helme has shown that it is inefficacious for more than a week; moreover, it tends to diminish uterine contractions as well as to dilate vessels. In all cases where rapid action of the ergot is needed the drug should be injected into muscle.

Compression of the abdominal aorta against the spine may be advantageously employed in all bad cases in addition to other measures. This is not only beneficial in checking the flow of blood through the uterus, but also in stimulating the uterus to immediate contraction, as Helme has demonstrated experimentally. Strong styptics—*e. g.*, perchlorid of iron—should never be employed for the purpose of checking postpartum uterine bleeding. These fluids may enter the veins, and they destroy a large quantity of tissue on the inner wall of the uterus, thereby producing a condition of the parts favorable to microbic growth if infection should occur. Faradic electricity applied to the uterus through the abdominal wall is a valuable stimulus to uterine contraction, but it is rare that a battery is at hand when it is needed in these cases.

In addition to the local measures just described, it is important in all cases in which much blood is lost to employ the following means for the purpose of counteracting the effects of the acute anemia: The foot of the bed should be elevated 12 in. or more.

A pint of hot (110° F.) normal saline solution should be introduced into the bowel through a long rectal tube, in order that absorption may take place, the volume of fluid circulating in the vessels increased, and the body temperature raised. This should be repeated in thirty to sixty minutes and again in four or five hours. If this be not retained, a subcutaneous injection (110° F.) may be given under each breast. In extremely acute cases, where the danger of death is imminent, an arm and an opposite leg may be elevated and bandaged from their extremities to the trunk, in order temporarily to increase the quantity of blood circulating in the head and trunk. After thirty minutes the bandages may be loosened if abundant saline solution has been introduced into the system, and, if necessary, the other arm and leg may be similarly treated. In bad cases it is also advisable to apply heat to the exterior of the body by means of hot-water bottles. It may be necessary to give cardiac stimulants hypodermically. As soon as the patient can retain fluid in her stomach, hot strong coffee, hot milk, or hot brandy and water may be given repeatedly in small doses.

In the convalescent stage the patient should remain in bed longer than the normal period; in bad cases at least a month. Nursing should be prohibited. Careful medicinal and dietetic measures should be employed to build up the blood. The increased risk of infection should be remembered, and if there has been any imperfection as regards a sepsis in the manipulations employed in the genital tract, antiseptic douches should be freely used.

(Secondary postpartum hemorrhage will be considered in the chapter dealing with the Pathology of the Puerperium.)

#### RETAINED PLACENTA.

This term may be applied to conditions in which the placenta is not delivered within the normal period, including the cases in which it is unseparated or partly separated, lying in the upper uterine segment; or separated and lying in the lower segment and cervix, in the vagina, or in all three. Many, however, restrict the term to the cases in which it is in the upper segment, attached or partly separated.

**Causes.**—When the placenta is separated, but remains below the upper uterine segment, the reason for the failure in its delivery is, in the great majority of cases, faulty action of the accessory muscles, often associated with marked stretching of the linea alba, the voluntary efforts of the patient being insufficient to bring about expulsion. Very rarely is the placenta firmly held by an abnormally contracted cervix. Occasionally adhesion of the membranes prevents the expulsion.

Retention of the placenta in the upper segment is due to inertia of part or the whole of that portion of the uterus. The inertia may be due to constitutional weakness, prolonged or difficult labor, or too rapid delivery. It may also be due to the condition of the uterus described as "hour-glass contraction." This is simply an excessively contracted or retracted ring-like portion of the uterine wall above the remains of the lower uterine segment; it is, indeed, a postpartum retraction ridge, the lower edge of the upper uterine segment. Below this ridge the lower segment and cervix may usually be felt soft and flabby.

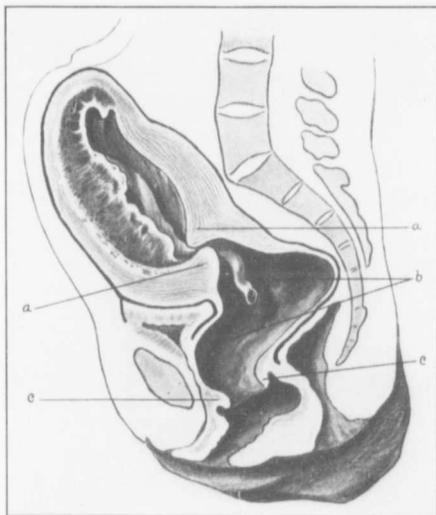


FIG. 251.—Hour-glass contraction of uterus. The contraction is due to abnormal development of the retraction ridge below the placenta: *a a*, Internal os; *b*, cervical cavity; *c c*, external os (Bumm).

**Diagnosis.**—As long as the placenta remains within the upper uterine segment the body of the uterus, as palpated through the abdominal wall, remains as large as it was immediately after the birth of the fetus. The fundus is in the region of the umbilicus; the body feels somewhat rounded, the retracted wall being firm, usually relaxing and hardening at intervals. If intra-uterine hemorrhage occurs, the blood being retained, the organ may be much enlarged and its outline may become inde-

finable; in this condition there are symptoms of anemia. On internal examination the placenta may be felt above the cervix and lower segment.

When the placenta is held partly above and partly below the retraction ridge, the body of the uterus may be felt through the abdominal wall, slightly smaller than when the placenta is entirely in the upper segment, unless blood accumulates in the latter. On internal examination the lower portion of the placenta is felt below the ridge, while the latter is felt firmly holding the placenta.

When the placenta lies below the upper uterine segment, the latter, if firmly contracted, is felt hard and no larger than it is in the normal early postpartum state. It is, however, much higher above the pelvic brim, being prevented from sinking down because of the retention of the placenta. On internal examination the latter is easily felt in the cervix or upper part of the vagina.

**Treatment.**—In all cases of retained placenta careful examination of the uterus should be made through the abdominal wall, in order to determine the procedure. A vaginal examination is rarely necessary, and should be made as seldom as possible. If the bladder contain urine, it should be emptied before manipulations are carried out. When there is uterine inertia, catheterization may be followed by fresh uterine contractions. If the examination of the abdomen proves that the upper uterine segment is empty, the uterus should be grasped with one or both hands and pressed downward in the axis of the pelvic brim, in order to expel the placenta. As the latter appears at the vulva it should be rotated, the membranes being thereby twisted into a rope, so as to lessen the chance of tearing them.

When the placenta lies in the upper segment, the uterine body should be steadily massaged through the abdominal wall. If, after ten or fifteen minutes, there is no expulsion of the placenta, the upper part of the uterus should be compressed anteroposteriorly, not forcibly, but cautiously. If this fails to make the placenta descend, no further efforts of this kind should be made. After cleansing the patient's external genitalia the right hand, thoroughly sterilized, should be introduced in the shape of a cone into the vagina and passed through the cervix, the latter being dilated, if necessary. The fingers, placed side by side, are then inserted between the lower edge of the placenta and the uterus and moved from side to side, so as to bring about complete separation. During this procedure counterpressure is exerted with the other hand placed on the abdominal wall. The placenta is gradually withdrawn by the hand and is rotated as it descends in the vagina, so as to twist the membranes into a rope, lessening the chances of their retention. Immediately afterward the placenta and membranes should be carefully examined in sterile water. If a portion of the placenta is missing, the uterine cavity

should be explored. If a considerable portion of membranes be retained, the fingers should be introduced into the uterus to extract it. When there is marked closure of the retraction ridge (so-called "hour-glass contraction"), dilatation must be carried out by the fingers, deep anesthesia usually being necessary.

In conclusion, it must be emphasized that internal examination is rarely necessary when the entire placenta is retained, since a diagnosis may almost always be established by external examination



FIG. 252.—Method of separating and removing placenta by introduction of hand into uterus (Bumm).

if the anatomic relationships are thoroughly understood. In a few cases, especially those complicated by hemorrhage, internal examination is necessary.

#### ADHERENT PLACENTA.

Occasionally the placenta is retained in the uterus because the tissue that is normally torn is abnormally firm. It must, however, be remembered that adherent placenta is sometimes diagnosed when the condition does not exist, the retention being due to other causes.

It is usually said that the causes of adherent placenta are inflammations of the decidua and placenta. It is very doubtful, however, if inflammatory changes in the villi ever interfere with the delivery of the placenta. The normal separation plane is through the decidua, and it is likely that the so-called "adhesions" are merely portions of decidua so firm, as the result of inflammation, that they are not torn in the normal manner. In most cases it is probable that the toughness of the tissues is due to an old inflammatory process that existed before pregnancy, though sometimes it may be induced in pregnancy—*e. g.*, in some forms of syphilis. The condition is met with in different forms. Rarely the tissues are so extensively altered that no part of the placenta separates. Usually only one or more portions of the decidua are affected, partial separation taking place. The adhesions are much firmer in some cases than in others.

**Diagnosis.**—When the placenta does not separate at all, it remains in its normal position in the upper uterine segment, the uterus being retracted around it. There is no hemorrhage from the uterine cavity. If attempts are made to expel the placenta by moderate compression of the uterine body, they are ineffectual.

When the placenta is partly separated in its lower portion, hemorrhage occurs and a large quantity may escape through the cervix; in some cases the loss may be rapid and alarming.

When the upper part of the placenta is separated, very little blood may be poured out, and it may accumulate in the upper part of the uterus, very little escaping through the cervix; in some cases a considerable quantity may escape.

**Treatment.**—When the diagnosis of adherent placenta is made, removal by intra-uterine manipulations is necessary, the fingers being used in the manner already described to separate the placenta. In some cases this is accomplished with difficulty, and it may be impossible to remove the placenta without tearing it and extracting it piece by piece. The procedure should be followed by very thorough washing out of the uterus with hot normal saline solution, in order to remove loose portions of tissue and blood-clot.

With regard to the frequency with which artificial separation and removal of the placenta are necessary, it is interesting to note Littauer's statistics of 10,978 labors in Leipzig. He found that, excluding placenta prævia cases, it was practised in the proportion of 1 in 186 labors at or near term, or 1 in 161 including premature labors. Hönek, of Hamburg, in a large maternity experience, had a proportion of 1 in 365.

#### RUPTURE OF THE UTERUS.

The cervix and the lower and upper segments of the uterus may be ruptured in connection with labor. The term as here employed signifies the condition in which rupture of the uterine body

is the predominant lesion. Reference has already been made to its occurrence (rarely) in pregnancy; in the great majority of cases the lesion is related to labor. While in pregnancy rupture is rarely spontaneous, in cases of labor the majority are of this nature. According to Jolly, in 573 cases, 376 were spontaneous and 197 traumatic.

**Etiology.**—Certain conditions may be regarded as predisposing. Thus, rupture is more frequent in multiparae than in primiparae, the proportion being, according to Bandl, 8 to 1. Trask found that in 303 cases there were only 24 primiparae, while Jolly noted only 37 in 455 cases. Very frequent child-bearing, especially if the pregnancies succeed one another closely, leads undoubtedly to a deteriorated condition of the uterine wall. The arteries and veins in the uterus and broad ligaments may be considerably altered. In the former degeneration may be present in the intima; in the veins dilatation and varicosity are present. As a result the nutrition of the uterine tissue is altered and it is more readily torn. There is an increase of the intermuscular connective tissue that lessens the resistance of the uterine wall. Chronic inflammatory changes in the wall lessen its resiliency. Abnormal thinness predisposes to rupture; this may be due to hydramnios or multiple pregnancy; it may be caused by a fibroid tumor or may be congenital (*i. e.*, malformed uterus), but it is most frequently produced in labor by conditions shortly to be described. Cicatrices following a previous rupture or a Caesarean section are weak areas. The lower uterine segment is more easily torn in cases of placenta previa than in normal cases. The wall may be weakened by fatty degeneration or by carcinoma. In a few cases of spontaneous rupture early in labor the cause of the friable uterus can not be determined. When the cervix is very rigid, so that it will not dilate easily, or when it is the seat of a tumor, there is increased risk of rupture. All forms of contraction of the hard passages that interfere with the normal action of the uterus in labor and with the descent of the child are predisposing factors. Similarly, any narrowing of the soft canal due to congenital defects, cicatricial contractions, or the pressure of tumors and other swellings, are favoring conditions. Rarely rupture follows thinning of the wall in hydatidiform degeneration of the chorion. On the part of the fetus must be mentioned excessive size, deformities of parts—*c. g.*, hydrocephalus or monstrosity, malpositions and malpresentations—*c. g.*, transverse. Rupture is more frequent with male than with female children.

The exciting or determining causes of rupture in labor are as follows: Rarely there is some form of external traumatism—*c. g.*, a fall or blow. The most frequent form of traumatism is that resulting from attempts at delivery on the part of the accoucheur—*i. e.*, performing version or using instruments. The administration

of ergot in delayed labor may cause rupture of the lower uterine segment by inducing excessive contractions in the upper segment. Sometimes the wall may rupture as the result of long-continued pressure between the fetus and the bony wall of the pelvis. In a very large percentage of cases spontaneous rupture takes place as a result of extreme retraction of the upper uterine segment, the lower segment being stretched and thinned over the presenting portion of the fetus.

The differentiation of the uterine wall in labor has already been fully considered. (See p. 160.) It has been pointed out that the retraction ridge which extends around the wall of the uterus is the lower boundary of the upper thick active segment, that part of the uterine wall below it being thin and to a large extent inactive in labor. When labor is obstructed from any of the causes enumerated above and the upper segment continues to be active, excessive retraction accompanied by contractions results in the elevation of the retraction ridge, while the lower segment thins and stretches and may at length rupture. In almost all cases this occurs after the membranes have burst. While it is probable that as long as these are intact the danger of uterine rupture is lessened, it must be remembered that occasionally this lesion may take place before the liquor amnii has escaped. Occasionally spontaneous rupture of a friable uterus may occur early in labor, before the retraction ring is well differentiated, when the cervix is not abnormally rigid. Such cases have been reported by A. R. Simpson and Milne Murray.

**Frequency.**—Statistics as to the frequency of rupture of the uterus vary greatly. Though it is not so common as in the pre-anesthesia days, it is probably more frequent than is generally believed. It is extremely rare in labors conducted by skilled obstetricians, and is generally found in the practice of midwives and unskilled practitioners. It is more common in districts where marked pelvic deformities are found. A few of the statistics are as follows: Koblanck's, 1 in 462 labors; Winckel's, 1 in 666 labors; Bandl's, 1 in 1200 labors; Jolly's, 1 in 3403 labors.

**Pathologic Anatomy.**—Rupture may be found in any part of the uterine wall. This is especially the case when the rent is due to external injury—*e. g.*, a fall—to a new growth causing thinning, or to the tearing of an old cicatrix. In the great majority of instances, however, it is the lower uterine segment that is affected. Ruptures are described as complete when the whole wall is torn so that a communication is established between the uterine and the peritoneal cavities. The rupture varies in size, shape, and direction; it may admit the passage of one or two fingers or of one or two hands. The openings caused by pressure-necrosis are usually small and rounded; they may be opposite the promontory, top of the symphysis, or an exostosis. Generally the

rupture is an irregular slit. It may be vertical, oblique, or transverse; straight, curved, irregular, zigzag, stellate, T-shaped, L-shaped, etc. Rarely it is circular, involving almost the whole circumference of the lower uterine segment; in this condition the main portion of the uterus may rise in the abdomen. The edge of the rent is usually irregular and rough, somewhat contused and swollen, and infiltrated with blood. Where there has been much pressure against the bony wall the tissue may be somewhat necrotic. The peritoneum is loose around the rent and separated to a greater or less extent; effused blood may burrow under it, forming a clot. Rupture most frequently occurs on the left side. It is generally single, but sometimes the wall may be torn in different places. With a complete tear there may be one or more incomplete rents.

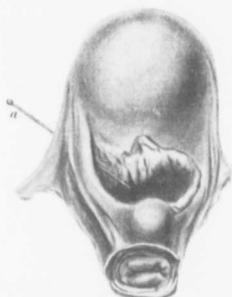


FIG. 253.—Transverse rupture of lower segment of uterus (Spiegelberg): *a*, Probe inserted under the peritoneum.

The fetus usually dies when there is a well-marked rupture. Sometimes it remains entirely within the uterus. When the rupture is large, it generally passes partly or entirely into the peritoneal cavity. In the latter instance it may lie close to the uterus or at some distance from it, among the intestines. The uterus may remain relaxed after the escape of the fetus, but it may retract more or less firmly. The placenta may remain in the uterus, separated or not, or may pass partly or entirely into the peritoneal cavity. Rarely it may pass through the rupture, the fetus remaining in the uterus. Stoltz has reported a case in which, in advanced gestation, a rupture of the uterus occurred, extending from the fundus to the cervix, through which the entire ovum escaped, with unbroken membranes, into the peritoneal cavity. Blood escapes among the intestines in varying quantities, usually mixed with liquor amnii. In cases in which the cervix has been dilated and the membranes ruptured micro-organisms may enter the uterus and peritoneal cavity, especially if labor has been protracted or has been conducted in a dirty manner. Decomposition and septic infection may follow, in connection with which emphysematous changes may take place in the fetal and maternal tissues; escaped blood may be entirely fluid or partly coagulated. Through the rupture intestines may enter the uterine cavity, though this cannot take place to any marked extent when the uterus retracts well, as it often does after the escape of the fetus. The bowel may pass as low as the vagina; sometimes it

becomes strangulated. The rectum is rarely ruptured along with the uterus; more frequently the bladder is involved. The cervix and vagina may also be implicated.

Incomplete ruptures are usually those in which the mucosa and musculature are more or less divided, the peritoneal coat being intact. The peritoneum around the rent may or may not be dissected away and bulged out by blood-clot. Sometimes a very large subperitoneal accumulation may form and may burrow in the broad ligaments, iliac fossa, and elsewhere. Sometimes the peritoneum bursts and the rupture is made complete. The fetus may remain entirely in the uterus, or part of it may protrude through the rent and lie under the peritoneum. Rarely the placenta may escape and remain in the latter position.

Another form of incomplete rupture has been described—viz., that in which the serosa and part of the musculature are divided. They may be slight or extensive and may involve large sinuses, leading to marked escape of blood into the peritoneal cavity. They may be found on any part of the uterus, chiefly in the upper portion.

**Symptoms and Physical Signs.**—In the majority of cases of rupture the accident is preceded by clinical conditions that should suffice to give warning of the threatening danger. Usually there is a history of a protracted labor, especially after dilatation of the cervix and rupture of the membranes. The cause of delay should have been recognized—*e. g.*, contracted pelvis, malpresentation, tumor, etc. There may have been marked uterine contractions with expulsive efforts on the part of the accessory muscles without advance of the fetus. Increasing abdominal distress or pain, more or less continuous, may be present. In palpating the uterus, especially above the pubes, the woman complains of tenderness. Through the stretched lower uterine segment the fetus may be felt with great distinctness if the abdominal wall be not too fat. Along the line of the round ligaments there is increased resistance and soreness, and one or both may be very distinctly felt. The retraction ridge is felt to rise higher and higher above the symphysis, and may be felt as an oblique or transverse thickening, two or more inches above the pubes. The pulse and temperature usually rise and the patient is anxious and distressed. Rupture usually occurs during uterine contraction or while some manipulation is being carried out; it may be accompanied with great pain and the woman may have a sensation of tearing. Movements of the fetus and contractions of the uterus cease, and there is usually a feeling of relief, succeeded by shock and signs of hemorrhage, and often dull abdominal distress. Sometimes uterine contractions may continue for a little while. External bleeding may or may not take place. The woman becomes greatly collapsed and may soon die.

The appearance of the abdomen varies. It may present a uniform roundness, especially when much blood has escaped into the cavity and the intestines have been floated up and distended. Sometimes an irregular mass is visible, consisting of the uterus with the fetus partly delivered through the rent or lying alongside it. Sometimes the uterus may form a marked anterior projection, the fetus lying behind it. Palpation usually causes distress, so that it may be difficult to outline the parts. The difficulty is increased when there is much meteorism. The uterus varies in shape and size according to whether the fetus is entirely within it, entirely without, or partly escaped from it. In the first case the mass is large, firm, and irregular, the uterine wall being moulded on the fetus. In the second case the uterus is sometimes soft and relaxed, but generally retracted and somewhat firm, lying anterior to the fetus or on one side. When the fetus is only partly escaped through the rupture the whole mass is large and very irregular. It is rare that fluid blood can be detected by palpation and percussion. When a large subperitoneal hematoma is formed on the anterior wall of the uterus, in the broad ligament, or in the iliac fossa it may be palpated. Fetal movements and the fetal heart sounds are rarely detected after escape from the uterus. Emphysematous crackling may sometimes be detected at the seat of rupture by palpation.

On vaginal examination the part of the fetus that presented earlier in labor is found to have moved. No portion whatever may be felt if it has passed completely into the peritoneal cavity. If it has partly escaped it may be found in the torn rent. The placenta and membranes may be palpated, the former separated or not; abundant blood-clots may be present. The irregular edge of the rupture may often be felt, and through it intestines may sometimes extend into the uterus. On catheterizing the bladder no urine may be obtained if the rupture has extended into the viscus, though sometimes bloody fluid may be present. Occasionally blood may be found, though no rupture exists; it probably results from contusion of the wall in labor.

In exceptional cases complete rupture may not be associated with the above distinctive phenomena. It may exist without interfering with the delivery of the fetus through the vagina. The rupture may not be accompanied with pain, hemorrhage, or change in uterine contractions. These are usually cases in which the rent is not large. Sometimes the fetus may pass into the peritoneal cavity, causing very little shock, hemorrhage, or pain, and the woman may not be able to state the time of its occurrence.

In incomplete subperitoneal rupture the symptoms are not as marked as in complete rupture. Uterine contractions may cease sometimes, but they may continue, though considerably modified.

The fetus does not escape entirely from the uterus. It may remain within the cavity, or part of it may bulge into the rent under the peritoneum. Hemorrhage is usually present, varying in amount in different cases. The blood escapes to the exterior, but may accumulate internally, burrowing under the peritoneum. The symptoms due to loss of blood may, therefore, vary considerably; they are rarely of the worst type.

On physical examination, when the fetus remains in the uterus, no change may be distinguished. If the peritoneum external to the rupture is bulged by a hematoma, the swelling may be palpated if it be large and situated laterally or anteriorly. If part of the fetus bulges into the rupture, it may often be palpated as an irregular projection from the uterus proper, and the latter may be sometimes correspondingly reduced in size. On vaginal examination the edges of the rupture may frequently be palpated. The peritoneum may sometimes be felt as an unbroken layer, and a blood-accumulation may be outlined when situated anteriorly or laterally. When rupture of the peritoneal surface of the uterus occurs, there is no external hemorrhage, and no rent can be felt on vaginal examination. The symptoms are those of loss of blood internally, and they vary according to the extent of the hemorrhage.

**Prognosis.**—The risks to the mother and child are very great in complete rupture of the uterus. The child dies in nearly all cases, death being due to asphyxia. The chief danger to the mother in all cases are primarily, loss of blood, and secondarily, septic infection. The risks are increased by prolapse and strangulation of intestine and by rupture of the bladder. In subperitoneal rupture the risks are much smaller. The mortality is much greater in cases of complete rupture when surgical treatment is not carried out than when it is.

**Diagnosis.**—The diagnosis of rupture is, as a rule, easy. When the condition is produced slowly; when the loss of blood is not great; when the fetus remains in the uterus and the contractions of the latter do not cease, there is difficulty in being certain as to whether a rupture exists or whether it is complete or incomplete, especially in cases where there is a normal vertex presentation of the head.

Rupture of the uterus must be diagnosed from placenta prævia. In the latter there is not necessarily any abnormality in the shape of the uterus or in the position of the retraction ring; moreover, the placenta may often be felt on vaginal examination. Occasionally in rupture of the uterus the placenta is detached and prolapsed; it may then be mistaken for placenta prævia. It must also be distinguished from detachment of the normally situated placenta. In the latter there is no elevation of the retraction ridge nor extra tension in the round ligaments. There is no sudden change, such

as is found in most cases of rupture of the uterus. Moreover, accidental hemorrhage generally occurs before labor or in the early first stage. Rupture of the liver or spleen may simulate that of the uterus as regards shock and loss of blood, but no abnormality is necessarily found in the uterus.

In all cases it is essential to bear in mind the complications that may exist with uterine rupture—*i. e.*, prolapse and strangulation of the bowel, rupture of the bladder or rectum, escape of the liquor amnii with vernix caseosa and meconium into the peritoneal cavity, and septic infection.

**Treatment.**—Prophylactic measures vary according to the conditions that exist in any given case. The most careful physical examination is necessary to determine the position of the retraction ridge and the presence of any of the causes that lead to rupture. If it be feared that the accident may occur, the patient should be anesthetized to diminish uterine activity and delivery should be promoted. Sometimes it may be that a cervix requires to be dilated. Forceps delivery or embryulcia may be indicated. Version is always contraindicated, since it increases the risk of rupture. In some cases Cesarean section may be necessary.

When rupture occurs, various procedures may be adopted. When it is incomplete, the fetus being in the uterus, delivery should be accomplished by means of forceps unless the cervix be not sufficiently dilated, or there be some obstruction in the hard or soft parts contraindicating its use. Version may be employed if the presentation be transverse or if the fetus be alive and not firmly impacted; but if it be dead or impacted, embryulcia or Cesarean section is necessary. If the cervix be only partially dilated, artificial dilatation may be necessary, though sometimes it may be deemed best to perform Cesarean section.

After removal of the fetus by the natural passage the placenta should be separated manually, and at the same time the extent and position of the rupture studied. A hot saline douche should be given and an antiseptic gauze tampon introduced into the uterus. In cases of complete rupture, if the fetus has not passed into the peritoneal cavity, it should be extracted by the vaginal route, if possible, either by forceps or after embryulcia. Version should never be employed, on account of the risk of increasing the rupture. After removal of the fetus and placenta the rent should be examined. If the latter be of small size, the uterus should be packed with antiseptic gauze. If it be extensive, abdominal section should be performed. This is especially indicated if the fetus has been dead for some time. When the fetus has passed partly into the peritoneal cavity, it is rarely expedient to attempt withdrawal and delivery through the vagina, unless the patient's condition be too serious to allow abdominal section to be performed. In such cases the fetus may be firmly held by the retracted uterine tis-

sue, and withdrawal may enlarge the opening and cause fresh bleeding.

When the fetus is entirely within the peritoneal cavity, abdominal section should be performed. The fetus and placenta should be removed and the rupture sutured, unless it be too extensive and irregular or there is a strong suspicion that infection has been introduced. In the latter cases hysterectomy is most expedient; this should be followed by gauze drainage of the peritoneal cavity into the vagina for a few days. If the patient's condition will not warrant the performance of the more extended operation of hysterectomy, the rupture should be partially sutured and an antiseptic gauze tampon placed in the pelvis and passed through the rupture into the uterus and vagina. The abdomen should be well flushed with hot normal saline solution and closed. In all cases of rupture the effects of shock and loss of blood must be counteracted by the ordinary well-known measures, saline injections into the bowel or subcutaneous tissue being especially valuable; these are of the greatest value when operative measures are to be carried out. In performing abdominal section every moment should be considered as precious, delay increasing the patient's risk.

When prolapse of the intestine follows removal of the fetus by the vaginal route, an effort should be made to replace it at once. This may be expedited by raising the level of the patient's hip. If reposition is impossible, abdominal section is necessary. When strangulation exists, the latter procedure must be adopted and resection of the gut performed if the bowel be much injured. If the rectum be torn, it should be sutured. When the bladder is ruptured, abdominal section should be performed as soon as the condition is determined. The bladder rent should be sutured and the uterus treated on the lines already indicated. The bladder should afterward be drained several days. If the uterus interferes with satisfactory closure of the bladder, the former should be sacrificed if deemed necessary.

**Lacerations of the Cervix.**—The cervix may be torn in abortion and in premature and full-time labor, most frequently in the latter. It may be produced by the passage of the head or body of the fetus, especially if the labor be precipitate, the cervix be rigid, or the presentation or position be abnormal; in artificial dilatation of the cervix; in artificial delivery before the cervical canal is sufficiently dilated; in instrumental or normal manipulations, and in cases in which the lip of the cervix is incarcerated between the fetal head and the pelvic wall. In the great majority of cases the vaginal portion of the cervix is alone affected; occasionally more of its substance may be involved. The site of the laceration is variable. Most commonly it is found on the left side (to be associated with the most frequent position of the head in

labor—viz., that in which the occiput is left anterior). Sometimes the right side may be torn. Sometimes more than one laceration is produced in a labor. Rarely a circular portion of the cervix may be torn off. Lacerations vary in appearance; they may be simple fissures or irregular gaping clefts. Sometimes the cervical tear extends as well into the vaginal wall; rarely into the bladder.

Bleeding usually follows as the result of tearing, after the birth of the child. In some cases it may be noticed at an earlier period—*c. g.*, where artificial dilatation of the cervix is the cause. The hemorrhage may be considerable; rarely it may be alarming. It must always be early diagnosed from the bleeding that takes place from the body of the uterus. Abdominal examination generally suffices to differentiate between them. When the blood



FIG. 254.—External os and a portion of cervix higher up which have been torn off during delivery (Winckel).

flows from the torn cervix there is no necessary alteration from the normal retraction and contraction of the uterine body. Careful vaginal examination by the fingers or inspection reveals the laceration; only in this way can the extent of the tear or the involvement of neighboring tissues be estimated. Examination is, however, rarely necessary, and should always be made with the strictest asepsis.

Cervical laceration is occasionally serious from the loss of blood that it causes. Its chief significance is, however, in relation to infection. The raw surface produced is frequently a favorable place of entrance for micro-organisms. Every effort should be made to check hemorrhage, success frequently being obtained by hot douching. If this be insufficient, a firm vaginal tampon may be placed against the cervix, the uterine body being pushed well down through the abdominal wall. In serious cases the cervix may be exposed with a speculum and the laceration may be closed with chromic catgut sutures. Immediate repair should, however, never be carried out unless the facilities are such that perfect technic may be observed; otherwise the risk of infection is great. In ordinary practice the operation is rarely necessary; reparative measures should be postponed for weeks or months. If a torn cervix be not stitched, the risk of infection is very slight, providing that the labor be conducted properly. Sometimes severe hemorrhage may be checked by the application of hemostatic forceps to the bleeding points for ten or twelve hours.

**Lacerations of the Vagina.**—The hymen is stretched and torn in almost all first labors. Very rarely after retraction no evidence of laceration may be found in it. The vagina may be torn in part

or the whole of its extent. The conditions favoring lacerations are brittleness and dryness, often found in old primiparæ; cicatricial changes in the wall, due to past tears; operative procedures or inflammation; very rapid delivery; dystocia due to abnormalities on the part of the fetus or hard passages; the use of instruments, and manual interference. The lacerations are more frequent on the posterior than on the anterior wall. When the upper part of the vagina is affected, the tear is frequently a continuation of one in the cervix, though it may occur independently. Sometimes the cervix may be torn completely away from the vagina. The rent may be transverse, vertical, oblique, or irregular. It varies greatly in depth, involving part or the whole thickness of the vaginal wall, and may extend through the paravaginal tissues, sometimes as far as the bony wall. The laceration may extend into the peritoneum, rectum, bladder, urethra, and ureter. Generally the relations of the fetus are not altered by vaginal laceration. Rarely, when the peritoneum is opened, the fetus or part of it may pass through the opening. When the rectum is torn, a limb may pass into it. When the lower part of the vagina alone is torn, it is usually associated with rupture of the perineum, in connection with which it will be considered.

The **symptoms** associated with laceration vary. Sometimes there is a certain amount of shock, but it is never so marked as in cases of rupture of the uterus. Hemorrhage is usually present and may be very profuse, though sometimes it may not be marked until the child is delivered; in some cases it may be very slight. When the paravaginal sinuses are torn, the bleeding may be very profuse and alarming. The rent may sometimes be detected soon after it is produced, especially when caused by the hands or instruments. When it occurs spontaneously, it is not usually found until the child is born, unless the hemorrhage has led to an investigation. Vaginal lacerations may be repaired at the time of their occurrence by sutures if they can be introduced with perfect technic. If surgical cleanliness is impossible, interference is liable to infect the patient. Fortunately, the hemorrhage can be checked in the great majority of cases by a hot douche or by vaginal tamponade. Occasionally, when the bleeding is excessive, it is advisable to secure the bleeding edges of the rupture with hemostatic forceps, which may be left in position for twenty-four hours. In any case, if the edges of the rupture be contused or edematous, it is best not to introduce sutures, as they are liable to tear out.

If the peritoneal cavity be opened, allowing the intestine to enter the vagina, the bowel should be replaced after being washed with hot normal saline solution, and an antiseptic tampon placed in the rent and packed in the vagina. If the rupture be very large, it may be partly closed with catgut sutures.

If the fetus has passed into the abdominal cavity, the case is treated on the lines indicated in considering rupture of the uterus followed by this complication. When the bladder or rectum is opened, closure should be carried out at once if proper technic can be instituted; otherwise, attention should be given to the prevention of the upward extension of infection, repair work being left until a later period.

**Lacerations of the Parts External to the Vagina.**—

Frequently the vestibule is torn mesially or laterally; the tear may extend along the clitoris or urethra. In some cases it may be associated with considerable contusion or with laceration of neighboring parts—*i. e.*, labia majora, labia minora, or vaginal wall. The labia majora or minora may alone be torn, the lacerations varying greatly in extent and shape. Sometimes multiple tears are produced. Such lacerations are best treated by sutures, the external genitals being constantly covered with moist antiseptic dressings during the early days of the puerperium.

**Lacerations of the Perineum.**—Though this expression has long been in use, it is liable to be misinterpreted. The perineal body should not be studied as a separate entity. It is merely the anterior portion of the sacral segment of the pelvic floor, and is a composite structure, composed of different fascial and muscular structures. Of these, the most important are the following: Triangular ligament, anterior and posterior layers; rectovaginal visceral layer, anal fascia, and deep superficial fascia.

The muscles that meet in the perineum are the transversus perinei, transversus perinei profundus, small offshoots of the levatores ani, sphincter vaginae, and sphincter ani.

The significance of the laceration depends upon the extent and number of these various structures divided.

In the majority of labors the fourchet in front of the perineum is torn. Frequently this is associated with slight laceration of the anterior margin of the perineum; in other cases a deeper tear is produced. It is usually mesial, but may extend on one or both sides, involving the vagina or inner surface of the vulva. In more marked cases part or the whole of the sphincter ani may be involved. The rectovaginal septum may be torn slightly or extensively. Rarely the perineum may be ruptured between the anus and the anterior margin. Central rupture may be incomplete, affecting only the vaginal or the skin surface, or complete. It may occur spontaneously or may be due to injury with instruments; the child may or may not be delivered through the laceration. Frequently the various tissues are lacerated subcutaneously with little or no external laceration.

The following conditions lead to rupture: Large head or body of the child; precipitate labor; rigidity of the tissues; excessive softness—*i. e.*, edema; improper use of instruments; introduction

of the hand without previous dilatation; delivery of malrotated occipitoposterior or face cases; narrow subpubic angle; straight sacrum, and excessive anteroposterior measurement of perineum. Tearing is favored by flexion of the thighs on the abdomen. The more the thighs are extended, the more the perineal tissues are relaxed. All tears of the perineum are to be regarded as serious, not only because of the increased risk of infection arising from them, but chiefly because of troubles that may arise afterward from the weakness produced in various elements of the supporting framework of the pelvic floor; and, in complete tears, from interference with the sphincters of the anus. Hemorrhage results from perineal tearing, but it is rarely excessive.

**Treatment.**—The prophylactic measures to be observed in labor for the prevention of rupture of the perineum have already been described (p. 230). Slight tears that involve the skin alone may or may not be repaired; they should not be sutured if the procedure cannot be carried out aseptically. Deeper tears should always be stitched at the end of the delivery if the operation can be properly performed. If the light be poor, the assistance limited, and the facilities scanty, or if thorough asepsis cannot be assured, the procedure should be postponed for a few hours (not later than twelve) until it can be thoroughly carried out. In the interval dressings soaked in antiseptic solutions should be applied to the vulva. It has been successfully done several hours later than the period mentioned, but the chances of poor union are great. If the operation cannot be well performed within twelve hours of labor, it should be postponed for seven or eight weeks.

In repairing a laceration the patient should be placed in the lithotomy position, the genitalia and buttocks being cleansed and protected with sterile coverings. If the tear be superficial or of medium depth, a series of interrupted stitches should be introduced along the wound, from the upper to the lower end. Each should enter the skin  $\frac{1}{2}$  cm. external to the tear and should be carried deeply under the raw surface, emerging at a point in the skin opposite the place of entrance. When the laceration extends along the vagina or vulva, it also should be closed. Thoroughness is necessary in performing this operation, in order that the wound may be closed in its entire depth, and not the skin edges only. The suture material may be linen, silkworm-gut, silk, or chromic gut. Antiseptic dressings may be kept on the vulva several days after the operation. Catheterization may be necessary for a day or two. The bowels should be kept regularly open, straining at stool being forbidden.

In cases of laceration involving the anus the edges of the rent in the latter are first closed by a fine running chromic-gut suture, tied on the bowel side. The ends of the torn sphincter muscles, which are usually retracted, should be lifted up with forceps and

stitched together with catgut. The rest of the wound is then closed with a series of interrupted silkworm-gut or linen sutures, in the manner described in speaking of medium tears.

After this operation wet antiseptic dressings are constantly applied to the perineum and vulva for four or five days. The vagina is douched daily with an antiseptic solution—normal saline solution containing formalin (gtt. xxiv-Oj). The patient may require to be catheterized for a day or two. The bowels need not be disturbed for four days. Then, before the first movement, a mixture of olive oil (ʒij) and glycerin (ʒj) should be carefully injected into the rectum by the medical attendant, in order to soften the feces. The patient is cautioned not to strain. Non-absorbable sutures may be removed in eight or nine days. The patient should lie in bed until the sixteenth day, or longer if healing be not satisfactory.

#### INVERSION OF THE UTERUS.

This condition, in which the fundus is depressed within the cavity of the uterus, is a rare complication of labor. It is found in various degrees:

(a) As a cup-shaped concavity of the fundus.

(b) The depressed fundus may lie within the cervical canal or partly in the vagina.

(c) The body of the uterus, turned inside out, may lie in the vagina or partly protruding through the vulva.

It is most frequently produced during the third stage; in some cases within a few hours of labor; rarely at a later period in the puerperium.

**Etiology.**—In order that the uterus may become inverted the normal contraction and retraction must be absent, partially or completely. The organ may be found momentarily in this softened condition in normal cases immediately after the fetus is expelled, but in the great majority of cases, when a longer period of deficient contraction and retraction is present, some factor has been in operation producing the inertia—*e. g.*, precipitate labor, prolonged labor, hydramnios, twins, excessive child-bearing, etc. Inversion is impossible if normal retraction and contraction exist. When partial inertia exists, it is generally believed to affect that part of the uterus to which the placenta is attached. When complete inertia exists, inversion may be caused in various ways. There may be traction on the cord, while the placenta is attached, if the delivery take place while the woman is standing, or if the cord be naturally or accidentally very short and the birth take place in any position. Apart from spontaneous production, inversion may be caused by artificial traction on the cord or on an adherent placenta when there is inertia of the uterus. If the latter condition be not present, it is unlikely that inversion can be pro-

duced. It is stated by several authorities that occasionally spontaneous inversion may be caused by excessive intra-abdominal pressure—*e. g.*, straining or coughing.

External manipulations of the uterus through the abdominal wall, for the purpose of compressing the organ or expelling the placenta, may cause inversion. In cases of partial inertia of the uterus, usually of that portion to which the placenta has been at-

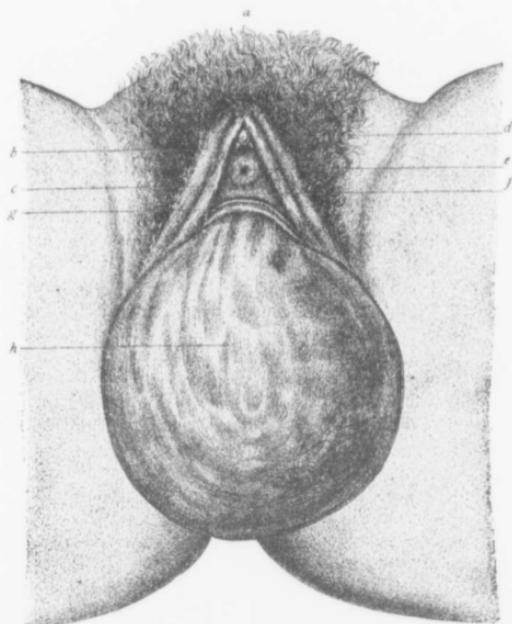


FIG. 255.—Complete inversion with prolapse (Boivin and Dugés): *a*, Mons veneris; *b*, labium majorus; *c*, labium minorus; *d*, clitoris; *e*, urinary meatus; *f*, external anterior border of vagina; *g*, external border of os uteri; *h*, internal surface of uterus, now external.

tached, inversion may be brought about spontaneously through contractions in the surrounding active uterine musculature. The placental part of the wall, remaining inert, is depressed within the uterine cavity. If the placenta be attached, its weight tends to drag the wall still farther down. The intestines also sinking into the depression help to promote its descent. Traction on the cord or placenta or faulty manipulations of the fundus may initiate or promote inversion in these cases.

**Pathology.**—In suddenly produced inversion the inverted portion may lie in the vagina or partly protrude through the vulva. It may be smooth, if covered by the placenta and membranes, or raw, red, soft, and bleeding if the latter are absent. In some cases the placenta may be only partially attached. The raw surface is irregular, clots may be seen in the opened blood-sinuses, and sometimes the openings of the tubes may be visible. On palpation the mass is found to vary in consistence: it may be soft and compressible, or may be hard when the musculature is contracted. The cervix may be felt loose around the inverting mass or may form a tight constriction; it may be partly inverted, but never completely. Sometimes the vagina may be somewhat inverted. The uterine mass may be very dark, owing to excessive congestion, and its tissues may become very edematous. The ovaries, tubes, and even omentum and intestines may rest in the depression on the peritoneal surface of the uterus. The depression tends to shrink in course of time. When the uterus is prolapsed as well as inverted, the bladder is dragged down. When complete inversion is not produced, the depression in the uterus is easily felt through the abdominal wall, while the vaginal fingers feel the inserted part of the uterine body through the cervix.

**Symptomatology.**—When the inversion is slight, there may be no symptoms whatever; sometimes there may be more or less bleeding. When the inverted portion reaches the cervix, the patient may complain of distress or pains, though these may be absent. In cases of complete inversion the patient may feel as if something had given way; there may be severe pain, hemorrhage, and collapse. A mass is felt in the vagina and there may be marked desire to urinate. Occasionally complete inversion may be produced without any special signs or symptoms whatever.

**Physical Examination.**—Bimanually the normal convexity of the fundus is found absent and a depression is felt, varying according to the extent of the inversion. In marked cases a mass is felt at the vulva or in the vagina, with the characters already described; it is somewhat moulded by the vaginal wall. The rim of the cervix can usually be distinguished, and a finger may be passed up around the inverting portion in some cases. This is impossible when the cervix forms a tight constriction. If the inversion has not passed the cervix, a finger passed into the cavity may distinguish the condition.

Inversion of the uterus must be distinguished from: 1. Intra-uterine polypus. 2. Polypus extending into the vagina. 3. Polypus with inversion. 4. Prolapsus uteri. 5. Inversion with prolapsus uteri.

The inverted mass may also be mistaken for the head of a second fetus, for a placenta, or a vulvovaginal thrombus. Serious results may follow a mistake in diagnosis.

**Course and Results.**—In the majority of cases the inversion, whether partial or complete, is rapidly produced. Occasionally the change is gradually brought about, a marked inversion being produced only during the course of several days. In all cases there may be hemorrhage, and this may sometimes be very serious. In complete inversion the uterine mass may become gangrenous, infection may occur, inflammation and ulceration of the surface may be extensive; secondarily, peritonitis may follow. Death may be due to shock, loss of blood, or sepsis. Rarely spontaneous reposition of a partial inversion may be noted. Sometimes the gangrenous inverted portion may separate. Occasionally a condition of chronic inversion may develop.

**Treatment.**—Inversion of the uterus should almost never occur if labor be conducted properly. The causes of uterine inertia should be prevented as much as possible; if this complication exists, special care should be taken to induce retraction and contraction. The fundus should not be depressed by manipulations through the abdomen. The cord and placenta should not be pulled until separation from the uterine wall is insured. Frequent examinations of the uterus through the abdominal wall should be made.

