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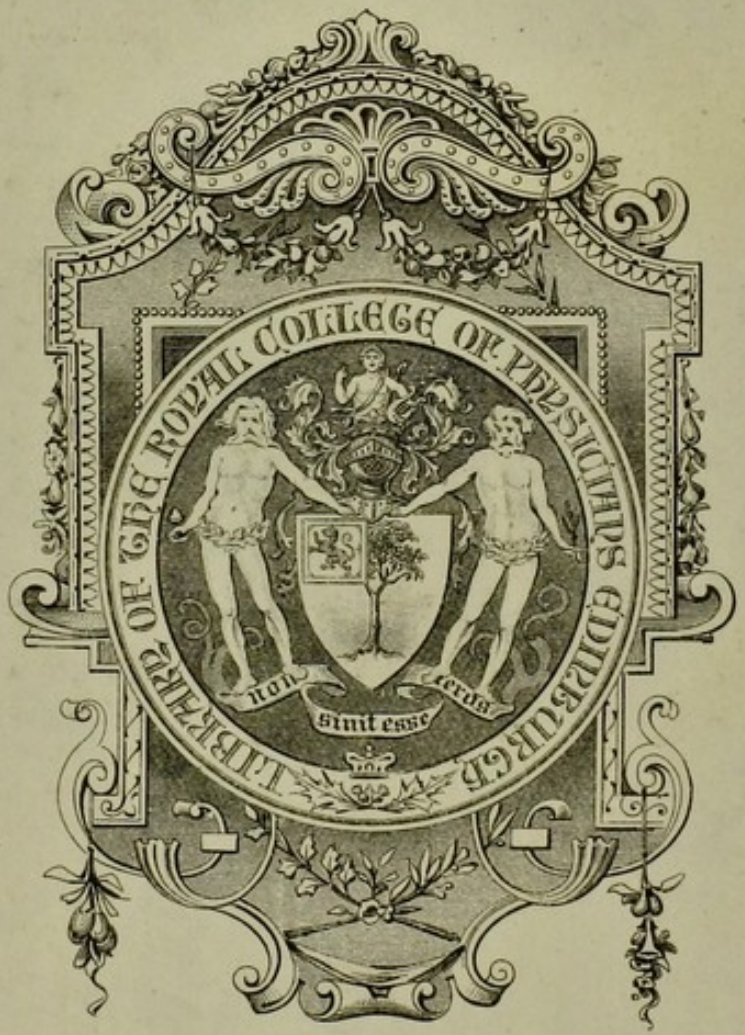

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A TEXT-BOOK

OF

MIDWIFERY

FOR STUDENTS AND PRACTITIONERS

BY

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JOHN HALLIDAY CROOM, KT.

M.D., F.R.C.P., F.R.C.S., F.R.S.E.

PROFESSOR OF MIDWIFERY IN THE UNIVERSITY OF EDINBURGH

TO THE INSPIRATION OF WHOSE TEACHING

IT OWES WHATEVER GOOD MAY BE FOUND IN IT

THIS BOOK IS GRATEFULLY ASCRIBED

PREFACE

This volume is the outcome of an attempt to place before the student and practitioner a concise and practical presentment of Midwifery. The chapters on the early development of the ovum and placenta have already appeared separately in very much their present form. The favourable reception accorded to them has seemed to justify the hope with which they were written, namely, that the complicated subject of human embryology, so far as its study is necessary to the obstetrician, may be made more simple by stating what is believed to occur in the development of the human ovum without reference to the ascertained facts of comparative embryology, upon which to a great extent that belief is based.

It is a pleasure to express my gratitude to Professor Sir Halliday Croom for his constant encouragement throughout the whole preparation of the work, and for his permission to illustrate the text by drawings of several specimens in the Obstetrical Museum of the University.

I sincerely thank my friend Dr. Clayton Grosvenor for his kindness in reading the manuscript, and for many valued criticisms and suggestions.

I am greatly indebted to several authors for permission to copy certain of their illustrations—in particular to Professor Whitridge Williams for Figs. 3, 96-7, 102-4, 109, 179 and 205 from his *Obstetrics*, published by Messrs. Appleton & Co., New York and London; Dr. Barbour for Figs. 90 and 92 from his *Atlas of the Anatomy of Labour*; Professor Munro Kerr

for Figs. 154 and 221-4 from his *Operative Midwifery* (Messrs. Bailliere, Tindall & Cox); Professor Bumm for Figs. 11, 25-7, 93 and 141 from his *Grundriss zum Studium der Geburtshülfe* (Bergmann, Wiesbaden); Professor Clarence Webster for Fig. 142 from his *Textbook of Obstetrics* (W. B. Saunders Co.); Dr. A. E. Giles for Figs. 169-172; Professor Jellett for Figs. 213-216 from his *Manual of Midwifery* (Messrs. Bailliere, Tindall & Cox); Professor Bryce for Figs. 34 and 41 from his volume in Quain's *Anatomy* (Messrs. Longmans & Co.); and Mr. Wade and Professor Watson for Figs. 166-7.

For his skill and patience in drawing all the other illustrations I am glad to take this opportunity of thanking Mr. John Grieve.

R. W. JOHNSTONE.

10 Alva Street,
Edinburgh, *March* 1913.

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SECTION I

ANATOMY AND PHYSIOLOGY

CHAPTER I

THE PELVIS

A KNOWLEDGE of the anatomy of the pelvis is one of the most essential foundations of a sound understanding of Obstetrics. For a detailed description the student is referred to his text-books of anatomy, and all that can be done here is to consider the pelvis from the standpoint of the obstetrician, and point out the features of special importance in that connection.

We must consider first the pelvis stripped of its muscular coverings, consisting of the constituent bones and ligaments only. This is known as the *static* pelvis. Secondly, we must consider the pelvis as it is during life, with its upholstery of soft parts in position—the so-called *dynamic* pelvis.

STATIC PELVIS

The importance of the pelvis to the obstetrician is (1) that it is the bony basin which contains and protects the internal organs of generation, and (2) that it is the bony ring through which the fœtus has to pass during parturition. It is formed by the union of four composite bones—the two innominate bones laterally, and the sacrum and coccyx behind. The union is completed by strong ligaments at the joinings of the bones.

Joints.—These are four in number:

Right sacro-iliac synchondrosis.
Left sacro-iliac synchondrosis.
Symphysis pubis.
Sacro-coccygeal joint.

Sacro-iliac Synchondroses.—On either side the iliac and sacral bones are applied to each other by their large auricular surfaces. The surface of each bone is covered by a flat plate of fibro-cartilage, and these are more or less adherent except at the lower end of the joint, where there is a small but (during pregnancy) definite cavity containing a little synovial fluid. The joint is completed by strong ligaments in front and behind, which really give it all its strength.

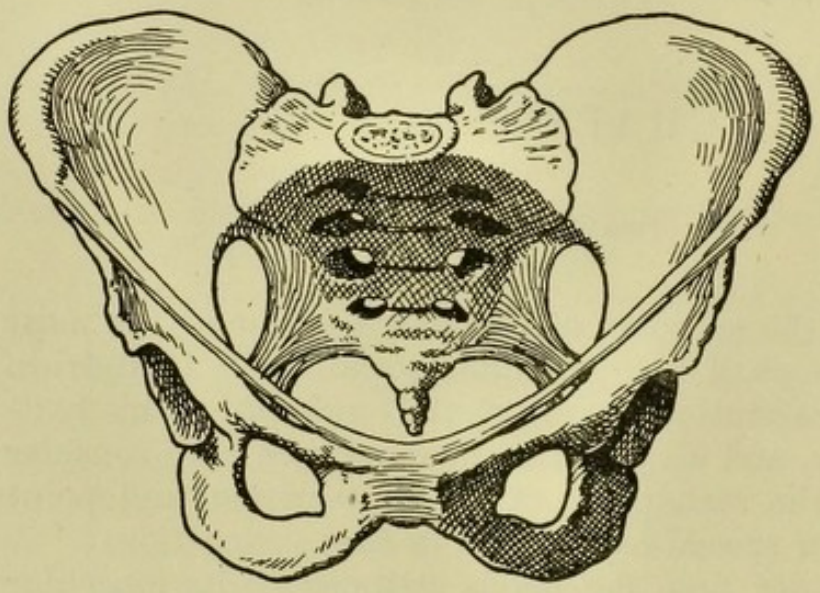


FIG. 1.—Normal female pelvis with ligaments.

During pregnancy, probably as a result of increased vascularity, the ligaments of the pelvis all become softened, so that they admit of some stretching. The fibro-cartilages share in this, and the cavities of the joints become enlarged and the fluid increased. All this is calculated to increase the range of movement, and so it is found that although there is practically no movement at the sacro-iliac synchondroses in the non-pregnant woman, there is a small but perfectly definite range of movement during pregnancy. It is of importance to remember that the joint portion of the synchondrosis is near the lower end, opposite the second body of the sacrum, and not at the level of the promontory. Thus the movement permitted is one of nutation (nodding) of the promontory either towards or away from the symphysis, with a corresponding movement in the opposite direction of the coccyx. These facts are of the greatest

practical importance in cases of contracted pelvis, and explain the rationale of what is known as Walcher's position.

Symphysis Pubis.—The ends of the pubic bones are covered by flat plates of fibro-cartilage, which are separated by a small space containing fluid. Strong ligaments above, below, in front, and behind keep the bones in position. The space between the cartilages is in many cases only found during pregnancy. Normally the movement at this joint is very slight, but in some cases the ligaments may become so softened in pregnancy as to allow considerable movement, and cause difficulty and pain on walking.

Sacro-coccygeal Joint.—This is normally an amphiarthrodial joint bound round by ligaments, which soften during pregnancy and so allow of the movement of the coccyx backwards during labour.

Other **ligaments** taking part in the formation of the pelvis are the great and small sacro-sciatic ligaments, the obturator membrane, and Poupart's ligaments.

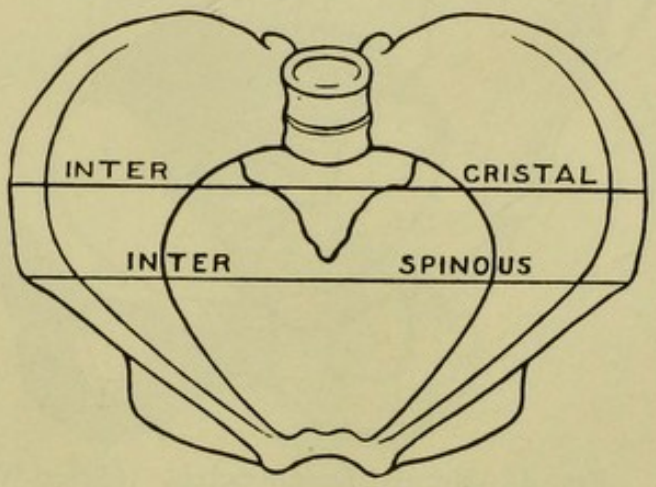


FIG. 2.—Transverse diameters of false pelvis.

Obstetricians divide the pelvis into two portions—the upper part or *false pelvis*, and the lower part or *true pelvis*. The two are separated by the *linea terminalis*, which passes from the summit of the symphysis pubis along the ilio-pectineal lines, and is continued along the upper margin of the alæ and the anterior margin of the promontory of the sacrum.

The **False Pelvis** is thus enclosed by the wings of the iliac bones. It is of little moment in obstetrics, but when covered by the iliacus muscles it forms a cushion for the gravid uterus to rest upon, and also acts as a funnel to direct the head of the foetus into the brim of the true pelvis. It is of interest also in so far as its measurements bear a more or less constant relationship to those of the true pelvis. Of these measurements two are of importance.

(1) The *interspinous diameter* is the distance from one

anterior superior spine of the ilium to the other, and measures 9½-10 inches (23·75-25 cm.).

(2) The *intercristal diameter* is the distance between the widest apart points on the iliac crests, and measures 10½-11 inches (26·25-27·5 cm.).

The inch of difference between these two measurements is the most important point, as it indicates a normal curvature of the iliac crests, a feature which is absent in the most common forms of contracted pelvis. The intercristal diameter is also approximately double the transverse diameter of the brim of the true pelvis.

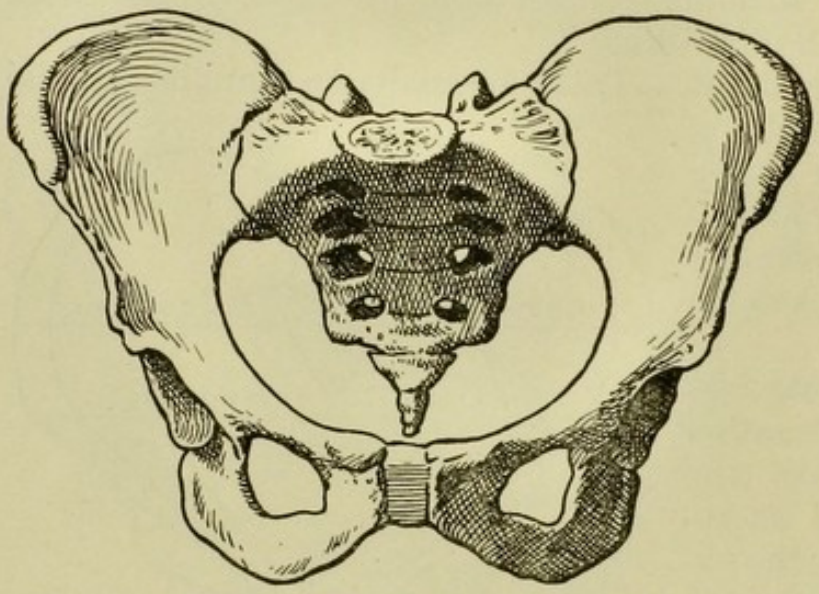


FIG. 3.—Normal female pelvis. (After Whitridge Williams.)

The *intertrochanteric diameter* is the distance from one great trochanter of the femur to the other, and measures about 12 inches (30 cm.).

All these diameters may be measured clinically by means of a pelvimeter or large pair of callipers.

The **True Pelvis** is the all-important part in obstetrics. For convenience in description it is usually divided into three parts—the brim, inlet, or superior strait; the cavity; and the outlet or inferior strait.

The *brim* of the pelvis is bounded by the linea terminalis. It is somewhat heart-shaped owing to the projection forwards of the promontory of the sacrum. The imaginary flat surface bounded by the linea terminalis on either side is known as the plane of the brim. Strictly speaking, it is not a perfectly flat surface, but the conventional use of the term "plane" is helpful in the description of parturition.

The *cavity* is bounded above by the plane of the brim, and below by the planes of the outlet. In front it is bounded by

the pubic bones, the front wall being thus about 1½-2 inches deep (3·75-5 cm.). The lateral walls are formed by the ischia anteriorly, and the sacro-sciatic ligaments posteriorly, and are midway between the front and back walls as regards depth. The back wall is formed by the sacrum and coccyx, is curved and long, measuring about 4½-5 inches (11·25-12·5 cm.). In shape the cavity is roughly circular, and with the woman in the upright position it is at no horizontal level bounded entirely by bone. Owing to the curve of the sacrum the direction of the cavity alters as it passes down. The upper portion is directed downwards and backwards, and is straight as far as the junction of the second and third bodies of the sacrum. There it begins to curve forwards, and at the actual outlet is directed downwards and forwards.

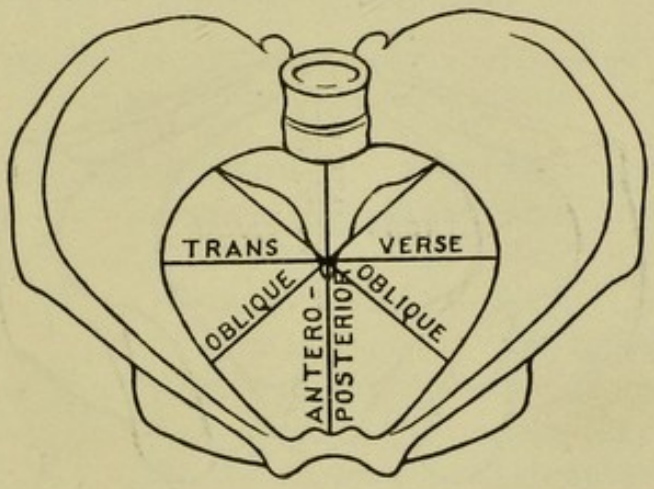


FIG. 4.—Diameters of the brim or inlet.

The *outlet* of the pelvis is lozenge-shaped. It is bounded posteriorly by the coccyx and the sacro-sciatic ligaments, and anteriorly by the lower edge of the symphysis and the rami of the pubes. Laterally it is bounded by the tuberosities of the ischia. It may be regarded as consisting of two triangular plane surfaces meeting at an angle along a line joining the two ischial tuberosities.

DIAMETERS OF THE TRUE PELVIS

Brim.—(1) The *antero-posterior* diameter is measured from the centre of the promontory of the sacrum to the top of the symphysis pubis. Owing to the rather elliptical shape of the brim and the fact that the shortest diameter of an ellipse is called the conjugate, this measurement is often spoken of as the *conjugate diameter*. Strictly speaking, there are two conjugates to be described, according as the measurement is taken to the summit of the symphysis or to the upper margin of the posterior surface. Owing to the bevelled shape of the

top of the symphysis there may be almost a quarter of an inch (0·6 cm.) difference between the two, and obviously this space is not available for the passage downwards of the head. The measurement to the very summit is therefore called the *anatomical conjugate* or *conjugata vera*; while the diameter measured to the upper edge of the posterior surface is known as the *obstetrical* or the "*available*" *conjugate*. The former measures $4\frac{1}{4}$ inches (10·6 cm.), the latter about 4 inches (10 cm.).

The *right oblique diameter* is measured from the right sacro-iliac synchondrosis to the left ilio-pectineal eminence. It measures $4\frac{1}{2}$ inches (11·25 cm.).

The *left oblique diameter* is measured from the left sacro-iliac synchondrosis to the right ilio-pectineal eminence. It measures $4\frac{1}{2}$ inches (11·25 cm.). In this country, in America, and in Germany these diameters are named from the synchondrosis *from* which they are measured. In France, on the contrary, they are named according to the ilio-pectineal eminence *to* which they are measured. In most cases the right oblique is a trifle longer than the left.

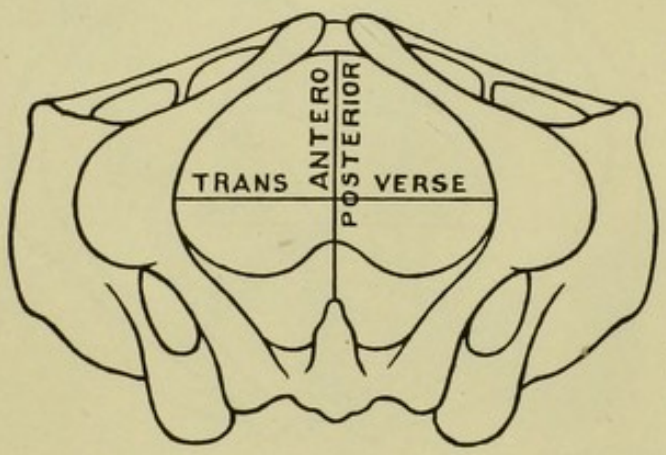


FIG. 5.—Diameters of the outlet.

The *transverse diameter* is the greatest distance between the two ilio-pectineal lines. It measures 5 inches (12·5 cm.).

Cavity.—In the cavity at the level of the third body of the sacrum, and the middle of the posterior surface of the symphysis, all the diameters—*antero-posterior*, *oblique*, and *transverse* measure about $4\frac{1}{2}$ inches (11·25 cm.).

Outlet.—The *antero-posterior diameter* is measured from the tip of the coccyx to the centre of the under margin of the pubic symphysis. With the coccyx pointing forward it measures about 4 (10 cm.) inches, but with the coccyx turned backwards as in labour it measures 5 inches (12·5 cm.).

The *transverse diameter* is measured between the inner surfaces of the ischial tuberosities and is 4 inches (10 cm.).

Two *oblique diameters* are sometimes described, measuring $4\frac{1}{2}$ inches (11·25 cm.), but as one of the terminals on each side is the sacro-sciatic ligament, which is not rigid, the figure is not a constant one.

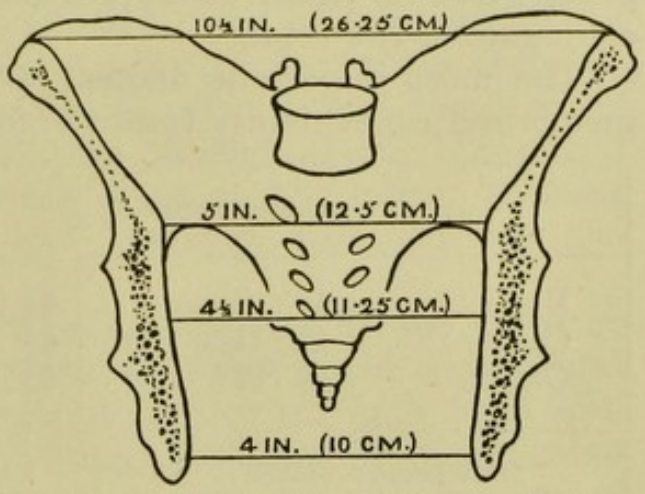


FIG. 6.—Coronal section of the pelvis, showing the various transverse diameters.

These diameters cannot be measured in the living woman without considerable difficulty, and the employment of internal pelvimeters. In most cases we have to rest content with an indirect measurement of the conjugate of the brim, which gives an approximately accurate result. For this purpose we measure two other diameters, as follows :—

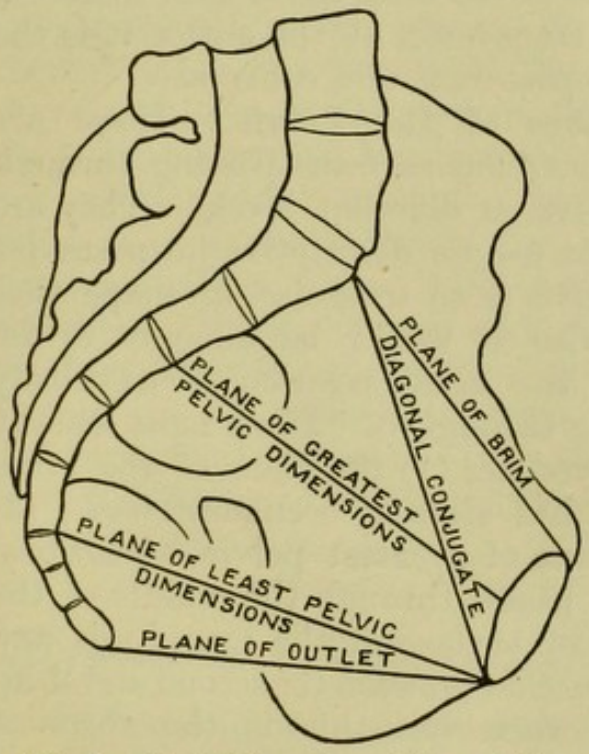


FIG. 7.—Sagittal section of the pelvis, showing the more important planes.

The *diagonal conjugate diameter* is the distance from the centre of the promontory of the sacrum to the centre of the under margin of the symphysis. It usually measures about $4\frac{3}{4}$ inches (11·9 cm.), varying a little with the depth and the inclination of the symphysis. Subtraction of from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch (1·2-1·9 cm.) from this measurement gives us the approximate size of the conjugate of the brim.

The *external conjugate* or *Baudelocque's diameter* is the distance between the tip of the spine of the last lumbar vertebra and the front of the symphysis pubis. In a well-formed pelvis this should not be less than $7\frac{1}{2}$ inches (18·75 cm.), so that the subtraction of

$3\frac{1}{2}$ inches (8·75 cm.) for the thickness of the bones and soft parts gives us again an approximation to the length of the conjugate of the brim.

The most important diameters of the true pelvis may be memorised conveniently from the following table :—

	Antero-posterior.	Oblique.	Transverse.
Brim	4* (10 cm.)	$4\frac{1}{2}$ (11·25 cm.)	5 (12·5 cm.)
Cavity	$4\frac{1}{2}$ (11·25 cm.)	$4\frac{1}{2}$ (11·25 cm.)	$4\frac{1}{2}$ (11·25 cm.)
Outlet	5§ (12·5 cm.)	$4\frac{1}{2}$ (11·25 cm.)	4 (10 cm.)