When partial inversion exists, reposition is easily brought about by bimanual manipulations. If the placenta be attached, it should be removed by the fingers. When complete inversion exists, it should be replaced as soon as possible; in order to do this the patient should be anesthetized, placed in the lithotomy position, and a thorough aseptic technic observed. The rectum and bladder should be empty, and the placenta should be removed, if attached, before reposition is attempted. In carrying out taxis the following methods may be adopted: One hand is placed on the abdomen, steadying the cervix, while the other grasps the fundus, pushing it up and undoing the inversion, following the axis of the pelvis. If this method fail, an effort may be made to dimple in one part of the wall near the cervix, making the rest follow, while the other hand endeavors to enlarge the cervical ring through the abdominal wall. Sometimes the fundus may be dimpled, reduction of the inversion following. When reposition fails by these manipulations, the patient should be kept in bed on low diet for several hours, hot antiseptic douches or fomentations being applied to the inverted uterus. The bowels and bladder should be thoroughly emptied and manipulations should again be attempted. If these fail on account of the tightness of the constricting cervix, the latter should be divided in the middle line, anteriorly or posteriorly, or in both places, as recommended by Matthews Duncan, in order to facilitate reduction. In all manipulations the uterine wall must be handled gently, lest it be torn or injured. After reposition it is always advisable to tampon the uterine

cavity for twenty-four or forty-eight hours. The measures to be followed in chronic inversion or in inversion complicated by sepsis need not be described here, as they belong to the domain of gynecology.

**Hematoma.**—This condition has already been referred to as a cause of delay in labor; it may also develop at the end of labor. Most frequently the labia majora are affected, but blood may also be effused into the labia minora, vaginal wall, cervix, parametrium, retroperitoneal tissues of the anterior and posterior pelvic and abdominal walls, and elsewhere. In most cases the blood is extravasated before the end of labor and accumulates afterward. According to the situation of the extravasation, variations are found in the size and extent of the hematoma. When the blood is poured out near the peritoneum, large swellings may result.

The reason for the rupture of vessels is not known in all cases. Throughout the pelvis there is increased congestion of the vessels; in some parts they are much increased in size. Sometimes the veins become markedly varicose. It is easy to understand why the traumatism of labor may lead to rupture. The injured vessel is usually a vein.

The hematoma develops with varying rapidity in different cases. Sometimes it is very gradual in formation. The distention of the tissues with blood often causes pain, though in some cases this symptom may be absent. When the extravasation is marked, the usual signs and symptoms of loss of blood may be present. On physical examination the swelling is found localized or diffused, fluctuating or tense, and dark in color if it be visible. The mass may interfere with the passage of the fetus or placenta, or afterward with the escape of the lochia. It may be mistaken for a mass of varicose veins, hernia, prolapse, or inversion of the uterus or vagina. It has been diagnosed as a fetal head or as placenta prævia in labor.

A hematoma may burst externally or into the peritoneum with serious or fatal results. It may gradually become absorbed. Infection may take place and suppuration follow.

As regards treatment, if the swelling be large enough to obstruct labor, it should be incised and the clots expelled. After the fetus and placenta are delivered, the bleeding may be checked by sutures or by a tampon and firm pressure. When the hematoma is noticed only after delivery, pressure may prevent its increase. Absorption is promoted by rest. If the mass be visible, care must be taken to prevent infection. If rupture threatens, the mass should be opened and packed with antiseptic gauze. If internal rupture occurs, abdominal section is necessary.

**Rupture of the Pelvic Joints.**—The symphysis pubis may be ruptured as the result of forced delivery after turning or by

means of forceps. It is most frequent in instrumental cases; it rarely occurs spontaneously. Rupture is favored by excessive softening of the joint ligaments or by disease.

Sometimes the patient feels the joint tear and may complain of pain. In some cases the accident may be discovered only after labor, when the patient attempts to walk. Sometimes the peritoneum, bladder, or vagina may be torn. Suppuration in the joint may sometimes follow this accident. If the condition be neglected, permanent weakness may be established, especially interfering with locomotion.

**Treatment.**—Laceration of the bladder or vagina should be immediately repaired with sutures. The hips should be bandaged firmly, as after a symphysiotomy, or a hammock bed should be used and the patient kept at rest for five or six weeks.

**Rupture of the sacro-iliac joints** may be caused in the same manner as tearing of the symphysis pubis. Pain may be felt in the region of the joints at the time of the occurrence of rupture, but the chief discomfort is felt when the woman sits up or attempts to walk. There are a sense of distress and insecurity and weakness in the lower limbs. The trouble is intensified if inflammation of the joint follows rupture. When the lesion occurs, the patient should be kept at rest in bed for two months at least, the hips being inclosed in firm strapping, and the joints kept from movement by double long splints or some other suitable orthopedic apparatus. A hammock bed may also be used in these cases.

Sometimes the sacrococcygeal or one of the intercoccygeal joints may be stretched or torn in labor, leading to distress or pain.

**Fractures of the Pelvic Bones.**—Rarely the rami of the pubes and ischium may be injured by the injudicious use of forceps. Ankylosed coccygeal bones or the junction of the coccyx and sacrum may sometimes be spontaneously broken by strong expulsive efforts when the head is low in the pelvis; sometimes the injury is caused by forceps delivery. Ankylosis of these bones is chiefly found in old primiparæ. The rupture may be transverse, oblique, or irregular. Considerable distress or pain may afterward be felt in the region of the coccyx. The severed portions may heal in such a manner as to cause obstruction in a succeeding pregnancy.

**Diastasis of the Recti Abdominis Muscles.**—Reference has already been made to the separation of the recti muscles and the stretching of the linea alba in pregnancy. The condition is found to a varying extent in almost all women who have borne

children. It is least marked, as a rule, in primiparæ, and most developed in those who have had a number of children. Indeed, the examination of the abdomen of primigravida in a large number of maternity cases has convinced me that in the great majority of women there is some degree of separation of the recti in the region of the navel as a result of the distention of pregnancy. In many instances, however, after labor owing to retractibility of the abdominal wall, all evidence of stretching may disappear, though in a considerable proportion of cases permanent widening remains, which is likely to become increased in succeeding pregnancies.

All conditions increasing intra-abdominal pressure in pregnancy tend to favor the development of the diastasis. Thus, women who work hard in the second half of pregnancy, especially those who lift or carry heavy weights, are more apt to become affected. Sometimes a sudden strain or fall is the starting-point of the condition. Among all classes the wearing of corsets in pregnancy is not infrequently an important associated cause. It is very easy to understand how this acts detrimentally. The intra-abdominal space being artificially constricted above, and being gradually encroached on by the growing uterus from below, the various viscera are more and more compressed into the intermediate area, where the weakest and least resistant portion of the abdominal wall is the region of the umbilicus. Excessive development of the uterus, —*i. e.*, hydramnios,—the presence of an abdominal tumor, etc., are to be placed among the causes. In all women flatulence and constipation, and abundant adipose tissue in the mesentery and omentum, must be regarded as favoring causes. So also is any condition that induces excessive coughing in pregnancy. General weakness or emaciation by lowering the tone of the tissues of the abdominal wall also predisposes. Straining during the second stage of labor may lead to increased stretching of the linea alba, especially if the stage be prolonged or the expulsive efforts be very strong. Immediately after labor the extent of stretching can be easily estimated by careful examination of the abdominal wall, the muscles being brought into action by the patient. During the puerperium some degree of retraction takes place in the stretched tissues, and in cases in which the recti have been but slightly separated the parts may return almost to the nulliparous condition. In many instances, however, permanent widening remains, which is likely to become increased during succeeding pregnancies. The condition may be aggravated after labor if women are careless in regard to those influences that tend to increase intra-abdominal pressure. Thus, constriction of the waist with corsets or skirt, bands may cause abdominal pressure on the linea alba, especially below the umbilicus. If a woman goes to work too soon, especially if she lifts or strains or stands long on her feet, the linea alba is affected unfavorably.

It is important that this condition be recognized in every instance, in order that women may be advised concerning it. There is no doubt that it is a frequent cause of ill health in women, because of the influence it exerts in the production of enteroptosis. In marked conditions it may lead to much discomfort in pregnancy and to trouble in labor (p. 427).

Whenever the condition exists in pregnancy the patient should be prevented from doing heavy work and from standing or walking too much. Corsets should be removed, the skirts should be suspended from the shoulders, and a broad silk-elastic abdominal binder should be worn. After labor similar rules should be followed. During labor a binder may be necessary. In marked cases it may often be advisable, when the patient is not pregnant, to bring the separated recti together by a surgical operation. This has been described by the author in the *Journal of the American Medical Association*, Dec. 22, 1900.

**Rupture of an Air-passage.**—Rupture of some part of the air-passages is a rare occurrence in labor; it may result from excessive straining. The air escaping from the passage may cause emphysema in the subcutaneous tissue of the neck and face when the upper tubes are injured, or in the lungs when the terminal passages are ruptured. As soon as the condition is noticed labor should be artificially ended, the patient being cautioned not to make any expulsive efforts.

#### HEART DISEASE COMPLICATING LABOR.

The subject of cardiac disease in relation to pregnancy has already been considered (p. 291). The conduct of labor in such cases is always a serious responsibility.

In the first stage of labor trouble may start or symptoms already present may become aggravated. There may be palpitation or attacks of dyspnea. The exacerbation is due to the increased strain on the heart, and to the pulmonary congestion during the periods of uterine contraction when the circulation of blood through the uterus is interfered with. If straining efforts are made by the patient, the symptoms are more marked. At the termination of the first stage after rupture of the membranes slight relief is experienced in some cases as a result of some diminution in the size of the uterine mass, owing to the escape of liquor amnii.

During the progress of the second stage the condition of the patient tends to become worse. This is probably chiefly due to the straining efforts made to bring into action the accessory powers. Moreover, the uterine contractions are longer and more powerful, and there is a resulting greater strain on the heart from

the interference with the uterine circulation. The pulse may become more rapid, irregular, or intermittent, the breathing may be rapid and oppressed, the patient being restless and having a feeling of great anxiety.

As the child escapes there may be a feeling of relief on the part of the patient from the great diminution in abdominal distention, but this may be counterbalanced by another factor—viz., the interference with the circulation caused by the retraction of the uterus that occurs after the birth of the child. Though we do not know exactly to what extent the circulation through the retracted organ is arrested, there can be no doubt that it must be greatly slowed, less blood circulating through it, while more is thrown into the non-uterine vascular system. As a result of this there is an increased amount poured into the right side of the heart as well as a rise in arterial pressure. These changes increase the patient's risk, and often the symptoms become much worse at this time. Yet it is very rare that the patient dies immediately after the child is born. The most dangerous period is yet to follow.

It is at the end of the third stage that there is the greatest danger, especially in mitral stenosis cases. The placenta may be born all right, but immediately or soon afterward the patient may die. The explanation of this is evident if the condition of the pelvis at this time be studied. In my researches into the anatomy of the normal pelvis during the puerperium I found that normally after the delivery of the placenta the retracted and firmly contracted uterus forms a large mass, which fills the upper part of the pelvis like a ball-plug, compressing all the extra-uterine tissues against the bony wall. As a result of this the circulation in the great mass of the uterus is practically checked, the organ being quite anemic; also, owing to the pressure of the uterus, the circulation in the extra-uterine pelvic tissues is greatly interfered with. The only congested parts are the small lower uterine segment, the cervix, the vaginal wall, and neighboring parts of the pelvic floor. It is this very great alteration in the circulation that throws the extra burden on the already overburdened heart. The whole vascular area of the body has been greatly diminished, and the extra strain on the right side of the heart may be too much for it; overdistention of its already weak and thinned walls results, and paralysis of the heart may follow. This condition in mitral disease was first pointed out by Spiegelberg. It has been described by Berry Hart, and I have also noticed it in a case of my own where death occurred. Fritsch, Barbour, and others deny that death is caused in this way. They think that extra strain is not thrown on the right side of the heart, but believe that the blood thrown out of the uterine circulation is accommodated in the extra-uterine vessels of the pelvis and ab-

domen, owing to the change in intra-abdominal pressure conditions consequent upon the emptying of the uterus. They say that the condition brought about is one of syncope, and that the cardiac failure results because an insufficient amount of blood reaches the heart, which consequently begins to beat irregularly; this along with the nutritive defects leading to a fatal ending.

It is important clearly to understand the difference between these two views, chiefly because the methods of treatment based upon them differ so markedly. There is no proof of Fritsch's theory. Pathologic evidence is against it. In postmortem cases there are usually found distention of the right side of the heart, or marked distention especially of one or both auricles, and pulmonary congestion. During life the face does not show signs of syncope, but is flushed or deeply cyanosed during the period of danger. Fritsch's theory cannot explain the death that follows emptying of the uterus in early pregnancy. It is indeed very interesting to note that the strain thrown on the heart by an abortion may prove too much for it. Moreover, were the theory correct, syncope might be expected often to follow normal labor, whereas it is very rare, save where much blood has been lost. That some of the uterine and pelvic blood is accumulated in abdominal parietal and visceral vessels after the uterus is empty and contracted is undoubtedly true; that this does not go on to the extent described by Fritsch is equally true. The congestion of these vessels that does occur is really a condition of safety for the patient, for the strain on the heart will be for a time diminished in proportion to the amount of blood accumulated in them. Very soon, however, the vasomotor mechanism will tend to diminish this accumulation, thereby correspondingly increasing the burden on the heart. These various factors must differ considerably in different women, and it is not, therefore, difficult to understand why there should be such variations in the clinical phenomena witnessed in a series of cases in which the same cardiac lesion exists.

When labor sets in, what is to be done? The patient should be carefully watched from the first. If she has been previously in good condition, she may be allowed to go through the first stage without interference, an occasional dose of a stimulant being given if necessary. If she be very restless or makes straining efforts, she should be quieted. If it is impossible to manage this, and if signs of heart failure appear, the patient should be chloroformed and the cervix dilated with Barnes's bags or manually.

We are now at the second stage. In some instances she may pass through this stage without trouble. In bad cases, however, especially in mitral disease, she should not be allowed to pass through it in her own strength. She should be chloroformed by an assistant, who gives his whole attention to his duty, while the

child is extracted with forceps. Occasional inhalations of ether may be required. I wish, however, especially to recommend the use of nitrite of amyl. This drug was first tried with success in heart disease complicating labor by Fraser Wright, who gave it after the third stage was completed, when his patient was in danger of dying of pulmonary and cardiac congestion. Its action is to lessen the strain on the heart through the dilatation that it causes in the small peripheral vessels throughout the body, from paralysis either of the muscular fibers of the arterioles or of the vasomotor ganglia in them. Soon after its administration (from twenty to thirty seconds) its effects are seen. The drug is best given by the chloroformist in capsules containing 4 or 5 minims, which are broken and held to the patient's nose. It is also useful in opposing the tendency to chloroform syncope; a threatening of this condition may be kept off by a careful anesthetist. As the child is delivered the nitrite of amyl is of great value in neutralizing the increasing strain on the heart due to the additional blood thrown out of the uterine circulation as a result of the uterine retraction that follows delivery.

Hypodermic injections of nitroglycerin may be used instead of amyl nitrite.

The third stage now follows—that most to be feared. Opinions differ regarding the treatment to be employed here. According to the view of those who hold that the danger is due to the accumulation of blood in the abdominal vessels and the consequent diminished supply to the heart, the loss of blood even in drops is very dangerous. According to the view that appears to me to be correct, and which I have advocated, the indication is not to conserve, but to allow the free escape of, a certain amount of blood from the body, in order to prevent overdistention of the lungs and of the right side of the heart. How can this best be brought about? The patient is still kept under chloroform; ether is given hypodermically from time to time, and the nitrite tends to counteract the contractility of the uterus, and so to delay the separation and expulsion of the placenta. This event must not be allowed to take place naturally, because it is apt to cause too sudden a change in the vascular pressure and to prevent the loss of blood, which it is our chief aim to bring about. Neither should the Dublin or Credé method of expelling the placenta be used, for the same reason. The most satisfactory procedure is to pass one hand into the uterus, separating the placenta gradually, the other hand being placed on the abdomen, against the uterus. As the sinuses are torn through blood escapes, the amount lost being carefully watched. In carrying out this operation the greatest skill, coolness, and judgment are required. As the uterus retracts and contracts following the removal of the placenta, the heart should be carefully watched and another dose of nitrite of amyl given if nec-

essary. If, owing to the amount of chloroform and amyl nitrite administered, marked contraction does not occur in the uterus, no alarm should be felt. This condition is better than sudden contraction, because the changes in the circulation are more gradually brought about. The organ can easily be compressed between the hands, and if necessary, the hot douche can be used, but the latter agency should not be employed save where there is danger of the loss of too much blood. Neither should ergot be used in these cases except in the last-mentioned condition, because it opposes the escape of the blood from the uterus, which we desire to a certain extent to encourage. Hitherto it has been recommended by many to bleed the patient from the neck or arm. This, it appears to me, is altogether unnecessary, when we have at our disposal the easy method of bleeding from the uterus that I have just described.

The treatment of heart cases during the puerperium is of the greatest importance. Rest in bed for some weeks is advisable. For a time after delivery stimulants of ether and brandy may be required. Strophanthus or digitalis is to be given cautiously. The most easily digested nourishing food is to be taken. There should be no straining at stool or in passing water. The bowels should be regulated so as to move easily, and for some days the urine should be drawn off. The retrogressive changes that take place in the heart during the puerperium introduce a new element of danger, and, therefore, the greatest watchfulness must be exercised. Complete quiet and good nursing are imperative. The patient should not lose sleep nor be disturbed in any way. As soon as the stomach is able to bear iron it should be given.

**Diseases of the Respiratory Tract.**—These have already been considered in connection with pregnancy. Labor may be very serious in some of these conditions—*i. g.*, pneumonia. Its conduct is practically the same as that recommended for serious heart lesions.

**Pulmonary Embolism.**—Embolism of the pulmonary arteries rarely occurs during labor. In the puerperium it may also occur. Von Fiesenhausen reports that only 3 cases occurred during twenty-five years among 50,000 labors in the St. Petersburg Maternity. In each of these the symptoms appeared when the patient first got out of bed—in one on the fourth, in another on the sixth, and in the third on the seventh day. Death took place in 2 cases within twenty-five minutes, and in the third in ten minutes.

It is stated to arise from clotting in the right side of the heart, and also to be caused by clots carried from the uterine veins, especially in the third stage. The symptoms are dyspnea, fluttering heart, weak, rapid pulse, cold skin, and pale face. Death may

rapidly occur. There may be an improvement for a short period, followed by a return of dyspnea, cyanosis, and death. Occasionally the patient may recover, infarct formation occurring in the lung, usually associated with hemoptysis.

**Treatment.**—Diffusible stimulants are valuable and oxygen may be administered.

**Air Embolism.**—Very rarely air embolism causes death or endangers life. The air is believed to enter the uterine sinuses as a result of improper douching when the placenta is partly or wholly separated, in carrying out intra-uterine manipulations that affect the placenta—*e. g.*, in placenta prævia. The symptoms produced are feeble pulse, cold limbs, dyspnea, jerky breathing, and cyanosis. On postmortem examination little blood may be found in the left heart, frothy blood being in the uterine veins, vena cava, right heart, and pulmonary artery, the lungs being anemic and containing frothy serum.

**General Embolism.**—Rarely in labor is a clot formed in the left heart and carried to one or more arteries in the shape of emboli. In such a case old endocarditis is likely to be present. The symptoms vary according to the artery affected.

**Collapse.**—Collapse and fainting may be caused in labor when serious lesions exist—*e. g.*, cardiac, renal, and pulmonary disease; in marked loss of blood from any cause—*e. g.*, rupture of the uterus or other viscera, separation of the placenta; in embolism, etc. In some cases it appears to be a purely nervous manifestation, following exhaustion and pain.

## PART VI.

# PATHOLOGY OF THE PUERPERIUM.

### CHAPTER I.

#### SUBINVOLUTION, SUPERINVOLUTION, ETC.

**Subinvolution.**—When the uterus does not undergo its normal involution or reduction in size in the weeks succeeding labor, the term "subinvolution" is applied to it. This alteration is associated with a number of conditions, which probably act chiefly through an alteration in the blood-circulation in the uterus. These may be described as follows: Uterine and other pelvic inflammations; retained portions of placenta or membranes; laceration of the cervix, followed by infection; placental or fibrinous polypi in the uterus; uterine displacements; all diseases causing chronic venous congestion in the uterus, among which should be mentioned enteroptosis, especially if associated with marked separation of the recti muscles; non-lactation; too early rising and working, and too frequent pregnancies.

Subinvolution is usually associated with more or less ill health. The woman does not regain her full vigor, tires easily, and frequently complains of backache and dragging; leukorrhœa, menorrhagia, and metrorrhagia are common. On examination the uterus is found to be larger than it should be, the enlargement being uniform.

**Treatment.**—Preventive measures are of the greatest importance, care being taken to keep the woman from the influence of the conditions above mentioned. When subinvolution is present, therapeutic measures should be adopted according to the conditions found. If the uterus has been imperfectly emptied, it should be thoroughly curetted. If there be chronic renal or cardiac disease, causing venous congestion, it should be treated. The bowels and bladder must be well regulated. Displacements of the uterus should be rectified, if possible. Local inflammatory conditions should be treated by the well-known methods. The woman may require to stop work or to lessen it. Tonics often are beneficial.

Ergot is believed by some to favor involution, by others to retard it. It may be used in hemorrhagic cases.

**Superinvolution.**—This is the condition in which the uterus becomes smaller than normal after labor. The degree of atrophy varies. In the most extreme cases the cavity may measure less than an inch. A. R. Simpson in one instance found that it was reduced to  $\frac{1}{2}$  in. Usually the organ measures from  $1\frac{1}{2}$  to  $2\frac{1}{2}$  in. The atrophy takes place with varying rapidity in different cases.

The etiology is not definitely established. It has long been associated with the following conditions: Marked loss of blood in labor; exhausting diseases; excessive nursing; nervous derangements—*e. g.*, puerperal insanity; and marked inflammatory changes in the pelvis, especially those interfering greatly with the ovaries.

In most cases the uterine atrophy is only transitory, being followed by a return to the normal. In some instances, however, the atrophy remains and menstruation never returns, the woman being afterward sterile. The latter must undoubtedly be regarded as cases of menopause induced by the disturbances connected with the labor and puerperium.

Vineberg and others have, however, noted that during lactation superinvolution is very frequent and should be regarded as normal, being quite independent of relative debility or anemia. They point out that in women who remain feeble after labor or become weak from any cause, and in patients anemic before pregnancy, the uterus tends to remain large. When suckling does not occur, no matter what the condition of the woman, the uterus usually remains large. There can be no doubt that a certain degree of superinvolution is to be regarded as normal in the lactation period, verification of which may be obtained if the uterus be measured in a number of cases.

**Anemia.**—Normally after labor the blood tends rapidly to return to the normal condition, great progress being made in the first two weeks. In many conditions the return is slow, while frequently true anemia develops. In such cases the patient should be kept in bed longer than the normal period, and should be kept from fatigue or hard work when she arises. The usual treatment for anemia must be carried out. In marked cases nursing is contra-indicated.

**Pulmonary Embolism and Thrombosis.**—Pulmonary embolism has already been described in connection with labor. Though it is rare under all circumstances, it is more frequent after than during labor. The emboli may arise from thrombi in the uterine veins or other pelvic or thigh veins, the thrombosis often being associated with puerperal infection. In some cases the pulmonary arteries may be occluded by thrombosis which is primary in them or which extends from the right heart.

**Systemic Embolism.**—Rarely in the puerperium portions

of fibrin may be carried from the left heart to one or more arteries in the brain or other parts of the body. In such cases there is usually a previous history of endocarditis, rheumatic fever, or sepsis.

**Puerperal Hemorrhage.**—This term is applied to losses of blood, in addition to that which is found in the lochial discharge, which may occur at any time in the puerperium. The hemorrhage is caused by various conditions:

**Retention of Portions of the Placenta and Membranes.**—

Pieces of the placenta may be left in the uterus as the result of bad management of the third stage. It may result from excessive compression of the uterus when the placenta is attached, especially if it be adherent, or it may be due to imperfect removal by intra-uterine manipulations. Careful examination of the placenta in water after delivery should usually reveal the deficiency in its continuity. In some cases, owing to abnormality of the placenta, portions may be left in the uterus where the greatest care is exercised, or even where the labor is entirely left to nature; this is due to the existence of a lobed or succenturiate condition of the placenta. A hole in the membranes near the edge of the placenta should always lead to the suspicion of retention of such a portion.

Retained placenta may cause irregular losses of blood from the uterus, which may be very profuse. In some cases, however, it leads to no hemorrhage. It is frequently associated with puerperal infection, the placental tissue being attacked by saprophytic organisms, though in some cases septic infection may also be present. A portion of membranes may also be retained, and is usually not suspected unless there be a gap of considerable size. Any or all the component layers may be left. Some authorities hold that retained membranes do not cause hemorrhage, but the statement is incorrect; bleeding may result, though it is a rare occurrence. Saprophytic infection may readily take place. Subinvolution may follow. With regard to the decidual portion of the membranes, it is stated by some that retention of this alone may lead to hemorrhages. This is unlikely, since normally very little of the decidua is shed with the amniotic and chorionic portions of the membranes, the place of separation being usually through the compact layer, the chief bulk of the decidua remaining after the third stage.

**Treatment.**—If at the time of labor it is discovered that a piece of placenta or a large portion of membranes has been left *in utero*, it should be removed by intra-uterine manipulations, carried out with strict aseptic precautions. The tissues can generally be removed with the fingers. If the uterus is too firmly contracted, it may be necessary to employ dilatation to a certain extent. When the fingers fail to remove the portions, curet forceps may be employed. Later in the puerperium the latter is usually necessary.

**Fibrinous Polypi.**—When a portion of the placenta or membranes is retained, fibrin may be deposited upon it and a polypus may gradually be formed, reaching a considerable size. It causes enlargement of the uterus, interferes with involution, and leads to hemorrhage. If it becomes infected, a foul-smelling discharge occurs, with symptoms of infection. The condition simulates malignant disease. The mass, along with the remains of the placenta and membranes, should be removed by the curet forceps or the curet.

**Retention of Blood-clots.**—When blood-clots form in the uterus and are not expelled, owing to uterine relaxation, displacements, firm contraction of the lower part of the uterus, or other causes, fresh bleeding may result from the uterine vessels. The clots should be removed either by compression of the uterus or by an intra-uterine douche. Occasionally it is necessary to remove them with the fingers.

**Uterine Displacements.**—During and after the second week prolapse or retroversion of the uterus may take place. Such displacements are especially found in multiparæ, and are particularly associated with excessive child-bearing, protracted or difficult labors, too early rising, and walking or working. Retroversion and retroflexion may often be found in normal cases, afterward disappearing, the displacement being probably due to the influence of the dorsal position and of a frequently distended bladder. The symptoms vary considerably; there are backache, frequency of micturition, increased lochial discharge, and irregular hemorrhages. Clots may accumulate in the upper part of the uterus, being expelled with pains. A favorable nidus for saprophytic infection is thus produced. The progress of involution is impeded.

In all cases the displacement should be rectified as soon as possible, and a pessary introduced into the vagina as soon as it can be worn. The rectum and bladder should be regularly opened. After the nursing period the question of correcting the displacement by operative measures may be considered.

**Puerperal Infection.**—In infection of the endometrium it occasionally happens that thrombi closing the large blood-sinuses in the placental area may be disintegrated as a result of invasion by micro-organisms, leading to the escape of blood. The hemorrhages vary considerably in extent. For this condition a firm intra-uterine tampon should be used, ergot being given internally.

**Relaxation of the Uterus.**—After the first day of the puerperium uterine relaxation occasionally takes place, causing hemorrhage. It may sometimes be due to a sudden shock or great emotion. It may occur in a woman much weakened by an exhausting labor, loss of blood, disease, etc. The treatment is the same as that in cases of hemorrhage occurring within the first twenty-four hours.

**Retraction of the uterus** may sometimes take place irregularly.

**Pelvic Congestion.**—Uterine hemorrhage may be present in all conditions causing pelvic congestion—*e. g.*, heart, kidney, and liver disease; pressure of new growths; inflammations; constipation, and too early or excessive sexual intercourse.

**Wounds in the Cervix, Vagina, or Vulva.**—Occasionally secondary hemorrhage may take place from lacerated areas in the lower genital tract. The tampon is usually sufficient to check the bleeding, though sometimes ligatures may be necessary.

**Hematoma.**—Sometimes hemorrhage may result from the bursting of a hematoma along some part of the genital tract.

**New Growths.**—Fibromyomata of the uterus may cause hemorrhage, chiefly by interfering with the normal retraction and contraction of the uterus. Carcinoma or sarcoma of the uterus very rarely arises in the puerperium and leads to hemorrhage.

**Chorio-epithelioma Malignum.**—In 1888 Sanger, of Leipzig, described 2 cases in which, after abortion, soft, spongy tumors developed in the uterus, with metastases in the lungs and other tissues, leading to a fatal issue. He believed the growths to belong to the sarcomatous group, and introduced the term "deciduoma malignum" to describe them.

Since that time quite a number of similar cases have been described, and there has been much difference of opinion as to their pathology. Various other names have been given to the disease—*e. g.*, sarcoma deciduocellulare, sarcoma chorio-cellulare, syncytioma malignum, carcinoma syncytiale, etc.

By some the growths have been regarded as fetal, by others as maternal, and by others as a mixture of both. There have also been differences of views as to whether they are of epiblastic or

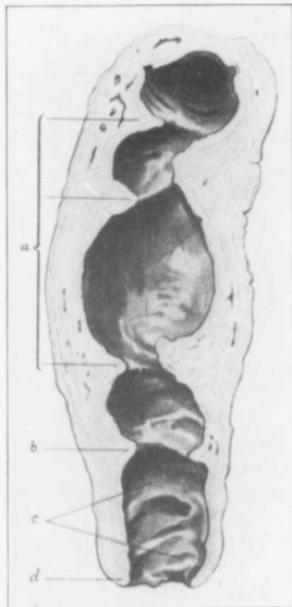


FIG. 256.—Uterus with several retraction rings (Bumm): *a*, Three retraction rings in the body of the uterus; *b*, ridge of os internum; *c*, cervix; *d*, os externum.

mesoblastic origin. The term "chorio-epithelioma malignum," introduced by Marchand, may be regarded at the present time as the most satisfactory appellation, for the tumors must be regarded as malignant proliferations of the epiblastic elements of the chorion—viz., syncytium and Langhans's cells, developing primarily in the genital organs and secondarily as metastases in various other tissues. The condition has been found at all periods of sexual life, mostly between twenty and thirty. McCann has recently reported a case occurring shortly after the menopause.

**Relation to Pregnancy.**—The disease may sometimes begin during pregnancy, though usually it appears within a few days, weeks, or months after labor. MacKenna states that in the cases collected by him the average interval between labor and the earliest symptoms was ten weeks. It has also been stated that rarely one or more years may elapse. It may follow abortion, full-time labor, ectopic pregnancy, and hydatidiform degeneration of the chorion. A considerable proportion of cases has been described in relation to the latter.

**Clinical Features.**—Hemorrhage is usually the first and most prominent symptom; it is at first irregular, afterward becoming more profuse and frequent. A dirty, watery discharge gradually makes its appearance. Weakness and cachexia supervene. Other symptoms may be produced by metastatic developments—*e. g.*, in the vagina, lungs, kidneys, intestines, liver, ribs, etc. There is often elevation of temperature and the pulse is rapid. In cases following uterine pregnancy the primary growth is usually in the uterus, rarely in the vagina; Wehle has reported a case of its appearance in the labium. When the disease begins in the uterus, it forms a nodule in the mucosa, which is soon followed by others. They are soft and pliable and recur rapidly after curettage. The uterus is larger and softer than usual on palpation and is somewhat tender. Rarely the growth causes rupture of the uterine wall. Vaginal growths are recognized as soft, bluish nodules, which readily break down. The disease progresses rapidly and is almost always fatal, death usually occurring within six months, whether or not operative treatment be carried out.

**Etiology and Pathology.**—That these tumors are a development from fetal chorionic structures is now well established. The microscopic appearances vary considerably, according to the distribution and relationships of the constituent cells. Usually there is a mixture of cells, derived both from the syncytium and the Langhans layer of the epiblastic covering of the chorion. In some cases the former predominate; in others, the latter. Recently growths have been described consisting entirely of syncytial elements. The syncytium consists of irregular masses of nucleated protoplasm, often vacuolated, the nuclei being rich in chromatin, somewhat oval, their long axes often being parallel to the border

of the masses. Mitoses are not found in them. The cells derived from the Langhans layer are clear and mostly polyhedral, varying in shape and size, and do not possess any intercellular connective tissue. They contain glycogen; the nuclei are round or oval, larger than those of the syncytium, and stain less deeply. Blood is found around and among the cell-groups. Degeneration and necrosis are frequently present in the tissues. In another class of cases, in addition to these cellular elements, structures have been found exactly resembling early villi—*i. e.*, vacuolated buds or rings of epiblast filled with early mucoid tissue. These have been



FIG. 257.—Portion of villus-like structure from vaginal metastatic growth. Case of chorio-epithelioma. The proliferated fetal epithelium in this portion is almost entirely syncytium (Neumann).

chiefly noticed in cases of hydatid mole. Growths are carried by the blood-vessels; they resemble the primary nodules. In the description of normal placentation it has been pointed out that portions of the fetal epithelium are often found in the veins of the uterus, whence they are carried into the general circulation without causing any known disturbance.

**Diagnosis.**—In the early stages of the disease, before the development of any large swelling, metastases, or cachexia, diagnosis is

not easy. Loss of blood from the genital tract in the puerperium may be due to various conditions—*e. g.*, subinvolution, retained portions of fetal tissue, fibroid tumors, etc. Foul discharge may also be caused by infection of blood-clot, fetal remains, tumors, etc. Moreover, sarcoma or carcinoma of the maternal tissues may cause these changes.

In every case the most thorough physical examination of the genitalia must be made, the interior of the uterus being explored by the fingers. Abnormal projections of tissue should be removed and examined microscopically. If marked proliferation of the syncytium and Langhans's cells be found, especially in a nodule, the suspicion of the existence of chorio-epithelioma malignum is very strong. In difficult cases the opinion of one who is an expert in the microscopic study of the uterus and its contents during pregnancy is of the greatest value, for it must be remembered that after

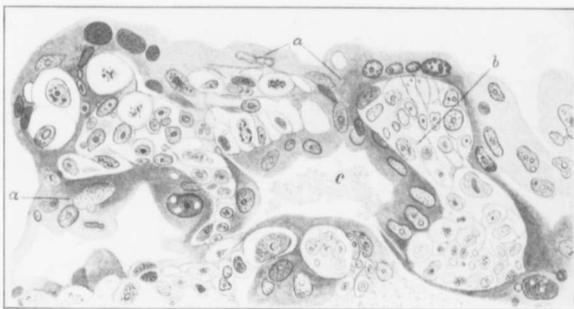


FIG. 258.—Portion of chorio-epithelioma, highly magnified (von Franqué): *a*, Syncytium; *b*, Langhans's cells; *c*, space containing blood.

abortion, hydatid mole, and full-time labor, scrapings of the uterine mucosa may contain different chorionic elements that have not been expelled at birth, and these might easily be regarded as chorio-epithelioma malignum by inexperienced observers. Moreover, decidual cells may also be found in the scrapings, and these may sometimes be very difficult to distinguish from the chorionic epithelial elements, especially the proliferated Langhans's cells of the malignant growth.

As Pierce states, extreme caution must be used, especially in the case of a young woman. He advises that if the examination of the first scrapings is not conclusive, the patient be kept under observation a short time and curetted again. If malignancy be present, increased proliferation of the cells will be found; if not, a small quantity of the cells or none at all will be detected. After

curettage the malignant growth usually rapidly recurs. Thus, Marchand reports a case where five days after thorough curettage the uterus was again filled.

The disease may be difficult to distinguish from carcinoma or sarcoma of the maternal tissues. In the latter growths true syncytium or structures resembling early villi are not found. Giant cells may, however, sometimes resemble portions of syncytium. Chorio-epithelioma has no stroma, differing from carcinoma; the latter disease is carried by the lymphatics, and the metastases develop more slowly than in the case of chorio-epithelioma. Only rarely are the lymphatic glands involved in chorio-epithelioma. Liver metastases are more common in sarcoma and carcinoma.



FIG. 259.—Section of vein in outer part of uterine musculature containing a villus-like structure with greatly hypertrophied epithelium. Case of chorio-epithelioma following hydatidiform mole (Neumann); v, Wall of vein; c, connective tissue of villus; s, syncytium; L, Langhans's cells.

Carcinoma mostly occurs after forty; chorio-epithelioma before thirty.

**Treatment.**—Only one form of treatment is advisable—viz., total extirpation of the uterus, when the disease begins in this organ, and of the uterus and vagina when it begins in the latter. Owing to the frequency of the disease after hydatid mole, Riesmann advises routine curettage of the uterus ten to fourteen days after expulsion of the mole. If proliferation of the chorionic epithelium be found, he removes the uterus.

As regards the method of extirpation of the uterus, Pierce rightly advises the abdominal route, because the organ may be removed with less disturbance than when the vaginal operation is

chosen. He points out that manipulations of the uterus are apt to force fragments of the uterine growth into the veins, thus increasing the risk of metastatic development.

When the abdomen is opened, the first step in the operation should be ligation or clamping of the uterine and ovarian vessels before the uterus is handled.

When metastases have developed in the vagina, following a primary growth in the uterus, total extirpation is likely to be soon followed by developments in other parts of the body. Distant metastases, indeed, indicate that treatment can only be palliative.

**Elevation of Temperature.**—Various references have been made to rises of temperature in the puerperium. The causes may be recapitulated as follows:

1. Infection through the genital tract at or after labor.
2. Infection of some other part of the body—*e. g.*, mamma, bladder, etc.
3. The presence of a local inflammatory process antedating the labor.
4. Specific diseases developing before or after labor—*e. g.*, typhoid, pneumonia, malaria, syphilis, scarlet fever, influenza, etc.
5. Constipation and intestinal intoxication.
6. Various non-infective conditions: Shock or emotional disturbances; severe after-pains; exposure to chill; interference with the free flow of milk in the milk ducts, leading to accumulation; rapid distention of the breasts, causing distress in the latter.

**Puerperal Rashes.**—Erythematous rashes distributed over wide or small areas may be associated with puerperal infection. They may resemble the eruption of scarlet fever very closely. It has been suggested that in some cases these rashes are due to a specific organism. Sometimes more serious skin eruptions may result from puerperal infection—*e. g.*, bullous formation. Occasionally skin eruptions are due to the influence of articles of diet. They may be due to various diseases—*e. g.*, scarlet fever, measles, erysipelas, small-pox, etc. In some cases the skin eruption may be the exacerbation of an old trouble—*e. g.*, eczema.

**Changes in the Urine.**—The normal constituents of the urine have already been described (p. 269). Albumin sometimes appears as a temporary and quickly passing phase. In some cases albuminuria is the continuation of a condition existing before labor. It may be due to an inflammation in any part of the urinary tract or to the presence of blood. Sometimes it is due to degeneration of the renal epithelium following labor; sometimes to a true nephritis. It is frequently found in puerperal sepsis.

**Blood in the urine** in the puerperium may be due to injury to the urethra or bladder during labor, and occasionally to vesical

hemorrhoids; sometimes to acute septic infection. It may also be caused by various conditions entirely independent of pregnancy—*v. g.*, calculus, new growth, etc.

**Disturbances of Urination.—Retention of the urine** in the puerperium may be due to paresis of the bladder-wall or to interference with the nervous mechanism regulating the sphincter of the urethra; the latter may also be reflexly stimulated. Sometimes the urethra is pressed against the pubes by the uterus; sometimes its mucous membrane is swollen from injury in labor.

**Incontinence of the urine** may be due to paresis of the sphincter, to dribbling from an overdistended bladder, or to a fistulous communication established between the bladder or ureter and the cervix or vagina. When vesicovaginal fistula is produced as the result of laceration, the incontinence is usually present from the beginning of the puerperium. When it is due to necrosis following prolonged pressure in labor, it does not begin until two or more days have passed after labor.

**Suppression of the Urine.**—Apart from eclampsia and Bright's disease, suppression of the urine following labor is very rare, yet it may occur completely or partially in women who have not suffered from these troubles. Recently a few such cases have been recorded by McKerron, Boxall, and others. In most of these the age of the women was under thirty. The labors were mostly premature, and the fetus was dead in the majority of cases. In most cases during the period of suppression the symptoms were not marked, the patient feeling fairly comfortable. Headache, pain in the back, and vomiting were usually present. The fatal cases developed drowsiness, coma, and muscular twitchings. In two, convulsions were noted before death. In the fatal cases scarcely any urine could be obtained; it contained albumin, casts, and blood. It is unfortunate that careful examination of the urine was not made in these cases during pregnancy. In most of them there was nothing unusual in the clinical symptoms. It is probable that renal insufficiency was present before labor, and that the influence of the delivery acted in precipitating the anuria. In cases of neurotic women the condition may possibly sometimes be akin to hysteric suppression.

**Cystitis.**—Infection in the bladder in the puerperium is generally due to carelessness in technic, catheterization frequently being responsible. Sometimes it is part of an infective process that affects the genital tract. Occasionally it may be an exacerbation of an old cystitis or may develop from an old uncured urethritis. There is a great tendency in these cases to an upward infection of the whole urinary tract. Various organisms are found in cystitis, the colon bacillus being one of the most frequent. The infective process occurs with varying intensity in different cases. Rarely large portions of the mucosa may be exfoliated,

and sometimes a large portion of the bladder-wall may become gangrenous and slough away.

**Injuries to Nerves.**—In cases of instrumental or difficult labor, especially in contracted pelvis, various nerves may be injured. Pain may be felt in the sacral region during defecation or when the vagina or rectum is examined and pressure is made against the sacrum; it may be aggravated on movement. In some cases pains in the lower limb may be marked in relation to one or more nerve-trunks. Paresis or paralysis of one or more groups of muscles in one or both lower extremities may also result from nerve injury; considerable atrophy may also take place. The skin is frequently affected, so that areas of anesthesia or hyperesthesia are produced. Occasionally inflammatory changes may take place in some of the affected nerves.

**Puerperal Neuritis.**—Neuritis may develop after childbirth, or may appear in the puerperium as a continuation of an affection that began during pregnancy. It may occur as a generalized or a localized condition. According to Bayle, the first form manifests itself chiefly during pregnancy, being preceded by severe vomiting. The disease is preceded by pyrexia, and usually runs a rapid course, tingling, shooting pains, itching, feeling of cold, heat, etc., evidence of changes in peripheral nerves, soon developing. These are followed by numbness and signs of paralysis in the upper or lower limbs, abdominal, laryngeal, or pharyngeal muscles. Usually the weakness affects the lower limbs first. The respiratory and cardiac muscles usually escape, and the bladder and rectum are rarely involved. Patients become irritable, restless, and depressed. There may be hallucinations or delirium. This generalized form of neuritis progresses for years. If recovery takes place, a relapse is likely to occur. The prognosis is fairly favorable, though sometimes there is an early fatal termination.

In the localized form of neuritis different areas may be affected. Thus, one or both arms may be involved in various degrees, or the lower extremities may be affected. When the latter are in the stage of paralysis, the condition may be mistaken for traumatic paralysis due to injury caused by labor. The history of preceding sensory disturbances, and usually of septic infection, suffices to establish the diagnosis of neuritis.

The disease is probably due to toxic influences. It may be caused by toxins produced in the body during pregnancy or resulting from infection at or after labor. Möbius and Tuilant have shown that it is the homologue of the neuritis that follows erysipelas, typhoid, small-pox, and other diseases. Anemia, exhaustion, and psychic disturbances may favor the development of the disease. The treatment is that carried out in non-*puerperal* neuritis. Bayle recommends the use of ergotin.

Meyer has reported 17 cases of anterior crural neuritis occurring in 1000 patients in the Copenhagen Lying-in Hospital. In none of these was there any sign of puerperal infection. The anterior crural nerve is not subjected to pressure during labor. In 7 of the cases the neuritis was bilateral.

**Puerperal Insanity.**—The minor and serious mental disturbances that may complicate pregnancy have already been described (p. 286). Insanity may also develop during the puerperium and much more frequently. Clouston states that 1 in every 400 labors is followed by it. In 50 per cent. of cases it begins within the first week, and in 80 per cent. within the first two weeks. The most acute cases are those developing in the first fortnight. It is more frequent in primiparæ.

**Etiology.**—Frequently there is a predisposing cause—*e. g.*, bad heredity and prolonged mental or physical strain. Anemia, sepsis, albuminuria, marked emotional disturbance, and the pains and excitement of labor are often factors in its production.

**Symptoms.**—The onset is usually sudden. The woman may take no interest in her baby or husband, may lose appetite, and get sleepless. She may take violent dislikes, become excitable, incoherent, and violent. There may be a suicidal or homicidal tendency. The pulse gets weak and the temperature rises. In most cases the type of insanity is maniacal; in other cases there are melancholia, lethargy, and stupor. In some cases there is marked delirium; in mild cases marked depression is frequent. Often during the course of an attack there are variations in the manifestations. An acute insane attack must be diagnosed from the occasional temporary hysteric outbreaks of labor, alcoholic delirium, and mental disturbances of puerperal infection.

**Prognosis.**—The disease is curable and relapses are rare. Clouston has reported 75 per cent. of recoveries in his cases, generally rapid; one-half of the patients being well in three months, and 90 per cent. within six months. Occasionally recovery takes place after years of impaired mentality. There is probably a larger number of recoveries in acute and severe cases than in mild ones.

**Treatment** is best carried out in an asylum. If, however, the patient be kept at home, skilled nurses should be constantly in attendance on her.

**Puerperal Myelitis.**—Rarely myelitis may develop after labor, usually beginning during the second week, with impairment of sensation and motion in the lower extremities and incontinence or retention of urine. Spastic paralysis may become well marked. The disease is probably caused by septic infection.

**Puerperal Tetanus.**—This subject has already been noted. (See p. 288.) The treatment is very unsatisfactory. The uterus has been several times extirpated in the hope of preventing the

extension of the disease, but usually with unsatisfactory results. The antitoxin should always be tried.

**Puerperal Tetany.**—This condition has very rarely been reported. It is generally one of a number of hysteric manifestations.

**Puerperal Gangrene.**—This condition is very rare; it may be due to embolism associated with heart disease that existed before the pregnancy or developed during its course or in the puerperium. It may result from thrombosis due to various causes; sometimes it occurs in phlegmasia alba dolens. In a few instances it has been due to Raynaud's disease. In a number of cases the etiology is obscure. The prognosis is fairly good in the dry forms, but is bad in the moist and septic varieties. In the former amputation may be deferred until a line of demarcation has formed; in the latter it should be performed immediately, well above the disease.

**Disturbances in the Breasts.—Anomalies.**—Absence of one or both breasts is a rare occurrence. Partial development is common. Extreme hypertrophy is rare and may be more marked on one side than on the other. Supernumerary breasts and nipples are not infrequent; they are usually below the proper breasts, but may be on any part of the trunk—*i. g.*, back, axillæ, buttocks, abdomen, and external genitals. The nipples may be defective, due to congenital or acquired causes; they may be abnormally small, depressed, inverted, or irregularly shaped. In some cases the child is not able to use the nipple without the use of a nipple-shield. Sometimes it cannot be used even in this manner.

**Defective Milk Secretion.**—Deficiency of milk secretion is not infrequent. Complete absence is extremely rare apart from absence of the breasts. The conditions that favor defective milk secretion are faulty mammary development, child-bearing at an extremely early or advanced age, exhausting diseases, mastitis, obesity, poor nutrition, and emotional disturbances. Altmann has pointed out that in certain districts in Europe, where it has long been customary to feed infants artificially, there is a congenital form of atrophy of the breasts in the women.

*Treatment* is unsatisfactory except where the deficiency is due to general conditions. In these cases, by judicious dieting and tonics, the mammary function may be improved. Plenty of fluids should be given, especially milk; fluid extract of malt is also valuable.

**Polygalactia.**—Excessive milk secretion during lactation is occasionally found in healthy, well-nourished women. In such cases the fluids in the diet should be reduced. The bowels must be regularly moved. If necessary, some milk may be drawn from the breasts in addition to what the infant sucks.

**Galactorrhea.**—This term is applied to cases in which the

milk runs from the nipples when the child is not nursing, and to those in which it flows after weaning. The condition may be very distressing to the woman and tends to reduce her strength. It has been known to last for years.

The *treatment* during the nursing period should consist in strict reduction of fluids in the diet, and in the application of firm breast-binders. The bowels should be kept open. After weaning, iodid of potassium may be given internally, and atropin may also be used if necessary.

**Hyperlactation.**—Prolongation of the nursing period is frequent among women, who try thereby to prevent conception. In

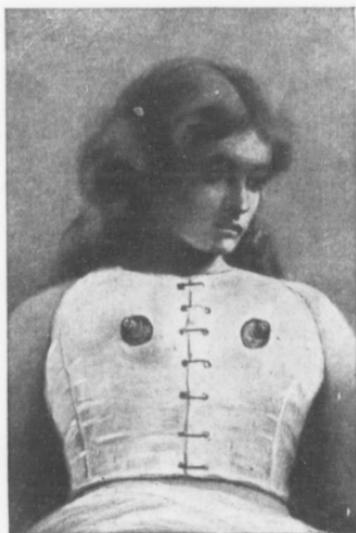


FIG. 260.—Modified Murphy breast-binder (Dickinson).

some countries—*e. g.*, Japan—it is customary to nurse two or more years. The practice is an evil one, as it usually leads to deterioration of the mother's health. Anemia, loss of weight and strength, and neurasthenia frequently result.

**Galactocele.**—This is the distention of a mammary acinus with milk. It is due to congenital absence, stenosis, or atresia of the duct, or may result from inflammation; it may be single or multiple. In some cases the cyst shrinks and causes no trouble. When it tends to enlarge, it is advisable to open and drain it, or to dissect out the lining.

**Defective Quality of the Milk.**—The milk is liable to many qualitative variations that may affect the health of the child, apart from those normally present at different periods of lactation. Occasionally an apparently healthy woman produces milk that disagrees with the infant, the cause being undetermined. Lack of exercise, emotional excitement, and many drugs and diseased conditions impair the quality of the milk, though the nature of the change may not be known.

Peculiarities of diet exercise an important influence. Excess in nitrogenous diet tends to increase the fat and casein in milk, while a fatty diet tends to diminish them. A vegetable diet increases the sugar and diminishes the fat and casein. Defective diet diminishes all the milk solids except albumin. Excess of proteids in the milk often causes trouble to the child. Rotch points out

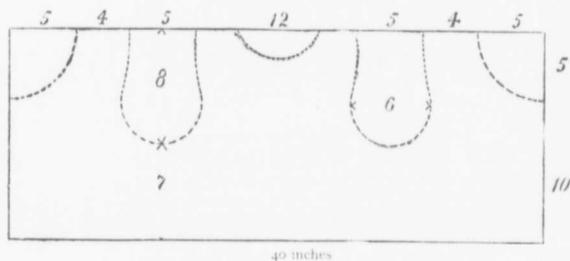


FIG. 261.—Modified Murphy breast binder (cut on dotted lines).

that disturbances may be caused by a too abundant diet and insufficient exercise. Frequently there are excessive casein and deficient fat. Emotional disturbance often leads to an increase in proteids, which disturb digestion. Rotch gives the following table of variations:

|                        | NORMAL MILK.<br>Normal exercise<br>and food. | POOR MILK.<br>Starvation. | VERY RICH MILK.<br>Generous diet; little<br>exercise. | BAD MILK<br>Pregnancy,<br>disease, etc. |
|------------------------|--|---------------------------|---|---|
| Fat . . . . .          | 4.0  | 1.50                      | 5.10  | 0.80                                    |
| Proteids . . . . .     | 1.2  | 2.40                      | 3.50  | 4.50                                    |
| Sugar . . . . .        | 7.0  | 4.00                      | 7.50  | 5.00                                    |
| Ash . . . . .          | 0.2  | 0.00                      | 0.25  | 0.00                                    |
| Total solids . . . . . | 12.40  | 7.90                      | 16.35   | 10.30                                   |
| Water . . . . .        | 87.60  | 92.01                     | 83.65   | 89.61                                   |
|                        | 100.00                                       | 100.00                    | 100.00  | 100.00                                  |

Angel Money states that a poor milk may be improved by regulating the mother's diet, giving more meat and milk, diminishing exercise, lessening the intervals of nursing, and reducing the quantity of fluids. Rich milk may be diluted by increasing the

intervals of nursing, decreasing the amount of meat, increasing exercise, and augmenting the quantity of fluids drunk. He points out the widespread error of believing that beef broth and chicken tea are valuable for nursing women, or that ale and porter improve milk. Purgation of the mother should not be employed to alter the character of the milk. In regulating the bowels, dieting, massage, and exercise are better than laxatives.

All diseased conditions may affect the milk. In acute febrile and toxic disturbances the change may be marked. For this reason nursing should be discontinued in puerperal infection. Moreover, it should be borne in mind that the septic organisms may be found in the milk and may infect the child. Tubercle bacilli and also other organisms may be transmitted. In the early stages of a febrile condition there may be a marked diminution of the mammary function for several hours. While it is in progress, menstruation may sometimes affect the quality of the milk, but frequently the child is in no way disturbed.

Colostrum corpuscles sometimes appear in the milk during lactation—*i. e.*, when menstruation or any acute affection occurs. It is held by some that if they are present after two weeks' nursing the formation of milk is defective. They may be found occasionally months or even years after child-bearing or nursing. They are, therefore, no proof of recent delivery.

**Sore Nipples.**—In a considerable percentage of nursing women the nipples are a source of trouble, generally within the first few days following labor. Various changes are found—*e. g.*, erythema, fissures, maceration, vesicular formation, erosions, and ulceration.

These conditions are mostly the result of careless management of the breasts during the later weeks of pregnancy. If the colostrum be allowed to cake, dirt accumulates and infection may follow. This is especially apt to occur if the nipples are irritated by the pressure of the clothing. When nursing begins, milk oozing from the nipples and allowed to saturate the clothes may lead to softening of the epithelium; as a result, vesicles may form and burst, giving rise to erosions. These may deepen and become ulcers. Sometimes these areas become infected from aphthous patches in the infant's mouth. Fissures may be caused by the compression of clothing or may develop from the erosions just described. Sometimes they follow the tearing away of a portion of encrusted colostrum along with the subjacent epithelium. They occur usually at the base of the nipple, but they may be found on the projecting portion. When milk-ducts open into the base of a fissure or ulcer, they are apt to be occluded as the latter heals. These lesions of the nipples are a source of distress and pain to the woman while the child nurses, and they are important as affording a place of entrance for infective organisms, which may give rise to mastitis.

*Treatment.*—Prophylactic care of the breasts during pregnancy is important. They should not be compressed by clothes or corset. The nipples should be carefully cleansed each day. They should not be allowed to rest against soiled clothing, nor should colostrum be allowed to gather on them. For cleansing purposes borax and water or mild soap and water suffice. Hardening agents are not necessary—*e. g.*, alcohol; they are likely to lead to cracking of the epithelium. When the nipples are small or depressed, it is advisable to use massage during the last two or three months. The nipple should be well soaked in lanolin or fresh cocoa-butter at bedtime, being kneaded and drawn out by fingers that have been well scrubbed. In this way they may be enlarged and prepared for the irritation caused by suckling. The daily application of a breast-pump serves the same purpose.

When the nursing begins the nipples must be carefully protected. During the first few months it is advisable to wash the nipple with boric lotion (saturated) and boiled water before and after nursing. Between the times of suckling olive oil may be applied to the nipples. The infant's mouth must be regularly inspected, and also cleansed with boric lotion if it is not perfectly healthy.

*Curative Treatment.*—When a fissure, excoriation, or ulceration is present, the nipple should be well protected by antiseptic solutions or ointments. The compound tincture of benzoin is often satisfactory, applied once or twice a day; Lassar's paste is also serviceable. If the child suckles, these applications must be washed away before it takes the nipple. When the nipple is painful during nursing, a sterile cocain solution may be applied to it five minutes before the act, the nipple being washed in sterile water before the child suckles. Very painful fissures sometimes require the application of silver nitrate, the area being made anesthetic beforehand by cocain, the breasts being rested for a few days afterward. It is often advisable to use a nipple-shield, but if the child refuses to take it or the pain is still excessive, nursing should be discontinued on the affected side for a few days, and the breast should be relieved by stroking it from base to apex or by the use of a breast-pump. When a nipple shield or breast-pump is used, it should be boiled beforehand.

If both nipples are affected, the intervals between nursing should be made as long as possible, or each breast may be rested on alternate days. Rarely it may be necessary to wean the child before the nipple lesions can be cured.

**Mastitis.**—Inflammation occurs in about 6 per cent. of nursing women, and usually begins within a month after delivery. The lesion is due to infection by various micro-organisms, *Staphylococcus aureus* and *albus* being most frequently found. *Streptococcus* and other septic germs may occasionally be the active agents. In

most cases the infection is derived from external sources—*i. e.*, dirty or diseased nipples, unclean clothing, fingers, or applications, and the infant's diseased mouth.

The organisms usually enter the milk-ducts, though they may spread directly to the subcutaneous tissue by the lymphatics when the skin is injured. Recent researches appear to show that microbes are often found in the milk-ducts of women who are healthy and whose breasts are normal. Indeed, Honigman and Ringel state that the milk normally contains the *Staphylococcus aureus* and *albus*. Köstlin has studied bacteriologically the milk from 100 pregnant and 137 puerperal women. Micro-organisms were found in 86 per cent. of the former and in 91 per cent. of the latter. With few exceptions they were *staphylococci*, the *Staphylococcus albus* being most common. This being the case, it is probable that other factors are necessary before a mastitis can develop. These may be found in conditions of impaired general health, local injury to the breast—*i. e.*, injudicious massage or use of the breast-pump, superficial excoriation, etc. Many hold that milk stasis may sometimes play a part by distending the milk canals and possibly injuring the lining membrane. It is generally believed that in cases in which a septic process is present in some other part of the body—*e. g.*, septic endometritis—the organisms may pass from the blood into the milk canals of the breasts, and may sometimes lead to breast infection. It may be considered as almost certain that mastitis does not occur without the agency of micro-organisms.

*Varieties.*—Mastitis is found in three varieties—*viz.*, subcutaneous, glandular, and submammary. These may occur singly or combined. The subcutaneous tissue over any part of the breast may be affected, though the areola is a frequent site. All stages of inflammation may be found. When the areola is affected, the infection may occur around the sebaceous follicles, giving rise to small boils, or may be diffuse; suppuration frequently occurs and may lead to fistulous communication with the milk-ducts.

When the glandular tissue is affected, the inflammatory process may occur in one or more areas, forming tender thickenings. The interglandular connective tissue is usually involved. All stages of inflammation may be found. As a result milk-ducts may be constricted or closed, the milk secretion being gradually arrested in the affected lobules. Abscess cavities may be formed from acini as well as from interglandular tissue. Small cavities tend to coalesce and form large ones, the lining wall being ragged and irregular. If a pus cavity communicates with an open duct, the pus may escape through the latter. Sometimes an abscess bursts through the skin, pus and milk flowing through the opening. Sometimes gangrene occurs in these cases. Occasionally general septicemia or pyemia results. Great destruction of breast tissue may occur as the result of extensive infection.

Submammary inflammation is rare. According to Billroth, the infection starts in the deep-lying glandular tissue and spreads through the layer of dense connective tissue at the base of the mamma into the looser tissue underneath. As pus accumulates the breast is elevated, and can usually be moved as though it rested on a water-bed.

The *symptoms* of mastitis are those of inflammation in other parts, varying according to the location, extent, and nature of the infection, etc. Pain, swelling, tenderness, fever, chills, etc., are found. When pus lies near the surface, it may be detected by palpation, except when the quantity is small. When deeply seated it may easily be mistaken, even when abundant. The exploring-needle may require to be used in its detection.

*Treatment.*—The prophylactic measures to be adopted are those which have already been given in describing the hygiene of the breasts during pregnancy and the nursing period. Milk engorgement should be prevented by suitable methods. The nipples must be kept in good condition. The general health must not be allowed to decline.

When mastitis threatens, the most satisfactory means of checking the process is to apply ice-bags or an ice coil to the breast, protected by a couple of layers of flannel, the patient being kept at rest in bed. Pain is likewise greatly diminished. The child should be taken from the affected breast, and the milk withdrawn by a breast-pump or by massage. Light, dry diet should be administered, and the bowels opened with salines. When the patient is allowed to sit up the breasts should be supported, enveloped in cotton-wool, and a binder placed over them.

When pus is detected, it should be evacuated. In opening superficial collections local anesthesia may often suffice. The incision should be in line with the milk-ducts and should be free. When there are several cavities it may be advisable to break down the septa between them. Sometimes several openings are necessary. The areola should be avoided as much as possible, in order that healing may not be followed by abnormal pigmentation. Free drainage is necessary, and to obtain this gauze (chinosol gauze is satisfactory) packing or drainage tubes may be used. The cavities may be irrigated each day with appropriate antiseptic solutions. A submammary abscess should be opened freely at the most dependent part as the woman lies in bed. A counteropening may often be advisable, in order that the cavity may be well irrigated and drained.

**Hypertrophy of the Skin Glands in the Axilla.**—Occasionally a skin-swelling develops in or near the axilla on one or both sides three or four days after labor; in some cases more than one may be noticed on the same side. Champneys found the condition 37 times in 377 cases, and states that it may occur rarely in preg-

nancy. The swelling is due to hypertrophy of sweat glands, which in this neighborhood are normally longer and larger than those in the general skin surface. Sometimes a little secretion may be squeezed from the swellings. They usually subside in the course of a few days.

## CHAPTER II.

### AFFECTIONS OF THE NEWBORN INFANT.

**Injuries to the Head during Labor.**—Various parts of the infant may be injured during delivery, the head being most frequently affected. The different mouldings of the latter, marked by changes in the bones and by the development of a swelling in the scalp (caput succedaneum), have already been described.

**Cephalhematoma** is an effusion of blood between the periosteum and the outer surface of the bone in any part of the cranial vault. It occurs rarely—about once in 200 or 250 labors, according to Ballantyne. It is more common in male children than in female; in primiparæ than in multiparæ. It is usually found in cases of

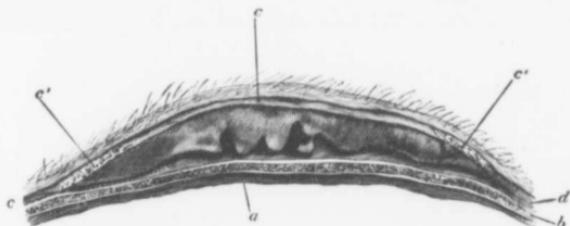


FIG. 262.—Longitudinal section through a cephalhematoma: *a*, Dura mater; *b*, cranium; *c*, periosteum; *e*, scalp (Davis).

head presentation, though it may be present in others. It occurs generally in difficult labors, but is sometimes found when delivery is quick, easy, and non-instrumental. It is most frequent over the parietal region, but may be found elsewhere. The cephalhematoma may appear within a few hours or days after labor. Sometimes more than one swelling may be found on the head. Féré has found fissures in the parietal bone in cases of cephalhematoma, due to imperfect development, and suggests that stretching of them during labor causes rupture of small vessels running across them, leading to the blood-accumulation. The effusion is usually limited by the sutures to the surface of the bones. The

elevated periosteum produces bone on its inner surface, especially around the base, though it may be elsewhere. The effused blood is gradually absorbed within a couple of months. Rarely suppuration occurs. On palpation the swelling is at first uniformly tense; later it is firmer around the edges than it is in the center. When a ring of bone is found, it may sometimes be mistaken for a perforation in the skull. There is no pain on palpation unless suppuration occurs.

The condition must be diagnosed from a caput succedaneum and from encephalocele. Sometimes blood-effusions occur between the periosteum and overlying aponeurosis; these are not, however, limited by sutures.

*Treatment.*—The swelling should be protected from injury. Absorption usually occurs spontaneously. If the mass increases in size, it may be covered by sterile wool and compressed by means of adhesive plaster. If signs of inflammation develop, the mass should be incised with strict asepsis and compresses applied. If symptoms of brain irritation should develop, incision should be carried out and the bone examined for fracture, trephining being performed if necessary.

**Indentations of the skull** may be furrow-shaped, spoon-shaped, and cup-shaped, the first two being most frequent. Munro Kerr has recently drawn attention to the spoon-shaped variety, and points out that it is usually found after labor in deformed pelves, especially in those that are rickety. It is usually found in cases where the fetus is delivered by forceps or turning, though it may occur in spontaneous labor. Indentations are ordinarily caused by the promontory of the sacrum, though they may be produced by the anterior pelvic wall—*e. g.*, iliopectineal eminence and bony growths; also by an ankylosed coccyx and by tumors of the soft parts. Veit has reported a case in which the pelvis was normal, the indentation being produced by tetanic contractions of the uterus, due to ergot. Contractions of the pelvic floor muscles, prolapse of a limb, and deviations of the uterus have also been mentioned as causes. The indentation caused by the forceps is usually furrow-shaped, but, according to Kerr, the majority of indentations found in forceps cases are due to the pressure of the head against some bony prominence.

Sometimes two depressions are found in the same skull, one being usually opposite the other. The results of the indentations are variable. Sometimes they are slight and disappear. In other cases they cause death, nervous disturbances, or poor health. Sometimes death may be prevented if the indentation be at once relieved.

Various methods have been tried to effect this. Kerr advocates compression of the head, and states that he has several times caused the indentation to be bulged out. If this method

fails, surgical interference for the purpose of raising the depressed bone should be tried.

**Fractures of Bones.**—The cranial bones may be fractured, the parietals being most frequently affected. The injury is usually due to forceps, though it may occur spontaneously, especially in birth through contracted pelvis. Fracture may or may not be followed by hemorrhage external or internal to the skull, though either or both of these may be present.

The brain is liable to be injured, but often escapes. When it is lacerated, the lesion may be serious. Intracranial hemorrhage may also cause death. When there are no symptoms of irritation or compression of the brain, no active treatment is necessary. When there are pressure symptoms, incision of the scalp is advisable, the depressed skull being elevated or trephined.

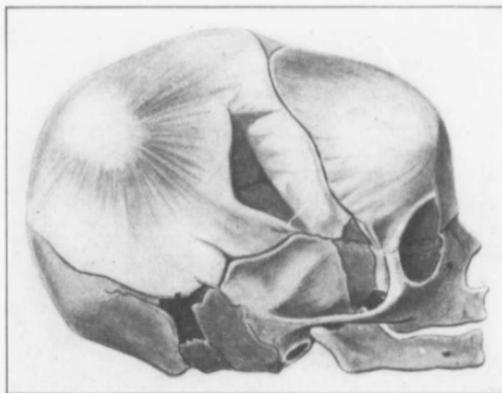


FIG. 263.—Triangular depressed fracture of fetal skull in temporal region (Tarnier and Budin).

Fractures of the limbs mostly occur during delivery after turning or in breech cases. Separation of the epiphysis from the shaft is more common than fracture. Dislocations are rare. The clavicle or inferior maxilla may be broken in attempts to deliver the after-coming head. Fractures of the vertebrae are usually fatal. In treating these accidents it is almost impossible to apply splints satisfactorily. Indeed, when the upper limbs are injured, they should be bandaged to the thorax.

**Injuries of the Muscles.**—Hemorrhage is sometimes produced in the substance of the sternocleidomastoid, especially in breech deliveries. It leads to the formation of a firm swelling or hematoma, generally situated near the anterior border of the

muscle. It may occur within a week of birth, but may not be detected until a later period. It usually disappears in the course of a few weeks. It may be followed by inflammatory changes and contraction of the affected muscle and torticollis. When it is discovered, massage and inunction should be carried out.

**Injuries of the Nerves.**—Peripheral injuries to nerves occasionally occur. The seventh nerve is sometimes affected by the pressure of forceps, leading to the peripheral form of facial paralysis. The nerve is injured where it leaves the stylomastoid foramen, or where it divides in front of the ear. Sometimes facial paralysis is



FIG. 264.—Left facial paralysis following delivery by forceps (Budín).

produced by pressure against some bony point in the maternal pelvis in non-instrumental deliveries. This affection is noticeable when the child nurses or cries. Usually the nerve recovers its function. If it is slow, faradism may be employed. Permanent paralysis is rare. Sometimes the brachial plexus or arm nerves are injured by pressure of the physician's fingers, instruments, or fractured bones, especially in artificial delivery in breech cases. The deltoid, biceps, brachialis anticus, and supinator longus are most frequently affected. In marked cases the injury is noticeable soon after birth; in slight cases not for one or more weeks. The affected muscles tend to atrophy. Some cases recover entirely in a few weeks, others only after months or years; others never recover. In treating these conditions massage and electricity may be started ten or twelve weeks after birth.

**Injuries of the Brain.**—The brain may be injured in labor by depressed portions of fractured bone, by intracranial hemorrhage, or by both of these combined. Most frequently it is due to the rupture of a blood-vessel. Meningeal hemorrhages are more frequent than cerebral, the arachnoid space being a favorite site. The accident is frequently caused by forceps, but may occur spontaneously in deformed pelves or in conditions in which the head is subjected to marked pressure.

Sometimes brain injury is the starting-point of mental or physical weakness that may last through life—*e. g.*, epilepsy and nervous diseases. Hemorrhage may cause paralysis, from which recovery may or may not take place. It may lead to compression and the child be born asphyxiated or comatose. Vomiting, convulsions, twitching, and stupor may be produced. Sometimes death rapidly supervenes.

**Other Injuries.**—The pleura may sometimes be injured in difficult extractions. Small hemorrhages are not infrequent in the thoracic and abdominal viscera. Sometimes they have been ruptured. The face, breech, and trunk may be much swollen and discolored when these parts present.

**Asphyxia Neonatorum.**—This condition, also termed "still-birth," is due to causes that act while the fetus is still within the genital canal, as well as to those that may be operative after the child is born. The intra-uterine causes act by interfering with the normal respiratory process carried on in the placenta, with the fetal circulation, or with the brain centers. They are as follows: Premature detachment of the normally situated placenta; separation of placenta prævia; compression of the umbilical cord or placenta; compression of the brain by the birth passage, forceps, or intracranial hemorrhage; maternal diseased conditions—*e. g.*, extreme anemia; and sudden death of mother. In cases in which the circulation in the cord is interfered with or the respiratory changes in the placenta checked or diminished, the medullary pulmonary respiratory center is stimulated, and amniotic fluid, mucus, blood, or meconium may be drawn into the air-passages. In other cases—*i. e.*, when the brain is compressed—no respiratory efforts may be made.

Extra-uterine causes are unruptured membranes and the presence of maternal discharges in the mouth and nose. Sometimes the child falls or is placed in such a position as not to be able to inhale the air.

**Diagnosis.**—When the fetus is asphyxiated, its pulse-rate becomes slower and spasms of the body are induced as respiratory efforts are made. As the asphyxia becomes more intense the pulse accelerates and respiratory efforts cease. When the fetus is in the uterus, these changes in the heart-beats may sometimes be detected on auscultation.

After birth the appearance of the infant varies according to the degree of asphyxia. When not too far advanced, the heart beats slowly and strongly, the muscular tonicity is not altogether lost, occasional respiratory efforts may be made, and the reflexes are not entirely abolished. The skin is much congested and darkened, the blood containing much  $\text{CO}_2$ , and hence this condition is often termed *asphyxia livida*. In a more advanced stage the  $\text{CO}_2$ -poisoning is more serious. The heart is rapid and feeble, the muscles are flabby, the reflexes abolished, and respiratory efforts are rarely made. The skin is very pale, and the description of *asphyxia pallida* is given to this stage. In this condition the outlook is very unfavorable. In every case in which the heart beats efforts should be made to restore respiration. It may be difficult in some cases to determine whether the fetus is dead. If the heart has ceased to be felt or heard, mouth-to-mouth insufflation of air may cause it to beat if the capability be present, but not if it is stillborn. In the latter condition the temperature may fall rapidly 10 to 15 degrees below normal.

**Treatment.**—Preventive measures in labor are all procedures calculated to prevent the complications that cause asphyxia. When the child is born, it should be held by the feet while its mouth and fauces are cleansed by a finger covered with gauze. At the same time the skin should be slapped and sprinkled with cold water. If it does not yet breathe, it should be plunged into a dish of hot water ( $100^\circ$  to  $105^\circ$  F.) for a few seconds, and then lifted out while cold water is sprinkled on its chest. This procedure should be repeated several times. The child should not be placed in a basin of cold water, since too much heat may be abstracted from its body. When these measures fail, artificial respiration must be carried out. Several of these are employed. They may be tried as long as the child's heart beats. While they are being tried the child must be kept warm.

1. *Schultze's Method.*—This consists in grasping the infant from behind, so that the forefingers are in the axilla, the thumbs in front of the shoulders, and the hypothenar eminences on each side of the head. The lower part of the body is then swung forward, upward, and inward toward the physician's face, so that marked flexion is produced and the lungs compressed. The child is then restored to its original position, the body being extended, so that the pressure is removed from the lungs, which are thus able to expand. This movement should be repeated about ten times a minute.

This method should not be used when the child is feeble. Accidents may occur—*e. g.*, slipping of the infant from the grasp, fracture of the bones and trachea, rupture of the viscera, and internal hemorrhages.

2. *Buist's Method.*—This consists in placing the child so that its

anterior surface rests on the palm of one hand, its head away from the operator, the limbs and head hanging down. The child is then turned or rolled so that its back lies on the other hand, in an attitude of extension, the head and limbs hanging down. It is then changed to the other hand. In this way alternate expansion and relaxation of the chest are obtained. Pressure with the fingers aids expiration.

3. *Byrd's Method*.—The child is placed on its back on the palms of the physician's hands. Alternate flexion and extension of the trunk are then carried out by the movements of the hands.

4. *Sylvester's Method*.—The child is placed on its back, the



FIG. 265.—Schultze's method of artificial respiration: A, Inspiration; B, expiration.

shoulders slightly raised, the lower limbs fixed, and the tongue pulled out; the elbows are alternately drawn up by the side of the head and then slowly depressed against the chest, so as to produce the effect of inspiration and respiration.

5. Laborde recommends rhythmic traction on the tongue.

6. Intubation of the larynx is recommended by many. A gum-elastic catheter (No. 6 to No. 8) may be passed into the trachea, while air is blown every ten seconds into the lungs by the physician and expelled by pressure on the chest. Fluid that may have entered the air-passages may be sucked out through the tube.

Direct insufflation is recommended by some. The child is placed on its back, the head being extended by means of a rolled towel placed under the neck. The nose, mouth, and fauces are cleansed and a handkerchief placed over the child's face. Holding its nose with the fingers of one hand, and pressing over the abdomen with the other hand to prevent distention of the stomach, the physician gently forces air from his own mouth into that of the child. The chest is then compressed to expel the air, and the process is repeated.

Champneys points out that the objections to direct insufflation are—(a) The danger of rupturing the lungs; (b) the risk of inflating the stomach; and (c) the danger of tuberculous infection. This author has made a special study of the methods of restoration described, and recommends especially those named after Schultze and Sylvester. He regards the procedures of Marshall Hall and Howard as useless in children.

In bad cases  $\frac{1}{100}$  gr. of strychnin may be injected hypodermically, along with ten drops of brandy or whisky. A rectal injection of hot normal saline solution ( $105^{\circ}$  F.) may also be used. After the restoration of respiration in an asphyxiated child it should be watched with the greatest care during the first day or two. It must be kept warm; hot saline rectal injections may be given; strychnin and brandy may be used if the heart is feeble. Pneumonia or bronchitis may sometimes follow in cases in which fluids have been drawn into the lungs.



FIG. 266.—Two varieties of insufflators.

**Sepsis Neonatorum.**—The fetus may be infected in various ways at the time of labor—*i. e.*, through the navel, abrasions of the skin, eyes, respiratory tract, alimentary canal, genital passage, and urethra. A variety of diseases may, therefore, be found.

**Some Diseases of the Newborn Infant.**—**Septic Infection of the Umbilicus.**—Infection of the umbilicus may cause general sepsis with little or no change at the navel, though usually an

ulcer forms in the latter situation. The thrombi in the umbilical vessels tend to break down and the vessel-walls may be infected. In some cases there may be considerable local redness and swelling, which sometimes leads to abscess or gangrene; erysipelas sometimes develops. The infected navel should be treated with antiseptic applications, and measures must be adopted to keep up the general strength. Granulation tissue may form fungous masses after the cord drops off; sometimes they develop around the remnant of the omphalic duct. Bloody serum usually oozes from them. They may be removed by repeated application of silver nitrate, but it is most satisfactory to ligate the base and cut the mass away.

**Omphalorrhagia Neonatorum.**—Bleeding from the cord may take place as a result of insecure ligation, shrinkage of the cord after ligation, and tearing of the cord between the ligature and the abdomen. It may also occur after the cord drops off. The vessels become obliterated from the ligature toward the fetus, and when the cord separates, the thrombi may be dislodged. In some cases the coagulability of the blood may be at fault as the result of a hemophilic tendency, jaundice, syphilis, sepsis, or some other condition. The mortality is very high in such cases because of the difficulty in controlling the hemorrhage.

In bleeding due to slipping or slackening of the ligature the cord should again be tied. When the trouble occurs after the cord has dropped off, gauze soaked in a sterile solution of gelatin in normal saline (2 to 5 per cent.) should be packed over the navel and fastened with adhesive plaster, being renewed every few hours. If this is not successful, the umbilicus may be transfixed with two needles placed at right angles, a figure-of-8 ligature being firmly fastened around them; these should be kept in position for a few days, being covered with antiseptic dressings.

**Umbilical Hernia.**—At birth there may be a projection of the abdominal cavity outward at the attachment of the cord, and when the latter drops off, it may form a hernial protrusion. A binder should be worn over the projection.

**Icterus.**—This is frequently found in the newborn. In mild forms the jaundice is slight and may affect only the head and chest. It is stated to be due to blood-changes or to bile carried into the circulation. Probably the first of these is generally the cause. It usually appears on the second day. In more marked forms the whole body is stained deep yellow. The jaundice appears within or after the first twenty-four hours. The urine is high-colored and the feces often clay-colored. There may be slight gastro-intestinal disturbances. The discoloration may last for days or weeks, but usually improves under calomel administration. The marked forms are chiefly found in feeble premature infants and in those born after lesions or difficult labors, especially if they have been asphyxiated.

Malignant icterus is rare and is usually associated with malformations in the bile-passages—*i. e.*, absence or obliteration of various parts; in such cases the liver is usually enlarged and cirrhosis is present. The spleen also enlarges, and the whole abdomen appears abnormally increased in size. Hemorrhage may take place at the navel, nose, mouth, or internally. Death takes place usually in these cases within a few weeks or months.

Severe jaundice may also be due to catarrh of the bile-ducts; also to inflammatory changes in the liver, usually caused by syphilis. It is also caused by septic infection.

**Melæna neonatorum**, or hemorrhage in the stomach or intestine, is a rare occurrence. It is generally found within a few hours of labor. The cause is often obscure, and may be due to ulceration, intussusception, hemophilia, or may occur in jaundice. The infant may vomit, or pass from the rectum red or black blood. Death often results.

The condition must be distinguished from that in which blood is swallowed—*i. e.*, from harelip, cleft palate, nose or lungs, or mother's nipple.

**Hemoglobinuria.**—This is a rare condition, usually occurring as an epidemic in maternity hospitals, and developing within two or three days of birth. The infant becomes bronzed, the soles and palms being violet-colored. The urine and feces are darkly pigmented. The pulse is rapid; convulsions and squinting are usually present. Fever is absent. On postmortem examination hemorrhages are found in many situations. The disease is probably due to micro-organisms, which have been found in large numbers in the blood and kidneys. The red blood-corpuscles rapidly diminish.

**Buhl's disease** is a somewhat similar condition; in addition to the hemorrhages, however, there is marked fatty degeneration in various internal organs. Bleeding from the navel may take place.

**Tetanus** is rare; it is due to the entrance of the tetanus bacillus through the navel. The symptoms usually begin within ten days of birth and the disease is usually fatal.

**Ophthalmia.**—Conjunctivitis may sometimes be caused by strong antiseptic lotions that enter the eyes at the time of delivery. Generally the disease is due to infection by the gonococcus or septic organisms. If these are introduced at birth, the symptoms appear on the second or third day. When they develop later, the eyes have probably been infected by contact with infected fingers, water, or cloths. The ocular and palpebral conjunctivæ are involved, and there is an abundant purulent discharge. The tissues are much swollen, so that the eyelids may scarcely be opened. There are photophobia, tenderness in the eyes, and fever. Unless the disease is checked it destroys the eye, the cornea becoming

ulcerated. If it begins in one eye, the other becomes infected unless well protected.

*Treatment.—Prophylactic.*—At birth the eyes should be washed out with normal saline solution. Then 2 drops of 10 per cent. solution of protargol or of a 2 per cent. solution of silver nitrate should be placed in the eyes. They should then be washed out with normal saline solution.

*Curative.*—The eyes should be washed out every hour, day and night, with saturated boric solution, and cold compresses should be constantly applied. Two or three times a day, according to the intensity of the affection, the protargol or silver nitrate solution should be dropped in the eyes and washed out with normal saline. If possible, the child should be placed in charge of an oculist.

**Skin Diseases.**—Keratolysis—dermatitis exfoliativa or Ritter's disease—is sometimes found. It consists in marked exfoliation of the cuticle. There may be a preceding dryness, followed by erythema and exudation. After the exfoliation there may be eczema, boils, and abscesses. Constitutional disturbances may be present.

*Pemphigus* sometimes develops in the newborn child.

*Sclema* is a rare condition, consisting in induration of the subcutaneous tissue, accompanied by a lowering of body temperature.

### CHAPTER III.

#### PUERPERAL INFECTION.

PUERPERAL infection is a term applied to the various morbid processes, pelvic and general, that are manifested in lying-in women as a result of the action of micro-organisms; they are identical in character with the various forms of infection that may complicate surgical operations or wounds of the body. The true nature of this disease has only recently been established, and the designation here employed is not yet universally adopted, a much older expression, "puerperal fever," introduced by Willis in 1676, being widely used. The latter term should be discarded, for while it emphasizes a prominent clinical feature, the former indicates the essential etiologic factor in the disease—microbial infection; and the employment of this term by the medical profession may serve as a valuable means of self-education.

That puerperal infection has been known throughout many ages is evident from references to it in works of writers as early as Hippocrates. Many theories have been advanced to explain

its occurrence. At various periods it has been held that the condition arose from decomposition of placental remains or of the lochial discharge, poisonous matter being absorbed into the system. Frequently it has been considered as a special mysterious scourge sent by Providence. It has often been attributed to atmospheric, climatic, or geographic conditions.

In 1791 Dr. White, a surgeon in Manchester, England, published a work in which he stated that puerperal fever was due to the absorption of putrid material by the lymph- and blood-vessels of the uterus. He noticed the resemblance between puerperal fever and the disturbances associated with putrid changes in other parts of the body. He pointed out that puerperal fever almost always developed after, and not before, delivery, and observed that surgical openings often became putrid. In his treatment of lying-in women he tried to prevent putrefaction and to eradicate it when it developed. He recommended ventilation, cleanliness, drainage, and a daily change of clean linen, and urged that foul, damp, or overheated air should be avoided. In order to prevent accumulation of the lochial discharge in the vagina he advised patients to sit up in bed or out of bed, to lessen the chance of putrefactive changes. He injected antiseptics into the uterus in cases of puerperal fever, and observed that the latter was assuaged and in many cases wholly extinguished. White's views and practice failed to influence the profession of his time and were rapidly forgotten. In 1839 Ferguson associated an outbreak in the Westminster Lying-in Hospital with an unclosed sewer in the neighborhood. By many puerperal infection has been termed an inflammatory disease, Plater, in the seventeenth century, being the first to emphasize the prominence of inflammation in the uterus. About the middle of the eighteenth century Puzos advanced the view that the disease was caused by a milk metastasis. Ritger, in the early part of the nineteenth century, considered that there was a metastasis to the peritoneum and other parts, not of milk, but of the blood destined to form that secretion—a view widely held in Germany at the time. About the same period Locock and Ingleby insisted upon the nervous nature of the affection. Ferguson held that it resulted from a vitiation of the fluids, and that all the varieties of puerperal fever depended on this one cause. In 1837 Eisenmann stated that he considered puerperal fever to be identical with surgical septicæmia.

In 1843 Oliver Wendell Holmes published an important paper in which he called attention to "the contagiousness of puerperal fever"; it had very little influence, and served only to excite the fiercest criticism among the leading obstetricians of the time. Samuel Kneeland, in 1846, stated that puerperal fever could be produced by the inoculation of a woman with fluid from a sick woman or from the body of one who had died after labor, as well as from air vitiated by sick persons, especially when several women were together in a hospital ward, ill with puerperal fever. He stated that infection could be carried by the physician, clothes, and everything that had been in contact with a woman already infected.

In 1846 Semmelweiss, an assistant in the Vienna Lying-in Hospital, began his memorable observations on the cases of puerperal infection occurring in that institution. In studying the history of the institution he found that from 1784 to 1822 the obstetricians performed no postmortem examinations, and that the average mortality during that period was 1.25 per cent. From 1825 to 1833 postmortem examinations were made, the mortality increasing to 5.3 per cent. In 1839 the institution was divided

into two parts, one for students, the other for midwives. In the latter the mortality fell to 2.6 per cent., whereas in the former it rose to 9.5 per cent., remaining at this level for five years, excepting in 1841-43, when for a period of twenty months it averaged 16 per cent., at one time being as high as 31.3 per cent.

One of his friends, in making an autopsy on a case of puerperal fever, contracted blood-poisoning and died after a short severe illness. Semmelweis noted that the postmortem conditions were similar to those often found in women who had died of puerperal infection, multiple abscesses and suppurative phlebitis being present. He concluded that the lying-in women were inoculated by the fingers of students who worked in the autopsy- and dissecting-rooms, and he believed the infective material to be animal matter. Thereupon he ordered the students in attendance upon the women to refrain from making autopsies and to wash their hands in a solution of chlorid of lime. Immediately the mortality from puerperal infection fell to 3.05 per cent. Subsequently he stated that the infective material was not only cadaveric material, but any animal tissues in a state of putrefaction, and also the lochial discharge of women already diseased. He insisted that possible carriers of infection—*i. e.*, hands, clothes, and instruments—should be cleansed. The mortality soon fell to 1.27 per cent. Owing to the jealousy of his colleagues, Semmelweis was forced to leave Vienna, and his ideas found little acceptance anywhere. In Buda-Pesth the mortality in the Rochus Hospital under his supervision averaged 0.85 per cent.

Sir James Y. Simpson made similar observations about the same time in Edinburgh, and for several years had used cyanid of potassium as a handwash before attending women in labor. In 1851 he strongly insisted upon the origin of puerperal fever from infecting material directly transferred from women ill of the disease, from dead bodies, and other sources, and pointed out the resemblance between puerperal and surgical fevers. Though he differed with Semmelweis in some minor points, he supported his main conclusions. Tarnier, in 1857, and Trousseau, in 1858, also recognized the likeness between puerperal and surgical infections. For years, however, these views made little progress, and the death-rate among women in Europe and America, due to puerperal infection, remained high, especially in maternity hospitals. As late as 1872 Churchill's well-known text-book stated that puerperal fever was due to mental emotion, putrefaction of retained placenta, gastro-enteric irritation, the state of the atmosphere, epidemic influences, and contagion. Gradually, however, the contagious nature of the disease became generally admitted. Rokitsansky, in 1864, found germs in the lochia, and by injecting the latter into animals, produced abscesses. In 1867 Tarnier isolated the infected cases in his maternity and the mortality was immediately reduced from about 10 per cent. to 2.32 per cent.

Pasteur's magnificent studies of micro-organisms, and Lister's work in demonstrating that surgical infection was due to their growth in human tissues, very soon led to the investigation of puerperal infection, and in the last thirty years great progress has been made in the study of the various microbes which are capable of producing the disease, their modes of entrance into the body, and the means of protecting the lying-in woman from their action.

**Microbial Factors in Puerperal Infection.—Streptococcus Pyogenes.**—This organism was first discovered in the lochia of women with puerperal sepsis by Mayerhofer, in 1865. In 1869 Coze and Feltz found it in the blood of such cases in

short and long chains. Pasteur first cultivated it in 1879, and his pupil, Doléris, in 1880, proved its frequency as an infecting agent. Many other workers have added to our knowledge of this organism. While it is found in different forms, these have not been classified into distinct species, and we are not able to associate particular forms with different clinical manifestations. It has been shown that streptococcus may be made to grow in short chains or long chains according to the condition of growth. Great variations are found in the virulence of the organism according to the conditions of its development. Thus, Marmorek has shown that the same species may cause at one time merely a slight temporary erythema, at another a local suppuration, at another a spreading erysipelas, at another a general septicemia. Its virulence rapidly diminishes in cultures, and tends to increase in passing from one human being or animal to another. Of great importance was the demonstration that erysipelas is caused by the streptococcus of septicemia. Widal and Besançon have shown that in the mouth a non-pathogenic form of streptococcus is often found which may be made virulent by passing it through a series of animals or by inoculating it along with the colon bacillus.