* Obstetrical conjugate. § Coccyx turned back as in labour.

This table shows at once two important facts: (1) that the pelvis diminishes in transverse measurement as we pass down; and (2) that whereas at the brim the longest diameter is the transverse, at the outlet it is the antero-posterior, and conversely.

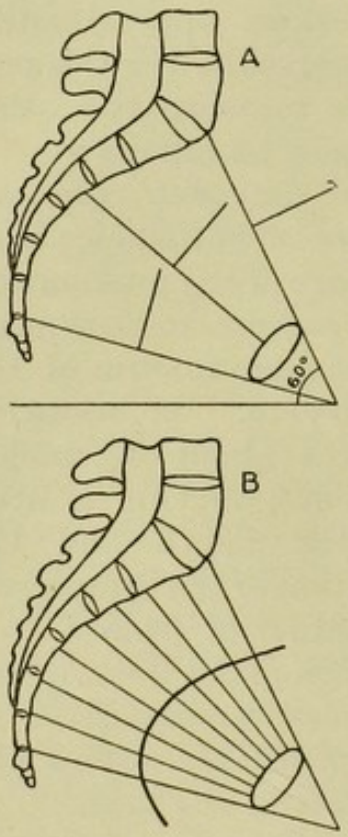


FIG. 8.—A. Showing the inclination of the pelvis and the axis of the pelvis at its main planes. B. Showing the axis of the pelvis as a whole, or "Curve of Carus."

Planes of the Pelvis.—These are imaginary flat surfaces passing through the pelvis at different levels. They are of great use for descriptive purposes, for the pelvis is so irregular in shape that otherwise it would be difficult to describe the exact position of any body passing through it. Those most usually employed are (1) the plane of the brim, which has already been described; (2) the plane of greatest pelvic dimensions, which passes through the middle of the posterior surface of the symphysis and the junction between the second and third sacral vertebræ—this is the roomiest part of the cavity; (3) the plane of least pelvic dimensions, which passes through the lower margin of the symphysis, the tip of the sacrum, and the ischial spines.

Axis of the Pelvis.—This is theoretically the path traversed by the

centre of the fœtal head during birth. At any of the above levels it is represented roughly by a perpendicular passing through the centre of that plane, and the axis of the pelvic canal as a whole is a curved line formed by the combination of a number of such axes. The axis of the plane of the brim would, if produced, pass through the umbilicus and the tip of the sacrum, while that of the plane of least dimensions would, if produced upwards, pass through the promontory of the sacrum.

Inclination of the Pelvis.—If the plane of the brim be produced to meet the floor when the woman is in the upright position, it does so at an angle of 60 degrees or a little less. This can be estimated by holding the dried pelvis in what corresponds to the upright position, namely, with the top of the symphysis and the anterior superior spines in one vertical line, as for example against the wall. In this position the tip of the sacrum is at a slightly higher level than the lower edge of the symphysis, therefore the plane of the outlet also meets the horizontal at an angle—in this case one of about 10 degrees. The promontory of the sacrum is about four inches above the level of the top of the symphysis. These angles are of no obstetrical significance except when they show some marked departure from the normal. Of greater practical value is the angle which the symphysis makes with the conjugate of the brim. This is usually about 95 degrees, but varies with the inclination and shape of the pubic bones, and the important fact to remember is, that with it varies the amount to be subtracted from the diagonal conjugate in making an estimate of the true conjugate (Fig. 7).

Sex Differences in the Pelvis.—These may be conveniently put in tabular form :—

Characteristics of the Female Pelvis as compared with the Male.

1. Bones lighter and smoother, and muscular attachments less marked.
2. Iliac crests farther apart. Iliac fossæ more hollowed.
3. Sacrum broader.
4. Promontory less pronounced.
5. Symphysis less deep.
6. Brim more oval, less heart-shaped.

7. Brim more capacious.
8. Cavity shallower: less funnel-shaped.
9. Outlet wider: ischial tuberosities farther apart.
10. Pubic arch wider, 90° to 100°—in male about 75°.
11. Coccyx more movable.
12. Acetabula farther apart.

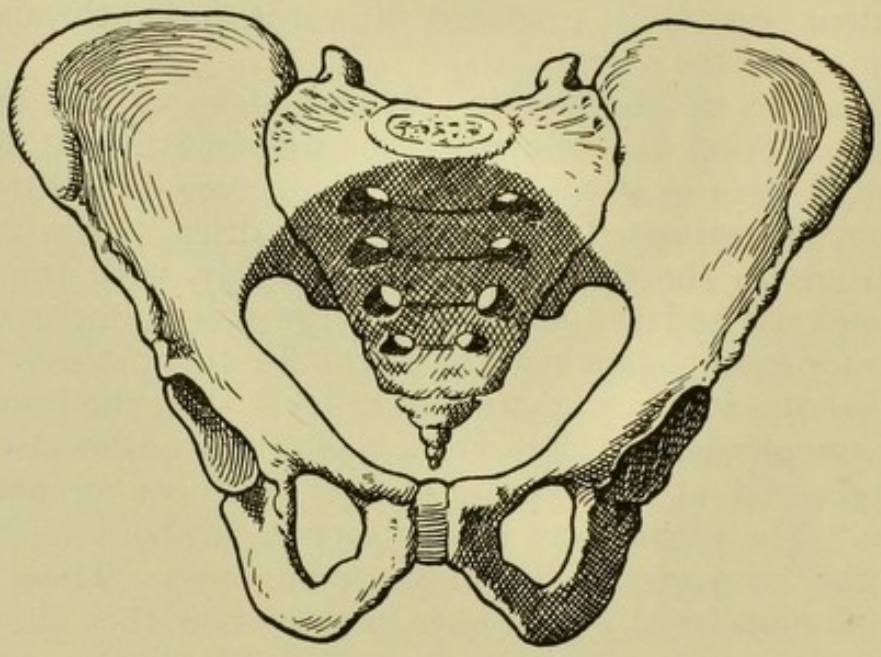


FIG. 9.—Normal male pelvis.

Development of the Adult Shape of the Pelvis

The fœtal pelvis is more funnel-shaped than the adult pelvis. The angle between the sacrum and the lumbar spine is hardly visible, and the sacrum is almost straight from above downwards. It is more curved laterally, but the wings are less developed, and thus the pelvis is narrower in its transverse measurements. It has been demonstrated that sexual differences make their appearance as early as the fifth month of intra-uterine life. These characteristics are therefore due to some intrinsic sexual influence. After birth, on the other hand, mechanical influences come into play which alter the shape of the pelvis as the child grows up. These, it must be remembered, affect both male and female pelves alike, but in the latter the unexplained sexual differences superimpose their effects gradually from the time of intra-uterine life right up to

the period of nubility, or full sexual maturity. It is important to study the mechanical influences now, because they are the factors which bring about the commoner deformities of the pelvis; and if their normal effects are understood, it is easy to follow their effects in abnormal conditions.

The main influence is the body weight, which, as soon as the child begins to assume the upright position, acts as a force passing downwards through the centre of gravity just in front of the sacrum. This tends to cause a rotation of the sacrum at the sacro-iliac synchondroses, the promontory being thrown forward and downward, and the tip backward and upward, while the whole bone sinks somewhat between the two innominate bones. This at once produces a marked increase in the sacro-vertebral angle. The tilting back of the tip is resisted by the strong sacro-sciatic ligaments, and the result is an increased curvature of the sacrum from above downwards. The sinking down of the sacrum causes a flattening of that bone from side to side to some extent, and, along with the rotation forward of the promontory, throws a strain upon the ligaments which bind the sacrum to the posterior extremities of the iliac crests. This results in an approximation of the posterior ends of the iliac bones, and a consequent throwing outwards of the anterior portions and crests, the sacrum acting as a fulcrum on either side, and the innominate bone as a lever. But this outward tendency of the anterior portions of the innominate bones is resisted by the powerful ligaments at the symphysis, and by the pressure of the heads of the femora. Hence we find an increased curvature of the sides of the pelvis, particularly just in front of the sacro-iliac joints. This curvature, combined with the growth of the alæ of the sacrum, causes a relative increase in the width of the adult pelvis.

Dynamic Pelvis

The soft tissues of the pelvis encroach to a decided extent upon the space in the true pelvis. At the brim the psoas and iliacus muscles pass over the sides of the pelvis, and encroach upon the transverse diameter. So much is this the case that the largest transverse space available for the passage of the head lies about one inch in front of what is the anatomical transverse in the static pelvis. This is sometimes spoken of as

the *obstetrical transverse* diameter, and it measures only about $4\frac{1}{2}$ inches (11·25 cm.) as against the 5 inches (12·5 cm.) of the other.

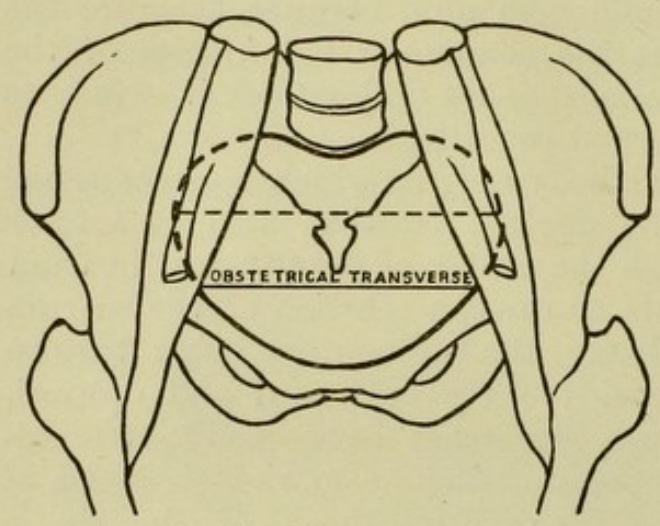


FIG. 10.—Dynamic pelvis.

In the cavity the space is encroached on laterally by the pyriformis and the obturator internus muscles on either side. The thickness of the uterine walls and the presence of the rectum must also be taken into account as diminishing the available space during labour.

The outlet of the pelvis is occupied by the pelvic floor, which requires special consideration in view of its importance.

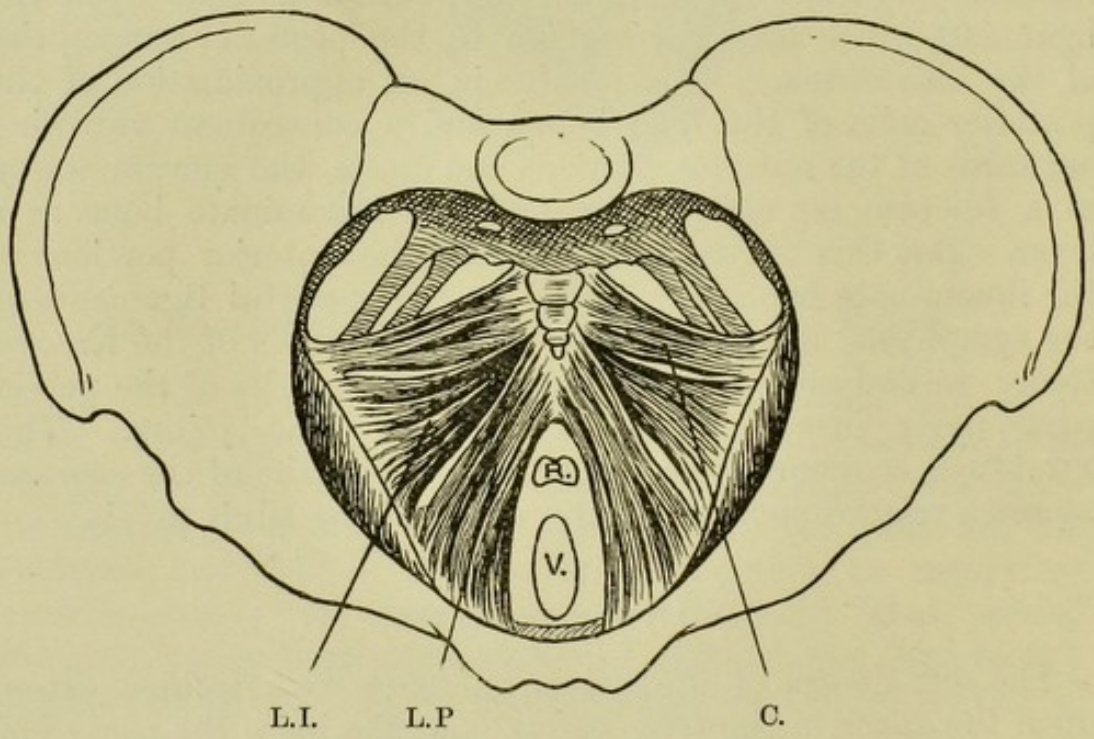


FIG. 11.—Muscles of pelvic floor from above. (After Bumm.)