In the puerperal woman streptococcus may cause a great variety of local and general septic processes. In its parasitic action it does not lead to foul-smelling lochia; when this feature is present in a streptococcal infection, it is usually due to the action of associated saprophytes. It is, however, possible that occasionally the organism may be so modified as to act only as a saprophyte.

The streptococcus must be regarded as a very frequent cause of puerperal infection and the most frequent cause of fatal cases. Czerniewski found it in 49 out of 91 cases; Widal, in 14 out of 16 cases; Krönig, in 56 out of 296 cases; while Bumm found it in every one of 17 cases. In a small percentage of cases it is mixed with staphylococci or other organisms. It is capable of penetrating the uterine wall to a greater extent than other infecting germs.

In some cases of streptococcal infection the micro-organism may have so little virulence as to cause little or no febrile disturbance. It is undoubtedly most virulent when it attacks the tissues as a parasite, having passed through no recent saprophytic stage.

**Staphylococcus.**—While in puerperal women the breasts are most frequently the site of infection by staphylococci, the genitalia may also be attacked and both local and distant morbid processes may be induced. In almost all cases investigated *Staphylococcus aureus* has been found, the other varieties being unimportant as causal factors. The first demonstration of their causal relationship to puerperal sepsis was made by Brieger, in 1888. The

results of infection vary greatly; they may be mild or severe and may end in death.

**Gonococcus.**—The gonococcus plays an important rôle in puerperal infection, producing mainly local pelvic changes—*i. e.*, endometritis, salpingitis, ovaritis, perimetritis, etc. It is rare that distant affections are produced—*e. g.*, endocarditis and arthritis. Krönig, in 1895, reported that he found the gonococcus in 50 out of 179 cases in which febrile symptoms occurred in the puerperium. Occasionally the organism may be found in the lochia without any febrile disturbances. In almost all cases the results of infection do not lead to death; sometimes, however, there is a fatal termination. It is of importance to note that the condition of the maternal tissues after labor is particularly favorable to the renewal of activity on the part of gonococci which have been lying latent in the female genitalia, whether derived from an old infection in the woman or man. It not infrequently happens that a woman is infected by the discharge from a husband affected with old, uncured gonorrhœa, as a result of the changes in her tissues caused by pregnancy and labor, whereas previously, though subjected to the same risk, the tissues were able to resist the action of the gonococcus.

**Colon Bacillus.**—Von Franqué, in 1893, reported this organism as a cause of puerperal infection, and it has also been found by Widal, Krönig, Marmorek, Williams, and many others. It is indeed surprising that it is not a more frequent cause, when the nearness of the rectum to the genital tract and its abundance in the feces are remembered. Vignal calculates that 1 decigram of feces contains 20,000,000 of colon bacilli; Gilbert and Dominici state that 12,000,000,000 to 15,000,000,000 are passed in the feces each day. This organism generally remains in the superficial layer of the endometrium, and is most likely to cause infection when portions of the placenta and membranes are left in the uterus. In its growth it causes fetor in the lochia, and also may produce gas that may distend the uterus. This was first stated by Gebbard, in 1896. Schnell afterward grew the organism in liquor amnii, but was unable to produce gas. It is held by some that this feature is due to the accompanying growth of certain saprophytes. When there is a mixed infection of colon bacillus and streptococcus or staphylococcus, the virulence of the organism is greater. Urinary infection in the puerperium is most frequently due to the colon bacillus.

**Bacillus Diphtheriæ.**—True diphtheric infection of the genitalia is very rare, yet it may sometimes be found. Nisot, Bumm, Williams, and others have found the Klebs-Löffler bacillus, and affected patients have been cured by antidiphtheric serum. Most cases of so-called "diphtheric infection" are those in which other organisms—*e. g.*, streptococci—are the infecting agents.

**Pneumococcus.**—Rarely this organism is found in the lochia of infected women, alone or combined with other organisms. The genitalia may be primarily attacked, or secondarily following systemic infection. The fetus may be infected during labor and develop pneumonia soon afterward.

**Tetanus Bacillus.**—Rarely a patient may be infected with this organism after labor, manifestations appearing usually within two weeks; according to Rubeska, from the sixth to the eleventh day. It has been held by some that the infection always follows changes in the genital tract caused by other organisms—*e. g.*, streptococci—but this statement is denied by others. The disease usually runs a rapid course and is fatal in the great majority of cases. Sometimes its duration is protracted and irregular. The temperature is usually elevated, marked variations being found.

**Bacillus Aerogenes Capsulatus.**—Several cases have been described in which this bacillus of Welch has been associated with puerperal infection. It grows chiefly in dead organic matter and produces gas, which rapidly accumulates in the tissues. Dobbin found it in the fetus and placenta of a woman in whom the former was dead and retained in the uterus several days as the result of a pelvic contraction. The lochia, fetus, and placenta were fetid and contained gas; the body of the woman became rapidly distended with gas after her death. The organism probably forms very virulent toxins.

**Other Organisms.**—A few cases of infection with the typhoid bacillus, *Proteus vulgaris*, and anthrax have been reported. It is possible that certain bacilli which are as yet unclassified may be able to induce true septic infection in the puerperium. The *Bacillus septicus*, described by Pasteur and Doléris, was in all probability only one of many saprophytic bacteria capable of developing on dead or dying tissue in the genital tract and affecting the woman by the toxins elaborated.

**Sapremia.**—In many cases puerperal infection is simply due to saprophytic organisms which enter the genital tract and attack dead or dying fetal and maternal tissues, the woman being affected by the absorption of the toxic products of their growth. In the great majority of cases these organisms are anaerobic, many of them producing gas and fetor. Only a few of these have been isolated. They may also frequently be associated with the various pathogenic organisms above described—a fact that must always be remembered in making a diagnosis. Whether some of these saprophytes may also become parasitic and directly infect the living organism is somewhat uncertain.

From recent investigations it seems likely that these anaërobes, which can only grow in the absence of oxygen, may invade the uterine wall and other tissues, producing a real septic infection. (It is believed by some that this may also occur when they are

mixed with the colon bacillus. The latter grows with or without oxygen, and if it absorbs oxygen, which may be present in the genital canal, it may lead to increased virulence of the saprophytes and enable them even to penetrate the uterine wall.) These anaërobes have been found in parametric abscesses and in purulent peritonitis. They cannot invade vessels containing circulating blood on account of the oxygen in the blood, but they may enter old thrombi, lymphatics, or serous cavities. Krönig thinks that such invasions are not so rare as might be supposed; indeed, he says that pure sapremia without some invasion of the tissues is the exception rather than the rule. The disturbances produced are generally much milder than those due to the pyogenic organisms.

It is probable that pathogenic organisms may assume a saprophytic rôle in the genital tract. In some cases in which sapremic features are prominent, streptococci alone may be found and cultivated. It has been stated that these organisms may lose their virulence and live a saprophytic existence in the vagina. While it is possible that putrefactive changes may be due to these modified organisms, it must always be remembered that they may be due to anaërobes which have escaped detection and cultivation. Krönig, in 179 cases of puerperal infection, reported 50 as sapremic, in 43 of which he found organisms which would not grow on the ordinary culture media, 32 being anaërobic.

**Mixed Infection.**—The occasional combination of different pathogenic organisms in producing infection has already been noted. Such cases are apt to be more virulent than when single infection is present. In treating an infected woman it is necessary that a strict technic be observed, in order that other organisms be not introduced. The association of pathogenic and saprophytic organisms has also been noted.

**Sources of Infection.—Hetero-infection.**—In the great majority of cases infecting organisms are introduced by the hands or instruments of obstetricians, nurses, and midwives who are surgically dirty and careless in their technic. The direct transmission of infection by physicians from septic wounds, puerperal septicæmia, erysipelas, etc., has been, unfortunately, so often demonstrated that it is not necessary to dwell on the fact. Infection from sores on the hands of physician or nurse has also been clearly established, as well as from hands not diseased but imperfectly cleansed. In some cases the genital tract may be infected by clothing, pads, rags, etc., or by water used in cleansing or douching the genitals. Sometimes the woman herself may be responsible, introducing her dirty fingers into the vagina. Coitus shortly before or after labor is sometimes the means of introducing infecting organisms. Reference has already been made to this means in cases of latent gonorrhœa in the husband. Infection is believed by some to be

frequently carried by the air, and many cases have been described in which a bad water-closet, a leaky sewer, or a dead animal has produced the infecting agents that have been transferred to the patient by the air. It cannot be denied that puerperal infection is possible in this way, but it must be regarded as a rare occurrence. If the influence of dirty fingers and instruments could be eliminated from the lying-in chamber, the condition of the atmosphere need not cause much anxiety.

**Autoinfection.**—Semmelweiss first used the term "autoinfection," meaning thereby an infection by decomposed animal material produced within the patient herself. When the germ theory of disease became established and antiseptic methods were introduced into obstetric practice, autogenetic infection was scarcely considered possible, since it could not be thought that micro-organisms originated *de novo* in the human body.

In course of time the occurrence of puerperal sepsis in occasional cases in which a strict technic was believed to have been employed led to the expression of belief that the genital canal is normally the seat of pathogenic micro-organisms, which may be introduced into the uterus at the time of labor, causing infection. This view was strongly advocated by Kaltenbach and Ahlfeld. In recent years many bacteriologic studies of the vagina have been made to determine the truth regarding its normal contents in pregnancy. A short account of this work has been already given. (See p. 111.) Regarding the cavity of the uterus in pregnancy, there is general agreement that it is normally sterile. Reports as to the cervix have been somewhat at variance, but the most careful studies show that the upper part of its canal, at least, is free from organisms. Regarding the lower part of the canal and the whole vagina there has been much dispute, but the researches of Krönig, Menge, Williams, and others show that this passage is normally sterile as regards pathogenic organisms, and that these, if introduced, are undoubtedly destroyed by the vaginal secretion, with the exception of the gonococcus. Regarding the various anaërobes found in the vagina, little is known.

The lochial fluid has been investigated in normal non-febrile cases by different observers. Thus, Döderlein found it sterile in 26 cases out of 27; Czerniewski, in 57 cases, found it sterile in 56; Krönig, in 63 cases, found organisms in 13 cases—viz., *Streptococcus pyogenes* in 3; *staphylococcus* in 2; gonococcus in 4; *Bacillus coli communis* in 4, and various anaërobic organisms in 6 cases. The discrepancies between Krönig's results and those of the other observers are probably explained by the differences in the methods of examination, Krönig's technic being more thorough. In regard to the presence of pathogenic organisms in a febrile condition it is to be stated that they may be of such slight virulence as to cause little disturbance. It is also possible

that the germs might have been introduced in the process of obtaining the lochial fluid.

At the present time it must be held that autoinfection, in the sense of infection by organisms having a normal habitat within the genital tract, is impossible. The term is, however, loosely applied by many to include cases of the following nature: The uterine mucosa may have been infected with the gonococcus before or during pregnancy, and the organisms, though latent, may show renewed activity as a result of labor, causing signs and symptoms of an infection which is almost always limited to the pelvis.

In some cases a necrotic carcinoma or sloughing fibroid in the region of the cervix, an old abscess, or a vesical or rectal fistula may give rise to the infection. In cases of pneumonia, scarlatina, and other specific diseases the infecting organism may set up local changes in the pelvis, reaching the uterus by the blood or air. Occasionally a puerperal infection may develop from a focus external to the uterus—*e. g.*, salpingitis, appendicitis, parametritis, etc. These old infected areas may have caused symptoms during the pregnancy or may have been in a quiescent condition. As a result of the changes in labor—stretching, tearing, bruising, etc.—the tissues become more favorable to the growth of organisms, so that they may multiply and spread, causing fresh infection. Occasionally it is possible that injuries in the region of the *introitus vaginae* may lead to an infection by the colon bacillus. Infection in the urinary tract may be the cause of puerperal sepsis in some cases, the colon bacillus being frequently the active organism. Contamination probably arises from urine entering the vagina, though it may possibly enter the uterus directly through the wall of the bladder.

The term "autoinfection," in the strict meaning of the word, cannot be applied to such cases as these; the expression "secondary infection" would more correctly explain their nature. In conclusion it must be urged that in all cases in which the obstetrician is prone to take refuge in autoinfection as an explanation of some unhappy case of puerperal sepsis, he should institute a rigid inquiry as to the details of the technic that has been observed during the confinement.

**Conditions Favoring Infection.**—General poor health of the woman, fatigue due to prolonged labor, loss of blood, and all debilitating conditions undoubtedly render the tissues less able to resist the invasion of micro-organisms. The relationship between premature rupture of the membranes and puerperal infection has been often noted. This is explained by some on the ground that the liquor amnii which escapes and remains in the vagina is a good culture medium for micro-organisms. Normally during labor the liquor amnii and fetus are free from micro-organisms.

Krönig and Menge have shown that the uterine cavity may be invaded, an infective process being set up. Putrefactive organisms may grow in the liquor amnii, their toxins being absorbed. These processes may cause febrile disturbances during labor. These authors have also shown that sometimes pathogenic and saprophytic organisms may grow in the liquor amnii at this time without causing any disturbance in the mother. Probably the fatigue of such labors, which are usually tedious, and the increased compression of the uterine tissue, associated with the absence of the liquor amnii, are also important factors. Moreover, it is probable that in such cases digital examinations and artificial delivery are more frequent than in normal labors, so that the introduction of infection may easily be explained. Blood-clot, placental tissue, or portions of membranes retained in the genital tract offer a favorable nidus for many organisms. All torn or bruised surfaces favor entrance.

**Frequency.**—It is difficult to estimate accurately the frequency of puerperal infection. Statistics as to mortality are no indication, for the morbidity is much greater than the mortality. Moreover, it is well known that official vital statistics may be incorrect because of false registration, puerperal sepsis being frequently diagnosed purposely as something else—*e. g.*, typhoid and influenza. It is the general impression that there has been a marked diminution in the mortality of puerperal sepsis since the introduction of antiseptics. This is probably true only as regards hospital practice. In the Rotunda Hospital, Dublin, during the years 1870-76, the mortality from puerperal sepsis was 1 in 90.9; in 1890-96 it was 1 in 908.5.

Budin's statistics in 1891-97 are as follows:

| Total mortality from infection.            | Mortality due to infection in connection with delivery. |
|--|---|
| Charité (1891-94) . . . . . 0.68 per cent. | 0.0 per cent.   |
| Maternité (1895) . . . . . 0.46 "          | 0.27 "  |
| " (1896) . . . . . 0.39 "                  | 0.15 "  |
| " (1897) . . . . . 0.27 "                  | 0.07 "  |

Kjelsberg reports a mortality of 0.15 per cent. in 439<sup>8</sup> cases of labor in the Christiania Maternity in 1891-96. Mermann has reported a series of 1200 cases occurring in the Mannheim Lying-in Hospital, without one instance of fatal infection; the technic in these labors was exclusively aseptic.

As regards private practice, it is doubtful if there has been much diminution in mortality, either in Europe or America. In Great Britain this has been demonstrated by the work of Boxall, Cullingworth, Williams, and others. Milne Murray gives the following table:

## MORTALITY FROM PUERPERAL FEVER IN ENGLAND AND WALES.

| Years.          | Period.   | Mean deaths for 1000. |
|-----------------|---|-----------------------|
| 1847-56 . . . . | Early anesthesia, no antiseptic . . . . .         | 1.89                  |
| 1875-84 . . . . | Anesthesia general, early antiseptics . . . . .   | 2.28                  |
| 1880-95 . . . . | Anesthesia general, antiseptics general . . . . . | 2.40                  |

Boxall shows that while in London the deaths in childbirth from all causes has diminished considerably since antiseptics came into general use, the reduction has scarcely at all been due to a lessened mortality from puerperal sepsis. In the English counties the death-rate is about the same as it was before the antiseptic era.

Bacon, in 1896, estimated that in Chicago, during the preceding forty years, 12.75 per cent. of the total mortality of women between twenty and fifty years of age died from puerperal sepsis; in recent years the percentage has not been so high. In other countries the frequency of puerperal infection has also been noted. This lamentable state of matters is to be explained as follows: Midwives are, generally speaking, very little if at all better than they were fifty years ago. Of the few who get some scientific education, only a small percentage ever attain to perfection in the practice of aseptic obstetrics; the majority are even more dangerous than those who are untrained, since, under the pretense of cleanliness, they may work abominations. Many practitioners are guilty of the same offense. They are even more dangerous than the midwives, because of the manipulations they are called upon to perform. The abuse of anesthesia is accountable for much of the puerperal mortality, interference with the course of labor being much more frequent than in the pre-anesthetic days, when the natural process was allowed to continue as long as possible. The lowest infant mortality at the present time, speaking generally, is found in hospital practice; next to that comes that in dispensary practice, which is carried on under a rigid scientific system. The same results can be obtained in private practice only when practitioners master the principles of aseptic technic and introduce them into their work with critical thoughtfulness and exactness.

**Pathologic Anatomy.**—Many lesions result from puerperal infection, and these are found with many variations in different cases. The changes may be local or general, or both of these may be combined. They may be due to pyogenic or saprophytic organisms, or to the combined action of these. The results of infection depend on various factors—*e. g.*, the nature and virulence of the organism, the state of the woman's health, the condition of her pelvic tissues, etc.

**Vulva and Vagina.**—Infection of the vulva and vagina is occasionally found, producing patches which have long been known as "puerperal ulcers." These areas are torn or bruised surfaces on

which micro-organisms have grown. They become covered with dirty, yellow-gray, necrotic tissue, which discharges pus. In some cases these patches resemble those produced by diphtheria. In rare instances the Klebs-Löffler bacillus may be the cause of these patches; ordinarily it is due to streptococci. It may also be caused by staphylococci, colon bacilli, and by anaërobic putrefactive organisms. The edge of the patch is usually edematous, and the swelling may extend from it to a greater or less extent. It is rare that these localized vulvovaginal infections are fatal or serious. When marked disturbances are present, it is almost certain that the infection has spread to other parts.

Occasionally the changes may be of a rapid malignant type, the superficial tissues having a gangrenous appearance. In some cases recovery is accompanied with extensive sloughing, and this results afterward in marked cicatricial contraction of the passage. The author observed one case in which such a process resulted from streptococcal infection, marked stenosis of the entire vagina afterward taking place. The vaginal wall may also be infected without the occurrence of superficial necrosis, the tissues being reddened, softened, and swollen. Ischio-rectal abscess is sometimes caused. Rarely the rectal mucosa is infected.

**Cervix Uteri.**—The cervix may undergo the various morbid changes found in the vagina. The lacerations produced in labor are frequently the site of infection, and through them the neighboring tissues of the pelvis may be attacked.

**Uterine Body.**—Various changes may be found in the uterus as the result of infection, being most marked and most frequent in the remains of the mucosa. Both placental and non-placental areas may be affected. The following naked-eye appearances may be found: In some cases the surface is bathed in pus. In others it is covered with a dirty, yellow-gray membrane, composed mainly of necrosed decidua tissue and fibrin, diffused over a wide area or localized in one or more patches. Sometimes thick, shaggy masses may be found, especially on the placental area; these may contain fetal remains or may consist entirely of fibrin and shreds of decidua. In some cases the lining of the uterus may have a dark-green, gangrenous appearance. When saprophytic organisms are present, there is usually an odor, and bubbles of gas are often present in the discharges. It is important to remember that these organisms are frequently present when true pyogenic germs are active. When infection is alone due to the latter, odor and gas are usually absent. The uterine wall is enlarged, relaxed, and softer than normal, in some cases being very friable. This relaxation of the wall undoubtedly promotes the extension of infection, the diminution of pressure on the veins and lymph channels making it easier for micro-organisms to pass along them. Frequently on section small collections of pus may be seen, usually

in lymphatics or in veins. In the latter thrombi sometimes may be found in various stages of suppuration. True abscess formation outside of the veins and lymphatics is very rare. Rarely extensive gangrene or necrosis of a large area of the uterine wall occurs, followed by expulsion through the vagina. By some this condition has been termed metritis desiccans. On the outer surface of the uterus various stages of inflammation may be found; it may sometimes be covered with a layer of fibrin, especially posteriorly. Under the peritoneum small cord-like elevations are sometimes present; these are lymphatics containing pus or thickened by inflammation. The whole uterus is usually larger than normal, being soft and flabby and easily indented by slight pressure. The cervical canal is generally patulous.

On microscopic examination various appearances are presented. In cases of infection by streptococci or other pathogenic organisms the superficial portion of the endometrium is more or less hyaline in appearance and stains badly, being altered by coagulation-necrosis. This change is found as a thin, irregular layer, being less marked than in cases where putrefactive organisms are at work. Underneath there is a zone of leukocytic infiltration, varying in thickness and forming a continuous or irregularly broken layer. On the surface of the endometrium are scattered the infecting micro-organisms; they are also found in the superficial necrotic tissue. In some cases, especially those in which the organisms are not virulent, they are not found deeper than the leukocytic layer; in others they extend through the latter at various points, spreading especially through lymphatics outward into the musculature. In the placental area the organisms may be found in the thrombi filling the divided sinuses, extending also inward along the vessels, producing inflammatory changes in their walls. In certain bad cases local areas of liquefaction may be noticed, surrounded by leukocytes and early abscess formation. These generally begin in lymphatics, and are especially found under the peritoneum. It is impossible to describe accurately the changes that occur in the muscle-fibers themselves. They often stain badly and present marked granular and fatty changes, but the latter are found in the normal postpartum uterus. In cases which recover there may be considerable atrophy of muscle and increase of the intermuscular connective-tissue elements.

In putrid or saprophytic endometritis the superficial necrotic layer is generally thick. If fetal remains are present, they also may show necrotic changes. The micro-organisms are on the surface as well as in the substance of the degenerated layer. Below the latter they are usually not found, being unable to penetrate the protective zone of leukocytes.

In cases of mixed infection by putrefactive and septic organisms the former are found mainly in the necrotic layer, while the

latter may be found under it, extending toward the peritoneum. Or, if two septic organisms are present, one may remain superficial, while the more virulent may penetrate deeply. In some instances both may be equally distributed.

**Tube and Ovary.**—The appendages may be affected by the spread of infection from the uterus along the mucosa or by way of the lymphatics and veins; sometimes from a peritonitis. They become swollen as the result of edema, congestion, and small-cell infiltration. Adhesions may form about them, and pus cavities may form in them. Sometimes the tubes may be much affected and the ovaries slightly, or *vice versa*.

**Parametrium.**—Frequently the infection produces changes in the various structures attached to the uterus, especially in the broad ligaments; they are found in different degrees of intensity. Sometimes only a slight edema is produced. In other cases there may be an extensive exudation of inflammatory products, which may afterward absorb; often abscess formation occurs in several small foci, or in one area, which enlarges, forming a large single collection. These parametric processes frequently extend under the peritoneum in various directions—*i. e.*, into the iliac fossæ, along the anterior and posterior abdominal wall, etc.

**Peritoneum.**—The peritoneum is usually infected by transmission along the lymphatics, but the organisms may also pass along the Fallopian tubes. Great variations are found as regards the extent and nature of the peritonitis produced; it may be slight and local or may be extensive. Serum, pus, bloody pus, fibrin, adhesions, etc., may be found. In a considerable percentage of cases of puerperal infection septic peritonitis is the factor that causes a fatal termination.

**Changes in the Circulatory System.**—In septic cases the heart is frequently affected. Degenerative changes may be found in the myocardium; endocarditis sometimes develops, pericarditis rarely being present. The walls of small arterioles may become infected in some cases; they may become blocked by masses of organisms, or, in cases of endocarditis, by portions of vegetations. The uterine veins may be invaded by the organisms and the walls altered by phlebitis. This change may spread beyond the uterus and may affect the veins of the broad or other ligaments, and may extend along the ovarian, uterine, internal iliac, external iliac, femoral, and other veins; rarely mesenteric veins are affected. The phlebitis is usually attended by thrombosis, and the latter may be followed by suppuration. Occasionally a thrombus may extend continuously from the uterus through the utero-ovarian veins, vena cava, right side of the heart, and pulmonary artery. In some cases the thrombi give rise to embolism. The phlebitis may sometimes not extend far from the uterus, though the thrombosis may. Phlebitis may, however, develop in the lower limb or

elsewhere in the body in septic cases as the result of the transmission of infecting organisms, not by direct extension from the uterus. Frequently the infection causes marked changes in the uterine lymphatics, and the lymphangitis may extend into neighboring tissues. Leukocytosis is noticed in many cases. Frequently the spleen is enlarged.

**Urinary Tract.**—Sometimes the bladder is attacked by the infecting organisms, which probably usually enter through the urethra. The infection generally spreads upward to the pelvis of the kidney. Often the epithelium of the kidney tubules is degenerated by the poisons circulating in the blood, produced by the infecting organisms.

**Alimentary Canal.**—Definite changes in the intestine are almost entirely limited to the cases in which septic peritonitis is present. The liver is often affected, degeneration occurring in the cells and small hemorrhages sometimes taking place; abscesses are rarely found.

**Respiratory Tract.**—Pleurisy occasionally develops, especially when peritonitis is present. Pneumonia may also occur. Embolism may lead to infarct formation in the lung, which may be followed by suppuration. Sometimes death may suddenly take place from a large embolus in the pulmonary artery.

**Nervous System.**—Occasionally cerebral hemorrhage may cause death or paralysis. Purulent meningitis rarely occurs. Brain abscess is rare.

**Acute General Septicemia.**—In some cases of puerperal infection, especially by virulent streptococci, there may be little or no local change in the uterus or in other organs, because death takes place from the intensity of the poison before any marked alterations have had time to take place. The micro-organisms are usually found abundantly in the blood and different organs in such cases.

**Puerperal Infection by Gas-producing Organisms.**—In cases in which there is infection by gas-producing organisms, as long as their action is limited to the uterus (as it is in the majority of cases), they produce only a foul-smelling discharge containing gas-bubbles. The latter are found as well in necrotic tissue that may lie on the inner surface of the uterus. Rarely the general system is invaded, the infection being carried by the circulation, producing characteristic changes in every tissue and organ that may be reached. They become enlarged by the formation of gas, sometimes becoming quite emphysematous. The most frequent cause of this condition is the *Bacillus aerogenes capsulatus*.

**Pyemia.**—In some cases the puerperal infection becomes pyemic in type. This development arises chiefly from the transmission of portions of thrombi that break down in the uterine sinuses and veins. Metastatic abscesses may thus form in all

parts of the body, leading to more or less destruction of tissue and usually to the gradual disorganization of the patient's life. When the infection leads to the formation of a large abscess in the pelvis, which becomes chronic, the system presents the ordinary appearances produced by the absorption of toxins.

**Signs and Symptoms.**—It is evident, from the variety of organisms which infect the puerperal woman, and from the great range of changes occurring in the body, that many variations must be found in the clinical manifestations produced. It is best to study these in relation to the pathologic conditions. In the common form of septic infection commencing in the endometrium, symptoms usually begin on the third or fourth day, though sometimes not until two or three days later. During the period immediately following labor the organisms multiply in the superficial layer of the endometrium, while deeper down there is an outpouring of leukocytes, forming a barrier or zone of resistance. In this interval the patient usually feels well. The first indication of illness may be a feeling of malaise, headache, or chilliness; there may be a marked rigor, followed by a rise in temperature and also in the pulse-rate. In some cases more than one severe chill may occur. The temperature and pulse may remain elevated after the first alteration, varying from time to time, or they may become reduced soon after the early rise. The greatest differences are found in the temperature, and these are probably mainly due to the character and quantity of the toxins absorbed from the uterus. In some instances hyperpyrexia may occur, the temperature reaching  $107^{\circ}$  to  $112^{\circ}$  F. In most cases such a rise indicates that death is near, but sometimes the patient may recover satisfactorily. It is frequently as high as  $103^{\circ}$  F., and may reach a higher point. The pulse often follows more or less closely the temperature curve, but sometimes this relationship may not be present. In some cases the pulse-rate may be the chief indication of serious danger; indeed, it may be the first important sign. The tongue usually becomes coated, the desire for food lessens, constipation is frequent, though sometimes there is diarrhea. Often, as elevation of temperature continues, the milk secretion is diminished.

The lochial discharge is frequently increased and may change in appearance, owing to the addition of yellow or white purulent material. It has no odor or only a faint one. A fetid smell indicates that saprophytes are at work, but one must never conclude from this sign that septic infection is not present; both forms may be combined. The blood in the lochial discharge may be considerably altered, becoming dark brown or chocolate-colored. In some cases there may be a marked diminution in the quantity of lochia. This is usually the case when the temperature continues much elevated, though it may sometimes merely indicate an accumulation in the uterine cavity, which often becomes enlarged.

The uterine wall normally relaxes somewhat, its volume being increased and its consistence less firm; it may be somewhat sensitive on palpation. If an intra-uterine examination be made, the cervical canal is found to be patulous or easily dilated. The inner wall feels much the same as in non-infected cases—*i. e.*, the non-placental area is fairly smooth and the placental area is slightly

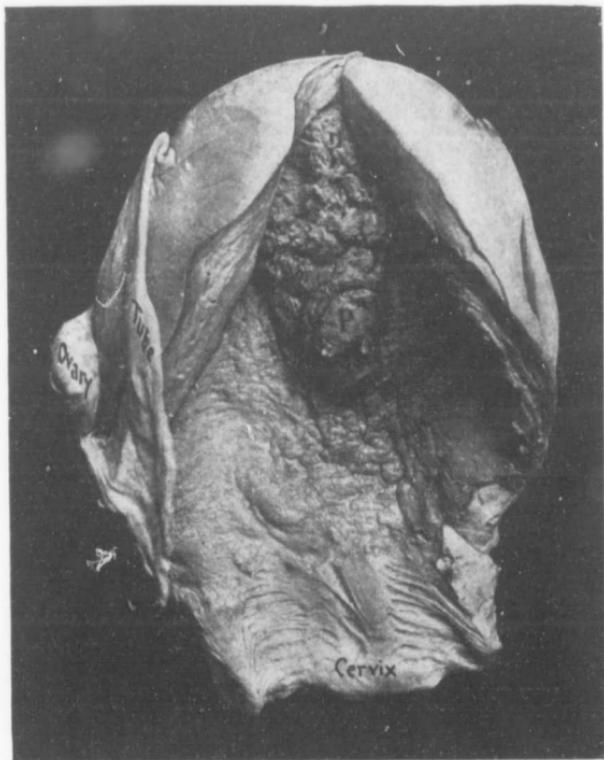


FIG. 267.—Portion of placenta (P) remaining *in utero*. Death from sepsis five days after delivery in a typhoid condition. Colored girl, nineteen years old, syphilitic, with dead fetus at term (Army Medical Museum, Washington, D. C., No. 7784).

irregular. When remains of placenta or membranes are attached to the wall, these may be felt as shaggy, irregular masses.

If putrid endometritis be present in a marked degree, superficial projecting portions of necrotic tissue may be felt. The symptoms

associated with the latter condition vary considerably, and in the early stages may resemble those of septic endometritis. As the case proceeds the general systemic disturbances are rarely as severe as in the latter condition. When the colon bacillus or *Bacillus aerogenes capsulatus* causes the putrid endometritis, there will likely be as well a systemic invasion by the micro-organisms. The ordinary saprophytes are, however, usually limited in action to the inner wall of the uterus, the systemic disturbances being due to the toxins produced by their action and absorbed into the system.

The progress of puerperal endometritis varies greatly. Subsidence may be rapid, or gradual and prolonged; exacerbations may occur. In cases which run a lengthy course the patient becomes much reduced in strength, the various functions of the body being imperfectly performed as a result of the continued poisoning. Fatal cases are usually those in which the micro-organisms have invaded the body outside of the uterus.

When peritonitis is present, the symptoms and signs vary according to the site, virulence, and extent of the infection. If localized in the pelvis, pains may be felt in that region, while elevation of the pulse and temperature is marked. There is usually much tenderness on palpation, the lower abdominal region becoming rigid on pressure. Rigors are common. The alimentary canal is disordered and vomiting is frequent. When the peritoneum is widely infected, the patient's condition is more serious. The various changes need not, however, be detailed here, as they are well described in works on gynecology. These cases are generally fatal, sometimes very rapidly, within one or two days. Ordinarily they last six or seven days, rarely longer. When the tube and ovary are infected, the symptoms and signs are the same as those occurring in any localized peritonitis, considerable variations being found. If at the same time general peritonitis is present, it may be impossible to determine accurately the extent to which the appendages are affected.

Parametric infections are usually accompanied by marked disturbances, especially when suppuration takes place. There are marked elevations of temperature and local pelvic pain. In pyemic cases, in which uterine phlebitis and breaking up of thrombi have been followed by the transmission of emboli to various parts of the body, the clinical phenomena are too well known to need special description here. They are the same as in pyemia developing from any infected area. A condition of hectic usually develops, fever, chills, and remissions being noted. Disturbances in various organs and tissues may be marked—*e. g.*, lungs, kidneys, and joints. Infection in the urinary tract results in disturbances that vary according to the part affected. Sometimes cystitis is present; sometimes there is marked alteration in

the kidneys. Various changes in the nervous system may be found—*e. g.*, mental disturbances, sleeplessness, aphasia, paralyses, neuritis, etc. In the skin inflammatory changes may be found—*e. g.*, erythematous and crysipelatous patches, bullæ, abscesses, gangrene, etc. Occasionally localized swellings due to edema may appear on different parts of the body. It may occur in the lower extremities, being mistaken for phlegmasia alba dolens. Most frequently it is regarded as an indication of abscess formation. The swelling is not painful and may disappear in a few days.

Finally must be mentioned those cases of puerperal infection in which an acute septicemia develops from the early entrance of septic organisms into the system. When this takes place before local changes have occurred in the uterus, the signs and symptoms are the same as those following the introduction of infection through any other part of the body, and are fully described in works on surgery and medicine. In the great majority of cases acute septicemia is due to streptococcal infection, though it may be caused by other organisms. Sometimes a gas bacillus—*e. g.*, *Bacillus aërogenes capsulatus*—may directly infect the system in addition to producing local changes in the uterus.

The leukocyte count is of little value for diagnosis or prognosis in puerperal infection. In normal conditions the number of leukocytes may be as high as is often found in severe infections, great variations being noted. In a series of observations made by Zweifel the count varied from 4000 to 21,000. Moreover, in such conditions the increase due to a septic process may be very slight.

**Prognosis.**—Under modern methods of treatment it is certain that puerperal infection, speaking generally, is less fatal than in the preantiseptic days. Severe types of the affection are much less frequent. The earlier the signs and symptoms of infection appear after labor, the more serious the case. The most fatal are those in which the phenomena develop within thirty-six or forty-eight hours. The outlook is very grave when the peritoneum is infected or when there is general septicemia; the pyemic form is very serious. When the micro-organisms are limited in their activity to the uterus or neighboring parts, the outlook is hopeful. In the mildest cases it must always be remembered that death may sometimes follow suddenly from embolism, though this is rare. More frequently a mild type may change to a severe type owing to renewed activity of the micro-organisms already present or to infection with others. It is important also to note that after-results—*i. e.*, chronic ovaritis, salpingitis, etc.—in cases which do not end fatally are often more marked after mild infection than after those which are severe. The streptococcus is the most common cause of serious infections, though it varies greatly in its

manifestations. The colon bacillus is frequently fatal in its action. The gonococcus and staphylococcus in the great majority of cases produce local disturbances which rarely cause death, but often lead to troublesome chronic disturbances. The anaerobes or saprophytes are usually the least dangerous infecting agents, the results of their activity being generally local. Occasionally, however, a serious general infection may be caused—*i. e.*, by *Bacillus aerogenes capsulatus*.

When infection is due to more than one organism, the prognosis must be more unfavorable. When the patient has been in poor health, has passed through a tedious, difficult, or complicated labor or has lost much blood, the outlook is more serious. Continued high temperature or pulse indicates a serious condition, especially if it persists after therapeutic measures have been carried out to clean up local infected areas in the genital tract. Marked alterations in the kidneys are very unfavorable.

**Diagnosis.**—In the great majority of cases it is easy to diagnose puerperal infection. Occasionally, however, there is difficulty, especially in the early stages, when there is no localization of symptoms or signs.

The greatest caution must be exercised in depending upon the temperature and pulse. After labor these may sometimes be elevated by causes other than infection. Thus, if delivery has been very tedious and exhausting, the temperature may rise a degree or a degree and a half. In the succeeding days emotional excitement of any kind may cause it to rise several degrees, though it usually rapidly falls again. Sometimes in nervous women there may be a simulation of rigor. Undue distention of the breasts, producing distress, may cause slight elevation of temperature. If any of the milk-ducts be obstructed, there may be a marked rise, especially in nervous women. In such cases, however, it is not always easy to eliminate the possibility of infection in the breasts until some hours have elapsed. Normally there is very little rise in temperature, less than half a degree or none at all, in connection with the establishment of the milk secretion. The pulse usually corresponds to the temperature in these various conditions. When much blood has been lost, the pulse remains rapid after labor and the temperature is more easily elevated.

In some cases it appears that auto-intoxication from the bowel may cause an elevation of pulse and temperature, simulating infection. The symptoms are probably generally due to the absorption of toxins produced by the intestinal micro-organisms. Dumont and others believe that in some cases colon bacilli actually pass into the peritoneal cavity. Budin was the first to insist on this, in 1892, and others have made similar statements. It is stated that this trouble may arise both in cases in which the alimentary tract has been much disturbed during pregnancy as

well as in those in which it has not. In this condition there are usually loss of appetite, malaise, headache, flatulence, distress, and pains in the abdomen. The pulse and temperature may be elevated and rigors may occur. The tongue is foul, the breath bad, and the intestines usually distended with gas. Distress may be caused by palpating the abdomen. The administration of purgatives and enemata generally results in large evacuations, and rapid improvement in symptoms usually follows, though in some cases recovery may be slow. It is stated by some that death may result.

The temperature may rise before an evacuation can be obtained, probably because the liquefaction of the feces caused by the medicines allows more toxic matter to be absorbed.

Septic inflammation in the breast may simulate infection through the genital tract, and until definite mammary signs have developed, there may be great uncertainty as to the exact condition. It must always be remembered that occasionally both pelvic and mammary infection may be present. Sometimes an intra-abdominal infection may follow injury to old infected areas—*e. g.*, ovaritis, salpingitis—produced during labor. In such a case the previous history might lead to a suspicion of the condition, while cultures from the interior of the uterus should be sterile. Torsion of the pedicle of tumors may also result in changes that may simulate puerperal infection. A knowledge of the previous history and careful examination are necessary to make a diagnosis. Malaria may sometimes affect women after labor and may be mistaken for puerperal infection. More frequently, however, the latter is diagnosed as the former, often purposely. The diagnosis of malaria should not be made unless the plasmodia of this disease are found in the blood and the uterine discharge is found to be free from infective organisms. Typhoid fever is also frequently diagnosed in cases of infection, but the diagnosis should be made only if the Widal reaction is decided. This disease may undoubtedly sometimes manifest itself in the lying-in woman, though rarely. An exacerbation of an old tuberculous lesion may sometimes follow labor and may easily be mistaken for puerperal sepsis. Influenza, especially the atypical forms, may simulate an infection.

It is believed that the secondary streptococcal or staphylococcal infections that may follow this disease may sometimes actually cause puerperal sepsis. In all doubtful cases bacteriologic examination of the uterine cavity should be carried out where the circumstances are favorable to this procedure. Döderlein's lochial tube should be used in collecting the fluid to be tested. It is about 25 cm. in length, 4 mm. in thickness, and is bent slightly at one end. As Williams suggests, this is most conveniently sterilized and carried in a large test-tube, resting in cotton-wool. The patient should be placed in the Sims or lithotomy position

and the external genitals thoroughly cleansed. The hands of the operator and his assistants should also be sterilized. With a vaginal speculum, aided by retractors if necessary, the vagina should be opened, the cervix drawn down with a volsella, and wiped clean with sterile wool. The lochial tube is then removed from the test-tube and its curved end passed high into the uterus. To its outer end a piece of sterile rubber tubing is attached, and to this a syringe is joined, for the purpose of drawing some of the uterine contents into the tube. The latter is then withdrawn, its ends being closed with sealing-wax. It is then carried in its case to the laboratory, where it is broken across in order that cultures may be taken from the contents and slides examined.

**Treatment.—Prophylactic.**—Bearing in mind that in the great majority of cases infection is due to carelessness in the technic observed during delivery, the physician should insist on the observance of the same rigid measures by those who assist him as well as by himself which would be enjoined by a careful surgeon in the conduct of a surgical case. The necessary measures have already been detailed in the chapters dealing with the management of pregnancy and labor, and need not again be repeated.

**Curative.**—When the perineum or lower part of the vagina is infected, it is necessary to destroy the organisms as soon as possible, in the hope that they may be prevented from spreading upward into the uterus. For this purpose the author has employed the following plan: The patient is placed in the lithotomy position and the vagina exposed, the affected area being washed with 50 per cent. peroxid of hydrogen solution. A gauze tampon is then placed in the vagina, soaked in a solution of formalin in glycerin and water (formalin, ℥xxx; glycerin, ℥iv; sterile water, Oj). After twelve hours the gauze is withdrawn, the affected parts again washed with peroxid, and fresh formalin gauze re-introduced for twelve hours. This may again be repeated until the infected area is in a healthy healing condition. This method is preferable to the employment of antiseptic douches, because it allows of the continuous application of a powerful penetrating antiseptic.

When the uterine cavity is infected, it is important to determine the condition of the uterus and of the entire contents of the pelvis. Some discharge should be first collected in a glass tube, from the interior of the uterus, in the manner already described. A thorough bimanual examination should be made to determine the condition of the ovaries, tubes, peritoneum, and parametrium. One or two fingers should then be introduced into the uterus to palpate its inner wall and to determine whether there is much debris in the cavity. If the wall has no abnormal masses attached to it, the debris in the cavity should be simply washed out with

normal salt solution. Curettage is not indicated in such a condition; it is indeed an unwise procedure. The infecting organisms in such a case are mainly in the superficial layer of the endometrium, while leukocytes are accumulated in a deeper zone as a line of first defense. In the great majority of cases this protecting zone is not penetrated, or is to such a small extent that serious systemic invasion does not occur. Curettage is dangerous, because it breaks up this protecting zone, exposing fresh raw tissue, which is likely to be invaded by the micro-organisms, which cannot, of course, be entirely removed by the curet.

The inner wall of the uterus should indeed be disturbed as little as possible. The author strongly advises introducing into the uterine cavity gauze soaked in an antiseptic solution that is penetrating and not dangerous to the system in the strength in which it is employed. For several years he has employed the glycerinated formalin solution referred to above. The gauze is left in the uterus about twelve hours, a fresh piece being then introduced. This procedure may be repeated one or more times if the patient's condition does not rapidly improve. In cases in which the organisms have not passed beyond the uterus it is rarely necessary to use more than one or two applications of the gauze. When there is evidence of general systemic invasion or of pelvic infection external to the uterus—*i. e.*, parametritis, salpingitis, etc.—it is useless to continue the intra-uterine applications.

The author has entirely abandoned the use of intra-uterine antiseptic douches in these cases, because it has been abundantly proved that the temporary dribble of such a stream is utterly without destructive or inhibitory effect on the micro-organisms, so many of which are not on the surface, but in the tissues. Moreover, it has been clearly shown that the employment of salts of mercury, so frequently employed in intra-uterine douches, is not without risk, several deaths having indeed been reported in recent years. There is indeed no place for the use of these salts or of others that are likely to damage the tissues or poison the system. Schucking's method of irrigating the uterine cavity continuously with an antiseptic lotion is rational if a solution be used that will not injure the tissues or poison the system. Though it has been enthusiastically adopted in some quarters, it has not been favorably received by the profession, on account of the inconvenience associated with its employment. The author's plan of using a tampon soaked in an antiseptic is a simpler method, and is suitable to private as well as to hospital practice. The plan of swabbing out the uterus with strong solutions—*i. e.*, corrosive sublimate, carbolic acid, formalin, etc.—is to be condemned, because of the destruction of tissue that is produced. No such risks exist with the use of gauze soaked in the solution of formalin that I have em-

ployed. In a number of cases I have used chinisol solution (1 : 1000) with satisfactory results, but I believe the former solution to be more penetrating.

When the wall is abnormally rough and shaggy and the lochial discharge has an odor, it should be scraped with the fingers and the debris should be washed out of the uterus with a stream of normal saline solution or swabbed out with pieces of gauze held in forceps. If the projecting masses are not completely removed in this way, a curet forceps should be employed. Occasionally it may be necessary as well to use a curet. Afterward gauze soaked in the glycerinated formalin solution should be introduced into the cavity for twelve hours and then changed.

In all cases of infection of the uterus ergot should be administered to counteract the tendency to relaxation in the uterus, in order that the lymphatics and veins may be compressed and so rendered less liable to convey infection. When there is evidence of localized pelvic inflammation beyond the uterus, an ice-water coil may be placed on the lower abdominal region, the water being allowed to circulate continuously through it. Many prefer to use hot fomentations rather than cold, patients usually preferring the former. When there is evidence of general intoxication from toxins, or of an active general septic process, it is important to keep up the patient's strength by easily digested nourishing food—*i. e.*, milk, plain or peptonized; plasmon, beef-juice, etc. Of great value are high rectal injections of warm normal saline solution (a pint every five or six hours). This fluid has a certain food value, is a stimulant, promotes the activity of the kidneys and skin, and dilutes toxins circulating in the system. If sodium acetate be added to it, the diuretic action is increased. The bowels should be kept regularly open. Brandy or whisky is valuable where there is much exhaustion and when abundant nourishment must be supplied continuously to make up for excessive waste of tissue. As much as 10 or 12 oz. or even more may be administered in twenty-four hours, chiefly for the food value, though the stimulant action is also important. One of the best stimulants for impaired cardiac action is strychnin given in large doses. The antipyretics that are so widely employed are inadvisable, as they are apt to depress the patient. Hydrobromate of quinin may, however, be given (3 to 5 gr. three or four times a day) without causing depression or any disturbance. When the fever is high, the cold pack, cold sponging, or cold baths are valuable, causing the same benefits as in the treatment of typhoid fever. The baths should not be used if there be peritonitis, a pelvic exudate, or phlegmasia alba dolens. Macé, an enthusiastic advocate of the bath, recommends that the water should be at about 75° F., the same precautions being observed as in the treatment of typhoid.

In 1886 Schultze, of Jena, performed hysterectomy in a case

of retained placenta with infection, and since that time the operation has been carried out in puerperal infection by several workers. At present it is little practised, because it is difficult to establish definite indications for its performance. Extensive infection of the uterine wall, with abscess formation, is considered by some a suitable indication, and indeed it may be so regarded, but unfortunately, when this condition exists, the whole system is likely to be invaded by infecting organisms, which will continue to be active after the uterus is removed. If, however, there is considerable certainty that they are mainly localized in the uterus, vaginal hysterectomy may be advisable. The general condition of the patient should be such as to warrant its performance. Bonamy has collected 31 operations, in which 11 deaths occurred; Treub, 36 cases, in which 21 deaths resulted. The latter author states that he has treated 734 cases of puerperal infection, with 34 deaths. In 6 of the latter there were no clinical signs of any infection outside of the uterus, but the autopsies revealed nephritis, purulent thrombosis, or other serious lesions in all but 2 cases. Consequently, out of the 34 fatal cases, probably only 2 might have been saved by hysterectomy. He holds that there is no absolute indication for the performance of this operation.

When abscesses form in one or other of the pelvic tissues and their presence is clearly indicated, evacuation of the pus is necessary. This should be carried out by the vaginal route, if possible, even when the tubes or ovaries are infected. Removal of diseased tubes and ovaries by the abdominal or vaginal incision is very risky while the tissues are invaded with active infective organisms. This radical procedure should be deferred as long as possible.

When general septic peritonitis is present, the treatment is the same as in non-*puerperal* varieties of this affection. Apart from the general measures already described, there is considerable difference of opinion as to the course to be adopted. The author recommends a mesial abdominal incision for the purpose of washing out the belly with normal saline solution containing formalin (16 minims of formalin to a pint). If there be a tubal or ovarian abscess, it should be removed. A wide opening should then be made into the vagina through the pouch of Douglas. If the uterus presents suppurating foci, it should be removed. Chinolol gauze should then be packed in the pelvis, its lower end being placed in the vagina. A glass drainage-tube should be placed in the anterior abdominal incision. Through it the formalin saline solution should be injected twice daily until improvement is noticeable; the abdominal incision should then be closed. On the third or fourth day a new piece of gauze may be introduced into the pelvis through the vagina, or douches of formalin solution may be used.

Within recent years considerable attention has been given to

the subject of serum therapy in puerperal infection. In 1891 Lingelsheim and Roger, and in 1893 Mironoff, believed that they partly succeeded in immunizing animals against streptococcus. In 1895 Marmorek reported that by growing streptococcus on blood-serum and agar and inoculating animals repeatedly, so as to obtain a very virulent culture, he was able by injecting this culture into immune animals to produce a preventive and curative serum. Charrin and Roger at the same time reported a similar serum, obtained in a somewhat different manner.

Many reports have appeared in different countries regarding the hypodermic injection of antistreptococcic serum. Glowing accounts of single cases in which improvement followed its employment have been given in many journals; they are mostly worthless. Accurate studies of many cases by skilled observers make it evident that no better results have attended the use of the serum than have followed other methods of treatment. In 1899 a committee of the American Gynecologic Society issued a report on this subject. They collected 352 cases of puerperal infection in which the serum had been used. Of these it was certain that there was streptococcic infection only in 101 cases, of which 33 died, or 32.69 per cent. Krönig has treated 56 and Williams 52 cases of streptococcic endometritis without the serum with a mortality of less than 4 per cent. The author has treated more than 160 cases with little more than 5 per cent., the mortality being chiefly due to peritonitis where operation was not carried out. If it be admitted that the antistreptococcic serum may do good in cases of streptococcic infection, it is irrational to suppose that it is valuable where other organisms are the cause of trouble. Yet it has been used indiscriminately, and success has been claimed for it in saprophytic as well as in the various forms of septic infection, when improvement has been undoubtedly due to other factors. Bar and Tissier have called attention to the various complications that have followed the use of the serum—*i. e.*, distress, malaise, shivering, rise of temperature, erythema, urticaria, pains in joints, effusion in joints, and abscess.

Hofbauer has advised the use of nuclein, claiming that it increases the number of leukocytes and so leads to improvement.

**Phlegmasia Alba Dolens (Milk Leg; White Swelling).**—Though this condition is a form of puerperal infection, it is usually considered by itself. It may accompany other manifestations of infection, but frequently it is the only evident result, and is often first noticed only after the first or second week of the puerperium. The left limb is more frequently affected than the right; sometimes both limbs are involved. In the great majority of cases the condition is due to phlebitis, starting in uterine veins and extending into the iliac vein, thrombosis occurring as well in the femoral or saphenous veins. Thrombosis is usually due to

the direct influence of the phlebitis, but may also be produced by the toxins of the infecting organisms. The veins of the lower limbs are favorable to thrombosis because they are often dilated and varicose, the blood-current being sluggish. The increased fibrin-forming tendency of the blood of the lying-in woman is another favoring factor. Occasionally there may be an independent distinct phlebitis in the femoral, external, or internal saphenous veins, not continuous with inflammation in the iliac or uterine veins. This was formerly believed to be the common cause of phlegmasia, but it is now known to be rare. Sometimes there may be an associated involvement of superficial veins on the anterior abdominal wall. The venous changes may be accompanied by lymphatic infection that has extended from the uterus, and marked obstruction to the flow of the lymph in the lower limb may be caused. Sometimes the cellular tissue external to the lymphatics may also be injected. In some cases the lymphatics of the upper part of the thigh are alone involved, the veins remaining healthy, the swelling of the limb being entirely due to the obstructed lymph current, the inguinal lymphatic glands being enlarged and sensitive in some cases.

**Symptoms and Signs.**—Pain is generally the first symptom. It is usually felt in the groin, along the course of the femoral or saphenous vein, or in the calf, great variations being found in its severity. Sometimes it is sharp and intense; sometimes it is merely a dull ache. On moving the limb or on standing the distress is increased. The easiest position is one of slight flexion with internal rotation of the thigh. Swelling of the limb usually follows the pain, though sometimes it occurs first. In some cases the eye fails to detect any difference in the size of the limbs, and careful measurements are necessary to determine the enlargement. In some cases the swelling appears first at the ankle or calf and spreads upward; in others it begins in the groin and extends downward.

In the majority of cases the swelling is due to edema of the tissues from venous obstruction. When the lymphatics are involved, their engorgement adds to the swelling. In extreme cases the whole limb may be enormously enlarged. The skin becomes stretched, pearly white, and glistening, with often a marbled appearance. Sometimes thickening and redness may be visible along the line of inflamed veins. When there is superficial lymphangitis, the skin may also be reddened. The edematous tissues pit on pressure. When the superficial swelling is partly or wholly due to lymphatic engorgement, the skin feels firm and brawny and cannot be indented like tissues enlarged by edema. Palpation of the limb usually causes distress, which varies in different cases; it is chiefly marked along swollen veins, especially when inflamed. Areas of lymphangitis are also usually painful to the touch. Edematous cellular tissue is not sensitive to pressure, as a rule,

unless the swelling be very marked. The affected veins may in parts be easily palpated, save when the tissues external to them are much swollen. When there is phlebitis of the external saphenous, it is usually felt at the top of the calf.

The limb is usually less sensitive to touch and to heat, though when the swelling is excessive there may be hyperesthesia. The general condition of the patient varies considerably. When the phlegmasia is the sole or chief manifestation of infection, she is not greatly disturbed so long as she keeps quiet. The temperature is elevated, though not generally to a marked extent. When there is marked phlebitis or lymphangitis, more or less disturbance of functions usually occurs—*i. g.*, loss of appetite, foul tongue, disordered stomach and bowels, general malaise, and sleeplessness. Occasionally at the beginning of the affection there may be marked disturbance and pains in the chest, due to emboli, which may cause pleurisy or lung infarcts.

The progress of the disease varies greatly. In most cases there is complete subsidence in three to six weeks, the swelling and temperature gradually disappearing. In some cases there are exacerbations from time to time. Occasionally the swelling lasts only a few days. In some cases recovery is followed by chronic swelling of the limb, which may last for months or years. In the course of the trouble various complications may arise—*i. e.*, erysipelatous inflammation in the skin, gangrene, abscess, and embolism. Permanent lameness and weakness may sometimes result from muscular atrophy.

**Treatment.**—The patient should be placed on her back in bed, the affected limb being enveloped in wool, elevated on pillows, and kept at rest. She should remain in this position for several weeks—ordinarily, three or four after the onset of the trouble. She should not be allowed out of bed until ten days have passed after tenderness, fever, and swelling have disappeared. On sitting up the limb should be kept horizontal most of the time, and should only gradually be used in standing or walking.

The diet must be nourishing and the bowels must be well regulated. When the bedpan is used, great caution must be exercised. Movements may detach portions of thrombi and lead to embolism, and the patient should be warned against making them. When the patient is allowed to sit up, gentle massage may be carried out for a few weeks, in order to improve the circulation and the tissues. During the progress of the disease it may be necessary to use drugs to lessen the pain. These may be applied locally or internally. Applications of lead and opium lotion are usually satisfactory, but must be applied without moving the limb. Occasionally hypodermic doses of morphin may be necessary. Complications must be treated as they arise; thus, if abscesses form in the limb, they should be incised.

## PART VII.

# OPERATIVE OBSTETRICS.

### CHAPTER I.

#### ARTIFICIAL INTERRUPTION OF PREGNANCY.

**Abortion.**—The interruption of pregnancy before the time of viability of the fetus may be justifiable for a variety of reasons. The procedure should never be undertaken without the gravest consideration, and only because of reasons that are entirely medical. The mere desire of a pregnant woman that gestation should be ended should never influence a physician in the slightest degree. In every instance in which he may consider it necessary he should seek consultation with one or more medical men, not only that the matter may be thoroughly discussed, but as well that he may be protected from any suspicion of wrongdoing.

**Indications.**—The conditions that may render necessary the induction of abortion have already been referred to in connection with "Pathology of Pregnancy," and need here only be recapitulated in a general way.

1. Certain disorders of the nervous system—*e. g.*, very bad chorea.
2. Certain disorders of the hemopoietic and circulatory systems—*e. g.*, large and rapidly growing thyroid, pernicious anemia, and some conditions of valvular heart disease.
3. Certain lung diseases—*e. g.*, some conditions of phthisis.
4. Certain affections of the alimentary system—*e. g.*, severe pernicious vomiting, endangering the woman's life.
5. Certain diseases of the urinary system—*e. g.*, marked renal inflammation and degeneration.
6. Certain diseased states of the uterus—*e. g.*, conditions leading to marked loss of blood, some forms of new growth, and incarcerated retroflexion.
7. Certain diseases and abnormalities of the ovum—*e. g.*, hydatidiform degeneration of the chorion, placenta prævia, detachment of the normally situated placenta, and death of the embryo.

8. Pelvic deformities. In extreme degrees of pelvic contraction abortion may be considered as an alternative to measures that must perforce be employed if pregnancy is allowed to go to full term. The period at which the abortion should be performed in such cases depends on the size of the pelvis. Lusk gives the following table:

| Anteroposterior diameter<br>of pelvis. | Latest period for inducing<br>abortion. |
|--|---|
| 1½ in. . . . .                         | Beginning of the sixth month.           |
| 1¼ in. . . . .                         | “ “ fifth “                             |
| 1 in. . . . .                          | Four months and a half.                 |

As De Soyre points out, with less than an inch the difficulties of inducing abortion are so great as to make the operation inadvisable.

**Methods of Inducing Abortion.**—Very many procedures have been tried. The administration of drugs—*i. e.*, ergot, cotton-root



FIG. 268.—Bougie passed through cervix and between membranes and uterine wall, and retained by a light vaginal tampon.

bark, quinin, pilocarpin, aloes, and various essential oils—*i. e.*, rue, savin, tansy, parsley, and pennyroyal—is uncertain, unreliable, and frequently dangerous. No drug can be relied on to produce abortion; the uterus is rarely completely emptied after their use. Incomplete abortion is frequently associated with hemorrhage and with septic infection. Sometimes harm results from the large doses administered.

The induction of abortion by the administration of large doses of purgatives, producing reflex stimulation of the uterus, is unjustifiable. Massage of the nipples, as recommended by Scanzoni, is not to be recommended. Galvanism applied to the uterus is rarely practical and is uncertain. Kiwisch's method of douching the upper part of the vagina and cervix with hot water (105° to 108° F.) is very uncertain and tedious. The injection of fluids into the uterus, outside of the membranes, is slow and risky; it

has frequently been followed by infection and sometimes by air embolism. A favorite method has long been the introduction of a flexible catheter or bougie into the uterus, outside of the membranes. It should not, however, be employed. It may be very difficult to introduce the instrument without perforating the amnion. The catheter should not be used, because it contains air; the bougie may perforate the uterus. The results, moreover, are very uncertain. Sepsis has frequently been introduced by this method, which necessitates the retention of the instrument in the uterus twelve or more hours.

The passage of a sound into the uterus is very uncertain in its effects; in unskilled hands it may cause perforation of the uterus. Frequently abortion may not be started until the instrument has been passed on successive days; the woman is thereby exposed to increased risk of infection.

Removal of the liquor amnii by direct puncture or by aspiration is also an uncertain method; abortion may start in a few hours or may be delayed one or more days. Moreover, the absence of the liquor amnii makes it more difficult for the uterus to expel the contents satisfactorily. Portions of the ovum are apt to be retained. In cases where pains do not occur until after an interval of some days the risk of septic infection in the uterus is considerable. It has been recommended by several that the membranes should be punctured some distance above the os internum, so that some fluid might be retained to act as a dilator. This procedure cannot, however, be carried out with ease and certainty, and should be attempted only by experts.

Tamponade of the vagina by means of gauze or cotton tampon or a rubber bag—*i. g.*, Braun's colpeurynter—is a very unreliable method. In some cases it will not induce abortion at all. It is tedious and often makes the vagina very sensitive or painful.

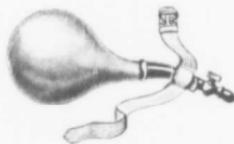


FIG. 269.—Colpeurynter.

The following procedures are most satisfactory:

I. *During the First Three Months of Pregnancy.*—(a) *Emptying the Uterus at One Sitting.*—In the great majority of cases it is possible to dilate the cervix so that the uterine contents may be removed with one or two fingers and with the abortion- or curet-forceps. If sufficient dilatation cannot be obtained for the introduction of one or two fingers, the curet forceps alone may be employed. The patient should be anesthetized, placed in the lithotomy position, and prepared with the same care observed in a surgical operation, the bladder and rectum having been emptied. If a general anesthetic is contraindicated, cocain may be injected into the cervix ( $\frac{1}{8}$  gr. in solution in each side), in order to render

dilatation less painful. The operator and his assistants must likewise be rigid in regard to aseptic technic. The cervix should be held by a tenaculum and gradually dilated by a series of graduated metal dilators. Caution should be exercised, in order that the wall should not be torn to any marked extent. In the third month the canal may sometimes be dilated sufficiently to allow the entrance of two fingers without tearing of the wall. Usually, however, this degree of enlargement is not obtained. In the first two months it is not advisable or necessary. After dilatation the amniotic fluid should be evacuated, and, if a finger can be introduced, the size and situation of the fetus and of the chorion frondosum should be determined; the left hand should depress the fundus uteri through the abdominal wall during this examination.

The curet-forceps should next be introduced, in order to pull out the embryo entire or piecemeal. The finger should then be introduced, in order to separate the entire ovum and decidua reflexa from the uterus, the latter being well pushed down from above. If this is successful, the tissue is removed in pieces by the curet-forceps. If the finger cannot be used in this way, separation and removal may be carried out by the instrument alone. During the procedure it is advisable to douche the uterus as much as possible with hot water (110° F.), in order to stimulate the uterus to contraction, so as to reduce its area and make its wall more easily felt, and at the same time check hemorrhage. The whole wall should be systematically scraped by the forceps; a curet is rarely needed. If one is employed, it should have a blunt or a well-rounded end, so that there should be little risk of perforating the uterine wall. After the uterus is emptied a strip of aseptic or antiseptic gauze should be packed in the cavity for twenty-four hours, being tied to another piece placed in the vagina. Ergot is rarely necessary after this operation, for the purpose of favoring uterine contraction.

(b) *In Two Stages.*—In the second and third months it may rarely happen that the cervix is so hard as to be undilatable to such an extent that the uterus can safely be emptied. In such a case dilatation should be carried out as far as possible without rupturing the membranes, and gauze should be packed inside the os internum and in the cervical canal, or a small rubber bag should be inserted, an antiseptic tampon being placed in the vagina. In twenty-four hours, if the uterus has not emptied itself, the patient should be anesthetized, the gauze removed, the cervix further dilated, and the uterine contents removed with curet-forceps.

II. *From the Third to the Sixth Month of Pregnancy.*—(a) *In One Sitting.*—In some cases the uterus may be emptied in the manner already described. The fetus is most easily delivered by

the breech. When this part does not present, turning should be carried out by bimanual manipulations, in order that the legs may be seized and pulled down. When the head is too large to pass through the dilated cervical canal, it should be perforated through the occiput, in order that its collapse may follow. The operation is usually more difficult than in the early months of gestation.

(b) *In Two Stages.*—When the cervical tissue is very firm, it is advisable to dilate the canal as much as possible without producing laceration. A rubber bag is then introduced so as to lie partly in the cervix and partly above it, under the membranes, distended with sterile water or normal salt solution. If a strong rubber bag is not obtainable, sterile or antiseptic gauze—*i. e.*, chinosol, may be packed in the uterus below the membranes, in the cervical canal, and in the upper part of the vagina. The patient is then sent to bed. Uterine contractions develop and may lead to the expulsion of the entire contents of the uterus. If this has not occurred within twenty-four hours, she should be anesthetized, the cervix further dilated, and the ovum removed with fingers and instruments.

(c) Occasionally it is inadvisable, on account of the patient's condition, to perform the abortion in two stages, even when the cervix is very firm and dilates with difficulty. The best procedure is one similar to vaginal Cæsarean section as performed in full-time cases. The cervix is dilated as much as possible, and the vaginal wall incised circularly at its junction with the cervix, the cut being extended for half an inch in each lateral fornix. The vaginal vault is then stripped upward from the cervix, care being taken to separate the bladder cautiously; the peritoneal reflection should be pushed up and held by a retractor. The cervix should then be split anteroposteriorly, the incision being carried into the lower segment as high as is necessary to afford room for manipulations. Through the opening the uterine contents are removed. Afterward the divided tissues are stitched together with catgut and a gauze tampon placed in the uterus.

**Premature Labor.**—The induction of premature labor after the period of viability may be undertaken for those reasons already mentioned as indications for the performance of abortion, the operation being undertaken solely with regard to the welfare of the mother. Most frequently, however, premature labor is an operation of choice, undertaken with a view to the safety both of mother and fetus. For this purpose it has been most frequently employed in contracted pelves, which do not admit of the safe delivery of a living child at full time by the natural passage. The increased safety of Cæsarean section has undoubtedly diminished the range of its employment in such cases in recent years. In the practice of some authorities symphysiotomy at term has also somewhat displaced the operation. Habitual death of the

fetus late in pregnancy, placental disease, and habitual large size of the head have also been regarded as indications.

**Preliminaries.**—A consultation is always advisable when premature labor is proposed. The patient should be kept in bed a few days before the operation, the diet being simple and the bowels well regulated. It is advisable to secure the services of a wet-nurse, and an incubator should be provided for the child.

**Methods of Inducing Labor.**—The various procedures used to bring about emptying of the uterus in early pregnancy have also been employed in the late months. The following are the most serviceable:

1. *In Cases where there is no Urgency*—The woman should be

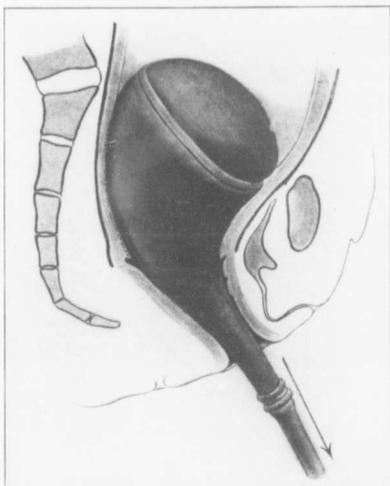


FIG. 270.—Champetier de Ribes bag lying in position in cervix and lower uterine segment (Bumm).

placed in the lithotomy posture, anesthetized, and prepared as for a surgical operation. The cervix should be dilated with graduated metal dilators as far as possible without laceration of its tissues. A finger should be introduced to separate the membranes a short distance above the os internum. A conical rubber bag, of the type devised by Champetier de Ribes or Boissard, is then introduced by means of forceps so as to lie below the membranes in the lower uterine segment, its lower end projecting into the cervix.

Through a tube attached to this end the bag is filled with sterile water or normal saline solution, the tube being closed, so that the water may be retained. The patient is then sent to bed. The bag acts as a stimulant to the uterus. Its conical shape prevents it from being expelled from the uterus too soon, and makes it valuable as a dilator. It is indeed a fluid wedge, like the normal bag of membranes. Labor is usually completed within ten to twenty hours. The patient should be attended as in a full-time labor. After pains have been in progress four or five hours a vaginal examination should be made. If the dilatation is well advanced, the bag should be removed, nature being allowed to complete the process. If it is not well advanced, the case may be left for a few hours longer, or if the patient is not in good condition, traction on the bag may be made, especially during the pains, to assist in dilatation.

An objection has been made to the Champetier de Ribes bag that it may displace the presenting part of the fetus—*i. e.*, it may change a head to a transverse presentation. This is a just criticism, but the objection is unimportant if the physician watch the case carefully. On removing the bag from the cervix, examination should always be made to determine the presentation. If there



FIG. 271.—Barnes's bag.

has been a displacement, it should be rectified by bimanual manipulations without rupturing the membranes. Labor may thereafter be completed by the natural powers, or it may be advisable to deliver by forceps or turning, when dilatation is completed. The habit of introducing a bag and allowing it to be born with the fetus, without making an examination, is to be condemned, because if the presentation has been altered, serious complications



FIG. 272.—McLean's model of Barnes's bag.

may arise which may endanger the life of the fetus. The Boissard type of bag has a concave top, and is less likely to cause malpresentation than that of Champetier de Ribes. Instead of these bags, the older forms devised by Barnes may be used; the cervix is dilated with metal dilators sufficiently to allow the entrance of one of these fiddle-shaped bags, which is then distended with

sterile fluid. Labor pains may undoubtedly be induced by its presence, but it is not so good a stimulus as the bag that rests mainly above the cervix. Moreover, it is soon expelled into the vagina after dilatation proceeds. Schauta and Tarnier have also recommended the introduction of bags internal to the cervix, but these forms are not conical in shape, and, therefore, lack the advantages of the de Ribes and Boissard types.

Of other methods employed, only that of Krause need be recommended, though it is inferior to that described above. It

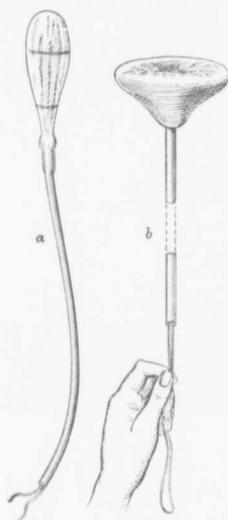


FIG. 273.—Boissard's rubber bag: *a*, Empty; *b*, distended. In the latter condition, as it lies in the cervix and lower uterine segment, the upper surface is concave (Tarnier and Budin).

consists in the introduction into the uterus, external to the membranes, of a flexible bougie, a gauze tampon being placed in the vagina, against the cervix, to keep the bougie in place. This procedure may act satisfactorily, but it is often very slow, and the cervix may not be dilated until many hours have elapsed. Sometimes it is very difficult to introduce the bougie. The instrument should not be used unless it can be sterilized by heat. It is best made of solid flexible rubber, which may be boiled.

The induction of labor by the vaginal tampon or colpeurynter is very uncertain. Evacuation of the liquor amnii is to be condemned, since it causes a protracted dry labor, adds to the risk of sepsis, and almost always destroys the life of the fetus. The injection of fluids—*i. e.*, water and glycerin—is very unreliable and not without risks.

Hamilton's method of separating the membranes for a short distance above the cervix is also very uncertain.

## II. In Cases where Urgency Exists.—The French expression *accouchement forcé*

is usually applied to the method of rapidly and forcibly dilating the intact or partially dilated cervix in advanced pregnancy or at term for the purpose of removing the uterine contents. The operation may be very difficult if the cervix be hard and unaltered, the risk of extensive laceration and hemorrhage being considerable. When the cervix is soft and the

canal partially obliterated the procedure is frequently easy. It is more difficult in primiparæ than in multiparæ.

*Indications.*—It is most frequently performed in eclampsia; sometimes it is necessary in antepartum hemorrhage, in heart, lung, and kidney lesions, and in other serious conditions of the mother in which the continuance of gestation may endanger her health.

*Methods.*—Occasionally a soft cervix somewhat dilated may be rapidly opened by Barnes's bags or by one of the Champetier de Ribes type; when the latter is used, it should be pulled down-



FIG. 274.—Method of performing rapid manual dilatation of the os uteri: 1, Position of fingers in the beginning of manual or digital dilatation of the cervix uteri, first position; 2, showing limit of dilatation in the first position; 3, second position; 4, showing limit of dilatation in the second position; 5, third position; 6, limit of dilatation in the third position; 7, fourth position; 8, limit of dilatation in the fourth position; 9, fifth position; 10, sixth position (Harris).

ward steadily and with intermissions. Recently, however, manual dilatation has to a great extent displaced the use of bags in such cases; the fingers of one or both hands may be used. The method described by Philander Harris is very serviceable. A finger is first introduced into the cervical canal, then a finger and thumb, then two fingers, and so on until the cervix is gradually stretched to the desired size. In cases in which there is no dilata-

tion whatever, several graduated steel dilators may be used, in order to allow a finger and thumb to be introduced. If the hand becomes tired during the maneuver, the fingers of both hands

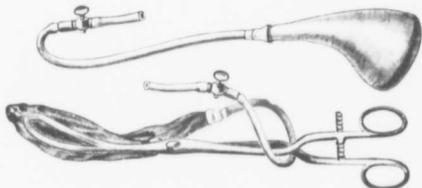


FIG. 275.—Champetier de Ribes bag: A, Inflated; B, folded for introduction into the uterus.

may be used for a time to stretch the cervix in opposite directions.

These procedures should be carried out, if possible, without rupturing the membranes. Rubber gloves should be worn and the strictest technic observed.

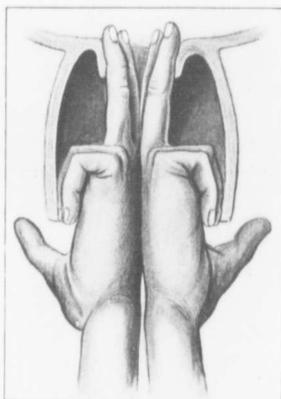


FIG. 276.—Artificial dilatation of cervix with fingers of both hands (Tarnier and Budin).

The patient should be anesthetized and placed in the lithotomy posture. In cases in which there is no abnormal rigidity of the cervix, complete dilatation may be obtained in twenty to sixty minutes. In cases of very rigid cervix these methods should not be employed, since dilatation cannot be accomplished unless unwarrantable force is used, and this may lead to dangerous laceration of the uterus.

In the condition of hard and undilatable cervix various procedures have been recommended. Dührssen has recently urged the value of multiple cervical incisions, previously suggested by Braun, Skutsch, Baudelocque, and others. Experience has, however, shown that this method is uncertain, and that it is associated with grave risk from bad laceration and hemorrhage; it is not to be employed except as a last resort. Effacement of the cervix is an indispensable prerequisite to the

use of incisions, and immediate delivery should follow them. Of greater value in such cases is the operation of vaginal Cæsarean section recommended by Acconci and Dührssen. (See chapter on Cæsarean Section.)

Bossi's four-bladed expanding steel dilator has recently been recommended, but it has not been sufficiently tested to establish its value. Some operators, while admitting that it may occasionally be serviceable, state that its routine use is likely to lead to very serious results from laceration and hemorrhage.

## CHAPTER II.

### VERSION OR TURNING.

VERSION is a manipulation carried out for the purpose of changing the presentation of the fetus for one considered to be more favorable for delivery. In some cases the vertex may be made to present; in others, the breech. Version may, therefore, be considered under the two headings:

1. Cephalic—causing vertex presentation.
2. Pelvic—causing breech presentation.

Of these, the latter is by far the more frequently employed in practice, though in head presentations it has become less common than in former years, owing to the increasing use of axis-traction forceps. Since this instrument has been introduced in the treatment of labor delayed by flattening of the pelvis, the scope of the operation is likely to be diminished still further.

Version may be performed by external, internal, and by combined external and internal manipulations.

**External Version.**—Turning of the fetus by manipulations carried out through the abdominal wall is occasionally performed, most frequently for the purpose of bringing the head into relation with the inlet of the pelvis. It is chiefly used in cases of transverse presentation discovered before or early in labor. Some authorities have advised its employment for the purpose of changing a pelvic to a head presentation; this has been opposed by others, and for a good reason—viz., the impossibility of being certain of bringing about a favorable position of the head after version. In face or brow presentations diagnosed early in labor, external manipulations have been used to bring about a vertex presentation. (See p. 499.)

The operation of external version is rarely easily performed. It should not be attempted in cases of multiple pregnancy, when the presenting part is engaged in the pelvis; after rupture of the

membranes, when the fetus is dead; when, after labor has started, there is abnormal stretching of the lower uterine segment, or when a uterine or other tumor complicates pregnancy. It is very difficult in primiparæ, in fat women, and sometimes when the uterus is much distended with liquor amnii. If the cord be short or wound around the neck, there may be risk to the fetus. It is most easily carried out in a multipara a week or two before the eighth month of pregnancy when the fetus is not too large.

In carrying out the operation the woman should be placed on her back, the head and thorax being slightly raised, and the thighs drawn up. The rectum and bladder should be empty. The hands of the operator should be warm. The fetal poles are moved by a combination of taps and pushes, the normal flexion being preserved. If the patient resists in any way, anesthesia should be employed. During a pain manipulations must cease, the hands endeavoring to hold the fetus, so that the progress already made may not be lost. In the case of a transverse presentation one hand is placed on the head, the other on the breech, the fetus being moved according to whether a head or breech presentation is desired. When a face or brow presents, the head should be grasped in both hands and an effort made to flex it so as to get a vertex presentation. (See pp. 495, 501.) The whole fetus should be raised toward the fundus in carrying out this manipulation.

After version the patient may be kept quiet; a pad may be applied on each side of the uterus and a binder placed around the abdomen, in order to preserve the fetus in the new position.

**Internal Version.**—Turning of the fetus by intra-uterine manipulations has been practised for many centuries. In the earliest times the head was brought to the pelvic brim. Celsus is believed to have first recommended the method of bringing about a pelvic presentation when the fetus was dead. Soranus, of Ephesus, first employed the maneuver to obtain a living fetus. Pelvic version was not much practised until Ambrose Paré introduced the operation in the sixteenth century.

At the present time cephalic version is rarely attempted by internal manipulations. It has been especially recommended in cases of shoulder presentation, soon after rupture of the membranes following full dilatation of the cervix. It should not, however, be carried out if the cord or an extremity be prolapsed. The shoulder is grasped by the hand and pushed up, assisted by manipulations of the other hand through the abdominal wall, so that the head descends toward the brim. The operation is occasionally successful; it should be tried only under anesthesia and should be followed by forceps delivery, the head being held at the brim by an assistant pressing through the abdominal wall.

Of greater importance is pelvic version, or, as it is more gener-

ally termed, podalic, since the feet are usually grasped in turning the fetus.

**Pelvic or Podalic Version.**—This operation may be carried out in the following circumstances: Transverse presentations in certain conditions; prolapsus funis in certain conditions; brow and face cases in certain conditions; prolapse of one or both arms or of a lower extremity; placenta prævia and accidental hemorrhage; threatened death in eclampsia or other complications; and flat pelvises.

In none of these conditions is the indication always absolute. The operation may be frequently chosen as an alternative procedure.

**Conditions Favorable to the Performance of Podalic Version.**—The pelvis must not be too contracted. The operation should

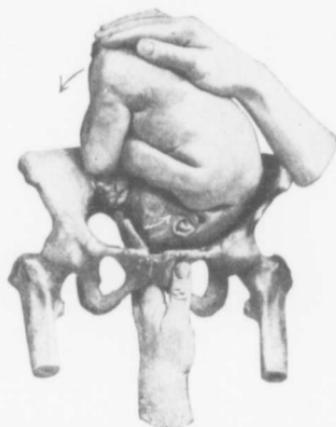


FIG. 277.—First step of bipolar podalic version: two fingers within the cervix lift the head toward the iliac fossa, while the breech is crowded over toward the other ilium.

not be carried out in a flat pelvis whose conjugate measures less than 8 cm., the fetal head being of normal size. The cervix must be fully dilated or capable of being dilated. The hand should never be forcibly pushed into the uterus. The presenting part of the fetus should not be firmly impacted in the brim, but should be mobile above it.

The uterus must not be firmly retracted down on the fetus, lest in the efforts to perform version the lower uterine segment be ruptured. The most favorable period is when the cervix is fully dilated and the membranes are ruptured by the operator. After

rupture version may also be performed, but the longer the procedure is delayed, the greater the difficulty and risk, because of the retraction of the uterus. It is impossible to define a limit for the safe performance of version. It might be feasible in one case four hours after the escape of the amniotic fluid, and dangerous in another one hour afterward. In some cases the uterus relaxes greatly under anesthesia; in other cases to a slight extent. Attention must always be paid to the level of the retraction ridge. The higher it is above the normal, the greater is the danger, owing to the stretching of the lower uterine segment. If the ridge can be felt two or more inches above the pubes, there is great risk in turning; it should not be firmly applied to the fetus.

**Operation.**—After the relations of the fetus have been determined by abdominal examination, the bladder and rectum having

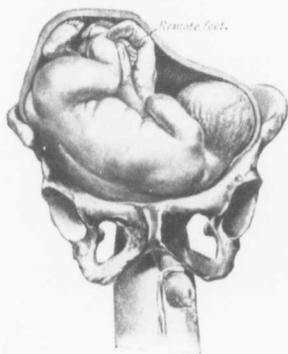


FIG. 278.—Direct method of seizing a foot in version for transverse presentations.

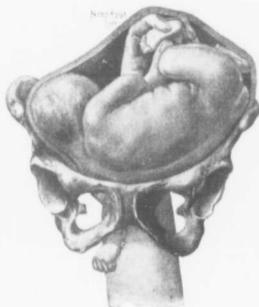


FIG. 279.—Direct method of seizing a foot in version for transverse presentations.

been emptied, the patient should be placed in the lithotomy position and anesthetized. In England the lateral posture is commonly adopted. Ritgen and others have recommended the genupectoral posture. The genitalia should be shaved and cleansed as if a surgical operation were in prospect. The strictest asepsis should be observed by the operator, and he should give special attention to the cleansing of the whole forearm and lower part of the upper arm. The author recommends the use of rubber gloves and long gauntlets, or of a sterile linen arm cover that the glove fits at the wrist. A faulty technic is apt to lead to infection in all cases in which the hand is introduced into the genital tract. It is important to decide which hand should be introduced into the uterus.

That one should be chosen which can carry out the manipulations most easily and satisfactorily. In vertex, face, and brow presentations, when the occiput looks to the left, the left hand should be used; when it looks to the right, the right hand. In transverse presentations, when the back is anterior and the head on the left side, the right hand should be used; when the head is on the right side, the left hand. In dorsoposterior positions the left hand should be used when the head is on the left side; the right hand when it is on the right side. Version in these positions is more easily carried out if the patient be placed on her side; in a left scapuloposterior, on the right side; in a right, on the left side.

The back of the chosen hand and arm should be lubricated with sterile vaselin<sup>1</sup> and the fingers arranged in the shape of a cone, which is gradually introduced into the vagina and passed through the cervix, being slightly rotated from one side to the other, the other hand steadying the fundus of the uterus through the abdominal wall, which is covered with a sterile sheet. If the cervix needs to be somewhat dilated, the membranes should be preserved if still intact. If the membranes are intact, they should be ruptured, and the hand advanced so that its palmar aspect is applied to the fetus and its dorsal surface next the uterine wall. It is important that as much fluid as possible be retained, in order to facilitate manipulations. Its escape may be considerably prevented by the plugging of the vagina by the forearm. It has been recommended by some authors that an effort be made to preserve the bag of membranes as long as possible, and that the hand should be passed up between the membranes and uterine wall as far as possible before they are ruptured. This procedure is in-

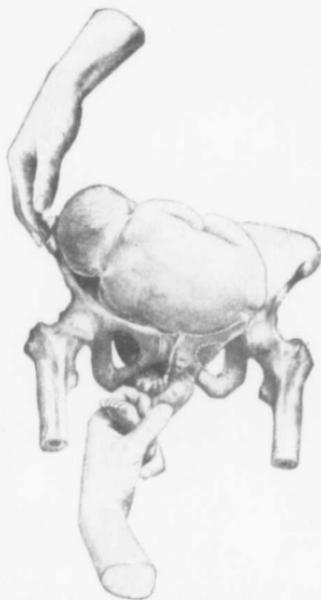


FIG. 250.—Traction on near leg is made diagonally across mother's pelvis to pull child's breech into the inlet.

<sup>1</sup> If rubber gloves are worn, vaselin should not be used, sterile water or creolin solution (1 : 100) sufficing as a lubricator.

advisable; it is not easily carried out and is apt to cause a separation of the placenta.

If the membranes have already ruptured, the hand is passed directly into the amniotic cavity. If any pressure is used, it should be applied to the fetus rather than to the uterine wall. If a uterine contraction occurs, the fingers should lie loosely on the fetus, the hand ceasing to advance until the pain passes off. If the head is in the way, it may be pushed toward the side on which the occiput lies. When the lower limbs are felt, the cord must be

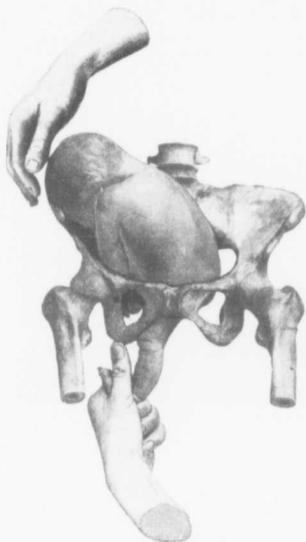


FIG. 281.—Breech enters pelvis with traction in right direction.

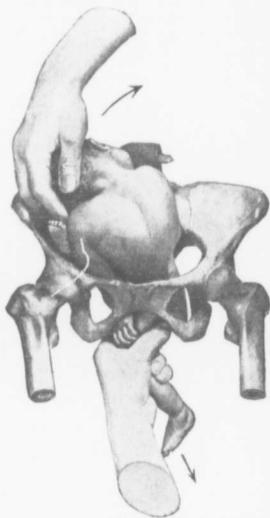


FIG. 282.—New seizure on thigh: the leg on which traction is made being anterior leg in pelvis.

disengaged from them before traction is made. There is a difference of opinion as to whether one or both feet should be grasped. In head presentations it is immaterial, except when there is doubt as to the completeness of dilatation of the cervix, and it is intended, after version, to leave the delivery to nature. In such a case one leg should be pulled down, the other being allowed to lie against the abdomen, in order that better dilatation of the cervix may take place before the head passes through it. A single foot should

be held at the ankle, between the thumb and fingers, or the whole leg may be grasped.

Some authors believe it to be advantageous in transverse cases to catch one foot, and there has been much discussion as to whether the farther or the nearer foot should be grasped. Hart's advice is valuable—viz., to grasp the leg that will maintain a dorso-anterior position or will change a dorsoposterior into a dorso-anterior—*i. e.*, take the farther limb for dorsoposterior cases, the nearer for dorso-anterior cases. Hart points out, however, that when in dorso-anterior cases the breech is in the fundus, traction on the nearer leg may convert it into a dorsoposterior; and when the breech is nearer the os in dorsoposterior cases, traction on the farther leg may not alter the posterior position of the back after version, owing to the necessary want of obliquity in the pull. In urgent cases the first foot obtainable may be grasped.

Some authorities recommend that a knee should be caught by a finger placed in the bend, instead of a foot. The former can be grasped more firmly than the latter. If there is sometimes doubt as to whether an upper or lower limb is grasped, the extremity should be felt. The wrist is more movable than the ankle; in the foot there is a projecting os calcis; the fingers are longer than the toes, the sole than the palm; and the arrangement of the thumb is characteristic. The foot or feet are next drawn toward the cervix, the fetus being thereby flexed. The external hand may greatly assist the movement of the fetus by manipulating the head toward the fundus.

As the knee or knees reach the vulva, the vertex of the head usually lies at the fundus. The rest of the delivery may be left to nature or may be assisted. If the cervix be not well dilated, it is always dangerous to the life or limbs of the fetus to hasten delivery; moreover, there is risk of injuring the cervix. When urgency is needed on account of fetal or maternal complications—*i. e.*, feeble fetal circulation, prolapse of the cord, eclampsia, hemorrhage, etc.—the fetus should be extracted artificially, as in the manner described in breech cases. (See p. 507.) Extraction must always be accompanied by external pressure of the fundus against the fetal head, and must not be too rapidly performed, because of the risk of upward displacement of the arms, extension of the head, uterine rupture, or inertia.

**Difficulties in Version.**—If the woman be not anesthetized or only partly, her restlessness may hinder the operator. The vulvar orifice may be small and may prevent the easy passage upward of the hand; in such a condition it should be carefully dilated. The vagina may also be too small to permit easy manipulations. Reference has already been made to an undilated cervix. When the soft passages are diminished by cicatrices, congenital atresia, new growths and other swellings, turning may sometimes

be absolutely contraindicated. Uterine contractions interfere with the passage of the hand. Sometimes a tetanic condition is present, making it impossible to perform version; this is especially noticeable when ergot has been administered. In some cases the retraction ridge is tightly applied to the fetus.