L.I. Levator ani—ischial portion. L.P. Levator ani—pubic portion. C. Coccygeus.

Pelvic Floor.—This is made up of a number of layers of tissue, which may be enumerated from within outwards as—

1. Peritoneum.
2. Subperitoneal connective tissue.
3. Recto-vesical layer of pelvic fascia.
4. Levator ani and coccygeus muscles.
5. Superficial layer of pelvic fascia.
6. Triangular ligament—two layers.
7. Deep layer of perineal fascia.
8. Transversus perinei and other superficial perineal muscles.
9. Superficial layer of perineal fascia.
10. Superficial fascia.
11. Skin.

Of these by far the most important items are the levator ani muscles, which are the really effective part of the floor in its action during labour. As they pass from the pubes back to their insertion into the coccyx, the two muscles have the shape of a horse-shoe open in front. They embrace the rectum and vagina, and act as a sling to hold them in position in the pelvic canal. On either side the levator ani arises from the back of the symphysis and horizontal ramus of the pubes, the white line of the pelvic fascia, and the inner surface of the ischial spine. As the muscles sweep horizontally backwards they embrace the sides of the vagina, and some fibres pass round the posterior vaginal wall and unite in the recto-vaginal

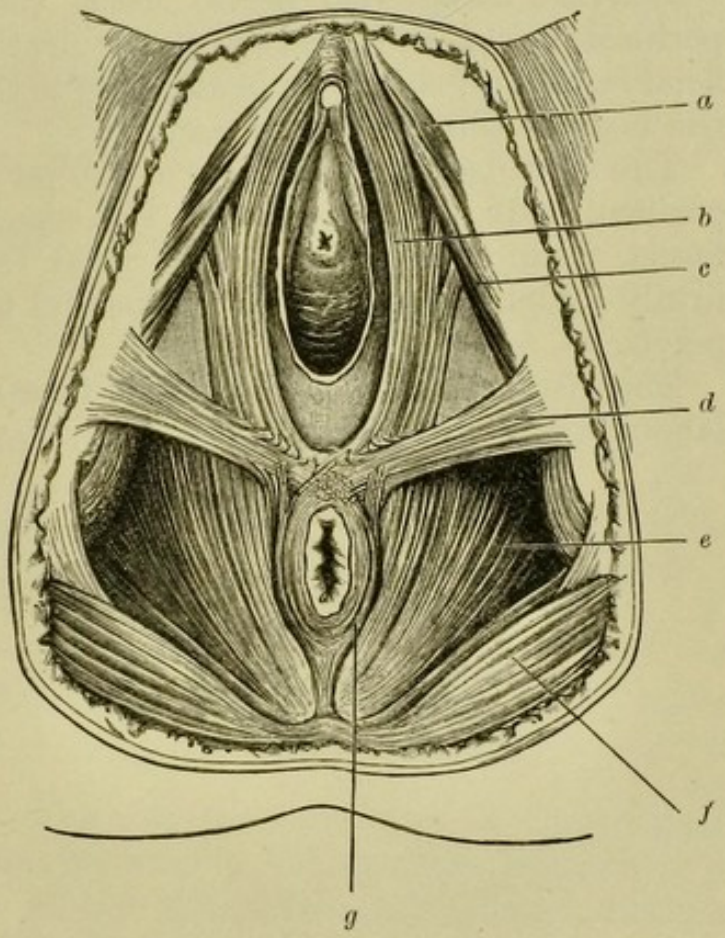


FIG. 12.—Muscles of the female pelvic floor (Thompson).

a. Ischio-cavernosus. *b*. Sphincter vaginæ. *c*. Ischio-cavernosus. *d*. Transversus perinei. *e*. Levator ani. *f*. Gluteus maximus. *g*. Sphincter ani externus.

septum. The rest of the muscles pass round the sides of the rectum and unite in the fibro-tendinous raphé between the anus and coccyx, while the most posterior fibres are attached to the sides of the coccyx. The coccygeus muscles support the levatores, and fill up the most posterior portion of the floor.

From the point of view of its action in labour, Hart has shown the value of regarding the pelvic floor as composed of two segments, as seen in sagittal section. The anterior or pubic segment and the posterior or sacral segment are divided by the cleft of the vagina. The pubic segment consists of the anterior vaginal wall, the urethra, the bladder, the cellular tissue between vagina and bladder, and between bladder and symphysis, along with pelvic fascia, the triangular ligament, perineal fascia, and muscles of the urethra and clitoris, superficial fascia and skin. It is attached to the pubes, and above to the body of the uterus and cervix.

The sacral segment consists of the posterior vaginal wall, the perineal body, the levatores ani and coccygei, the rectum, pelvic fascia, perineal fascia and superficial fascia, and skin. It is firmly attached at the sides and behind to the bony wall of the pelvis.

The displacements of the pelvic floor during pregnancy and labour will be mentioned later.

CHAPTER II

EXTERNAL GENITALS—VAGINA

The external organs of generation are generally spoken of as the *vulva*, or the *pudendum*. They comprise all that can be seen on inspection after drawing the labia aside, and include the following, the table giving also their relative positions :—

Labium Majus.	Mons Veneris.	Labium Majus.
Labium Minus.	Anterior Commissure.	Labium Minus.
Vaginal Bulb.	Clitoris.	Vaginal Bulb.
Bartholinian Gland.	Vestibule.	Bartholinian Gland.
	Meatus Urinarius.	
	Vaginal Orifice.	
	Hymen.	
	Fossa Navicularis.	
	Fourchette.	
	Posterior Commissure.	
	Perineum.	

The **Mons Veneris**, which is the only part of the genital organs visible when the woman is in the upright posture, is a cushion of fat in front of the symphysis pubis, covered after puberty with more or less short curly hair.

Labia Majora.—The mons veneris is continued in a backward direction into the two outer lips of the vulva—the labia majora. Each lip has an outer and an inner surface. The outer is covered with the same short crisp hair that covers the mons. The inner surfaces, which are usually in apposition, are smoother and almost more like a mucous membrane than skin.

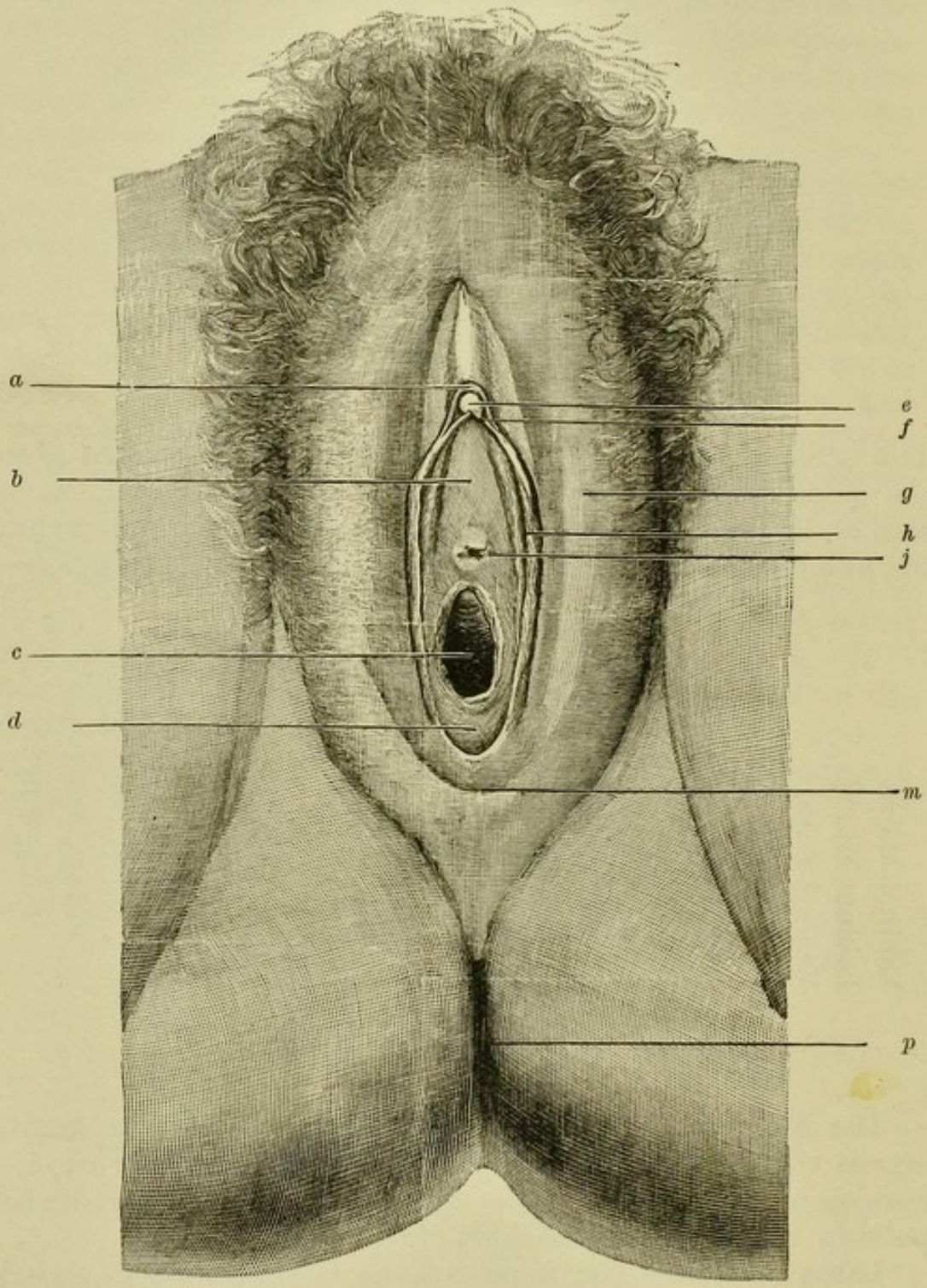


FIG. 13.—Female external genital organs (Dixon).

a. Prepuce of the clitoris. *b*. Vestibule—anterior part. *c*. Orifice of the vagina. *d*. Fossa navicularis. *e*. Glans clitoridis. *f*. Frenulum. *g*. Labium majus. *h*. Labium minus. *j*. Orifice of the urethra. *m*. Posterior commissure. *p*. Anus.

Posteriorly the fat disappears from the labia, and they are just two folds of skin that meet at the posterior commissure.

The labia majora are the analogues of the scrotum in the male, and present a somewhat similar structure. They have no dartos muscle under the skin, but it is represented by much elastic tissue and fat. They are copiously supplied with sebaceous glands, and each has a rich venous plexus—the vaginal bulb. The round ligaments of the uterus are inserted into the anterior portion of the labia.

Labia Minora.—Inside the labia majora, and only visible on drawing them apart in the case of most virgins, are two triangular folds of soft, smooth, moist skin. These are the labia minora or nymphæ. In front they meet as the prepuce of the clitoris, posteriorly they are joined by a fine fold called the *fourchette.* They have no hair, are well supplied with sebaceous and sweat glands, and, owing to an abundance of nerve endings, are extremely sensitive. When exposed to the air, as in many multiparous women, they become leathery and hard.

The **Vestibule** is the smooth, almond-shaped area bounded by the labia minora on the two sides. At its apex is the clitoris, and in the centre it is perforated by the urethra and the vagina. The *fossa navicularis* is the portion of vestibule behind the vaginal orifice and in front of the fourchette.

The **Clitoris** is the analogue of the penis in the male. It consists of a body with two crura, and a glans with a prepuce and frenulum.

The crura lie under the ascending rami of the pubes, and unite to form the body. The prepuce and frenulum are formed by the labia minora, and they are so shortened that the body is bent on itself until it looks downward to the vestibule. The small glans is rich in nerve endings, and is exquisitely sensitive. The whole organ is highly erectile, and is regarded as the seat of the voluptuous sensations experienced by the female during coitus.