In shoulder presentations an arm may be prolapsed. When this is not impacted and version may be carried out, the manipulations are not necessarily complicated. Some authorities advise replacing the hand in the uterus. This is not necessary, however; it is better to tie a piece of sterile tape around the wrist and to carry out version as described. The arm may be drawn up somewhat, but it cannot be extended above the head. Impaction of the fetus in the brim renders version very difficult and dangerous. Under anesthesia it should be attempted only when impaction is slight and early. In these cases it is always advisable to try the effect of the elevated lithotomy position. This can be obtained best on a Boldt table in a hospital, the patient being supported by shoulder supports. This position is preferable to the genupectoral position, since assistants are not needed to support the woman; neither is there unusual trouble with the anesthetic. If the retraction ridge be high or firmly applied to the fetus, and if marked relaxation does not take place under chloroform, version should not be made.

Sometimes, when the fetus is partly turned, it sticks, and external manipulations may fail to complete the maneuver. In such a case it is sometimes advisable to attach a sterile band to the lower leg, in order that traction may be made on it, while a hand is used inside the uterus to push up the head. When the fetus is turned by the posterior foot, the anterior buttock may catch on the pubes. To overcome this difficulty traction should be made more in a posterior direction. Sometimes it is necessary to push the hip away from the pubes with a hand. The complications and difficulties that occur after the fetus is turned are considered in the chapter dealing with breech cases.

**Dangers in Internal Version.**—The maternal risks—*i. e.*, rupture of soft parts, hemorrhage, inertia uteri, etc.—have already been noted. The fetus is also greatly endangered. Compression of the cord may cause asphyxia. Fractures of bones, separation of epiphyses, and dislocations are easily produced, and may be found in limbs, trunk, or head. A lower limb may even be torn away. Injuries of nerves, leading to paralysis, may be produced. Blood-extravasations are sometimes produced in or between the thoracic and abdominal viscera.

**Bipolar or Combined Internal and External Version.**

—This method, often named after Braxton Hicks, consists in the application of the hands to opposite parts of the fetus, one being placed on the abdomen and one or two fingers of the other being

introduced into the cervix, the fetus being moved in the direction required. The internal fingers do not pass above the lower surface of the presenting part. This method has the advantage that it may be used when the membranes are unruptured and when the cervical canal will admit only two fingers. There is less risk, therefore, of rupturing the uterus, of detaching the placenta, of compressing the cord, and of introducing infection than when the whole hand is passed into the uterus to turn the fetus.

Cephalic or pelvic version may be performed by this method. The latter is most common; it may be employed in brow, face, and transverse cases and in placenta prævia. In the latter condition it is of the greatest value.

**Operation.**—The patient is placed in the lithotomy posture and



FIG. 283.—Bipolar version: the shoulder and arm are pushed along; the breech is pushed downward.

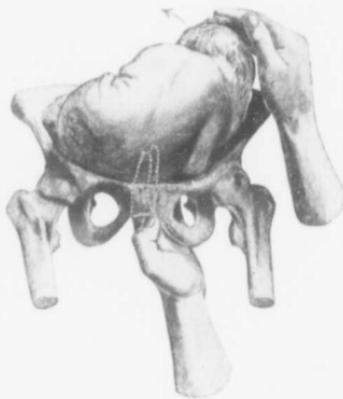


FIG. 284.—Bipolar version: the knee is almost within reach; the head is pressed upward.

all preparations are made as described for internal version. The cervix must be dilated, naturally or artificially, sufficiently to allow two fingers of one hand to be passed through the cervical canal as far as the membranes. When the placenta covers the os, the fingers burrow through the villi until they rest against the chorionic membrane that lies external to the amnion. These fingers are then used to jerk or push the presenting part toward one side, while the abdominal hand moves the opposite pole of the fetus in the opposite direction, the manipulations being made between the pains. In rotating the fetus its attitude of flexion should be preserved, if possible. When the head is brought to

the brim, it should be correctly placed by the fingers. Many advise that at this stage the membranes should be ruptured, to ensure that the head will not move away from the inlet, being prevented by the uterine retraction that follows escape of the liquor amnii. Others recommend holding the fetus in place by hands or by two lateral compresses applied to the abdomen, dilatation of the cervix and rupture of the membranes being allowed to take place naturally. The choice of either of these methods must be made according to circumstances. As a rule, the latter may be adopted.

In turning the fetus to bring the breech to the os, the outer hand should be used to raise the head as it begins to rise above the iliac fossa. When the breech is brought to the brim, the membranes should be ruptured and a leg brought well down into the vagina, the case being then left to nature, or artificial dilatation of the cervix may be employed when rapid delivery must be effected. (See pp. 507, 554.)

### CHAPTER III.

#### THE FORCEPS.

THE obstetric forceps is an instrument for holding the fetal head (rarely the breech), in order that traction may be exerted for the purpose of delivering the fetus.

**Historic.**—There is abundant evidence that the forceps was in use among Arabian physicians before the twelfth century, though it was not known in Europe. The modern instrument has been gradually evolved during the last three centuries.

After the massacre of St. Bartholomew in 1572, William Chamberlen, a French Huguenot, fled to England with his family for safety. Among his children were two sons, each of whom was named Peter. They afterward became physicians in London. The elder brother, born in Paris in 1560, was the inventor of the forceps. He had a large practice in London and attended Queen Henrietta Maria, wife of Charles I., when she miscarried of her first child. He died in 1631, leaving no children. His younger brother Peter had several sons, one of whom, named for his father, was eminent as a physician. He kept the knowledge of the forceps a secret, transmitting it to his sons, Hugh, Paul, and John, who also became physicians. Hugh Chamberlen went to Paris in 1670 in the hope of selling the secret of the forceps. Mauriceau invited him to use the instrument in a case of delayed labor due to marked pelvic deformity. Chamberlen was unsuccessful and

returned to London. In 1672 he published an English translation of Mauriceau's *Midwifery*, in which he refers to the method known to his family for the safe delivery of women in different cases, without, however, describing the nature of the secret. This reference attracted much attention in the medical world. In 1688 the same Hugh Chamberlen went to Holland, where it is claimed he sold his secret to Roonhuysen, who in turn disposed of it to Ruysch and others. The facts concerning these transactions are not accurately known. It is held by some that Chamberlen revealed the knowledge of a single blade or lever, which was also the invention of the original Peter Chamberlen. Others hold that Hugh showed the forceps, but that Roonhuysen and Ruysch separated the blades and used each as a lever. Certain it is that the secret, which was kept by the Medicopharmaceutical College at Amsterdam, and which all who desired to practise midwifery were required to purchase, referred to a single-bladed instrument, for in 1753 Visscher and Van de Poll made the secret public. Palfyn, of Ghent, in 1720, after having made many journeys to London to learn about the Chamberlen instrument, exhibited a pair of forceps before the Academy of Science at Paris. This



FIG. 285.—Vectis or lever.

must be regarded as the first public demonstration of the forceps. Very soon various patterns of forceps were introduced to the profession. The instruments used by the Chamberlen family were only discovered in 1813, when a chest stored away in a closet was opened in the Chamberlen country house, Woodham Mortimer Hall, Essex, where it had been for more than a century, the property having passed out of the hands of the Chamberlen family in 1715. The chest contained a single blade or lever, with a fenestrum, and 3 forceps; of the latter, one consisted of two blades jointed by a riveted pivot; another, of blades connected by a loose pivot, one blade fitting into a hole in the other; a third, in which the shanks fitted together without crossing, being held by a string wound around the shanks and passing through a perforation. In each instrument the blades were perforated. These varieties represent the modifications devised by the Chamberlen family, though there is uncertainty as to which is the oldest.

These forceps and all others introduced up to the middle of the eighteenth century were probably used only in cases in which the head was delayed below the pelvic brim. They were straight, with the exception of the curve of the blades, meant to fit the

fetal head, and known as the cranial or cephalic curve. Afterward this instrument became known as the short forceps, to distinguish it from the later instrument possessing a pelvic curve—termed long or curved.

There has been some dispute as to who introduced the first great improvement in the forceps—viz., the pelvic curve. It was undoubtedly first made public by Levret, who demonstrated the improved instrument in the Royal Academy of Surgery of Paris, in 1747, his account being published in 1751. In 1740 Benjamin Pugh, of Chelmsford, England, had independently devised the pelvic curve, though he did not describe it until 1754. Smellie also, in his text-book published in 1752, states that he had made the same improvement several years previously, and that he had used the forceps in his private practice. Pugh's claim has never

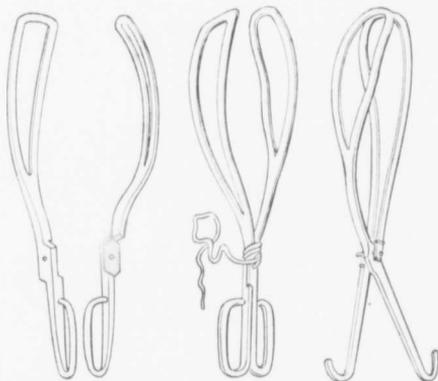


FIG. 286.—Three varieties of the original Chamberlain forceps.

been widely recognized, the curve having been generally named after Levret or Smellie. The introduction of this curve, whereby the forceps could be made to grasp the head high at the brim, in virtue of being able to follow the axis of the pelvis, must be regarded as the first advance in the evolution of the instrument.

The next improvement was the addition of an inverted or "perineal" curve. This was first described by Wallace Johnson, of London, in 1769. This curve was added in order that, in his own words, "the perineum may be saved from injury, the extracting force rigidly conducted, and the handles at the same time kept from pressing uneasily on the inferior and anterior parts of the pubes." This improvement was not generally appreciated,

the long or curved forceps of Smellie and Levret and the older short or straight forceps being used almost exclusively until after the middle of the nineteenth century.

Hubert, of Louvain, while recognizing that the perineal curve of Johnson added slightly to the advantage of forceps having a pelvic curve, evolved from it the improvement known as the "compensation curve," which must be regarded as the second important advance in the evolution of the forceps. In 1860 he proposed to bend back the free ends of the handles at a right angle, and in 1866 to attach to the handles, near the lock, a bar, through which traction could be made directly in the line of the chord of the pelvic curve of the instrument. His object was to pull the head in the proper axis of the pelvic inlet with less difficulty and uncertainty than accompanied the use of the simple

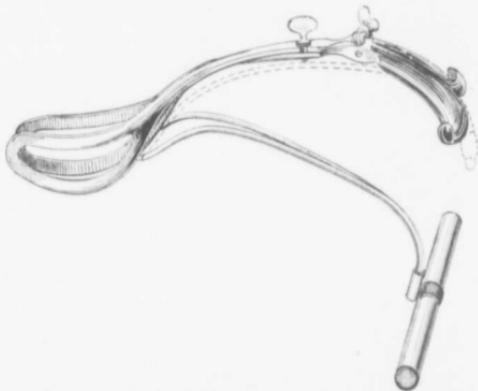


FIG. 287.—Early pattern of Tarnier's axis-traction forceps. The dotted line indicates the position of the traction rods when they lie close to the shank of the instrument.

curved forceps. Hubert's instrument was little appreciated or used by the profession. In 1868 Aveling, of London, advocated the use of a perineal curve. Morales, of Belgium, in 1871, introduced an instrument embodying this principle.

In 1877 Tarnier, of Paris, published a memoir in which he demonstrated the value of the compensation curve, but showed that the principle could be more advantageously, safely, and continuously employed by attaching curved rods to the blades of the ordinary forceps by movable joints, traction being carried out by means of a bar attached to the outer ends of the rods, hence termed the traction handle. Tarnier's improvement has been the last stage in the evolution of the forceps. Through it the delivery of the head is possible with the least loss and misdirection of the

force expended, and with the most perfect approximation to the axis of the pelvis. The instrument thus modified is known as the axis-traction forceps. Tarnier first added the rods to an instrument possessing a perineal as well as a pelvic curve. A. R. Simpson showed that the former was unnecessary, the rods giving the same advantages when applied to forceps with only the pelvic curve. Tarnier later adopted this arrangement. This authority did not at first recognize the superiority of the instrument in delivering the head through the outlet, for he taught that as soon as the head begins to extend at the outlet, the rods and application handles should be grasped together, the instrument being used as a long forceps. A. R. Simpson and Milne Murray have particularly insisted upon the harmfulness of this practice, and state that with a proper instrument the head can be extracted in the right direction with the least danger to the maternal tissues. The author desires to emphasize this statement, and to support those who have found that the head can be delivered with much less risk to the perineum than is possible with any other forceps. Since the introduction of the axis-traction instrument its superior advantages have slowly but surely gained recognition, in spite of



FIG. 288.—Forceps of Dubois.

much opposition on the part of those accustomed to the long forceps.

It has been claimed by Albert Smith and others that Tarnier's forceps was merely the readaptation of a device introduced by Hermann, of Berne, in an instrument introduced by this worker in 1844. Hermann realized the imperfections of the long forceps, especially the difficulty of pulling the head without loss and misdirection of force, and he added a couple of straight rods with handles. These fitted into depressions close to the lock of the forceps, and could be attached so as to lie on the pubic or sacral side. In the former position they were used to push the shanks of the forceps backward; in the latter, to pull them back. It is now generally admitted that Hermann's instrument in no respect embodied the principle of axis traction. While it was meant to reach the same end, its action was the same as that of any long forceps used with Pajot's maneuver. Hermann's instrument did not become popular, because it offered no real advantages over the ordinary long forceps manipulated with the hands.

It is interesting to note that Chassigny, in 1860, introduced an instrument in which traction was made not by the application

handles, but by a cord that was attached to a bar placed across the fenestrum. Chassigny pointed out what has since been well recognized in the construction of the axis-traction forceps, that when the blades are applied to the head, they may be displaced during traction around a hypothetical axis joining the centers of the blades. He held that this could not occur if traction were made from this imaginary axis, and introduced the transverse bars



FIG. 289.—One variety of Hermann's forceps represented as applied to head in pelvis: *a*, Application handles; *b*, traction handle (Müne Murray).

for the purpose of attaching cords on which traction was made during delivery.

Since Tarnier's instrument was introduced many varieties have been made. A. R. Simpson was one of the first to adopt the axis-traction forceps outside of France, and to his advocacy is mainly due the widespread use of the instrument in Scotland. He added traction rods to the well-known long forceps of Sir J. Y. Simpson, modifying the handles somewhat, the traction



FIG. 290.—So-called axis-traction forceps of Breus (the rods having right-angled bend are against shank when application is made).

handle being permanently attached to one of the traction rods. Lusk, in America, applied the principle to the Wallace pattern of forceps. Sânger adopted the principle in Germany, and first used a cumbersome arrangement of leather straps for the purpose. This he abandoned in favor of traction rods, which he attached to the Busch pattern of long forceps. Breus's instrument

is very inferior to the Tarnier type; it consists of a pair of blades to which fixed rods are attached anteriorly, the application shanks and handles being attached by a movable joint. Though the small rods may indicate the direction of the movement of the head, the construction of the instrument may be easily demonstrated, both mathematically and in practice, to be very faulty as a means of affording axis traction.

In the construction of the various patterns of axis-traction for-



FIG. 201.—Forceps of Simpson.

ceps sufficient regard has not been paid to precision in detail. Murray has done good service in insisting that a common standard of accuracy should be devised, and that mechanical devices should be adjusted to mathematic principles. Various minor peculiarities are retained in forceps made in different countries. English and American instruments generally possess the lock devised by Smellie, consisting of a shoulder projecting from each half. The French lock is composed of a pivot on one half, which fits into a hole on the other half, a screw top holding them together. The

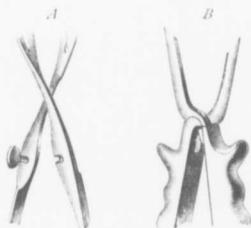


FIG. 202.—French (*A*) and English (*B*) locks.

German lock has a fixed pivot, with a button top on one half, which fits into a lateral notch on the other. The cross-knees on the handles of many forceps were a German invention. In French forceps the ends of the handles are bent outward. In the axis-traction forceps the application handles need neither the knees nor the curved ends; as they are not used in traction, they should be as light as possible.

**Mechanical Principles of the Forceps.**—A good idea

of the relative values of the different types of forceps that I have described may be gained by the following comparative study:

**Straight or Short Forceps.**—The inadequacy of this instrument in a case in which the head is at the brim in an occipito-anterior position is easily demonstrated. In introducing the blades it is difficult to apply them to the head symmetrically—*i. e.*,

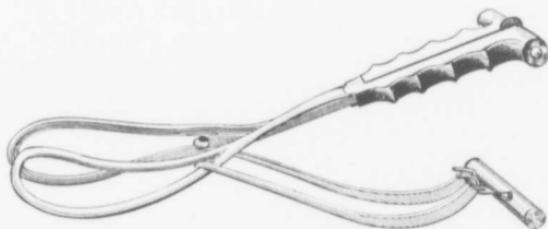


FIG. 293.—Forceps with Reynold's traction hooks applied. Such an instrument very imperfectly and inadequately represents the axis-traction principle.

neither too far back nor too far forward, because the straight instrument cannot follow the pelvic curve; indeed, it is usually impossible without marked pushing backward of the perineum and coccyx. An asymmetric grasp of the head too near the

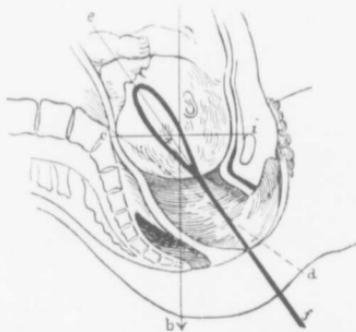


FIG. 294.—Application of straight forceps at brim (Milne Murray): *e-i*, Conjugate of brim; *a-b*, axis of brim; *c-d*, axis of outlet; *e-f*, axis of forceps and line of traction; *b-x-f*, angle of error.

sinciput tends to undo the normal flexion that exists, and so to increase the difficulty in delivery. But supposing that the head could be grasped properly, the disadvantages connected with traction are great. In the first place the blades are held against

the head by the compression of the handles as traction is made. This is always a source of danger to the fetus, owing to the risk of causing too great pressure. The greatest disadvantage, however, is that there is a great loss of the power exercised, and the loss is represented by undue compression of the maternal soft parts against the bony canal. This is illustrated in the diagram. *e-f* indicates the line along which traction is made; *a-b* is the axis of the pelvic brim, in the direction of which the head enters the bony canal. As these lines are not parallel, it is evident that the actual force is resolved into two portions, one of which, the effective, draws the head in the axis of the brim; the other, the ineffective, being wasted in pressing the head against the soft tissues resting on the pubes.

It is, therefore, evident that when the head is occipito-anterior and at the brim, the straight forceps may not only be of little assistance, but may actually increase the difficulty by pulling down the sinciput. When the head lies in the bony pelvis, the disadvantages of the instrument are reduced, but they still exist.

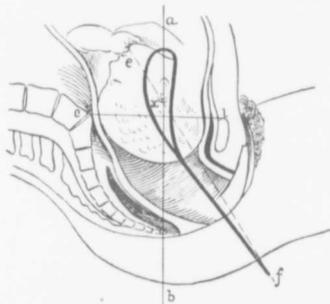


FIG. 295.—Application of curved forceps at brim (Milne Murray); *c-d*, Conjugate of brim; *a-b*, axis of inlet; *e-f*, axis of forceps and line of traction; *b-x-f*, angle of error.

Here also the head should be directed in the axis of the lower part of the canal, with the least expenditure of energy and damage to maternal tissues. With these forceps the proper line of traction is usually guesswork, and usually brute force is made to override all considerations of strategy.

Some authorities hold that the straight forceps has at least a place in cases in which the occipital end of the head is posterior. They hold that the blades, grasping the head toward the back, favor increased flexion when traction is made, and also that the absence of a pelvic curve allows rotation of the forceps to take

place if the occiput turns to the front, with little risk that the ends of the blades may cut the maternal soft parts. The first of these advantages may readily be granted; the second must be modified. Without doubt rotation of the head with straight forceps is less dangerous than with the curved instrument, but rotation itself must be more or less interfered with by the exercise of traction through the handles, whose compression keeps the blades applied to the head. This very compression is apt to be excessive with such an instrument, and consequently dangerous to the fetus.

**Long or Curved Forceps.**—When this instrument is used to deliver a head situated at the brim, what are its advantages over the straight forceps? The chief one is that, owing to the pelvic curve on the instrument, it is more easily passed along the genital canal, so that the blades may rest properly against the head. The latter is grasped symmetrically, so that when traction is ex-

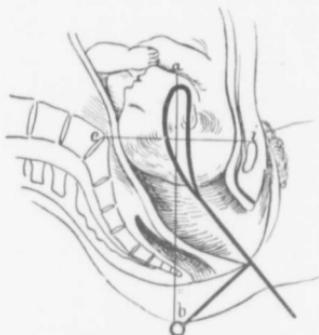


FIG. 296.—Hubert's forceps applied at brim (Milne Murray): *a-b*. Axis of inlet corresponds with direction of traction, hence angle of error has disappeared.

ercised, the sinciput is not displaced downward so as to induce extension and so to increase the difficulty of delivery. Apart from this the instrument has the disadvantages of the straight forceps. The operator, in pulling, compresses the handles and is apt to injure the fetal skull or brain or to stimulate the respiratory center. But the great disadvantage is that part of the actual force is ineffective and misused in pressing the head against the maternal tissues. As the head descends there is no means of knowing accurately how to pull to the best advantage, with the least resistance and danger to the tissues. Different rules have been given in regard to the manipulations to be employed. One of the best known methods is Pajot's maneuver, in which one hand is used to pull directly downward, while the other, placed near the shanks, presses them downward and backward, acting as a kind of movable

fulcrum, the combined manipulations being for the purpose of making the head follow the normal curve of the pelvis, with the least waste of power and the least pressure against maternal tissues. It is very evident that success depends upon the co-ordination of the amount and direction of the force exerted by each hand. This is a matter of skilled judgment, which is the product of individual endowment and experience. In a case demanding traction on the head through the entire length of the curved canal, the adjustment of the combined forces varies at successive stages of the passage. Consequently the successful employment of the forceps must be considered a complex and difficult procedure.

**Compensation-curve Forceps.**—Hubert's instrument applied to the head at the brim of a normal pelvis has one advantage over the long forceps when traction is first made. The rod attached to the handle is of such a length so that when it is pulled the line



FIG. 297.—"Pajot's maneuver" (Milne Murray).

of traction corresponds with the axis of the inlet, no force being wasted. But when the head has entered that part of the pelvic cavity whose axis curves, there is no means of knowing in what direction the handles should be pulled, and the instrument henceforth acts only as the long forceps, adjustment being constantly necessary.

**Axis-traction Forceps.**—When this instrument is applied to a head at the brim of the normal pelvis, the great advantage in traction is that the force may be exercised during the entire process, so that the head is made to move in the proper axis along the entire length of the canal. The blades are practically one with the head of the child, and the application handles indicate the direction in which the head is moving. As long as the operator keeps the upper parts of the traction rods parallel with the shanks

of the forceps during traction he may feel assured that he is using his power to the best advantage.

At the outlet the instrument may also be most advantageously used and is able to deliver the head in the proper direction better than the long forceps, and with diminished risk to the perineum. If the limbs be allowed to hang down, as in the Walcher position, during the passage of the outlet, the danger of injuring the soft parts to any marked extent is greatly reduced.

Both for scientific and practical reasons the axis-traction forceps should entirely displace the older instruments. The chief obstacle to the wider use of the former has been the prejudice of those whose argument is that they have often enough been successful with the older instrument. This statement is on a par with that made by the man who says that he enjoys a ride on an old-fashioned velocipede, and sees no reason, therefore, why he

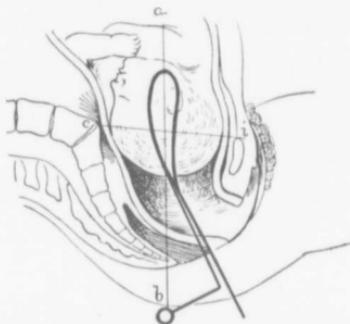


FIG. 298.—Diagram of Tarnier's forceps at brim. The traction bar of Hubert's instrument is continued up by a rod that is fixed by a movable joint at lower end of blade (Milne Murray).

should change to the latest improved bicycle; nor will he understand until he has made a thorough comparison of the machines. A. R. Simpson has well said: "If a practitioner accustomed only to the use of the old forceps will use the axis-traction forceps in one or two difficult cases he will find that it works with so much safety to the mother and child, and with so much ease to himself, that he will ever after use it in every case. There is no case, high or low, with presentation and position normal or abnormal, demanding forceps delivery where the axis-traction instrument may not be applied. Since it came into use the range of forceps application has been greatly widened, and the sphere of the competing operations, such as turning, embryotomy, and induction of premature labor, has been correspondingly narrowed."

**Construction of Axis-traction Forceps.**—The instrument introduced by Tarnier, and the adaptations of other workers, have all been constructed with reference to pelves possessing the normal curve. Some authorities, who have admitted the correctness of the principle of axis traction, have denied its attainability in practice, owing to the variations found in the curves of pelves and to the impossibility of accurately determining the curve in any given woman. This objection has some weight when applied to deformed pelves that deviate markedly from the normal; it is of no value as applied to the great majority of pelves in which the variation is slight. Moreover, as Milne Murray states, if we are working in a canal of doubtful curvature with an instrument whose construction is unknown, we are exposed to two sources of error; if, on the other hand, we are in doubt as to the canal and have definite knowledge of the instrument, the element of error is diminished by one-half. He has insisted that the forceps should be made in conformity with a

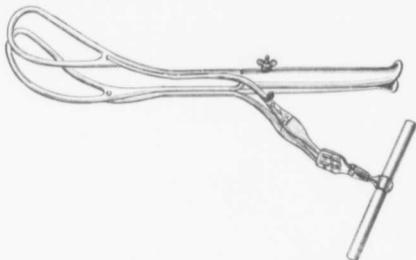


FIG. 209.—Milne Murray's ordinary axis-traction forceps.

standard scale by instrument makers, in order that purchasers should be able to judge for themselves as to the correctness of any given instrument. As his instrument has been constructed with great mathematic accuracy, I shall describe it. He has made two patterns, one referable to pelves with the normal curve, another capable of being adapted to pelves of different curves.

**1. The Forceps Constructed in Reference to the Normally Curved Pelvis.**—The instrument is made entirely of steel, of light but rigid construction. There is a well-marked pelvic curve, whose arc has a radius of 7 in., the length of the chord of the blades measuring  $5\frac{3}{4}$  in. The shanks are  $2\frac{1}{2}$  in. in length, the handles 6 in., and they are in one straight line. The chord of the pelvic curve forms an angle of  $120^\circ$  with the shanks. The halves of the forceps fit together by a Smellie lock placed at the junction



the junction of the blade and shank. Join these points by a straight line,  $x-y$ . Bisect this by a perpendicular,  $e-f$ . Draw a circle passing through  $y$ ,  $\tau$ ,  $x$ , whose center is in  $e-f$ ; the diameter of this circle should be about 7 in. Then draw a tangent,  $a-b$ , to this circle at  $\tau$ , where  $e-f$  crosses the circumference.  $a-b$  is parallel to the chord  $x-y$ . The forceps should then be replaced on the paper, the traction rods close to the shanks. If the instrument is properly made, the free ends of the rods should lie on the tangent  $a-b$ , and the traction handles should be so attached as to pull in this line. The diagram shows that  $\tau$  is the theoretic point to which the traction rods should be attached, because when traction is exerted, there is no tendency to the displacement of the blades, and the application handles are not interfered with in their function as an indicator of the direction in which the head moves and in which traction is to be made. Now  $\tau$  is seen to lie in the fenestrum; consequently, if the rods are to be attached at this

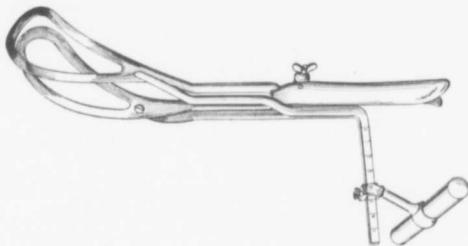


FIG. 301.—Milne Murray's new axis-traction forceps, capable of adjustment to pelves of different curves. The outer ends of the traction rods are bent at right angles, and on them the traction handle may be fastened at any point.

point, the fenestrum must be much reduced in size or a bar must be placed across it at  $\tau$ , as in Poulet's instrument. This is inadvisable, for if the bar be small, it may break and may injure the head, as well as prevent the latter from bulging into the fenestrum. It is advisable to have a large fenestrum, in order that the head may bulge into it. The rods are, therefore, attached behind the fenestrum; the resulting error is, however, of little practical importance and may be disregarded.

2. **The Forceps Constructed in Reference to Pelves of Different Curves.**—It is evident that a forceps constructed with reference to a normal pelvis must be used with a certain amount of error in an abnormal pelvis, especially when the head is high at the brim, for in these cases the line of traction and the pelvic axis do not coincide. In a flat pelvis the axis of the inlet is inclined somewhat farther back, and in a just minor or masculine

pelvis a little farther forward, than in a normal pelvis. This is well illustrated in Murray's diagrams (Fig. 302). Hence in these abnormal conditions, with the axis-traction forceps already de-

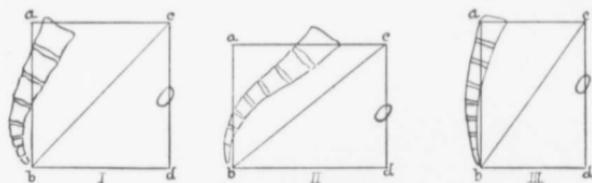


FIG. 302.—Comparison of inclination of axes in (I) normal, (II) flat, and (III) just-minor pelvis;  $a-b$ , Verticals through coccyx;  $c-d$ , verticals through symphysis;  $a-c$ , horizontal through promontory;  $b-d$ , horizontal through coccyx. The diagonals,  $c-b$ , indicate the *relative* inclination of line of traction through brim (M. J. Murray).

scribed, some of the force is inefficient, since the line of traction crosses the axis of the brim at an angle. To meet this difficulty Murray has constructed an instrument suitable for all such conditions. It is similar to the forceps already described, save in the

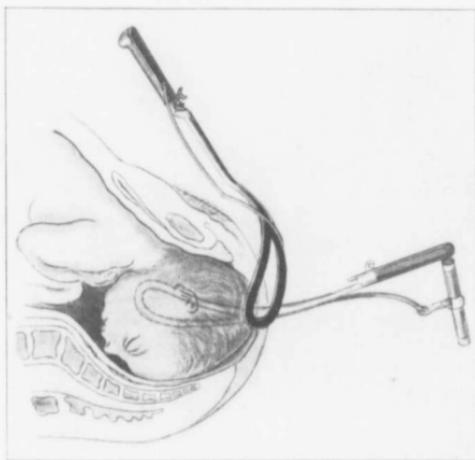


FIG. 303.—Illustrating application of A. R. Simpson's axis-traction forceps when head is low in pelvis. Left blade is in position, and right one is represented as being introduced into vulva (A. R. Simpson).

arrangement of the traction rods. These, after running down close to the shanks and handles, turn downward at a point  $2\frac{1}{2}$  in. behind the lock, and run at right angles for a distance of 4 in.

These horizontal limbs lie close together and are marked off into lengths of  $\frac{1}{2}$  in., being numbered from 0 to 7. The traction handle fits on these limbs by a pierced block, which can be fixed at any point by a screw. At one point is placed the word "normal." When the handle block is fixed at this level, the instrument is ready for use in a normal pelvis. To adapt the position of the handle of the instrument to a pelvis in which the axis of the inlet is anterior to the normal axis, the block is moved nearer the application handles. To adapt it for a flat pelvis, in which the brim axis is pushed back, the block is moved toward the free ends of the horizontal limb. In using the instrument when it is adjusted, the guide to the direction of the traction is the relation of the traction rods and shanks; they should always be parallel.

Of course, it must be admitted that variations in the inclination of the pelvis are difficult to determine accurately, and that the adjustment of the instrument will rarely be exactly what it should be, but the partial removal of an error is better than no removal at all. Moreover, it is easy to alter the position of the traction handles until a point is found at which the best results are obtained. There is no doubt that this instrument combines scientific accuracy with practical adaptability as does no other forceps yet constructed.

**Indications for the Use of Forceps.**—The forceps is to be used only after complete dilatation of the cervix, either in labors unduly prolonged or in conditions where dangers to mother or child exist.

1. **In Delayed Labors.**—1. *Faults in the powers*—*i. e.*, uterine inertia, manifested by weak or irregular pains; absence or weakness of the accessory muscles; wasted uterine force, as when the fundus is deviated forward, so that the long axis of the uterus does not correspond to that of the brim.

2. *Faults in the Passages.*—(a) *Soft.*—When there is abnormal resistance on the part of the vagina and vulva, from conditions inherent to the walls or due to causes external to them, forceps may be necessary. Frequently, especially in primiparæ, the chief difficulty is found in the perineum.

(b) *Hard.*—In contracted conditions of the hard passage, in its whole extent or in any part, the forceps is often used. In the past the pelvis in which it was most frequently employed were the justminor, the male, and the funnel-shaped. In recent years, owing to the work of Milne Murray, the axis-traction instrument has also proved serviceable in certain flat pelvis. (These various pelvis are referred to in the chapter on Pelvic Deformities.)

3. *Faults in the Passenger.*—A head slightly larger than normal, or one abnormally ossified, which will not mould well, may sometimes need to be extracted by forceps. In occipitoposterior

and in certain face cases it may be indicated. In extension of the head after delivery of the body in breech cases it may also be used to extract the head. Occasionally in delayed breech cases it may be applied to the breech.

**II. Dangerous Labors.**—In various maternal complications—*e. g.*, eclampsia, hemorrhage, heart disease, pneumonia, etc.—and in certain complications on the part of the fetus—*e. g.*, asphyxiation from any cause, prolapsus funis, etc., forceps may be needed.

**Function of the Forceps.**—The chief essential use of the forceps is as a tractor, the instrument replacing or supplementing the natural expulsive powers. In the older books various other functions are mentioned—*e. g.*, compression, rotation, leverage, and dynamic action.

Whenever the forceps is applied to the head, compression un-

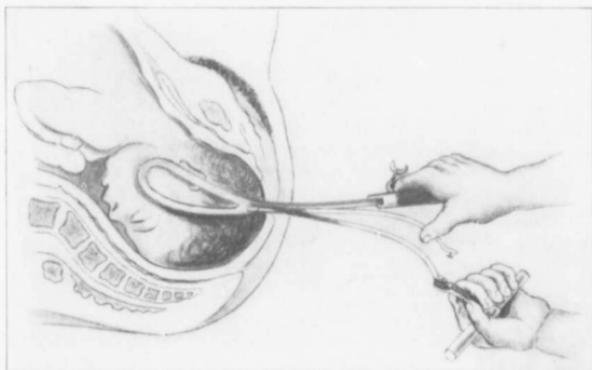


FIG. 304.—A. R. Simpson's axis-traction forceps applied to head lying low in pelvis. The illustration represents locking together of traction rods.

doubtedly is produced. With the axis-traction forceps this is slight; with the short or long forceps it is greater, because the hands, in exerting traction, are used to keep the handles together and can scarcely fail to compress the head unduly. The most marked compression occurs when the head is grasped antero-posteriorly or obliquely. Injury may be done to the skull or intracranial structures, yet frequently marked anteroposterior telescoping of the bones may be produced without injury. It has generally been held that anteroposterior compression causes transverse compensatory bulging. Murray has shown that bulging takes place in a vertical direction, and that, therefore, a long-held objection to the use of forceps in flat pelvis is removed. It is important to note that the more the head is compressed, the more

moulding and adaptation to the birth canal is prevented. The purposeful application of compression by the forceps is inadvisable. Ordinarily the blades should mark the head slightly or not at all. Rotation of the head, when the forceps is used, may frequently occur in association with adaptation movements. Intentional rotation produced forcibly with the instrument is dangerous both to maternal and fetal tissues, and should rarely ever be carried out, even by expert operators. As rotation occurs, when the forceps is in use, it may be necessary to withdraw the blades, lest their ends should cut the maternal tissues, reapplying them one or more times.

Leverage or lateral pendulum movements of the handles have long been employed by those who have used the long or short forceps as a method of promoting descent of the head in difficult cases. Even in expert hands it is not without risk, especially to the fetal tissues. With the axis-traction instrument leverage is absolutely unnecessary.

The dynamic action implies that the presence of the instrument in the genital passage stimulates the uterus to activity. Its influence is sometimes noted, during the introduction of the blades, to such an extent that the procedure must be stopped until the pains have ceased. When traction is begun, uterine contraction also may be induced.

**Application and Use of the Forceps.—Preliminary Considerations.**—A very careful examination of the fetal and maternal parts must be made. It is not sufficient to explore and measure the pelvis; the size and position of the fetal head must be carefully estimated. If the soft or hard canal be too small, forceps will be useless and dangerous. The same is the case if the head be too large and hard, macerated or perforated, or in a very bad position. The fetus should be alive and viable. It may also be extracted when dead if no difficulty exists; in the latter circumstance embryulcia should be substituted. In a high forceps case the head may be above the brim or partly engaged. When it is freely movable above the brim, an assistant should push it into the latter by pressure applied through the abdomen, while the operator applies the blades. The cervix must be fully dilated, either by maternal or artificial means. The membranes must be ruptured and retracted upward, so that they shall not be grasped by the blades.

**Preparation for the Operation.**—The bladder and rectum should be well emptied. The patient should be anesthetized with chloroform or ether; very rarely is it possible to operate satisfactorily without anesthesia. The patient should be placed in the lithotomy position on a good strong table, her limbs being held up by assistants or by leg-holders. When a table is not obtainable, the patient may be placed at the edge of the bed, which is

protected by a rubber sheet or ring-pad. In Great Britain the left lateral position has long been employed in delivery, and the position is usually termed the English position. The author, from an ample experience of both postures, has no hesitation in denouncing the latter, because it hampers the operator in his manipulations, does not allow the employment of Walcher's position, and is unfavorable to the adoption of a thorough aseptic technic, especially when the patient lies in bed. All that can be said in favor of the English position is that there is less exposure of the patient. This, however, is a matter of no importance when anesthesia is employed, and it always should be used.

The vulvar hairs should be shaved or closely clipped, and the



FIG. 305.—Patient placed on edge of table or bed (Bumm).

genitalia and buttocks should be cleansed and prepared with the same thoroughness observed in surgical procedure. The parts surrounding the vulvar slit should be covered with sterile cloths. The operator and the assistants who may take part in the manipulations must be as scrupulous in regard to the preparation of themselves, the instruments, dressings, etc., as they would be if a surgical operation were in contemplation. The author always wears boiled rubber gloves over his cleansed hands, and has rarely torn them.

**Operation.**—The application of forceps may be described as the high operation when the head is above the brim or partly

engaged in it, and as the low operation when it is entirely within the pelvic cavity. Some authorities employ the latter term to apply to the cases in which the head is at the vulva, those in which it lies between the high and low positions being termed *medium*. The high operation must always be regarded as a difficult procedure, requiring much skill and caution; the low operation is a simpler procedure, but yet not without risks.

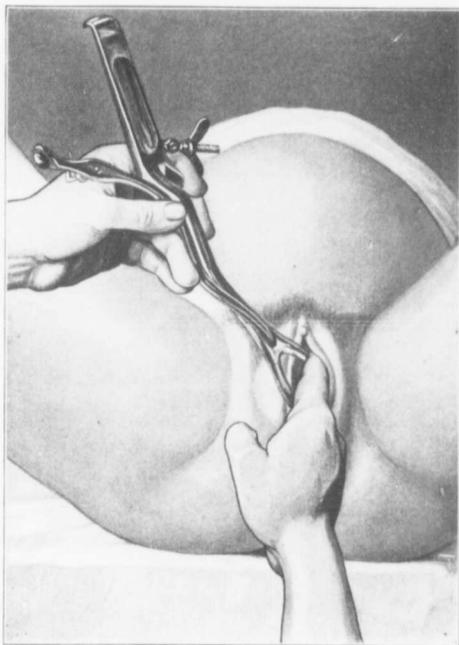


FIG. 306.—Application of axis-traction forceps. Introduction of first or left blade.

The blades should always be applied to lie right and left in reference to the maternal pelvis, the fetal head being grasped as it lies in relation to these positions of the blades. Some authors recommend that the latter may be applied so as to grasp the sides of the fetal head, no matter how they may lie in relation to the pelvis. This teaching is unscientific and ridiculous, and in practice is fraught with great danger. The forceps is constructed

with a pelvic curve, which allows the blades to lie safely only in one position—viz., right and left as regards the pelvis. Of course, it is better to grasp the head transversely than obliquely or anteroposteriorly. In the great majority of low applications it is caught transversely. In most high operations it is held obliquely, but experience has shown that with the axis-traction forceps this grip is satisfactory as regards delivery, and rarely a source of danger

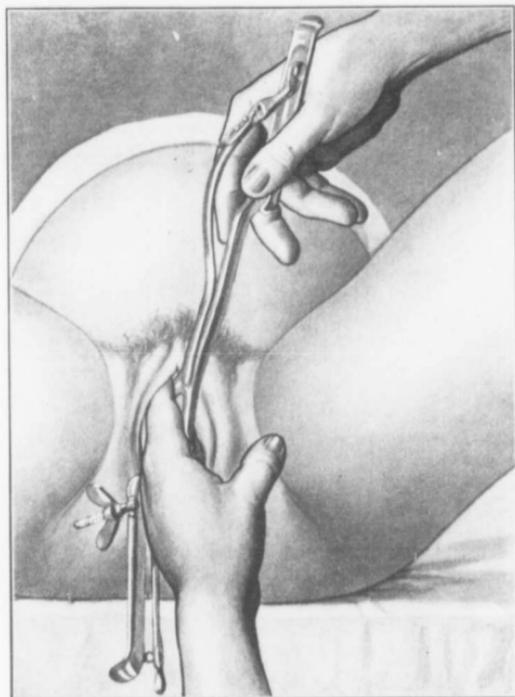


FIG. 307.—Application of axis-traction forceps. Introduction of second or right blade. The shank of first blade rests against perineum.

to the fetal tissues. Even in the few high operations (mainly in flat pelvis) in which the head has been grasped anteroposteriorly, Murray has shown that considerable compression may be employed without hurting the fetal head or without producing a detrimental compensatory bulging in the transverse diameter.

I do not refer to those authors who employ forceps of special

construction in order to grasp the head transversely in all circumstances; they fall under another condemnation. Their efforts have not impressed scientific obstetricians, praiseworthy though they may be. An instrument that can be applied safely to the sides of the head in all situations in the pelvis, so that traction may be exerted without the expenditure of some force represented in damage to fetal and maternal tissues, has not yet been con-

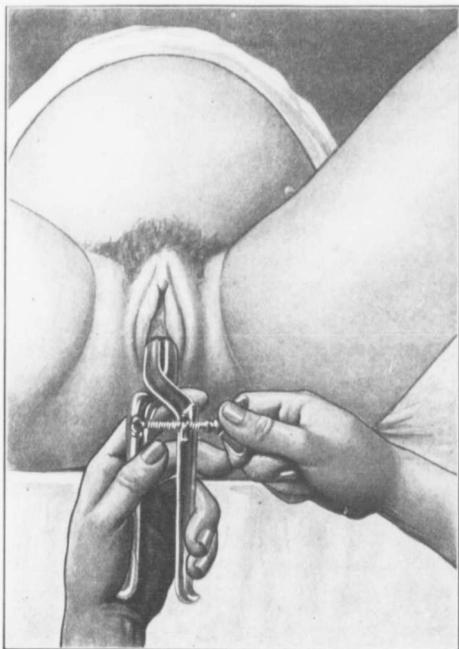


FIG. 308.—Application of axis-traction forceps. Adjustment of lock and fixation screw.

structed. The application of the axis-traction forceps so that the blades are right and left as regards the pelvis in every condition of the head in which forceps is indicated is the nearest approach to the highest attainable yet devised.

I. *High Operation.*—(a) *Introduction of the Left Blade.*—The halves of the instrument and the traction handle, sterilized, are placed on a sterile sheet, conveniently near the operator, who

stands or sits facing the perineum. The fingers of the right hand are introduced into the vagina and are pushed upward between the lower part of the head and the maternal tissues, the palmar surface resting against the former. If the head tends to move away from the brim, an assistant should keep it in position by pressing it downward through the abdominal wall. The application handle of the left half of the forceps is then lifted by the

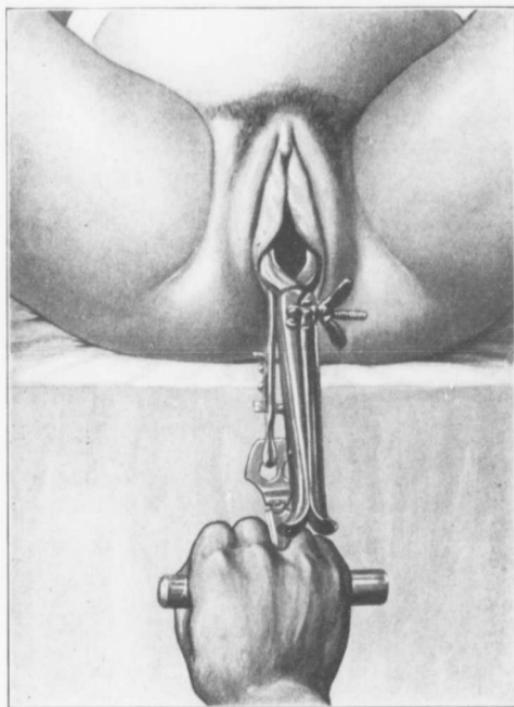


FIG. 309.—Application of axis-traction forceps. The diagram represents beginning of traction in a case in which the head is at inlet of pelvis.

thumb and fingers of the left hand, the traction rod being kept close to the shank. The blade is then introduced downward and backward into the vagina, the tip of the blade pressing against the palmar surface of the right hand. As it is passed upward it is made to follow the curve of the pelvis, the handle being gradually depressed toward the perineum. When the head is reached, the

blade must be cautiously advanced inside the fingers until it rests in position against the head. If the tip is obstructed, it must not be pushed forcibly onward, lest it cause tearing (sometimes a fetal ear may be lacerated in this way), but must be slightly withdrawn and manipulated past the obstruction. If a uterine contraction takes place, the manipulations must cease until it is over. When the blade lies properly, the head fits nicely within the cephalic

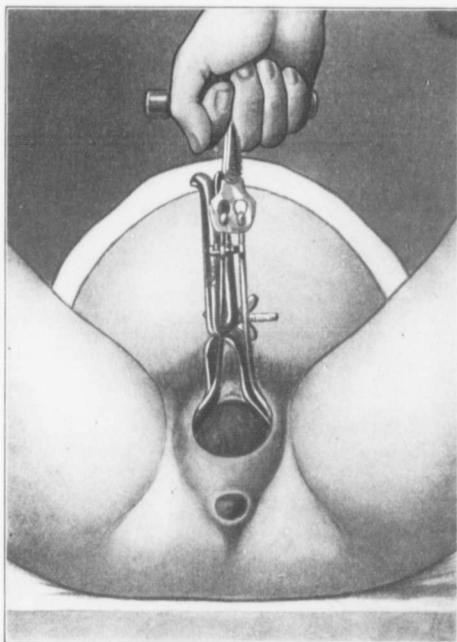


FIG. 310.—Application of axis-traction forceps. Head appearing at vulva. Note direction of traction.

curve. If the head is just at the brim, the upper end of the handle is a short distance external to the vulva.

(b) *Introduction of the Second Blade.*—When the first blade is in position, the right hand is withdrawn from the vagina and made to change places with the left hand, which has been holding the handle. It holds this half of the forceps in position while the

left hand is introduced into the vagina in the same manner in which the right hand was introduced. The fingers are passed between the head and maternal tissues, their dorsal aspect being directed against the left side of the pelvis; the head is then pressed well against the left blade of the forceps in order to keep it in position, while the right hand is removed from the handle to lift the right half of the forceps and introduce it in a manner

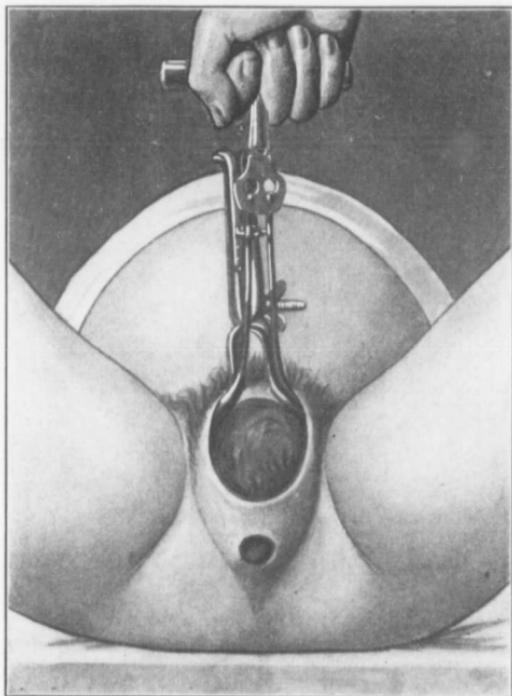


FIG. 311.—Application of axis-traction forceps. Head further advanced through vulva.

similar to that described for the first blade, the traction rod being placed well forward over the pubes. This procedure is sometimes difficult, especially if the traction rods get crossed. To prevent this it is sometimes advisable that an assistant hold the left traction rod aside. Great patience and caution are necessary at this stage of the manipulations.

(c) *Fixing of the Shanks and Adjustment of the Traction Rods.*

—When the right blade is in position, the left hand is withdrawn and made to grasp the application handle of the left half. If the blades lie properly, the halves of the lock, where the shanks and handles join, are laterally directed, being exactly opposite; by means of the hands on the handles they may easily be made to fit together. If one or the other blade has slipped from its proper position (frequently the left half moves somewhat to the back while the second half is being introduced), the halves of the lock will not fit together, and it is necessary to manipulate one or both handles carefully in order to succeed. The locking is expedited by depressing the handles as far back as the perineum permits. Force must not be used. Sometimes it is necessary to withdraw one or both blades partially or entirely and to replace them before

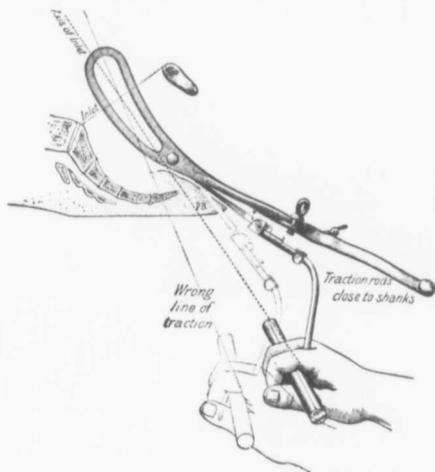


FIG. 312.—Diagram showing right and wrong methods of pulling on handle bar, and that the line of traction is directly in axis of inlet (much modified from Ribemont).

locking is finished. If the head be well within the cephalic curve, in case of a transverse or slightly oblique grasp, the handles are not far apart when locked; if the head be large or be grasped anteroposteriorly, they may lie considerably apart. In bringing the shanks together the vulva must not be pinched. One hand now grasps the locked handles while the other moves the traction rods behind the shanks. The fixation screw is then adapted but not tightened on the application handles. The traction rods are then locked and the traction handle applied. The fingers of one

hand are then introduced to feel that the blades are properly applied and do not grasp the umbilical cord or any part of the maternal tissues—*i. g.*, the cervix. The fixation screw is then turned sufficiently to insure that the blades will not slip from the head.

(*d*) *Extraction.*—The operator places himself so as to pull most efficiently without disturbing the application handles. Traction is made with the traction handles, the middle parts of the rods being kept parallel with the shanks. Force is applied during uterine contractions, but if these be absent, then at intervals of

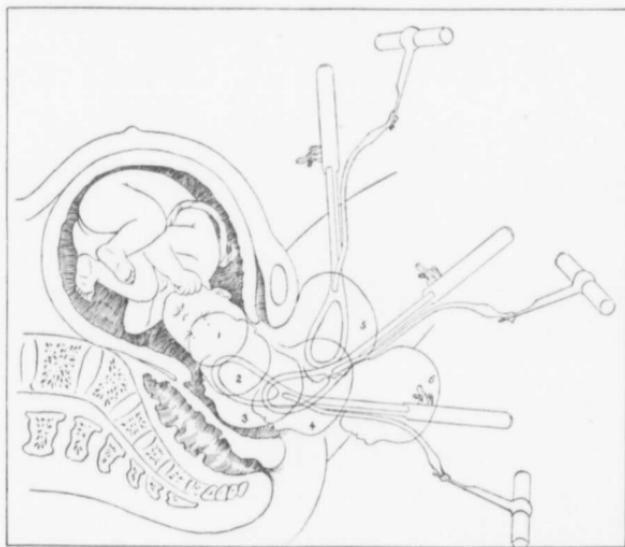


FIG. 313.—Diagram representing axis-traction forceps in successive stages of delivery. The application was made to head lying within pelvic cavity.

one or two minutes, and lasting for a minute. After each pull the fixation screw should be loosened in order to release the head from pressure. Frequent examination should be made to determine the advance made by the head and the condition of the maternal parts. The rate and force of the fetal heart should be determined by auscultation from time to time. Usually traction is exerted with one hand, though sometimes it is necessary to use both. Where rotation has to be assisted (this is rare), rectification may be made by means of the application handles. When marked

rotation occurs, so that the maternal tissues are endangered by the tips of the blades, the forceps must be removed and reapplied again laterally as regards the pelvis. As the head approaches the perineum, the latter should be covered with a sterile towel, the left hand being used to guard it in the manner described for normal labor. The legs should then be lowered from the lithotomy position and allowed to hang over the end of the table, in the manner recommended by Walcher, and held somewhat apart by assistants. (When the latter are not available, the legs may be kept apart by the body of the operator as he stands or sits between them.) In this position the perineum is most relaxed, and, therefore, less liable to be torn, than it is when the thighs are bent up in the lithotomy position. As the head is extracted from the

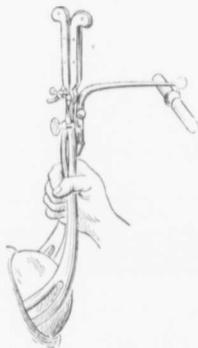


FIG. 314.—Misuse of axis-traction forceps at perineum (after Poulet, etc.). Complete delivery of head should be effected by means of traction handle only (Milne Murray).

outlet, traction should be kept up by means of the traction handles, for in this way can the best direction be taken and the natural mechanism be most closely imitated. During the birth of the head the application handles may point well up over the pubes. (The advice of some authorities, to the effect that at this stage the application handles should be grasped and used as a pair of long forceps, has already been noted and condemned.) The head should be delivered very slowly and gradually. If labor pains are strong at this period, they should be allowed to advance the head as much as possible. Sometimes it is necessary to perform episiotomy, in order to save a mesial tear of the perineum. As soon as the head is born the traction rods are separated, the fixation screw loosened, and the blades successively removed.

**II. Low Operation.**—The application of the axis-traction forceps when the head is at a medium or low level in the pelvis is much simpler than the procedure just described. The instrument is used in practically the same manner. Many authorities discard the axis-traction instrument for these cases and use the long forceps instead, recommending the former only for the high operation. This attitude is unscientific. If one instrument is suitable for all cases, it is useless to carry two. If the same instrument is the best in every circumstance, it is wrong to use the poor forceps except when the good one cannot be obtained. The axis-traction forceps needs only to be known to be appreciated, but requires to be studied in order to

be understood. Its principle is very simple, and a knowledge of its working easily acquired by a little practice with a manikin. If it be adopted, the old short and long forceps may be relegated to museum shelves.

**Use of Long Forceps.**—For the sake of those who may be called upon to use a pair of long forceps a few words may be said regarding the use of the instrument. The blades are introduced in the manner already described for the blades of the axis-traction forceps. To keep them applied to the head a certain amount of compression of the handles must be kept up by one hand. This should not be excessive, but it is very difficult to regulate the grasp of the fingers to a nicety while traction is made, and therein

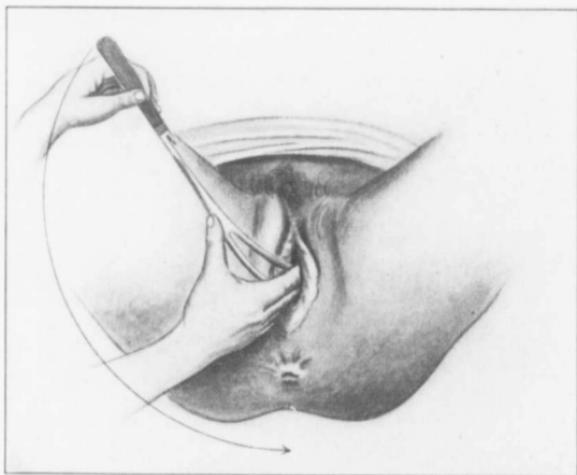


FIG. 315.—Introduction of first blade of long forceps, head being low in pelvis.

lies one great objection to the instrument. In pulling both hands generally require to be used, the fingers of one hand being placed on the cross-bars, attached to the handles near the shanks in English and German forceps, or at the ends of the handles in French forceps. If direct traction is made, much of the force is lost, especially in the high operation, and the head is pressed unduly against the maternal tissues. Consequently it is best to pull in such a way as to make the head move along the curved canal with as little loss of power as possible. Pajot's maneuver is generally used for this purpose, as follows: One hand holds the handles, the other the shanks; the former pulls downward, the

other backward. This maneuver may be carried out by the operator in the sitting or standing posture. The impossibility of combining these two forces so that the proper direction is given to the head without considerable waste of force, has already been explained. This constitutes the great inferiority of the long forceps to the axis-traction forceps.

**Dangers of Forceps.**—In introducing the blades the vagina or uterus may be bruised or torn to a slight or a marked extent. The risk of injuring the uterus is great when the cervix is closely applied to the head or during a period of contraction. Hemor-

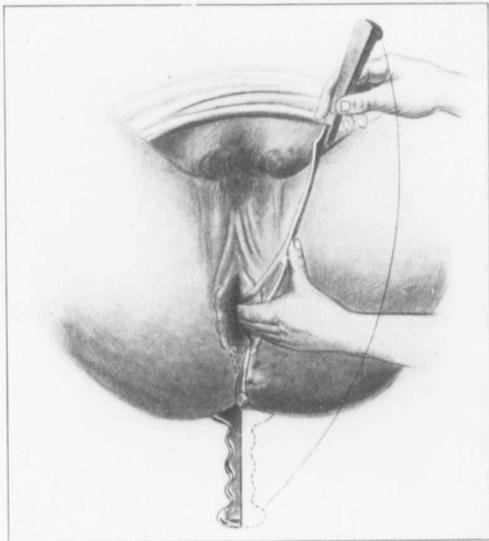


FIG. 316.—Beginning application of the second blade. The handle follows direction of arrow to reach position shown faintly near first blade in place.

rhage may thus be caused before as well as after delivery. The bladder, rectum, or peritoneum may sometimes be opened. The fetus may also be injured during the introduction. The soft parts may be contused or cut. In extraction the cervix may be torn if it has been caught between the blades and the head. The walls of the passage may be cut by the tips of the blades if they have been badly applied or if they are displaced. Injury may be done by the sudden slipping of the blades from the head. In misdirected

traction the maternal tissues may be badly bruised by compression against the bony pelvis. If traction be too forcible, the same result may be produced. The strength of the pull should rarely be more than 25 or 30 pounds. Very frequently open tears and cuts are produced—*e. g.*, perineal lacerations. It must, however, be remembered that important structures may be stretched or divided, though no surface wound is produced, and may be the cause of much discomfort and trouble afterward. The fetus may also be injured during extraction. Contusion or laceration of the soft parts, often associated with subcutaneous blood-extravasation, may result. Nerves may be injured—*e. g.*, facial and brachial plexus—and may not recover their function for a long time. The head bones may be fractured and may be associated with intracranial or extracranial hemorrhage. Blood may also be extravasated inside the skull without bone fracture. The antero-inferior corner of the parietal bone is especially apt to be broken.



FIG. 317.—Upward traction when occiput has passed pubic arch and pelvic floor is on stretch.

The fetus may thus be destroyed, or its health may be impaired for a considerable period after birth. It is believed by many that epilepsy, psychic disturbances, idiocy, and other lesions may in some cases be traced to instrumental delivery. If the umbilical cord be around the neck, it may be caught and the fetus be asphyxiated. Asphyxia may also be produced by the compression of the brain tissue. Too rapid extraction may cause inertia uteri with its attendant complications.

## CHAPTER IV.

## CÆSAREAN SECTION.

THE Cæsarean section, properly so called, is the extraction of the fetus from the uterus by means of an abdominal incision. The term *conservative Cæsarean section* is applied to the procedure in which the uterus is left after removal of the fetus, placenta, and membranes.

Porro's operation is that in which, after the extraction of the fetus, supravaginal amputation of the uterus is carried out. Total abdominal hysterectomy is also sometimes employed after removal of the fetus.

**Historic.**—Though Cæsarean section is believed to have been known in very ancient times, we have no certain knowledge as to its employment. There is no foundation for the statement that the operation was named after the first Cæsar, in memory of the manner in which he came into the world. The term is probably derived from *cadere*, to cut. It is not unlikely that the operation was known long before the time of Julius Cæsar. In the Middle Ages the Church urged that the operation should be performed on a woman who died in advanced gestation, in order that the fetus should be baptized before it died. The first certain record of a Cæsarean section performed successfully is that referring to a Swiss pig-gelder, Jacob Nufer, who operated on his own wife in the year 1500.

In Germany it was first performed by Trautmann, of Wittenberg, in 1610; the patient lived for three weeks. In 1581 F. Rousset published the histories of 9 successful operations that were reported to him from various sources. Several critics have considered these as doubtful, and some have supposed that the cases were ectopic gestations in which extraction of the fetus was carried out through the abdominal wall. Up to the time of Mauriceau the incision was made on the lateral abdominal wall; this surgeon first advised that it be made in the middle line. When symphysiotomy was introduced by Sigault, in 1777, the Cæsarean operation was decried by many, but it continued to be practised, the other procedure soon being forgotten. Lebas is said to have sutured the uterine incision first—in 1769. He was criticized by Smellie, Levret, and later by Baudelocque, Velpeau, and other distinguished authorities. They preferred the old plan of introducing no sutures, trusting to uterine contractions to approximate the edges of the incision. Others tried to introduce the suture, but without avail. In 1859 Lestocquoy recommended stitching the uterine wound to the abdominal incision.

Up to the antiseptic period the mortality of the Cæsarean

operation was very high, the women dying generally of sepsis or hemorrhage. Michaelis, in 1822, collected 258 cases, with 54 per cent. of recoveries; Mayer, in 1868, gathered 1605 cases, with the same percentage; Harris, in 1888, tabulated 153 cases from American literature, with 37 per cent. of recoveries. Indeed, throughout the civilized world, during the first three-quarters of the nineteenth century, embryotomy was universally practised in preference to the Cæsarean operation. With the introduction of antiseptic surgery the operation entered on a new era. The following table compiled by Williams reveals the progress that has been made:

| Operators.          | Cases. | Deaths. |
|---------------------|--------|---------|
| Zweifel . . . . .   | 76     | 1       |
| Olshausen . . . . . | 30     | 2       |
| Reynolds . . . . .  | 23     | 0       |
| Bar . . . . .       | 14     | 1       |
| Charles . . . . .   | 10     | 0       |
| Craigin . . . . .   | 9      | 1       |
| Total . . . . .     | 162    | 5       |
| Per cent. . . . .   | 3.08   |         |

Larger tables have been compiled by Braun, Bar, and Williams, giving a mortality between 6 and 7 per cent., but if the deaths of those women who were infected before operation be excluded, the mortality is about 4 per cent. It may safely be said that if the operation be performed by skilled hands, when the patient is not exhausted and not infected, the mortality is 3 to 4 per cent.; Braun and Bar state that the fetal mortality in all cases is about 5.7 per cent. In the hands of unskilled operators or of those whose technic is not perfect, the mortality may be expected to amount to more than 20 per cent. In the hands of the latter the risks are greatly increased by careless and unnecessary vaginal examinations, attempts at delivery, and protracted delay.

In 1876 Porro introduced supravaginal amputation of the uterus, after removal of the fetus, at the Maternity in Pavia. He did this in order to diminish the chances of hemorrhage and sepsis, and he referred particularly to the bad practice of leaving the uterine incision unsutured. For several years Porro's operation was widely practised, though for a considerable time the mortality was little better than that of the old Cæsarean operation. In 1884 Godson collected a list of 152 cases, with a mortality of 56.57 per cent. R. Braun and Demelin give statistics showing that the mortality for all cases has been in recent years 9 to 10 per cent. If the deaths due to infection previous to operation be excluded, the percentage may be considerably reduced. Several operators returned to the old operation, which R. Harris, of America, showed was safer when it was not too long delayed. Reuss and others stated that under the antiseptic system the uterine wall could be safely sutured.

It is to Sænger, however, that credit is chiefly due for the improved technic of Cæsaean section at the present time. In his paper, written in 1882, he showed that the old plan of leaving the uterine incision open was dangerous, not only because of the opportunity it afforded for the passage of material from the uterus into the peritoneal cavity, but also because when healing did take place it resulted usually in an irregular cicatrix, which was prone to rupture or to form hernial protrusions; if complete healing did not occur, fistulous openings were left. Sænger insisted upon suturing the wall under an antiseptic technic, and urged that the operation should not be prolonged too long. About the same time Kehrler, of Heidelberg, advocated the same views. Sænger recommended two layers of sutures in closing the uterine wound: one for the musculature, the other for the peritoneum. In recent years the conservative operation has come more into prominence, and the Porro operation has been restricted within comparatively narrow limits.

**Conservative Cæsaean Section.—Indications.**—These are *absolute* in all cases in which the fetus, living or broken up, cannot be delivered by the genital passage, and *relative* when there is a choice between the Cæsaean operation and symphysiotomy, embryotomy, or the induction of premature labor.

Owing to the great reduction in the death-rate of Cæsaean section (3 to 4 per cent. in cases in which no infection is present at the time of operation), it must take a more prominent place in the practice of skilled operators than it has in the past. It is probably as safe for the mother as is embryotomy, and has the advantage of saving the fetus in the great majority of cases. Pinard has reported a maternal mortality of 11.5 per cent. in 81 embryotomies, some of the deaths, however, being due to trauma and sepsis resulting from manipulations of practitioners before admission to his service. Premature labor, while being safe for the mother, is fatal to the fetus in a considerable percentage of cases. It has been widely taught that an absolute indication for Cæsaean section is a conjugata vera of 5.5 cm. Williams has rightly urged that this should be raised to 7 cm. With regard to the relative indication, he holds that the upper limit should be 8.5 cm. for flat and 9 cm. for justominor pelves, thereby placing the operation in competition with high forceps and version in those cases of moderate contraction in which the head does not tend to engage in the brim, instead of making it a rival of craniotomy upon the living child, as with the old relative indication of 7 or 7.5 cm. It is not always possible to state what may happen in such cases, for, while the pelvic contraction may be ascertained, the size and plasticity of the head and the strength of the uterine pains cannot be accurately determined. Spontaneous delivery occurs in a considerable number of these cases; in Williams's

experience it took place in one-third of the cases in which the brim measured between 7 and 8 cm., and in two-thirds of those in which it measured between 8 and 9 cm. This author, therefore, recommends that in dealing with this class of pelvis labor should be allowed to go on until the second stage has lasted an hour. If by that time the head has engaged, labor should continue, forceps being employed if there be undue delay. If the head does not engage, Cæsarean section should be carried out if the circumstances are favorable for the performance of a major operation, if the woman be uninfected and in good condition, and the child be alive.

Williams thinks that the treatment of such cases by forceps or version should disappear, Cæsarean section promising a great diminution in fetal mortality without appreciably raising the maternal mortality. These views are likely to meet with marked opposition. Those who are experts in the use of the best forms of axis-traction forceps will claim that this instrument may be safely used both for mother and fetus in flat pelvis with a conjugate as low as 7.5 cm. (3 in.) if the head be normal, especially where the Walcher position is used. They would urge that in some of the non-engagement cases the head might enter the brim if the patient were placed in Walcher's position. Most of all might they be expected to oppose the abandonment of axis-traction forceps in flat pelvis with a conjugate of 8.5 cm., and in just minor pelvis with one of 9 cm. Exponents of the value of version would equally strongly plead for this operation in flat pelvis with a conjugate in the neighborhood of 8.5 cm. Advocates of symphysiotomy would urge that in the best hands the operation is as favorable for the mother as Cæsarean section when the conjugate is above 7 cm. in flat pelvis, though the fetal mortality may be greater. Others would agree with Krönig in urging that Cæsarean section should not be performed for the relative indication after rupture of the membranes, but that symphysiotomy is then indicated.

Experience shows that section performed late in labor subjects the woman to more risks than one carried out early. While in most cases the woman's chances of safety might not be lessened by operating one hour after the beginning of the second stage, it is certain that she would not be in so satisfactory a general condition as if labor had not proceeded far. Moreover, if the first stage were very tedious, Williams's limit might mean a considerable addition of risk.

Williams's indications are meant only for those who are within the reach of expert obstetricians and operators. For those not so favorably placed he recommends the old indications. There is much to be said in favor of his views, which are based upon two factors—viz., the low maternal mortality in Cæsarean section per-

formed under favorable circumstances, and the desire to lower the fetal death-rate. There is no doubt that he is too sweeping in his condemnation of forceps in the class of cases under consideration. He is right if he refers to long forceps, but wrong if he means the best scientifically constructed axis-traction forceps—*e. g.*, those of Milne Murray. While admitting that the fetal mortality is higher when this instrument is used than in Cæsarean section, the author has yet to witness a maternal death produced by it in the hands of a skilled operator. Williams's indications are not likely to find wide acceptance, owing to the widespread tendency to regard the life of the fetus as secondary in importance to that of the mother, and to the general preference of husbands to sacrifice the former rather than hazard the latter. Were they to be widely adopted, the result would inevitably be that those who are not trained in the technic of asepsis and are incompetent to undertake the Cæsarean operation would do so under all circumstances, including those which are likely to introduce infection, such as frequent examination and injudicious attempts at delivery. Moreover, operators who are skilled in the use of axis-traction forceps and in version will always be inclined to adopt their favorite measure, knowing that the fetus may be alive and that there is little chance that the mother will die. If these procedures fail, they know that embryotomy yet remains to be tried. Probably the chief argument in favor of Williams's indications is a moral one. Those who regard the life of the fetus as important as that of the mother will be inclined to adopt them.

Cæsarean section is indicated in cases in which the outlet of the bony pelvis is so contracted that delivery with forceps is impossible, though it may sometimes be considered as an alternative to embryotomy. It is also indicated when tumors of the bone or soft parts, or cicatrization of the vagina, greatly diminish the parturient canal. In cases of marked displacement of the cervix following vaginal or ventrofixation previous to pregnancy, Cæsarean section may be necessary. It is rarely indicated in some cases of accidental hemorrhage. Recently it has been recommended in some cases of eclampsia and placenta prævia. For the former condition Halbertsma proposed the operation in 1878. Hillmann has recently reported 39 cases, with a maternal mortality of 51.3 per cent., and a fetal mortality of 43.9 per cent. The operation should not be performed in eclampsia unless some positive indication exists—*e. g.*, contraction of the birth canal. When, also, an eclamptic dies, the fetus being still alive *in utero*, it is the duty of a physician who may be present at the time of birth to advise immediate postmortem Cæsarean section. Bauer has recently reported 8 such cases, in which 4 infants were saved. It may be performed on a woman who dies in advanced preg-

nancy, in the hope of saving the fetus. It should not be carried out when the fetus is dead, save when the absolute indication exists. It should not be performed when labor has been long in progress, after repeated attempts at delivery have been made, if the mother is exhausted or has been subjected to the chance of infection, unless there is an absolute indication. Under such conditions the mortality of Cæsaean section is high, and symphysiotomy or embryotomy or both should be employed. Cæsaean section has been rarely employed where the diagnosis of monstrosity has been made, the latter being of such a nature as to imperil the mother's life by delivery through the maternal passage.

The importance of the careful examination and measurement of pregnant women cannot be too highly urged. Were this advice always followed, it would be possible to decide as to the future treatment after more thorough consideration than is possible when a sudden choice has to be made. Arrangements could be more satisfactorily made and the patient more considerably treated. Nevertheless, in certain cases it is impossible to decide that a Cæsaean section is necessary until labor has begun.

**Time of Operation.**—There is a difference of opinion as to when the operation should be performed in cases in which a choice can be made. When the absolute indication exists, it is generally believed that the most favorable period is immediately after labor has begun, because the uterus is likely to contract well after being emptied. Others hold that it is not necessary to wait for labor, the uterus being certain to contract and retract well if emptied before labor starts. It has been well established that actual labor pains are not necessary to prevent uterine inertia and hemorrhage. Uterine contractions take place throughout pregnancy, though painlessly, and the removal of the uterine contents is a certain stimulus. Those who operate after labor has commenced think that an advantage is gained in having a partly dilated cervix through which drainage may be established. It is, however, easy to dilate the cervix sufficiently to pass a piece of gauze into the vagina.

There is an advantage in selecting the hour of operation—viz., that it can be arranged during the day, at the most convenient time. In cases in which the relative indication for the operation exists, it may frequently be necessary to wait until labor has progressed even into the second stage. The woman should not be allowed to wait until she is exhausted, because the chances of success are thereby greatly diminished.

**Operation.**—All preparations are made as for any abdominal section, the strictest technic being observed. The vagina should be thoroughly sterilized. The incision is made mesially above the pubes, the length varying according to whether or not the pregnant uterus is to be lifted through it. In the former case it

should be about 8 in., and in the latter 5 in., in length. The author favors the long incision, in order that the uterus may be lifted through it; in this way it may be kept under good control and it is easier to prevent the entrance of fluids into the peritoneal cavity. Against the long incision is the extensive scar that is caused. This is not important, and need not favor hernia if the wound be stitched properly. In such cases the navel should be excised and the edges of the recti exposed in the entire length of the incision before closure is made. Zweifel's objection, that a greater extent of adhesions is likely to occur after a long incision, is trivial. If the peritoneum be properly stitched both on the uterine and abdominal walls—*i. e.*, be inverted on the former and everted on the latter—by a continuous catgut suture, and an aseptic technic be observed, no adhesions will follow.

After the long incision is made the uterus is carefully lifted through it and surrounded with towels soaked in hot normal saline solution. The peritoneal cavity is then packed with hot pads above the uterus, and the abdominal incision temporarily closed over them with a single through-and-through temporary suture. In this way the peritoneum is protected from contamination by blood and liquor amnii.

*Uterine Incision.*—Various uterine incisions have been recommended—*i. e.*, sagittal fundal, low transverse, anterior longitudinal, posterior longitudinal, and lateral. Fritsch, in 1897, introduced the transverse fundal incision. He believes that by this method the placenta is less frequently cut down upon; there is less bleeding; there is greater diminution of the wound, and less stitching is required; the child can be more easily extracted; the escape of blood and liquor amnii into the peritoneal cavity can be better prevented; there is less risk of after-hernia, because the abdomen can be opened higher up. These statements of Fritsch are marked exaggerations and cannot be upheld by those who consider the subject dispassionately. The results obtained by the transverse fundal incision are in no degree better than those obtained by the mesial incision through the fundus and anterior uterine wall.

Some recommend that the placenta should never be divided, because of the greater loss of blood. This also is unnecessary advice. It is usually most convenient to make the incision mesially from the fundus downward for 5 in. Olshausen first incises the fundus and then carries the incision anteriorly or posteriorly, according to the position of the placenta, which he tries to avoid. As the wall is divided opened vessels may be caught with forceps, but usually the pressure of an assistant's hands on each side of the incision is sufficient to check bleeding. When the membranes are reached, they bulge into the opening, appearing dark-colored. An opening is made into them and rapidly en-

larged. If the placenta is on the anterior wall, it should be divided without hesitation. The loss of blood need not be great and will not harm the fetus.

The assistant may now compress both broad ligaments with his hands, while the operator passes his hands into the amniotic sac, near the fundus, and grasps the fetus by a leg or buttock. If the head is uppermost, it may be grasped with both hands and delivered. If there is much resistance, the incision may be slightly enlarged. During the delivery the liquor amnii escapes freely. The cord is then clamped near the fetus and divided, the fetus being given to an assistant for resuscitation.

Soon after the removal of the fetus the uterus diminishes in size, its wall thickening. The hand should be immediately introduced into its cavity in order to peel off the placenta and membranes. The cervical canal may then be examined, and one or two fingers passed into it for the purpose of dilating it if it be small. In the latter case a piece of antiseptic gauze should be pushed through the cervix, the upper end being left in the uterine cavity to insure free drainage into the vagina. Further diminution in the size of the uterus follows. This may be hastened by pouring hot normal saline solution (110° F.) into the uterine cavity; the wall is thereby usually made firm and pale. The organ may then be placed inside the abdomen.

The procedure recommended by some operators of placing a rubber tourniquet around the broad ligaments and lower uterine segment before the uterus is opened is to be avoided. It is not necessary for the purpose of checking hemorrhage, and it may damage the tissues by its constricting effect and interfere with proper contraction and retraction of the uterus afterward.

*Suture of the Uterus.*—The author finds it most convenient to approximate the surface of the musculature of the uterine incision by means of a running catgut suture of medium thickness from within outward, in two or three layers, a separate suture being used for approximating the peritoneum, whose edges should be inverted.

Some operators use interrupted buried deep and superficial catgut sutures. Others introduce sutures on the peritoneal surface which pass deeply through the musculature, the peritoneum being closed by a separate row. Various other forms of suture material have been employed,—*e. g.*, silver wire, silk, and silk-worm-gut,—but these are not so satisfactory as catgut. The advice of Sanger, that the deep sutures should not pass through the mucosa on the side of the uterine cavity, is not necessary if operations be performed with rigid asepsis.

*Closure of the Abdomen.*—The pads are removed from the peritoneal cavity and all blood and liquor amnii sponged out. The edges of the parietal peritoneum are then stitched with fine

catgut, care being taken to evert the raw edges. The rest of the incision must then be closed by some well-recognized method. The navel should be cut away and the edges of the recti and their sheaths brought together carefully. It is the author's practice to flush out the belly, before closure, with hot normal saline solution, and to leave a pint or more inside.

*After-treatment.*—The after-treatment is the same as in the case of any abdominal section. The gauze drain may be removed from the uterus on the third or the fourth day. If the patient runs a satisfactory course, the infant may nurse in the usual manner after the second or third day.

**Conservative Cæsarean Section Associated with Sterilization.**—When it is desirable to render a woman sterile, the operation may be accompanied by complete removal of the tubes, care being taken to bury the stumps in the uterine wall. Mere division of the tubes after double ligature is not sufficient, as pregnancy has been known to follow this procedure, owing to the succeeding patency of the uterine end of the tube. Instead of removing the entire tube, it is recommended by some to remove half an inch of the uterine end, which is dissected for a distance out of the uterine wall. The raw surface should then be buried by a continuous catgut suture. The ovaries need not be removed unless there is a pathologic indication.

**Pregnancy Following Cæsarean Section.**—In the pre-antiseptic days, before the uterine suture was employed, pregnancy occurring after Cæsarean section caused stretching or hernial protrusion of the scar or suture in a considerable proportion of cases. This has been rarely reported in modern times, and is most apt to take place when the uterus is much distended. Caruso, Bar, and Abel have reported 43 cases in which Cæsarean section has been carried out two or more times without a death.

**Supravaginal Amputation of the Uterus (Porro's Operation).**—**Indications.**—Hitherto the most widely recognized indications for this operation have been:

1. The desire of the parents not to run the risk of another pregnancy in cases where natural labor is impossible. In reference to this indication, it is now to be said that it should not be recognized when the cause of trouble is contraction of the head or soft passages. The Porro operation is longer than the conservative operation, causes more shock to the woman, and has a higher mortality. Moreover, the woman may be rendered sterile by removal of the tubes, as above described. Amputation should, however, be performed if there be extensive tumor formation in the uterine body, or if there has been rupture of the uterus too extensive to repair (though in some cases total hysterectomy of the ruptured uterus is most advisable).

2. When the appendages are so diseased as to warrant their

removal. Porro's operation is advisable when this complication exists unless the condition of the patient contraindicates prolongation of the operation.

3. When labor has been prolonged and manipulations have been carried out that have exposed the woman to the risk of infection. This indication is to be recognized only when delivery is impossible by any other method. Any form of Caesarean section involves increased risk under such circumstances. The fetus should be removed by the natural passage by embryotomy or symphysiotomy if possible; only if these cannot be performed should the abdomen be opened and the fetus be removed by incision of the uterus. Then it is best to remove the entire uterus and not to perform the Porro operation. Though total hysterectomy is a little longer than supravaginal amputation, the tissue that is most likely to have been infected by manipulations—viz., the cervix—is removed, and drainage can be most satisfactorily made into the vagina.

**Operation.**—As originally performed by Porro, the lower uterine segment was constricted by a *serre noué* after removal of the fetus from the uterus, which was not lifted out of the abdomen in the early stage of the operation. The uterus was then cut away and the stump fastened in the lower angle of the abdominal incision. Müller modified this procedure by making the abdominal opening large enough to allow the pregnant uterus to be lifted through it. He also applied an elastic ligature around the broad ligaments and lower uterine segment previous to opening the uterus. To insure that the stump is held firmly in the abdominal incision, the parietal peritoneum is stitched around the stump below the elastic ligature, and the stump is transfixed with pins, which prevent its recession; the rest of the abdominal incision is then closed. The stump afterward separates, usually between the twelfth and fifteenth days.

This extraperitoneal method of treating the stump is to be recommended only when great haste is needed and when the operation is performed by one who is not an expert gynecologic operator. Under other circumstances the operation should be carried out so that the stump is not fastened into the abdominal incision. The following procedure has given the greatest satisfaction to the author: The technic is similar to that already described as far as the removal of the fetus from the uterus. The amputation is then performed as in the case of a fibroid enlargement of the uterine body. The round ligaments are doubly ligated close to the uterus and divided. The appendages may or may not be removed. In the former case the ovarian vessels are then secured by a catgut ligature embracing the infundibulopelvic ligament. One or two more mass ligatures are then placed below the tube and ovary. The broad ligament is then divided trans-

versely on each side from the infundibulopelvic ligament below the ovary as far as the side of the uterus. These incisions are then joined by one running transversely through the peritoneum above the junction of the bladder and uterus, and by a similar one at the same level dividing the peritoneum of the posterior uterine wall. The peritoneum is then stripped downward in front along with the bladder, and also behind and at the sides until the uterine vessels are exposed. These are ligated with catgut and divided from the uterus. The uterine wall is then divided close to the cervix or through the upper portion by a cone-shaped incision. The uterine body is then removed. The cervical canal should be thoroughly burned out with the caутery. The crater-shaped stump of the uterus should then be closed with catgut and carefully covered with the anterior and posterior layers of peritoneum. The edges of the divided broad ligaments should also be buried with running catgut. The abdomen is then closed. This procedure is a great advance beyond the original Porro procedure, in which the stump was stitched into the abdominal incision.

**Total Abdominal Hysterectomy.**—The whole uterus should be removed in cases in which the genital tract has been infected previous to operation, symphysiotomy being impossible; when there is malignant disease in the body or cervix, and in cases of bad rupture of the cervix and lower uterine segment.

In the case of cancer of the cervix it is advisable to scrape away as much as possible of the growth previous to the abdominal operation, the vagina being thoroughly washed out with a strong antiseptic solution. Some operators, however, prefer to perform supravaginal amputation through the abdominal incision, removing the cervix afterward by a vaginal operation, in order to lessen the risk of infecting the peritoneum.

**Operation.**—Special details of the technic need not be mentioned, since they are the same as those observed in the removal of the non-pregnant uterus and are described in modern works on gynecology.

**Gastro-clytrotomy.**—In 1821 Ritgen devised the plan of opening the uterus without entering the peritoneal cavity. During his first operation the hemorrhage became so alarming that he abandoned his procedure and had recourse to the ordinary Cæsarean section. In 1823 Baudelocque the younger had a similar experience, though he succeeded on a second occasion.

In 1837 Sir Charles Bell advocated the operation. It never became widely known, however, until Gaillard Thomas reintroduced it in 1870. Since that time several operators have performed it, but without the effect of popularizing it. Though the procedure was a praiseworthy attempt to avoid the dangers of the intraperitoneal operation in the preantiseptic days, it should have no place in obstetric surgery at the present time.

In Thomas's operation the wall of the abdomen is incised for several inches parallel with Poupart's ligament, the peritoneum not being opened. A deep dissection is made external to the latter until the vagina is reached. The wall of the vagina is then divided transversely and the fetus extracted through the opening artificially made.

**Vaginal Cæsarean Section.**—In 1895 Acconci performed vaginal incision of the uterus for the purpose of delivering the fetus. The same operation was carried out in 1896 by Dührssen, whose work has been chiefly responsible for the interest taken in the procedure by the profession.

**Indications.**—Dührssen advises the operation in the following conditions:

1. In new growths of the cervix, and rigidity and stenosis of the latter; in partial sacciform dilatation of the lower uterine segment.
2. In eclampsia, intra-uterine hemorrhage, and in affections of the lungs, heart, and kidneys where the mother is in danger and where rapid delivery is indicated.
3. In cases in which the mother is in *articulo mortis*.

The operation has not yet been sufficiently tested to warrant the expression of a definite opinion as to its merits, but it certainly deserves a thorough trial.

**Technic of the Operation.**—A circular incision is made through the mucosa covering the vaginal portion of the cervix, close to the fornix, and is extended into each lateral fornix for half an inch. The mucosal flap is stripped upward with the bladder, the cervix being pulled downward with a volsella. The bladder is then held up with a retractor, and the cervix is divided in the middle line anteriorly and posteriorly if the case be at or near full term. If it be premature, the posterior lip may not require to be divided. The cervical incision is then continued into the lower uterine segment anteriorly as far as necessary, care being taken not to enter the peritoneal cavity. In this way an opening in the uterus 8 to 12 cm. in length may be obtained, which allows the passage of the fetus. Bleeding is controlled by forceps. If it is thought advisable, the uterine vessels may be ligated. Through the incision the fetus is extracted by version or forceps. The placenta and membranes are then removed and a gauze tampon placed in the uterus. The incisions are then closed with catgut.

**Results.**—Maygrier has recently collected 16 cases reported by different operators, with a maternal mortality of 18.75 per cent. In 12 cancer of the cervix was present, and 2 of these died. The fetus survived in 6 instances, but several of those which died were premature.

Bumm has performed 13 cases, with 1 death due to eclampsia. He has tabulated 39 cases, with 8 deaths, of which 3 were due to eclampsia and 2 to heart disease.

**Abdominal and Vaginal Cæsarean Section as a Means of Accomplishing Rapid Delivery (Accouchement Forcé).**

—Abdominal and vaginal Cæsarean section are rarely necessary as a means of rapid delivery. The following conditions are those in which the operations may be necessary:

(a) **Eclampsia.**—Since 1878, when Halbertsma proposed abdominal Cæsarean section as a mode of treatment, it has been carried out in a considerable number of cases. Kettlitz, in 1887, collected 27 cases, with a mortality of 47.3 per cent.; Hillmann, in 1900, 40 cases, with a mortality of 52.5 per cent. These percentages are certainly higher than the average in large numbers of cases of eclampsia treated by ordinary means. There seems indeed no justification for the adoption of the procedure as a routine method of treatment. In rare cases of eclampsia it may be indicated—viz., in those associated with contractions of the birth canal, or other pathologic changes in the soft or hard parts that make delivery impossible by the natural passage.

When, also, an eclamptic dies, the fetus being alive *in utero*, it is the duty of a physician who may be present at the time of death to advise immediate postmortem Cæsarean section. Bauer has recently reported 8 such cases, in which 4 infants were saved.

Vaginal Cæsarean section is to be recommended in cases of eclampsia in pregnancy or in early labor in which the cervix is rigid and difficult to dilate. As a means of delivering a woman rapidly it is, in such a condition, a safer and more scientific procedure than Dührssen's incisions or forcible stretching with dilators, for it produces a clean incision in the mesial plane of the cervix and lower uterine segment, hemorrhage from which may be readily controlled.

(b) **Placenta Prævia.**—Within the last few years abdominal Cæsarean section has been carried out in several cases of placenta prævia; it was first suggested by Lawson Tait. Zinke has collected 6 cases of the conservative operation and 2 of Porro's operation, in which 5 mothers and 6 infants lived. The procedure has been widely criticized, and rightly. If the women were always in the hospital, where the operation could be carried out promptly by an expert operator immediately after the diagnosis was made, the results might be more satisfactory both to mother and infant than those obtained by all other methods of treating placenta prævia, but under the conditions that exist in ordinary private practice the results would undoubtedly be worse. Abdominal Cæsarean section must indeed be considered as rarely indicated in placenta prævia; practically only when some condition exists that renders the ordinary methods of treatment extremely hazardous or impossible. I have reported the case of a young girl of fourteen in whom excessive hemorrhage associated with a small vagina and a contracted pelvis necessitated the operation.