The **Meatus Urinarius**, or mouth of the urethra, is situated in the middle line of the vestibule just in front of the orifice of the vagina and about four-fifths of an inch below the pubic arch and clitoris. Its lateral walls are in contact, so that it appears as a vertical or antero-posterior slit. The mucous membrane round it is usually rather puckered and slightly

raised above the surface. The puckering is due to the contraction of circular muscle fibres round it.

Just at the sides of the meatus are the openings of two small ducts, known as Skene's ducts or the para-urethral ducts. They are very small and of interest only because some observers regard them as the terminal remains of the Wolffian ducts.

Bartholin's Glands are two in number, and open by small ducts one on each side of the orifice of the vagina, just below

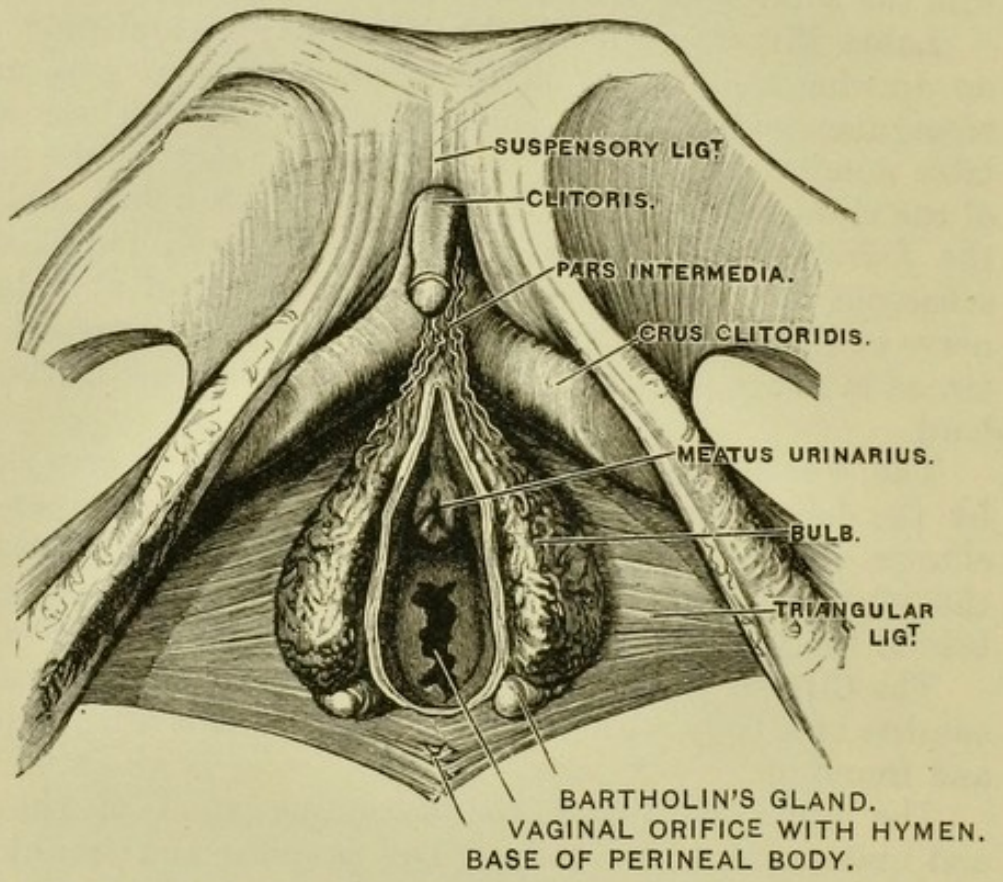


FIG. 14.—Dissection to show vaginal or vestibular bulbs (Cunningham).

and in front of the hymen. The glands are compound racemose, and lie under the constrictor vaginæ muscle. During sexual excitement they pour out a yellowish lubricant material. They are frequently infected in gonorrhœa.

The **Vaginal** or **Vestibular Bulbs** are two leech-shaped masses of veins situated under the mucous membrane at the sides of the vestibule, and immediately under the shelter of the rami of the pubes. Each is about one inch long. Anteriorly they unite in what is known as the "pars intermedia vestibuli" —a small venous plexus which connects them with the clitoris.

They are very erectile, and are the analogues of the corpus spongiosum of the penis. Their posterior ends, opposite the middle of the vaginal orifice, may be torn during labour, and give rise to serious hæmorrhage.

Vaginal Orifice.—This lies just behind the meatus urinarius. Behind and at the sides it is usually bounded by the hymen. In the virgin it is more or less closed by the hymen, and is completely hidden by the labia minora. In parous women the hymen is absent, and the orifice is frequently exposed by the gaping of the labia.

Hymen.—This is a crescentic or circular fold of connective tissue covered by mucous membrane like that of the vagina. It closes in the orifice of the vagina in the virgin, leaving an aperture varying in size, but usually large enough to admit one finger. The hymen varies very much in thickness and consistence. The most common shape is, as has been indicated, crescentic or circular (annular). Sometimes, however, it may be cribriform (a complete diaphragm with multiple small openings in it), or actually imperforate. In other cases it may take the form of a band (septate), or be fimbriated.

The hymen is usually ruptured at the first coitus, when there may or may not be hæmorrhage. At the first labour it is almost invariably completely torn up, and afterwards is represented merely by a number of little tags of skin—the so-called *carunculæ myrtiformes.* These are of medico-legal interest as almost certain signs of parity. The absence of a complete hymen is, of course, no proof of loss of virginity, nor the presence of it proof of chastity.

The Perineum and Perineal Body.—The perineum of the anatomists in the female is the skin between the anus and the posterior commissure of the vulva. This area of skin is really the base of the perineal body, which is the important structure in this region from the obstetrician's point of view. This body is a pyramidal mass of strong connective tissue and fat. It is about one and a half inches (3·75 cm.) broad, bounded in front by the lower part of the posterior wall of the vagina, and behind by the anterior wall of the rectum and anus. It forms the point of insertion of the small voluntary muscles of the region, and through it runs the strong fibrous raphé, into which the fibres of the levatores ani are inserted.

The Vagina

The vagina is the canal which unites the uterus and the vulva. It is faintly curved like an S, its lower and upper portions being directed more directly upwards, and the middle portion more backwards. It joins the uterus at an angle which is nearly a right angle (Fig. 17). The anterior and posterior walls are in contact so that on section it forms a transverse slit in the pelvic diaphragm. From below upward it is in relation anteriorly to the urethra and the base of the bladder; posteriorly to the perineal body, the rectum, and the pouch of Douglas. It is wider above than below, and is capable of great distension, as is seen during parturition or when it requires to be packed with gauze.

The anterior wall is from two to three inches (5-7·5 cm.) long, and meets the cervix at the junction of its lower and middle thirds. The posterior wall is from three to four inches (7-10 cm.) long, and meets the cervix at the junction of its middle and upper thirds.

The vault or roof of the vagina into which the uterus is thus thrust is divided for purposes of description into four fornices—anterior, posterior, and right and left lateral. Of these the posterior is the deepest, the anterior the shallowest, the lateral fornices becoming more shallow as they pass forwards.

At the vulvar end the vagina is partially closed in the virgin by the fold of the hymen.

Structure.—The vagina has four coats.

1. The cavity is lined by a mucous membrane covered by stratified epithelium. The superficial cells are flat, the deepest cuboidal. This mucous membrane is thrown into folds. Longitudinal columns run up both the anterior and posterior walls, and from these a large number of transverse or oblique ridges—the rugæ—pass out towards the sides. These ridges become obliterated by repeated child-bearing. There are no glands in the vagina. Very occasionally a few glands are found, but they are really cervical glands that have "wandered." The "secretion" is merely a transudation of lymph, with cast-off epithelial cells in it. It is strongly acid in reaction.

2. Below the epithelial layer is a submucous layer of connective tissue which passes up towards the surface in the form

of papillæ, just as in the subcuticular layer of the skin. This layer contains a free vascular supply.

3. Next comes the muscular layer, with its subdivision into an inner circular and an outer longitudinal layer. The muscle is, of course, of the unstriped variety, and is not very well developed.

4. The outermost coat is the connective tissue sheath, the striking feature of which is the very free blood-supply. It contains an enormous plexus of veins.

The vagina receives its blood from three sources. Above it is supplied by the *cervical branches of the uterine artery* which often unite to form an *azygos vaginæ artery.* The middle portion is supplied by the *vaginal* (*inferior vesical*) *artery*, and the lower third by the *middle hæmorrhoidal artery*, and some terminal branches of the *internal pudic.* The venous plexus drains into the internal iliac veins.

The *lymphatics* from the lower part of the vagina drain into the inguinal glands. From the upper parts they pass to the hypogastric and iliac glands.

CHAPTER III

THE UTERUS AND FALLOPIAN TUBES

THE uterus is a small, hollow, muscular organ placed between the bladder in front and the rectum behind. Its general

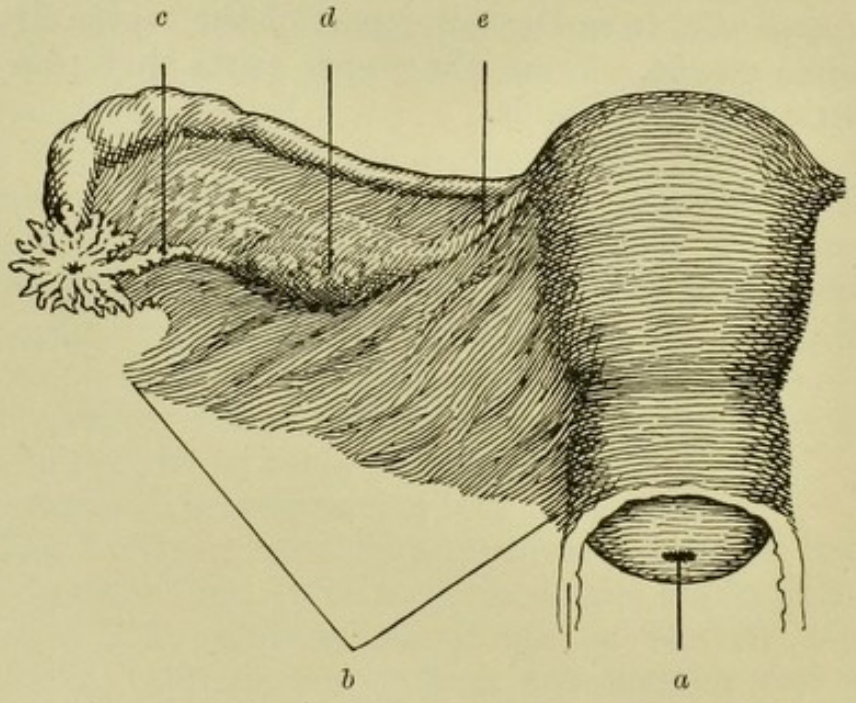


FIG. 15.—Uterus and left appendages viewed from behind.

a. Os externum. *b*. Base of broad ligament. *c*. Ovarian fimbria of tube. *d*. Ovary. *e*. Ovarian ligament.

shape is that of a pear slightly flattened, particularly on its anterior surface. It lies with its long axis directed forwards, and it is slightly bent forwards on itself—a position of combined *anteversion and anteflexion*. It is also somewhat rotated, so that its left edge is a little nearer the front of the pelvis

than the right edge. When the woman is standing upright the uterus lies almost horizontal, but its exact axis varies with the condition of fulness of the bladder.

A slight constriction indicates the division of the uterus into its two main parts—the *body*, or *corpus*, and the neck or *cervix*. The body is roughly similar to an isosceles triangle with the apex downwards. A Fallopian tube opens into each of the upper corners (cornua) and towards the apex it becomes continuous with the cervix. The cervix is cylindrical or barrel-shaped.

In addition to these main divisions, the uppermost part of the body, between the openings of the Fallopian tubes, is called the *fundus*. The area corresponding to the constriction between body and cervix is known as the *isthmus*, and it is important to remember that towards the end of pregnancy this area becomes altered, and is known as the *lower uterine segment*. At the upper end of the cavity of the cervix, just where it passes into the body, there is a slight constriction called the *os internum* (internal mouth). At the lower end of the cervix is a more marked constriction known as the *os externum*. The cervix is also divided into a vaginal portion and a supra-vaginal portion.