Bumm has recently successfully performed vaginal Cæsarean section in placenta prævia, and believes that this operation will become important in certain cases of this condition—viz., those, fortunately rare, in which the cervix is rigid and incapable of easy dilatation.

(c) **Accidental Hemorrhage or Ablatio Placentæ.**—Though several authorities have suggested the abdominal Cæsarean section in certain cases of premature detachment of the normally situated placenta, it has rarely been employed. It seems to the writer that the operation should enter into consideration only when it is impossible to carry out other procedures by the vaginal route.

Vaginal Cæsarean section is indicated in cases of accidental hemorrhage where the patient's condition is critical and where the cervix cannot be rapidly dilated by the ordinary methods, providing a competent operator is at hand.

(d) **Affections of the heart, lungs, kidneys, etc.,** where the mother is in danger and rapid delivery is indicated. In these various conditions vaginal section is indicated where the cervix does not admit of easy dilatation. The abdominal operation should not be employed save where there is no possibility of satisfactorily performing vaginal section.

(e) **Cases in which the Mother is In Articulo Mortis.**—If a physician be present at the death of a pregnant woman carrying a viable fetus, it should be his duty to advise immediate Cæsarean section, in the hope of saving the latter. Bauer has collected reports of 15 such operations. In 3 only was the fetus dead; in 2 it was alive, but soon died; while in 10 it lived. In 8 of these cases the mother's death was due to eclampsia, and in 4 the fetus was saved. Only 3 of the 10 breathed on being extracted. All were more or less asphyxiated, yet were resuscitated. In 1 case Bauer observed that after removal of the fetus, placenta, and membranes, uterine retraction immediately took place.

The abdominal operation is by far the simplest and quickest in such cases, for it can be performed merely with a knife and without assistance. The vaginal operation has also been recommended, but it would probably occupy a longer period than the other and assistance would be needed.

## CHAPTER V.

## SYMPHYSIOTOMY (SYMPHYSEOTOMY, SYMPHY-SOTOMY).

SYMPHYSIOTOMY is an operation that consists in dividing the symphysis pubis, in order that the ossa innominata may be separated; the bony canal is thereby enlarged and the delivery of the fetus facilitated. The operation was first performed on a woman, immediately after her death, by de la Courvée, of Warsaw (the date is not exactly known—somewhere between 1585 and 1655). In 1766 Plenck practised it also on a dead woman. In 1768 Sigault, a Paris medical student, proposed that the operation be employed on a living woman. In 1774 Ferrara, an Italian, who had been in Paris and had heard of Sigault's suggestion, first carried out the operation on a living woman, in Naples, the woman dying. In 1777 Sigault performed the first successful operation, both

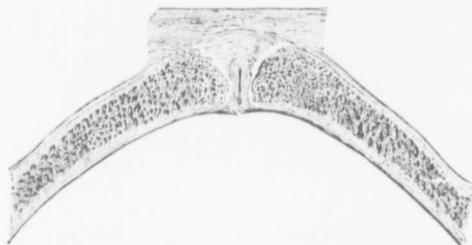


FIG. 318.—Section across symphysis pubis, showing pubic disk (Lusk).

the mother and child surviving, though the former was left with a vesicovaginal fistula, a prolapse of the uterus, and walked with a waddling gait. Sigault's operation was bitterly condemned by many leading surgeons, and during the next one hundred years was little practised. Neugebauer collected 136 cases reported between 1777 and 1866, of which 56 were Italian. Between 1820 and 1890 the operation was chiefly performed in Naples. Since 1866 it has been mainly advocated by Morisani and his pupils. In 1891 Pinard, of Paris, was induced to try symphysiotomy, and during the next few years performed a considerable number of operations. Jewett reported the first case in America in 1892.

**Scope of the Operation.**—Symphysiotomy was introduced into practice as a substitute for Cæsarean section on account of the high mortality of the latter procedure. The work of Morisani and Pinard for a time seemed likely to make the operation widely

popular, but recently it has gradually taken a less prominent position, while Cæsarean section has grown more into favor. This is due partly to the disadvantages associated with symphysiotomy, but largely to the marked improvement in the results of Cæsarean section. Though the maternal mortality in both operations has diminished, it is doubtful if symphysiotomy can claim at the present time a lower death-rate, while it undoubtedly has a record of after-troubles unknown to the other operation.

Symphysiotomy is condemned by many as an unscientific procedure, not to be practised under any circumstances. While this position is too extreme, it must be admitted that the operation has a very limited range of usefulness. The operation does not deliver the woman: it merely affords room for the passage of the fetus at the sacrifice of the normal architecture of the bony pelvis. To it must be added, usually, the risks of artificial delivery by version or forceps. Moreover, it is easy to miscalculate the size of the fetal head as well as the amount of gain following separation of the bones. Immediate and remote risks, maternal and fetal, must, therefore, be expected in a certain percentage of cases unless the operation be restricted within narrow limits. When it is carried out in too contracted a pelvis the dangers are very great. Jewett holds that it is suited

to those cases in which only a slight additional space is required for delivery, and that it may prove valuable when the axis-traction forceps unexpectedly proves inadequate. He thinks that it should not be used in flat pelvises with a conjugate less than 7.5 cm. (3 in.), or in just minor pelvises with one less than 9 cm., if the fetal head be of normal size. It may sometimes be advisable in certain impacted face or occipitoposterior cases. When the woman has been greatly exhausted or has been subjected to the risk of infection, symphysiotomy should replace Cæsarean section when the passage is large enough.

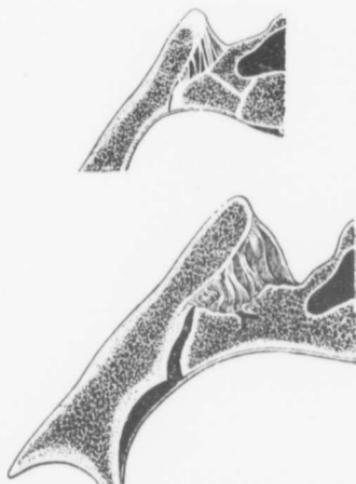


FIG. 319.—Separation of sacro-iliac joint on opening pubic symphysis (Farabœuf).

Symphysiotomy performed for the purpose of affording increased space at the outlet is safer than when it is used for expediting delivery of the head above the brim; it may, therefore, be adopted in funnel-shaped or kyphotic pelves when the outlet is not quite large enough to allow safe delivery with forceps. In all cases in which symphysiotomy is performed the fetus must be alive. Cesarean section has a great advantage over symphysiotomy in that the risks of the operation are independent of the degree of pelvic contraction, and the relationship between the latter and the fetal head. It offers greater chances of safety to the fetus, other conditions being the same. Symphysiotomy should not be carried out where there is inflammation or ankylosis in the sacro-iliac joints.

**Effects of the Operation on the Pelvic Measurements.**—When the pubic symphysis and subpubic ligament are divided, the ossa innominata may be moved to a certain extent at their junction with the sacrum. This movement is greater in pregnancy than in the non-pregnant state, owing to the softening of the ligaments of the joints in the former condition. As the pubic bones are separated they move somewhat downward, owing to the peculiar shape of the sacro-iliac joints. As a result there is an increase in the available space for the passage of the fetus. The true conjugate is lengthened, the gain varying according to the degree of descent of the pubes, the separation of the bones, and the size of the pelvis. Budin and Demelin give the following table:

| Extent of separation of pubic bones. | Conjugate.      | Increase in conjugate. |
|--------------------------------------|-----------------|------------------------|
| 7 cm. (2½ in.).                      | 6 cm. (2½ in.). | 1.3 cm. (½ in.).       |
| 7 "                                  | 7 "             | 1.2 "                  |
| 7 "                                  | 8 "             | 1.1 "                  |
| 7 "                                  | 9 "             | 1 "                    |

A separation of 7 cm. is the extreme limit of safety and should rarely be reached. Consequently, when a lesser degree of separation is obtained, the gain in the conjugate is less than is figured in this table. To be well on the side of safety, the extent of pubic separation should probably never be greater than 6 cm. Sandstein holds that symphysiotomy should never be performed with a conjugate of less than 2.78 in. (7.3 cm.). Morisani also states that there is not much scope for the operation when the conjugata vera is below 7 cm. In general it may be said that rarely can an increase in the conjugate greater than ¾ in. (1 cm.) be obtained. There is also an increase in the oblique diameter one and a half times that of the conjugate, and in the transverse about twice as much. Moreover, new space is gained between the ends of the separated bones, into which the presenting part of the fetus may bulge as it descends, the increase varying directly with the degree

of separation. To obtain the most satisfactory result, the ossa innominata must be moved outward an equal distance from the middle line. In estimating the gain to be derived from symphysiotomy, one must examine not only the pelvic brim, but also the condition of the anterior surface of the sacrum, for if the latter be flattened or bulging, the dystocia may not be limited entirely to the inlet.

Sandstein describes the movements occurring during the separation of the bones after symphysiotomy as follows:

1. Movement of the pubes outward by rotation of the innominate bones on vertical axes passing through the respective sacro-iliac joints.
2. Rotation of the innominate bones on a transverse hori-

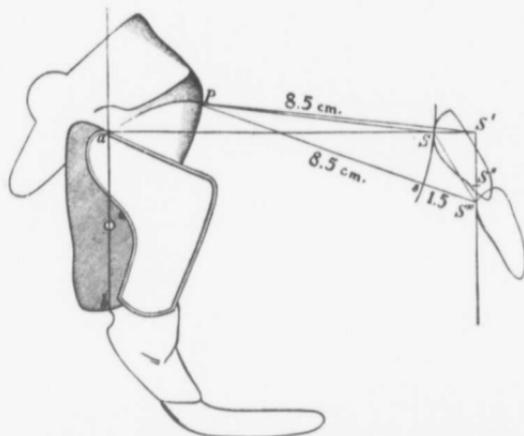


FIG. 320.—Effect of descent of pubic bones on gain in length of sacropubic diameter. By mere separation of bones the gain in conjugata vera would be  $S, S'$ , with added effect of descent it is  $S', S''$  (Wehle).

zontal axis passing through the sacrum, carrying the pubes downward.

3. Rotation of each innominate bone on its own long axis (an axis lying in a direction from the posterosuperior iliac spine to the iliopectineal eminence), so as to cause the ilium to become more erect or vertical. As the pubes pass downward and outward and the ischial tuberosities are carried farther apart, the iliac crests approximate one another.

He considers that the true significance of the operation in increasing the brim conjugate lies chiefly in the fact that it thereby permits increased descent of the pubic bones from their original

level, and holds that symphysiotomy is really a means of obtaining the results afforded by Walcher's position, only in a greater degree.

With 6 cm. of pubic separation, a mean depression of the pubes to the distance of 8.4 mm. can be obtained. Walcher's position alone gives a maximum descent of 5 mm. The outward movement of the pubic bones is usually a minor factor in producing increase of the conjugate.

**Operation.**—The operation should be carried out when the cervix is completely dilated. If dilatation be incomplete, it should be increased by manual stretching or by rubber bags.

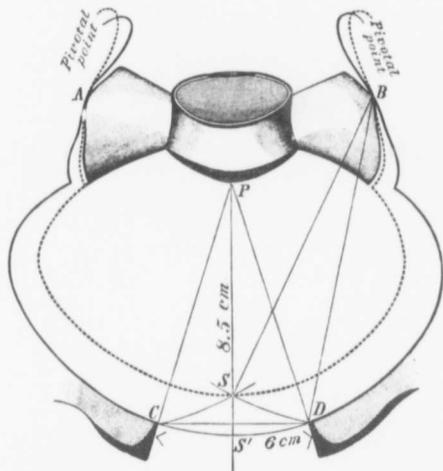


FIG. 321.—Diagram of pelvic brim, showing gain in space on opening pelvic joint: *F.S.*, Conjugate joint closed; *P.S'*, conjugate joint open 6 cm. (Wehle).

The patient is placed on a table, in the lithotomy position, shaved, and prepared as for a surgical operation.

Various methods are employed for dividing the symphysis:

1. **Open Method.**—After a metal catheter is inserted into the urethra, a mesial incision through the skin and subcutaneous fat is carried from a point 3 cm. ( $1\frac{1}{4}$  in.) above the pubes to as low as the clitoris. The latter is then drawn down while its suspensory ligament is separated from the subpubic ligament, care being taken not to injure its dorsal vessel. The upper edge of the symphysis is then exposed, the insertions of the recti muscles divided, and a

finger introduced between them, in order to separate the tissues from the posterior surface of the symphysis. A director is then placed behind the latter, being introduced above or below; it protects the soft tissues while the symphysis is divided. The division is made with a short knife or scissors, from without inward or from within outward. Care should be taken not to strip the periosteum from the bone.

2. **Subcutaneous Method.**—Many Italians favor the plan of making a mesial incision an inch in length above the symphysis, in order that a forefinger may be introduced between the insertions of the recti, for the purpose of separating the tissues from the posterior surface of the symphysis and protecting them while a curved probe-pointed bistoury or Galbiati's knife is passed behind the symphysis to divide the joint from below upward. If the subpubic ligament is not cut, it is necessary to introduce another

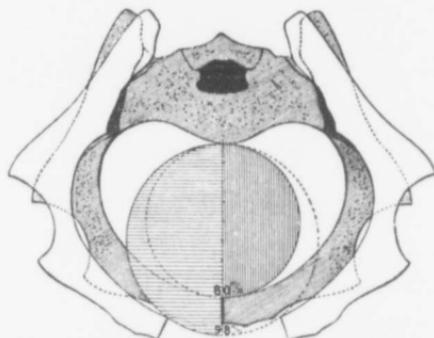


FIG. 322.—Diagram of pelvic brim, showing gain of space on separation of symphysis. Pubic joint closed, pelvic cavity admits a sphere 80 mm. in diameter; joint opened 6 cm., the cavity admits a sphere 98 mm. in diameter (after Farabœuf).

smaller knife for the purpose. Some hold that it is best not to cut the subpubic ligament in most cases, in order to prevent vaginal rupture and secondary slipping of the bladder into the joint. Harris recommends dissecting the ligament from the pubes for a short distance on each side of the middle line. If there be much bleeding, the wound may be packed for a few minutes with gauze.

**Ayers' Method.**—After the clitoris is raised from the symphysis an incision is made below it with a narrow sharp knife and carried vertically upward subcutaneously nearly to the upper end of the symphysis. Through this incision a straight blunt-pointed bistoury is introduced, in order to divide the joint from above downward and before backward. A metal catheter is kept in the urethra

while this is being done, and a finger in the vagina guides the blunt end of the bistoury.

After the division an assistant should stand on each side of the patient's hips, supporting the thighs and placing a hand against the trochanter. During descent of the head pressure may be made over the wound to lessen the risk of rupture of the anterior vaginal wall.

Spontaneous delivery may take place after the division of the symphysis, in which case close attention must be given to the pelvic bones, in order that separation may be symmetric and not excessive. Zwielf strongly urges that labor should be spontaneous, claiming that the results are much more satisfactory than when artificial delivery is employed. Most authorities, however, advise artificial delivery. Version is strongly recommended by

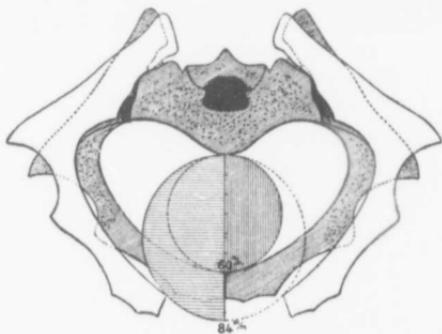


FIG. 323.—Diagram of pelvic brim, showing gain of space on separation of symphysis. Pubic joint closed, the pelvic cavity admits a sphere 60 mm. in diameter; joint opened 6 cm., the excavation admits a sphere 84 mm. in diameter (after Farabouef).

some and condemned by others. Many advocate exclusively the use of axis-traction forceps in head presentations. When extraction has begun, the pubic bones tend to move apart. It is the duty of the assistants to steady the thighs and press inward against the trochanters, in order to prevent sudden or excessive separation. It is best that the limbs should be held in Walcher's position. The operator must see that the ends of the pubic bones move outward equally distant from the middle line; that one which moves out farthest takes a lower level than the other. Should one bone move but slightly and the other excessively, there is a great risk that the ligaments of the sacro-iliac joint on the side of the latter may be badly torn. When there is an asymmetric movement of the bones, the Walcher position must not be adopted. The soft structures anterior to the birth canal must

be carefully protected, the external incision being packed with gauze, which may be held in position with sterile adhesive plaster.

Some authors, notably Faraboeuf, recommend forcible separation of the bones after division of the symphysis. This is apt to injure the ligaments more than will the gradual separation just described.

It has also been recommended that instead of employing assistants to hold the hips, it is advisable to encircle the hips with a flannel binder, which gives some support but does not prevent gradual separation. After delivery is completed the separated bones are brought together, care being taken not to pinch the bladder between them. Dawbarn suggests filling the bladder with fluid before bringing the bones together, in order to raise it above the brim, so that it may not be pinched between the pubic bones.

If the bladder has been torn, the rent should be closed with catgut; in such a case continuous drainage of the bladder by a catheter placed in the urethra is advisable for a few days. The fibrous tissues in front of the joint may be stitched with chromic catgut and the external incision closed. A dressing is placed over the pubes and held in position with adhesive plaster. The hips may then be encircled with a firm canvas binder or with adhesive-plaster strips. The patient may then be placed on a hard bed, her legs being kept straight and bound together at the knees, a long sand bag being placed against the pelvis and thighs. Ayers' hammock bed is an excellent arrangement for keeping the bones together and facilitating the nursing. The after-care is very troublesome. The greatest care must be taken to keep the external genitals clean and to avoid disturbance of the bones when the bedpan is used. The genitals should be washed with an antiseptic lotion two or three times a day.

Zweifel recommends draining the prevesical space into the vagina after symphysiotomy in all cases, in order to diminish the risks if infection occurs. For this purpose he employs a glass tube covered with rubber. In case the vagina is infected he carries the tube through one of the labia majora, below the corpus cavernosum. To place the latter in position, the hips of the patient should be raised and steadied by an assistant. If vaginal or uterine douches are necessary, they may be given with least disturbance to the patient by flexing the thighs toward the abdomen without separating them. The woman should be kept on her back for three weeks, and for the same period longer in bed, the binder being kept in position. When she sits up, the latter should not be removed.

**Complications.**—Excessive subcutaneous fat increases the difficulty of the operation. When the uterus bulges markedly over the symphysis, it should be held well up by assistants while the incision is made. Sometimes the division is difficult owing to

ossification in the joint; in such a condition a chain-saw or chisel may be needed. Several authors state that ossification is never found, cases described as such being those in which the joint has been missed and the bone divided. Sandstein points out that the upper end of the symphysis is not always in the middle line. In 50 per cent. of cases examined it was mesial; in  $33\frac{1}{3}$  per cent. to the left; in  $16\frac{2}{3}$  per cent. to the right. In 60 cases examined by Wehle it was mesial in  $13\frac{1}{3}$  per cent.; in  $66\frac{2}{3}$  per cent. to the left; in 20 per cent. to the right. Hemorrhage may sometimes be excessive and alarming, owing to the division of large veins, especially during division or separation of the bones. This may be aggravated after delivery of the fetus. Rupture of the anterior vaginal wall or vulva may be produced, especially in primiparæ. The urethra or bladder may be torn, either as the result of separation of the bones or of extraction of the fetus. In performing symphysiotomy on a woman who has already passed through the operation the bladder and urethra are apt to be torn in separating them from the pubes, to which they have become adherent by strong fibrous union.

Sandstein points out that the anterior and superior sacro-iliac ligaments are apt to tear, beginning in the latter, because the upper margin of the lateral mass of the sacrum is made to project above the corresponding upper border of the articular surface of the ilium. In his experiments rupture began in 44 per cent. of cases with less than 6 cm. of pubic separation, and in 56 per cent. with 6 cm. or more; in 2 it began only at 8 cm., and in 1 not even at 8 cm.

The mons veneris was often affected; after 7 cm. it always tore.

In 30 cases of lacerations directly due to the symphysiotomy, collected by Sandstein, the trouble was due to extension of the operation wound in 5; in 7 to tear of the vestibule; in 1 to tear of the labium minor; in 9 the anterior vaginal wall was ruptured; in 3 the urethra; in 2 the vestibule, clitoris, and urethra; in 1 the urethra and vagina; in 1 the urethra, bladder, and vagina; in 1 the urethra, vagina, cervix, and perineum. Lacerations are also caused by mismanaged labor.

After delivery there may be trouble from various sources. The smaller the pelvis, the slower the convalescence. Hemorrhage sometimes occurs. Infection is apt to follow; Bar reports fever 25 times in 62 cases—*i. e.*, 31 per cent. Various urinary disturbances may be present. The patient may be unable to pass water; or may be unable to hold it, owing to paralysis or division of the urethra. Infection of the urethra and bladder is not infrequent. Prolapse of the bladder and uterus has been reported in a number of cases. There may be weakness in the pelvis, a sense of insecurity, and impairment of gait for a long period after operation. Sometimes a fibrous band may form between the pubic bones, which stretches

and allows of movement. In some cases the sacro-iliac joints are tender for a long period and may become the seat of an arthritis. Suppuration or caries in these joints is rare; in 300 cases collected by Sandstein neither of these complications occurred.

**Prognosis.**—Before the antiseptic period the mortality after symphysiotomy was high. Harris collected 105 operations performed between 1777 and 1866, with a maternal mortality of 31 per cent. and a fetal mortality of 15 per cent. In 1881 Morisani reported 50 cases, with 20 per cent. mortality both for mothers and infants. In 1885 he published 18 additional cases, with a maternal mortality of 44.4 per cent. and a fetal mortality of 27.7 per cent. Spinelli collected 24 cases performed between 1888 and 1891, all the mothers and 23 infants surviving. Neugebauer has collected 278 cases, with a maternal mortality of 11.1 per cent.; Rubinrot, 136 cases, with a mortality of 11.03 per cent. Pinard has reported 100 cases, with 12 deaths. Rubinrot places the fetal mortality at 13.97 per cent., Pinard, at 13 per cent. Zweifel reports 31 cases, with a fetal mortality of 6.54 per cent.

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## CHAPTER VI.

### EMBRYOTOMY.

THIS term is applied to all procedures that have for their end the diminution of the bulk of the fetus, living or dead, so that it may be delivered through the genital canal. It includes the reduction of the head or body, or both head and body.

Within recent years the necessity for this procedure on the living child has been reduced, owing to the use of axis-traction forceps, to the increased safety of Cæsarean section, induction of premature labor, and symphysiotomy. Many authorities declare that the living fetus should never be destroyed, because of the great diminution in the maternal mortality attendant upon alternative measures adopted to save the fetus; others hold the same view on religious grounds. In the Anglo-Saxon countries the life of the mother has always been considered of the first importance, and there has been little prejudice against embryotomy on the living fetus. Within recent years there has been a tendency to the more frequent adoption of measures calculated to save the fetus as well as the mother. The choice of procedure must depend to a large extent upon the circumstances in which the patient is placed. In skilled hands a Cæsarean section performed at a chosen time is a comparatively safe operation; in unskilled hands it is a very dangerous operation. Symphysiotomy also

should never be attempted save where the operator is an expert and the facilities are satisfactory. Embryotomy, though not by any means free from dangers, is a safer procedure in unskilled hands than a Cæsarean section or symphysiotomy. At the present day emergency work in conditions calling for any of these operations should rarely be necessary. If medical practitioners examined their patients thoroughly during pregnancy they could detect most of the conditions that need these serious operations—*i. e.*, deformed pelves, tumors, contracted soft passage, etc., and could arrange to send the women to large cities for expert care if they



FIG. 324.—Trephine of Braun (curved and straight).

were felt unable to attend to them. There are few districts in most civilized countries where such an arrangement could not be made.

**Craniotomy.**—Under this heading are described the methods of reducing the head in order to facilitate delivery.

**Indications.**—1. Disproportion between the size of the fetal head and the hard or soft passages, due to contractions of the latter. If the fetus be dead, the indication to perform craniotomy is absolute, unless the contraction in the canal be too great, when delivery by the abdominal route is necessary. The operation may be very difficult with a conjugate of  $2\frac{1}{2}$  in., and should never be attempted when it measures less than 2 in. When the fetus is



FIG. 325.—Perforator of Smellie.

alive, the procedure must be considered as an alternative to Cæsarean section, or symphysiotomy with forceps extraction or turning, the choice depending upon the situation, circumstances, and expertness of the attendants.

2. Tumors of the hard or soft parts—*i. e.*, ovarian tumor, certain fibroids, carcinoma of the cervix, bony growths, etc. All these conditions are also indications for Cæsarean section, and craniotomy should never be undertaken, if the fetus be alive, except when the other operation cannot be performed. If the fetus be dead, craniotomy is indicated, unless it is regarded as more dangerous than the abdominal operation.

3. Prolapsus funis, when the fetus is dead and a disproportion exists between the head and the passage.

4. Hydrocephalus and certain fetal deformities—*e. g.*, monstrosity.

5. Malpositions and malpresentations—*e. g.*, impacted brow and face, and malrotated occipitoposterior, when the fetus is dead. When the fetus is alive and circumstances are favorable, other procedures that are capable of saving the fetus as well as the mother must be considered as alternatives—*e. g.*, symphysiotomy.



FIG. 326.—Craniotomy forceps of Meigs.

Cæsarean section may sometimes be employed, but only when the fetal head has not descended into the pelvis.

6. When rapid delivery is necessary for the sake of the mother. In any case where rapid delivery is advisable on account of the mother's condition, delivery after craniotomy, if the fetus be dead, is less risky than forceps application, and should be employed when the head is at the brim, especially if the cervix be not quite fully dilated. If the fetus be alive, turning or axis-traction forceps must be regarded as alternative plans if the conditions be favorable.

7. When the fetus might be extracted with forceps but is



FIG. 327.—Cranioclast of Braun.

dead, craniotomy should be performed unless there is a strong objection on the part of the parents to disfigurement, or unless the forceps cannot be safely used.

**Prognosis.**—Destruction and delivery of the fetus are more risky according to the difficulties of the procedure. The maternal tissues may be bruised or cut, causing loss of blood and favoring infection. The uterus, bladder, or rectum may be perforated. If the patient has been long in labor, or if she has been injured by attempts at delivery by forceps or version, the dangers of em-

bryotomy are increased, as are those of any operative procedure. Delay in performing the operation after it has been found necessary is a serious mistake.

**Operation.**—Craniotomy may be considered in three stages: (a) Perforation; (b) head comminution, and (c) extraction.

(a) *Perforation.*—Various types of perforators have been devised—*i. e.*, knives, boring-screws, scissors, and trephines. Of these only the second and third varieties need be noted. Sir J. Y. Simpson's perforator is a modification of the scissors type and is one of the best. The halves do not cross and the blades cannot be opened until the handles are compressed. Smellie's instrument is of the scissors type. Lucas-Championnière's perforator has a boring-screw like a gimlet. Of this type is the basilyst of A. R. Simpson, which was introduced for crushing the base, but serves admirably for opening the vault of the skull. In emergency cases, where no proper perforator is at hand, a large pair of scissors may be used.

*Preliminaries to Perforation.*—The patient is placed in the

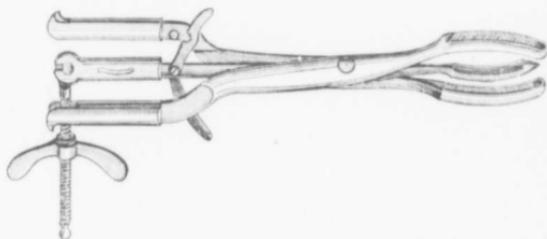


FIG. 328.—Auvard's combined perforator, cranioclast, and cephalotribe.

lithotomy position, anesthetized, the bladder and rectum being emptied. Strict asepsis is observed. The relation of the head to the brim is carefully studied. An assistant should be at hand to hold the head in position by pressure through the abdominal wall at the moment determined by the operator; he must be careful not to allow the head to slip away. If no help be available, the scalp may be held by a strong volsella while the skull is perforated. When the head is impacted in the pelvis, the aid of an assistant may not be necessary. The cervix should be fully or nearly dilated and the membranes ruptured. If the operation is indicated when the cervix is only partially opened, dilatation should be completed by means of rubber bags or by digital manipulations. To introduce the perforator, the fingers of the left hand should be passed up the vagina, holding the end of the instrument to guide it and to protect the vaginal wall from injury.

It should then be directed at right angles to the surface of the skull, and should be made to enter by semi-rotary movements if an instrument with flat blades be used; by a boring movement if the screw instrument be employed. During this procedure the head must be held firmly, and care must be taken to prevent the instrument from slipping and injuring the maternal tissues.

If possible, a flat bone should be pierced, and the opening should be made nearer the symphysis than the promontory. Sometimes it may be necessary to pierce a suture or fontanel. When the entire width of the perforator has entered the skull, the blades should be opened in different directions, so as to enlarge



FIG. 329.—Perforation of head with Simpson's perforator: right hand is grasping handles of instrument. The tips should not be separated until after they have entered the fontanel.

the incision. The end of the instrument should then be pushed into the skull to break up the brain, which, mixed with fetal blood, then pours out of the perforation. The cranial cavity should then be thoroughly washed out with sterile salt solution.

In face presentations the perforator may be passed into the skull through the orbit, or through the roof of the mouth behind the posterior nares.

The after-coming head should be perforated, if possible, at some point behind the ear, care being taken that the perforator, which must necessarily be held obliquely, does not slip. It may, however, be sometimes more convenient to perforate the skull through the roof of the mouth. Cohnstein has advised opening into the spinal canal in the neck, in order that a metal instrument may be passed into the skull to break up the brain matter. The author has sometimes found it advisable to sever the head from

the neck, withdrawing the brain matter through the foramen magnum, the skull being then broken at the base.

In some cases the head collapses sufficiently after perforation to allow it to be born. When further reduction in size is necessary, the skull must be broken.

(b) *Head Comminution.*—1. *By the Craniotomy Forceps.*—Strong forceps have long been used for breaking away the skull in small pieces around the perforation internal to the scalp, which is preserved with great care. The process is tedious and may be very difficult. It should not be employed save where no better appliances are at hand.

2. *By the Cranioclast.*—This instrument was introduced by Sir J. Y. Simpson and modified by Braun; the latter form is the more serviceable. It is really a magnified craniotomy forceps. One



FIG. 330.—Craniotomy on after-coming head: one method of perforating.

blade is fenestrated and is meant to fit outside the scalp of the head. The other is solid and is meant to be passed through the perforation into the skull, its convexity fitting into the concavity of the outer blade. The shanks fit together by a button lock, and the handles may be approximated by means of a screw at their ends. When the instrument is used, the blades are applied separately, the solid one being placed inside the skull, its end reaching the base. The fenestrated blade is then placed external to the skull, being fitted to the other; the screw at the ends of the handles is then turned to make the blades grasp the skull firmly. The instrument should then be rotated slightly to the right and left alternately, in order to break the bone that is held and loosen it from its attachment. The skull may be thus treated

in other portions around the perforation, and so may be greatly reduced in size.

3. *By the Basilyst or Basiotribe.*—In a small percentage of cases the cranioclast cannot reduce the base of the skull sufficiently to permit delivery. Different instruments have been devised to break up this portion, especially the basi-occipital bone. One of the earliest forms was that introduced by Lachapelle. Hubert devised an instrument for piercing the sphenoid, the operation being termed "sphenatresia." Guyon used a couple of trephines, one sliding over the other.

Tarnier's basiotribe consists of a perforator, two blades of unequal length, and a strong compression screw at the ends of the



FIG. 331.—Tarnier's basiotribe.

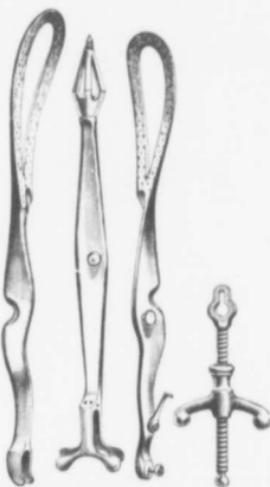


FIG. 332.—Tarnier's basiotribe (separate parts).

handles. When used, the perforator is bored through the vault and into the base of the skull. The blades are then applied to the sides of the skull, locked, and made to crush the head by means of the compression screw. This instrument is large and difficult to manipulate. Other varieties have been introduced, but need not be described here.

One of the most satisfactory instruments is A. R. Simpson's basilyst, which has already been described as admirable for perforating the skull. It consists of two halves, whose ends, when close together, form a screw, which is used to bore into the bone. When the latter is sufficiently penetrated, the handles are com-

pressed, in order to separate the blades and fracture the bone. Attached to the perforator above described is a blade that is applied external to the skull, so that a strong grasp may be taken. It may thus be used as a cranioclast to break the bones of the vault around the perforation and in extracting the head. It possesses an advantage over the cranioclast in being at the same time a perforator of the vault and base. When the cranioclast is used, perforation must be made with other instruments.

Though the base of the skull may be broken in the case of a markedly contracted pelvis, it is inadvisable to carry out the procedure in a flat pelvis when the conjugate is less than  $2\frac{1}{2}$  in., because of the risk to the maternal tissues.

4. *Cephalotripsy*.—In 1829 Baudelocque introduced the cephalo-

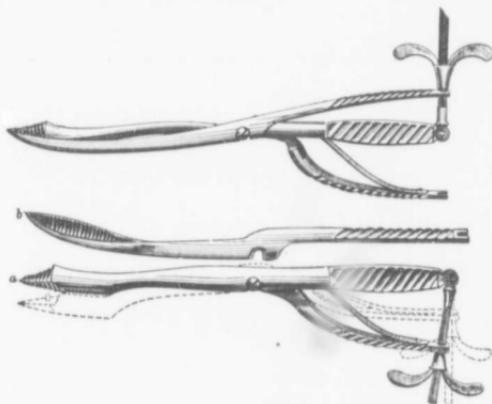


FIG. 333.—A. R. Simpson's basilyst tractor. The upper figure shows entire instrument: a, Basilyst used for perforation and comminution; b, tractor blade to be applied to skull externally when entire instrument is to be used in extracting fetus.

tribe, a long, heavy forceps whose handles could be closed by a screw. He meant the instrument to be used without previous perforation, and he represented that it could crush the head, breaking the vault and base within the scalp, the brain matter being forced out through mouth, nose, and eyes. Chailly, in 1842, advised that perforation should precede cephalotripsy. In recent times Sir J. Y. Simpson, Blot, Scanzoni, Hicks, Lusk, and others have devised patterns of the instrument.

Cephalotripsy is not to be compared to the methods already described for thorough reduction of the skull. Von Weber, Winckel, and others have shown that it may fail to crush not only the base, but the vault as well. It frequently only bends

and distorts the bones. When the instrument is used, it should be applied after perforation, and should crush the head in different directions. It may fail to grasp the head firmly after crushing.

5. *Other Methods.*—Cephalotomy, the removal of the head in segments, has been recommended by various authors. Van Huevel's saw forceps cuts the head into two vertical portions. Tarnier's instrument removes a wedge-shaped piece. The wire écraseur has been used to cut away successive parts of the head. The operation has never been widely adopted; it is difficult and dangerous to the maternal tissues and should not be attempted.



FIG. 334.—Coronal section of head whose base has been perforated with the basilyst. The transverse diameter of the reduced skull, in front of the ears, measured  $1\frac{1}{4}$  in. (A. R. Simpson).



FIG. 335.—Head compressed by cephalotribe (Simpson).

(c) *Extraction.*—The advice given by various authors that, after reduction in size of the head, delivery should be left to nature should be disregarded. There is no advantage in this procedure and several disadvantages. The labor may be delayed; the patient may be much distressed on coming out of the anesthetic to find that her troubles are not over; and in the downward progress of the fetus one of the broken bones may cut the maternal tissues. Artificial extraction, slowly and cautiously performed, should always follow the reduction of the head. It may be carried out in several ways:

1. The cranioclast may be used effectively as a tractor when the skull is well grasped. It should grasp the occipital end of the head if possible, but frequently another hold must be taken. In making traction the curve of the pelvic canal should be followed

as accurately as possible. The loosened bones should not be allowed to project outside of the scalp and cut the maternal soft parts. Traction should be made during uterine contractions, or at intervals if pains be absent. If the thorax and abdomen are too large for the birth canal, they may require to be reduced in size after the head is partly delivered.

2. The basilyst tractor of Simpson also serves admirably in extracting the head, the basilyst portion being inside the skull and the traction blade outside. Firm compression is obtained by means of a screw at the ends of the handles.



FIG. 336.—Tarnier's basiotribe in action; perforator being in place, as is also first blade.



FIG. 337.—First blade of basiotribe has crushed occiput and second blade is applied.



FIG. 338.—Second blade of basiotribe has crushed sinciput.

3. Tarnier's basiotribe is also used in extraction, but it is less satisfactory than either of the other instruments because, while compressing the whole head in one direction, it enlarges it in another at the same time, markedly altering its plasticity.

4. The cephalotribe is unsatisfactory for the same reasons. When the pelvic contraction is considerable, the compressed head, flattened in one direction, extended in another, and rigidly held, cannot be moulded, and may not be able to pass along the canal

without much damage to the maternal tissues. Moreover, the blades are apt to slip if the delivery be difficult.

5. The forceps has been recommended for extraction of the head after perforation in cases where it can safely be used. This procedure is not advisable. The head may be in a bad position for its application and it may easily slip.

6. Hooks of various forms—*e. g.*, the crotchet—were formerly used to extract the head, being fastened to the skull inside the perforation. They are often ineffective, and should be used only when no better instrument is at hand. They may easily slip and injure the maternal tissues.

7. Version has been recommended by some authors as a means of delivery and condemned by others. It need not be employed when instrumental extraction is possible. It should never be employed when the condition of the uterus is such that its walls may be ruptured or damaged by the manipulation. There is much risk that spicules of bone may cut the uterus.

Donald, of Manchester, has recommended version previous to craniotomy, in order that perforation of the skull may be carried out through the roof of the mouth, thus insuring that the base may be thoroughly broken. After the escape of the brain matter the base usually bends somewhat on itself. If the head requires further comminution, he uses a cephalotribe. Extraction may be carried out by this instrument or by traction on the body and lower part of the fetus, accompanied by suprapubic pressure. Donald's procedure should not be attempted in neglected cases or in any condition in which considerable risk is introduced by performing version. It might be particularly valuable in cases of rigid cervix, where complete dilatation of the canal cannot be obtained.

**Corporeal Embryotomy.**—This term refers to the reduction of the body of the child by mutilation in order to remove it from the uterus. In ordinary parlance the term embryotomy is limited to these cases. It is best, however, to use this word in its widest generic sense, and to consider it in the two divisions—cephalic embryotomy (craniotomy) and corporeal embryotomy.

These procedures are carried out in transverse cases where turning is impracticable—*e. g.*, when the uterus is firmly retracted on the fetus; when the retraction ridge is elevated, indicating stretching of the lower uterine segment; and when the shoulder is impacted in the pelvic inlet. In cases of pelvic contraction where craniotomy is necessary the body may also require to be broken up. Pathologic enlargements of the thorax or abdomen may also require mutilation. The operation may also be necessary in the case of monstrosities. Various methods have been practised, some of which have for their end the removal of the contents of the body; others the breaking of the bony skeleton.

The latter are the most efficacious. The choice of a procedure must often depend upon the position of the fetus.

**Decapitation.**—When the neck of the fetus is within easy reach, its division is advisable as a means of bringing about de-



FIG. 339.—Braun's hook.

livery. Decapitation may be performed in various ways. One of the most satisfactory is by means of a blunt hook, of which the angular pattern devised by Braun is the best (it is often termed a decollator). In using this instrument the first two



FIG. 340.—Decapitation with Braun's hook.

fingers and thumb of the left hand should be made to encircle the neck of the fetus, drawing it down as far as possible, the thumb being placed anteriorly. If an arm prolapses into the vagina, it may be encircled with tape and pulled down by an assistant. This helps to steady the neck and lower it somewhat. The hook should be passed up flat over the part of the neck situated anteriorly, and should be guided by the fingers into position. When the angled hook fits the neck, the handle should be pulled downward and rotated from side to side several times. In this manner the spinal column is divided. Round hooks are also used in a similar way. Hooks with sharp or saw-toothed inner edges are also employed, but they have no advantages over the Braun hook and are more apt to injure the maternal tissues. A chain écraseur or simple cord may be used to divide the neck, but it is difficult to place these in the proper position. Various

instruments have been devised for the purpose of carrying the cord around the neck. While the latter is being divided, the maternal tissues must be protected from the movement of the cord, by the

introduction of retractors which hold the vagina open, or of a tubular speculum through which the cord passes. Occasionally, when the neck is within easy reach, it may be possible to divide it with blunt-pointed scissors, the ends being guided by fingers of the left hand. After decapitation the trunk may be pulled down by the arm if it be prolapsed. It may be necessary to pierce the upper part of the chest with a cranioclast or basilyst tractor, in order to obtain a grasp by which the body may be pulled down.

The head should next be delivered. This may sometimes be managed by suprapubic pressure and traction on the lower jaw. Ordinarily it is advisable to reduce the size of the head and to deliver it with a cranioclast or some other form of extractor.

**Division of the Spinal Column.**—When the back of the fetus presents, it is advisable to divide the spinal column. This may be carried out in various ways. Various forms of scissors have been devised, to which the names of spondylotome, embryotome, etc., have been applied. Any long, strong pair of surgical scissors or bone forceps suffices for the purpose. When the division is made, the fetus is pushed against the brim by an assistant, whose hand is on the abdomen. After the column is cut and the body opened the lower section is pulled downward with a cranioclast or strong pair of forceps, while the rest of the body-wall is divided transversely as far around as possible. The lower half is then delivered, and the cranioclast is applied to the body wall of the upper half, in order to deliver it. If an arm is in the way, it should be amputated.

**Evisceration or Exenteration.**—In cases of labor delayed by large size of the abdomen or thorax of the fetus, caused by pathologic conditions, it may be necessary to open these cavities and remove the viscera before the fetus can be extracted. This procedure may also be carried out to a certain extent when the body is reduced in size by division of the spinal column. In transverse cases evisceration alone is of little value in effecting delivery. The trouble is caused by the head and vertebral column, and it is necessary to attend to these and not to the soft parts. In the rare condition of presentation of the anterior surface of the body in an impacted transverse case it may be necessary to remove the viscera and part of the chest-wall before the neck or spinal column can be reached. In some cases, by performing cleidotomy (division of the clavicle), it may be possible to deliver the fetus without interfering with the body.

**Cleidotomy.**—Within recent years the operation of cleidotomy, or division of the clavicle, has been recommended in various forms of delayed labor by several writers. It was first advocated by H. R. Spencer, of England, in 1895, who employed it in certain cases of impaction of the trunk of the fetus. Cases have since

been reported by Phänomenoff, Knorr, Strassmann, Ballantyne, and others.

**Indications.**—These cannot as yet be well defined. Ballantyne, describing the operation in 1901, says that it has hitherto been carried out only on the dead fetus, but that there is no good reason why it might not be performed on the living fetus in some circumstances. The great indication is disproportion between the size of the shoulders and the genital canal. Ballantyne describes various conditions, as follows:

1. Broad-shouldered fetus.

(a) Normal-sized head.

(b) Large head.

(c) Anencephalic head.

In the first and third of these cleidotomy may alone be sufficient; in the second it is accessory to a destructive operation on the head.

2. Contracted pelvis.

(a) Justominor.

(b) Flat.

(c) Kyphotic.

In the first and second cleidotomy is needed at the brim; in the third at the outlet. In all three it will doubtless be preceded by reduction of the size of the head.

3. Broad-shouldered fetus in contracted pelvis, neither being excessive.

4. Impacted shoulders in breech cases.

5. Danger from eclampsia, threatened uterine rupture, etc., necessitating rapid delivery.

**Operation.**—The clavicle is best divided with a pair of long, straight scissors. The index and middle fingers of the left hand are passed along the anterior surface of the fetus, whose head or neck has been born, until the ridge of the clavicle is felt. The right hand holds the scissors and directs it upward until it touches the middle of the clavicle or a point nearer the sternal end. The bone and the skin over it are then divided. If necessary, the other clavicle is cut in the same manner. This procedure results in a reduction of the bisacromial circumference, the cut ends of the bones overriding. Ballantyne found that the circumference of a dead infant which measured 27 cm. was reduced to 23 cm. with one clavicle divided, and 22 cm. with both divided. This author points out that there is little danger of injuring the maternal tissues or the subclavian vessels of the fetus if care be exercised.

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