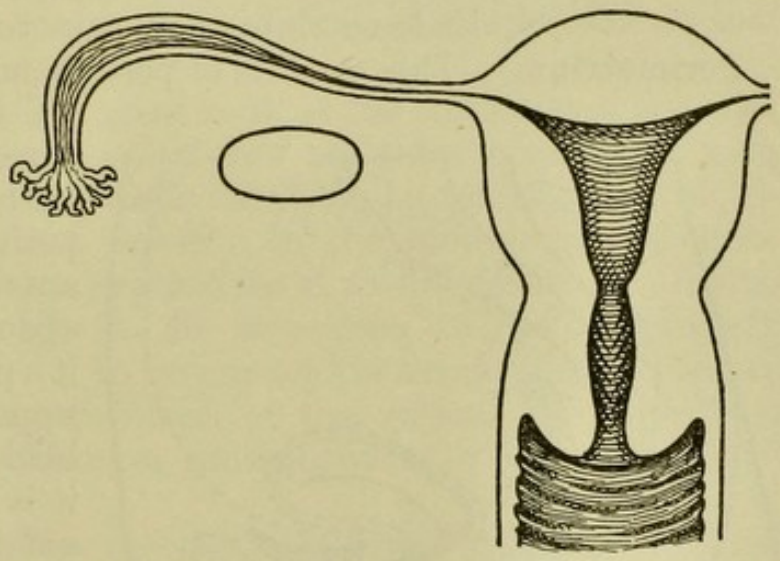


FIG. 16.—Diagram of coronal section of uterus and Fallopian tube.

The *cavity* of the uterus is a potential space only, the anterior and posterior walls being normally in contact. The cavity of the body is triangular in shape, 1 inch (2·5 cm.) wide at the fundus, and $1\frac{1}{2}$ inches (3·75 cm.) long. The cavity of the cervix is 1 inch (2·5 cm.) long, and is spindle-shaped. The whole length of the uterine cavity is thus $2\frac{1}{2}$ inches (6·25 cm.).

The external measurements of the uterus are—

Length—3 inches (7·5 cm.).

Breadth—2 inches (5 cm.) between the origins of the Fallopian tubes.

Thickness—1 inch (2·5 cm.) at level of the isthmus.

The virgin uterus weighs about $1\frac{1}{2}$ ounces (42 grms.). The measurements and weights of a uterus which has been pregnant are a little greater than those of the virgin uterus.

The *walls* of the uterus are about $\frac{1}{2}$ inch (1 cm.) thick, and consist of three coats—

1. Perimetrium or peritoneal coat.
2. Mesometrium or muscular coat.
3. Endometrium or mucous coat.

Perimetrium.—This consists of peritoneum, and is therefore an endothelial structure made up of flat cells. Tracing the peritoneum down the anterior wall of the abdomen we find that it passes on to the upper surface of the bladder, and from there it is reflected on to the anterior surface of the uterus. As it passes from the one to the other it forms two small folds known as the utero-vesical ligaments. The peritoneum reaches the anterior wall of the uterus just above the level of the isthmus or junction between body and cervix. It passes up the anterior surface—being but loosely attached to the lower part, and more firmly to the upper part of the body—over the fundus and down the whole of the posterior surface of the uterus. When it reaches the point where the cervix is inserted

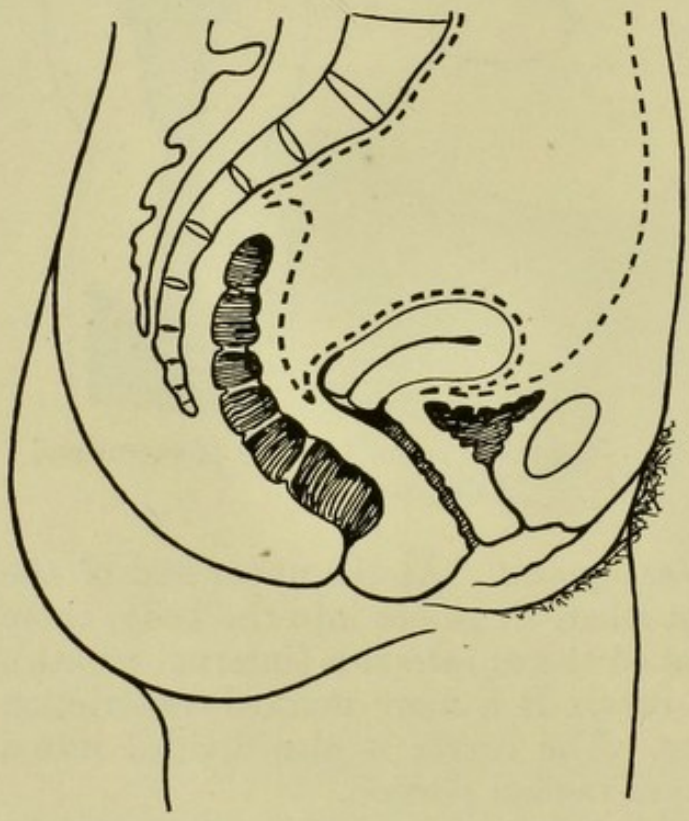


FIG. 17.—Mesial sagittal section of pelvis showing disposition of pelvic peritoneum.

into the vagina, it becomes reflected on to the posterior vaginal wall, and passes down it for a distance of ½ to ¾ of an inch. It is then reflected back on to the anterior surface of the rectum, forming in this way the pouch of Douglas. As it passes up the wall of the rectum it gradually surrounds the bowel more and more, until ultimately it entirely encloses it and forms a mesentery to the sigmoid colon.

At the sides of the uterus the peritoneum forms two double folds which pass outward and backward to the sides of the pelvis.

We see, therefore, that the whole of the uterus is covered with peritoneum except the two lateral edges, the supra-vaginal part of the cervix in front, and, of course, the vaginal portion of the cervix.

Mesometrium.—The great bulk of the thickness of the wall of the uterus is made up of the muscular coat along with connective tissue, some elastic tissue, and a multitude of blood-vessels, lymphatics, and nerves. In the unimpregnated state the muscle presents the appearance of a sort of feltwork, fibres, and bundles running in all directions in an apparently inextricable confusion. In pregnancy the arrangement becomes more obvious, and a description of the various layers will be given under the "Changes consequent upon Impregnation" (see p. 77).

Endometrium.—The mucous membrane consists of three main constituents:—

1. Epithelium.
2. Glands.
3. Interglandular stroma.

The surface *epithelium* consists of a single layer of deep columnar ciliated cells placed on a very thin "basement membrane" of flattened stroma cells. In appearance the membrane is pink in colour, and quite smooth in its arrangement. With a simple lens numerous small pores may be seen, which are the mouths of the utricular glands. The cilia work in a direction from the fundus towards the cervix.

The *glands* are simple tubular invaginations of the surface epithelium, which therefore lines them throughout. The cilia are not found in the deeper parts of the glands, nor is their presence to be expected in such a situation. The glands are very numerous, and pass right through the entire thickness of

the mucous membrane, some of them having their blind ends actually embedded in the muscular coat. Here and there a gland is seen to bifurcate at the deep end, and occasionally two glands open at the surface by one mouth, but for the most part they are simple tubes. In direction they run at right angles to the surface, or slightly obliquely. They secrete a thin, milky secretion, faintly alkaline, and just sufficient in quantity to keep the surface of the mucous membrane moist.

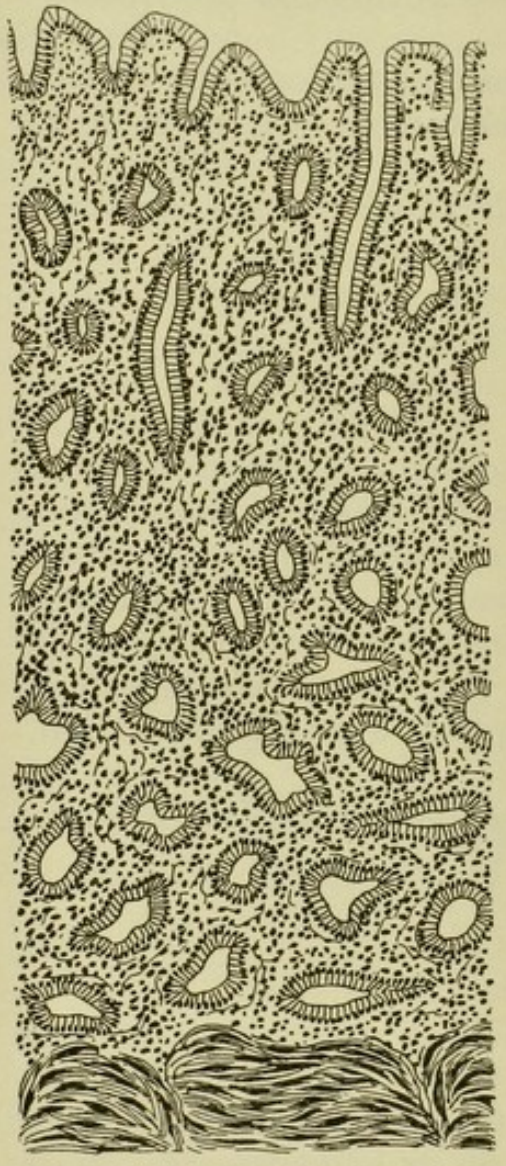


FIG. 18.—Normal endometrium on section.

The *interglandular stroma* forms the greater part of the thickness of the endometrium. It is made up of connective tissue of an embryonic type. That is to say, it has fewer fibrils and more cells than ordinary connective tissue. It is indeed closely packed with small cells containing little protoplasm, and branching in a stellate fashion at the corners. This embryonic structure probably explains the marvellous potentialities for rapid change and regeneration which the uterine mucosa shows.

There are many fine vessels in the mucous membrane. The arterioles run spirally, parallel to the glands, up to the surface, ending in capillary loops around the mouths of the glands.

It must be particularly noted that there is no submucous layer in the uterus. The mucous membrane is planted right down on the surface of the muscle. It cannot, therefore, slide upon the muscle. When it is stripped off, its outer surface is seen to be shaggy with little tags that have been embedded between the muscular bundles, many of these containing blind ends of glands. It is from such portions retained in the

superficial part of the muscular coat that the mucosa regenerates itself after a curettage, and to some extent even after labour.

Cervix.—The cervix consists essentially of the same three coats as the body, but with some important modifications. The relations of the peritoneum to the cervix have already been described, only the posterior aspect of the supravaginal portion being covered by it.

The middle coat consists of muscle, but with a much greater admixture of fibrous and elastic tissue. The mucous membrane differs in the cavity and on the vaginal aspect. That lining the canal or cavity is made up of the same three elements as in the body, namely, surface epithelium, glands, and interglandular stroma. The epithelium is deep columnar ciliated, continuous with that of the body. It is, however, arranged in a peculiar way. A longitudinal ridge runs down the centre of the anterior and posterior walls, from which branch off smaller ridges running obliquely upwards. This arrangement is known as the *arbor vitæ*. The cilia are found to be absent in the furrows between these ridges.

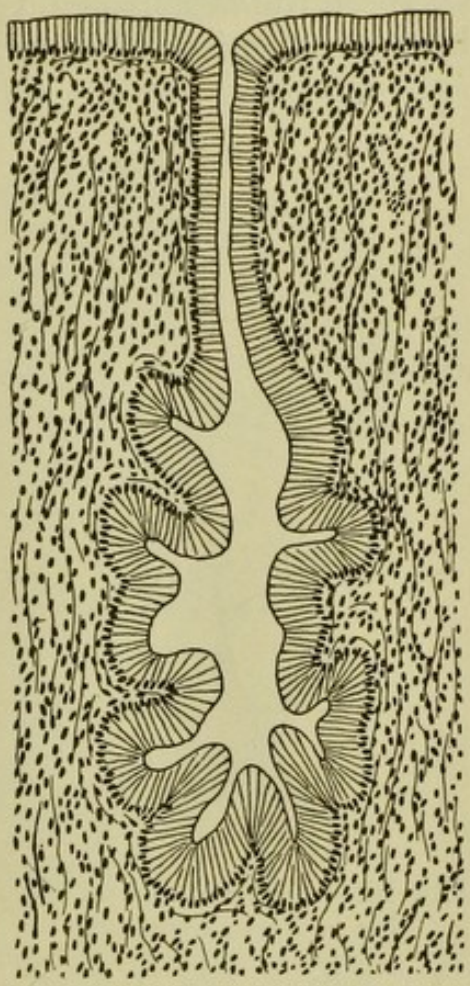


FIG. 19.—Cervical gland on section.

In regard to the glands also the mucosa of the cervix differs from that of the body. Here the glands are compound racemose glands. They are, however, lined as before with the same epithelium that covers the surface. Amongst the deep columnar cells of this epithelium are goblet cells which secrete the thick, sticky, tenacious, faintly alkaline mucus characteristic of the cervical glands.

The vaginal portion of the cervix is covered with an epithelium continuous with that lining the vagina. It consists of several layers of stratified squamous cells, with no glands. The two

forms of epithelium meet at the os externum. This, in the case of a woman who has not borne children, is a small rounded or oval opening. After labour it is a transverse slit with definite anterior and posterior lips.

Ligaments of the Uterus.—Four pairs are usually described —the broad, the round, the utero-sacral, and the utero-vesical. Of these the last named, two double folds of peritoneum caused by the reflection of that membrane from the bladder to the uterus, are of no value as ligaments, are not even constantly present, and may therefore be neglected.

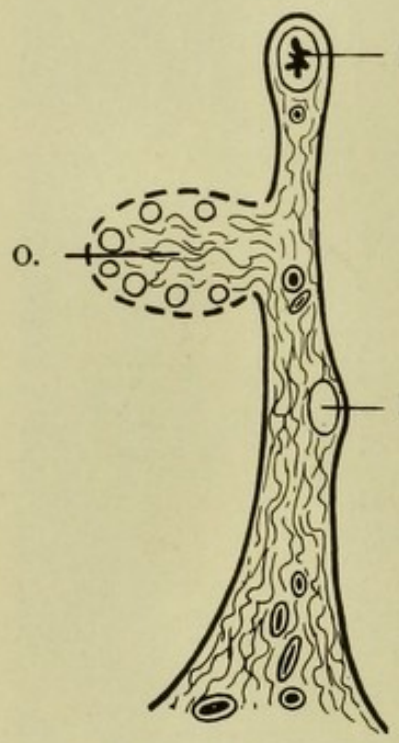


FIG. 20.—Vertical sagittal section of broad ligament.

F.T. Fallopian tube. O. Ovary. R.L. Round ligament.

The *broad ligament* on either side consists of a double fold of peritoneum passing out from the side of the uterus to be attached to the side of the pelvis just in front of the sacro-iliac synchondrosis. Along with the uterus they thus divide the pelvis from side to side.

The upper margin in its inner two-thirds contains the Fallopian tube; in its outer third, between the opening of the Fallopian tube and the side of the pelvis, it contains the ovarian artery, and is known as the *infundibulo-pelvic ligament* (or the suspensory ligament of the ovary).

Below this upper free margin the two folds of the broad ligament become more and more separated as they pass down, and at their base opposite the supravaginal portion of the cervix they contain a considerable quantity of connective tissue—the *parametrium*. The anterior layer is lifted up in its upper part to give a covering of peritoneum to the round ligament. The posterior layer likewise gives covering to the ovarian ligament (*q.v.*), and affords attachment (but not covering) to the ovary.

The *contents* of the broad ligament are, firstly, some unstriped muscle fibres which pass off from the surface of the uterus at its sides; connective tissue, scanty in the upper

parts, but more copious and denser at the base; and elastic tissue. Secondly, the following structures lie in the broad ligament—the Fallopian tube, the parovarium with its tubes and Gärtner's duct, the round ligament, the ovarian artery, the pampinniform plexus of veins, nerves, and lymphatics. At its very base are the uterine artery and vein, and the ureter.

The upper part of the ligament is lax, and allows a large range of movement to the fundus of the uterus. The base, containing the denser connective tissue, is the really effective

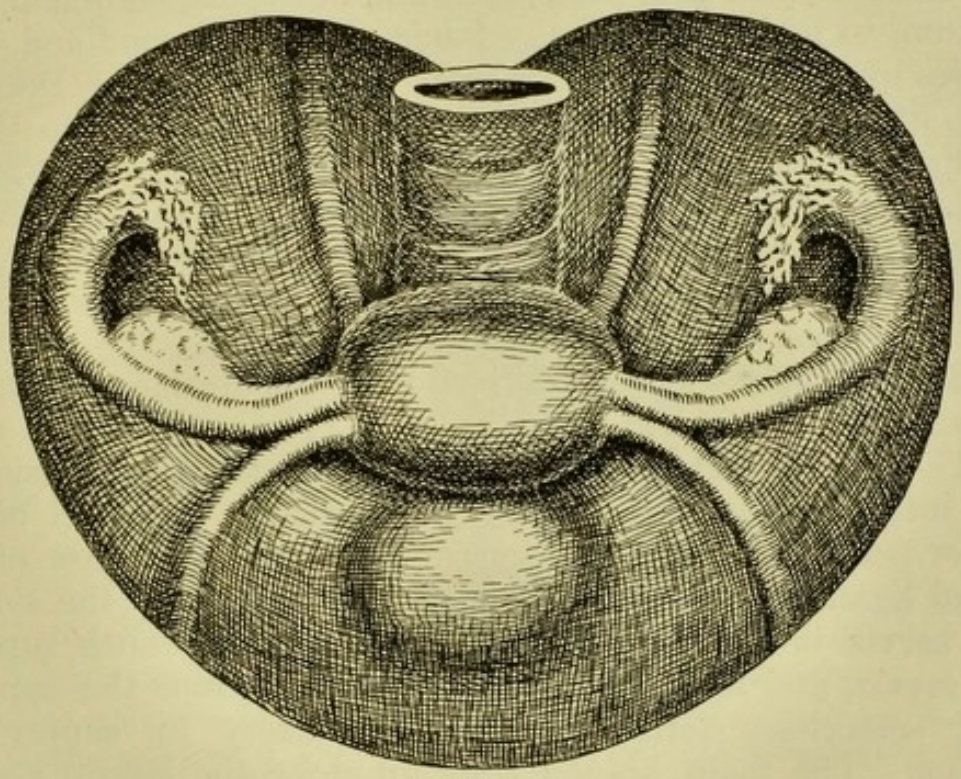


Fig. 21.—Pelvic contents viewed from above (semi-diagrammatic).

part in maintaining the uterus in its position. This tissue is really the perivascular connective tissue around the uterine vessels. It is sometimes spoken of as the ligamentum transversale colli, or Mackenrodt's ligament.

The *round ligament* arises on either side at the cornu of the uterus, just below and in front of the insertion of the Fallopian tube. It takes a curved course outwards, upwards, and forwards, lifting up the peritoneum of the anterior layer of the broad ligament as it does so. It reaches the anterior abdominal wall at the internal abdominal ring, passes through the inguinal canal, and is finally inserted into the pillars of

the external ring, the tissues of the labium majus, and the front of the symphysis pubis. It consists of connective and elastic tissues, some unstriped muscle fibres passing from the surface of the uterus, and an artery which is a branch of the deep epigastric. Normally it is quite lax, and of little value as a ligament, but any influence that it does have tends to keep the uterus anteverted. During pregnancy it is more taut, and may act as a stay to the uterus.

The *utero-sacral ligaments* leave the uterus at the level of the isthmus, and pass backwards and outwards, embracing the rectum, to be inserted in the fascia over the second and third bodies of the sacrum. They cross over the pouch of Douglas, and lift up the peritoneum, thus dividing it into three compartments, a central and two lateral. They consist of connective, elastic, and a little muscular tissue, and act by drawing the cervix upwards and backwards, and so tilting the fundus forwards. They thus tend to maintain the normal position of anteversion of the uterus.

Blood-Supply.—This is derived from the uterine and ovarian vessels on either side.

The *uterine artery* is a branch of the anterior division of the internal iliac, and reaches the uterus at the level of the upper part of the cervix, after running along the base of the broad ligament, and crossing over the ureter. At the side of the cervix it divides into two. The smaller branch supplies the cervix, and anastomoses with its fellow from the opposite side, sometimes forming an azygos artery to supply the vagina. The main branch runs up along the lateral margin of the uterus, giving off branches which pass over the anterior and posterior walls of the uterus, and which in their turn give off small vessels that run directly down into the substance of the uterine muscle. Towards the fundus the main branch breaks up into three terminal branches, one of which supplies the fundus, another the uterine end of the tube, and the third anastomoses with the ovarian artery.

The *ovarian artery* is a branch from the aorta. After passing over the brim of the pelvis, in front of the sacro-iliac joints, and crossing the ureter, it runs along in the infundibulo-pelvic ligament, gives branches to the ovary and tube, and terminates by anastomosing with the uterine.

All these vessels are very tortuous in their course, but this is

particularly the case with the smaller subdivisions of the uterine. This enables the vessels to stretch, and so keep pace with the very rapid growth of the uterine muscle during pregnancy.

The *veins* from the greater part of the uterus run close beside the arteries, forming on each side the uterine plexus, which passes into the internal iliac vein. From the upper part of the uterus, the tube, and the ovary, the veins pass into the large pampiniform plexus between the layers of the broad ligaments. From this they again form one large ovarian vein, which on the right side joins the inferior vena cava, but on the

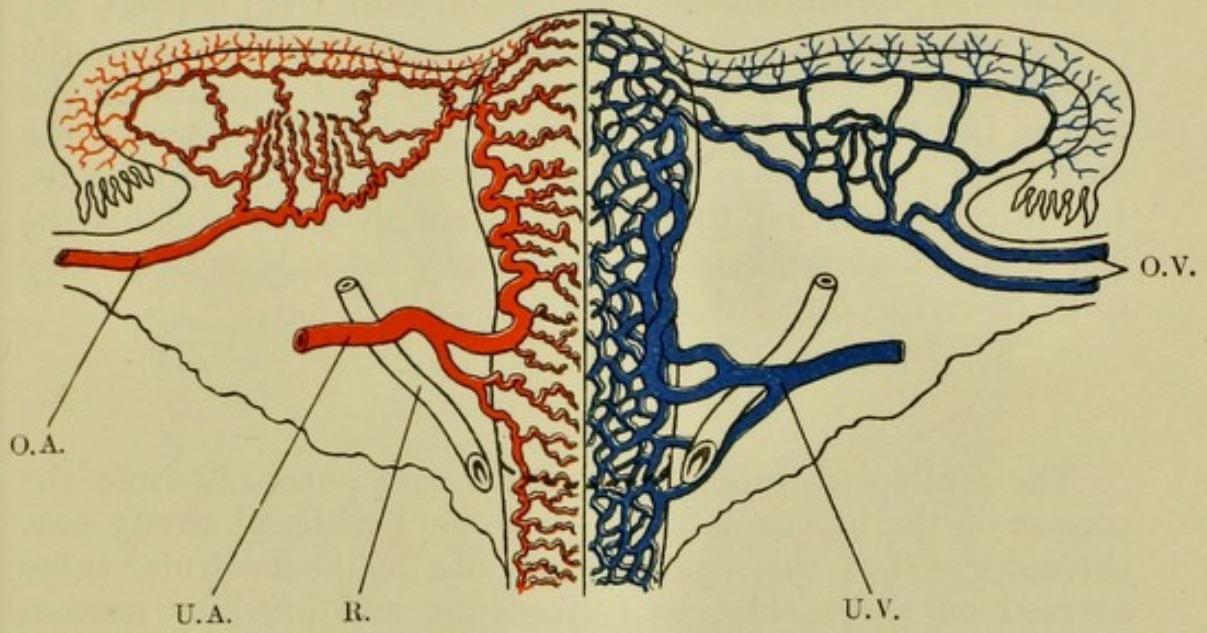


FIG. 22.—Blood-supply of uterus viewed from the front.

On the one side the arteries only, and on the other the veins only are represented. O.A. Ovarian artery. U.A. Uterine artery. R. Ureter. U.V. Uterine veins. O.V. Ovarian veins.

left passes direct to the left renal vein, with which it forms a junction at right angles. The left ovarian vein is said to be usually devoid of valves.

Lymphatics. — There is a lymphatic plexus under the perimetrium, into which the uterine lymph spaces pour their contents. From the upper portion of the uterus the lymph passes to the lumbar and hypogastric glands situated in close relation to the great vessels. From the lower portion drainage is to the hypogastric glands.

Nerve-Supply. — This is mainly sympathetic from the hypogastric plexus. A few fibres from the cerebro-spinal system pass from the second, third, and fourth sacral nerve

roots. All the nerves pass to the cervical "ganglion," a large plexus situated just behind the cervix, which acts as a sort of exchange from which the nerves are again distributed to the different parts of the uterus.

Parametrium.—This term is applied to the connective tissue around the uterus. In addition to fibrous tissue it contains some elastic tissue, and even a few unstriped muscular fibres, along with a free lymphatic plexus.

The parametrium is situated principally (1) between the layers of the broad ligaments, and particularly at their bases, around the uterine vessels (lig. transv. colli); (2) between the cervix and bladder; (3) in the utero-sacral folds between the cervix and rectum. Through the various ligaments of the uterus it becomes directly continuous with the fascia of the iliac fossæ, and the anterior and posterior abdominal walls. Its intimate relation to the cervix on all sides explains the fact that inflammation of the parametric tissue is so frequently to be traced to infected cervical tears.

The Fallopian Tubes

The Fallopian tubes or oviducts pass outwards from the cornua of the uterus and open into the peritoneal cavity near the outer end of the ovary. They are hollow muscular tubes covered on three sides by peritoneum, and lined by mucous membrane. The canal of each tube forms a direct communication between the peritoneal cavity and the uterus, and so with the outside, the only instance of such a communication in the human body, and a fact of great significance in regard to gynecological pathology.

The tube on either side runs outwards, arches slightly over the ovary, and turns backward so that its abdominal opening is directed posteriorly. It runs in the upper edge of the broad ligament, and is thus invested with peritoneum on every side except below, where the layers of the broad ligament are separated by a little connective tissue. The tube is usually about 4 to 4½ inches (10-11 cm.) long. In the fœtus it is proportionately longer and very tortuous, and this condition sometimes persists in the adult. In thickness it varies from about ⅛ of an inch at the narrowest part to about ¼ inch in diameter at the widest part (3-6 mm.).

For descriptive purposes the tube is divided into four parts :—

1. The *interstitial* part, which is included in the $\frac{1}{2}$-inch thickness of the wall of the uterus. The lumen here is extremely small, only admitting the passage of a bristle.

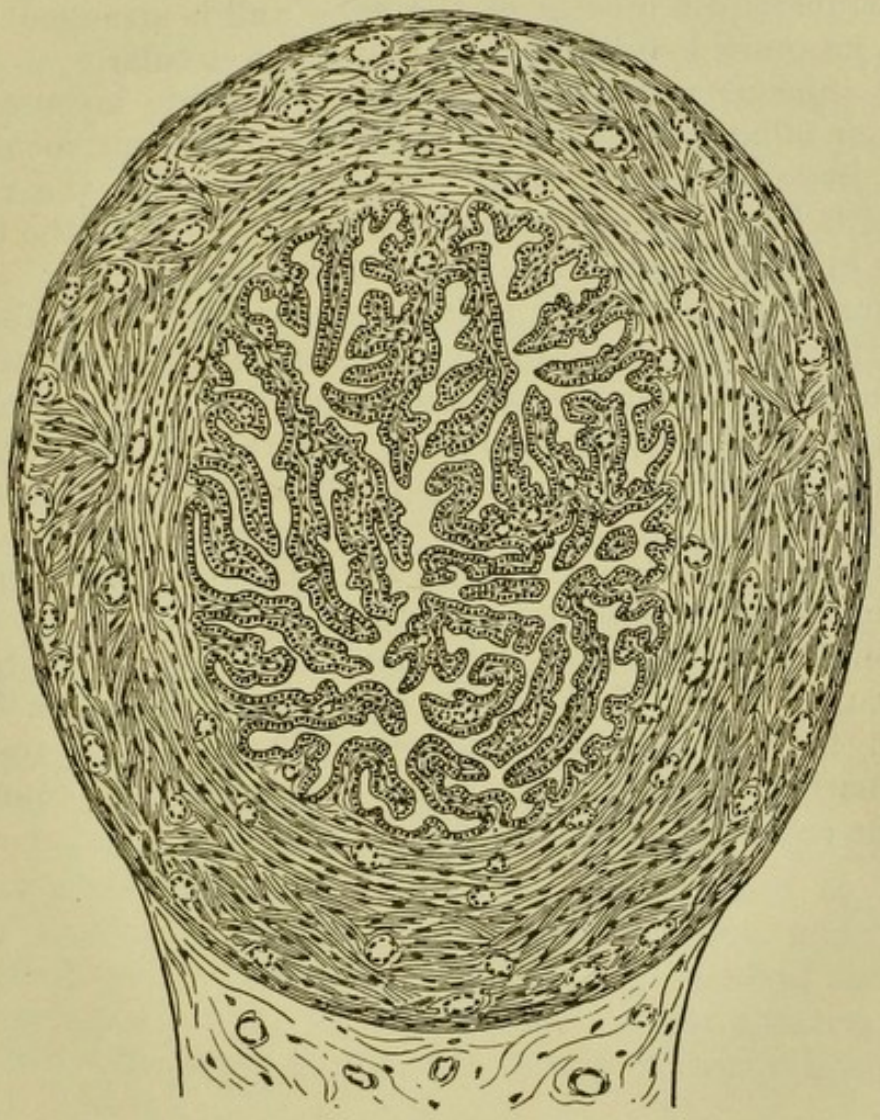


Fig. 23.—Transverse section through ampullary portion of Fallopian tube.

2. The *isthmic* portion, the narrow part immediately outside the cornua of the uterus.

3. The *ampulla*, the middle and the widest portion of the tube.

4. The *infundibulum*, the fimbriated extremity (abdominal ostium) opening backwards into the peritoneal cavity. The

opening is surrounded by a fringe of small terminal processes, folds, or fimbriæ. The largest of these is frequently so placed as to come in contact with the surface of the ovary, and is known as the *fimbria ovarica.* It is thought that it has possibly some influence in directing the ovum from the ovary into the mouth of the oviduct.

The unstriped muscle of the tube wall is arranged in two layers, an outer longitudinal and an inner circular.

The mucous membrane consists of a single layer of deep columnar ciliated cells, placed on a fine basement membrane, with a little connective tissue separating it from the muscle. The epithelium is directly continuous with that of the uterus, and, as in that organ, there is no submucous layer.

There are no glands in the mucosa of the tube, but the surface is thrown into a very complicated series of folds. These become more numerous and branch in a more complicated way as they pass outwards in the tube, and at the region of the ampulla a cross-section gives the maze-like appearance seen in the figure.

The cilia of the lining mucosa work in a direction from the abdominal opening towards the uterus.

Diverticula are occasionally found in the tubal mucous membrane. Some of these are congenital, others are formed by the folds of mucosa becoming adherent as a result of inflammation. Such diverticula are of importance in connection with the causation of tubal pregnancy.

CHAPTER IV

THE OVARIES

THE ovaries are two flattened almond-shaped organs attached to the posterior surface of the broad ligaments, one on either side of the uterus. They lie at about the level of the brim of the pelvis, and their long axis varies in direction from vertical to horizontal in different women, and in different attitudes in the same woman. There is also considerable variation in their size, but an average healthy ovary during the active sexual period measures about $1\frac{1}{2}$ inches long, $\frac{3}{4}$ inch wide, by $\frac{3}{8}$ inch thick ($3{\cdot}75 \times 2 \times 1$ cm.). The average weight of each ovary is about 90 grains (6 grms.).

The upper and inner end is pointed and is attached to the cornu of the uterus by a thick specialised band of the connective tissue of the broad ligament called the *ovarian ligament.* The lower and outer end is blunt and is attached to the end of the Fallopian tube by the ovarian fimbria, and by the infundibulo-pelvic ligament (suspensory ligament of the ovary) to the side wall of the pelvis. By its straight anterior edge—the *hilum*—the ovary is attached to the posterior layer of the broad ligament.

The posterior edge of the organ lies free and is convex in outline. Each ovary lies in a slight depression in the obturator internus muscle—the fossa ovarica— and is in relation to the tube above and outside. The left ovary lies in relation to the rectum, which fact, along with the conditions of its venous supply (see p. 31), accounts for the frequency with which it gives rise to symptoms.

Structure.—The ovary is composed of—

(1) Medulla. (2) Cortex.

The *medulla* consists of unstriped muscular and connective tissue with blood-vessels, lymphatics, and nerves. It serves as a supporting skeleton, over which the cortex is draped. At the hilum it forms what may be regarded as a flattened stalk, which passes through a slit in the posterior layer of the broad ligament, very much as the stalk of a flower may be passed through the buttonhole of a coat. This stalk, in which the vessels, nerves, and lymphatics pass to and from the ovary, spreads out between the layers of the broad ligament, with the tissues of which it is directly continuous, and in this way the ovary is attached. At the hilum just where the ovary is attached is a visible white line—**the white line of Waldeyer**—which indicates the transition from the peritoneum of the broad ligament to the germinal epithelium covering the ovary.

The **cortex** is the important functionating portion of the ovary. It consists of three main elements—

(1) Germinal epithelium.
(2) Stroma.
(3) Graafian follicles.

Germinal Epithelium.—This is a single layer of cuboidal epithelium covering the entire ovary up to the hilum, where it becomes continuous with the peritoneum. In appearance it is white with a faintly bluish tint like skimmed milk. It is dull and entirely lacks the shiny look of the serous membrane. It is called germinal epithelium from the belief that the ova are originally derived from it.

Stroma.—This consists of connective tissue cells with spindle-shaped nuclei and intercommunicating fibrils, richly supplied with blood-vessels, lymphatics, and nerves. The stroma situated immediately under the germinal epithelium is more dense than the rest, and has been given a special name by zealous microscopists—the *tunica albuginea*—from its whitish appearance. Scattered throughout the cortex are the Graafian follicles.

Graafian Follicles.—Each follicle contains a potential ovum. It has been estimated that at birth each ovary contains about 100,000 potential ova! By the time the ovary comes to its period of real functional activity the number has probably been reduced to about 35,000—surely a sufficient safeguard on the part of Nature against the extinction of the race!

As has been indicated, the ova are derived from the germinal

epithelium, and it is generally held that the cells immediately surrounding them and forming the follicles are derived from the same source. On this view the connective tissue underlying the germinal epithelium at a very early stage of development grows out and engulfs small groups of the cells of the epithelium, including those destined to become ova. The little cell nests so formed become further subdivided in the same way until ultimately an enormous number of follicles has been developed. In each follicle the epithelial cells that do not become ova persist as the epithelium of the follicle, and form a protective, and perhaps even nourishing, bodyguard to the all-important ovum.

In the ovary of a woman during the child-bearing period follicles in all stages of development are found, the smaller lying rather more superficially. At every ovulation one follicle comes to full maturity, rising to the surface of the ovary as it does so. In its earliest stage of development the so-called primordial follicle consists of an ovum surrounded by flat cells. In the course of growth the surrounding cells become more cuboidal and epithelial in appearance, and multiply in numbers. Later still fluid appears inside the follicle and distends it. The structure of the fully mature follicles must be studied in more detail.

Mature Graafian Follicle.—A study of this embraces two sets of structures. First, the follicle proper, and second, the arrangement of the cortical stroma immediately around it. The various structures enumerated from without inwards are—

Theca Folliculi
1. Tunica externa or fibrosa — derived from the stroma of the cortex.
2. Tunica interna or vasculosa — derived from the stroma of the cortex.

Follicle Proper
3. Membrana granulosa.
4. Discus proligerus.
5. Liquor folliculi.
6. Zona pellucida.
7. Perivitelline space.
8. Vitelline membrane — Ovum.
9. Protoplasm of the yolk — Ovum.
10. Deutoplasm of the yolk — Ovum.
11. Nucleus, or germinal vesicle — Ovum.
12. Nucleolus, or germinal spot — Ovum.

The two layers of the theca are connective tissue in origin. The *tunica externa* is simply the stroma of the ovarian cortex which has naturally fallen into a concentric arrangement around the spherical follicle. The *tunica interna*, however, has undergone a characteristic alteration. The connective tissue corpuscles have enlarged into polygonal "epithelioid" cells whose protoplasm contains many granules of a golden-yellow pigment called *lutein*. The tunica interna consists of several layers of these cells.

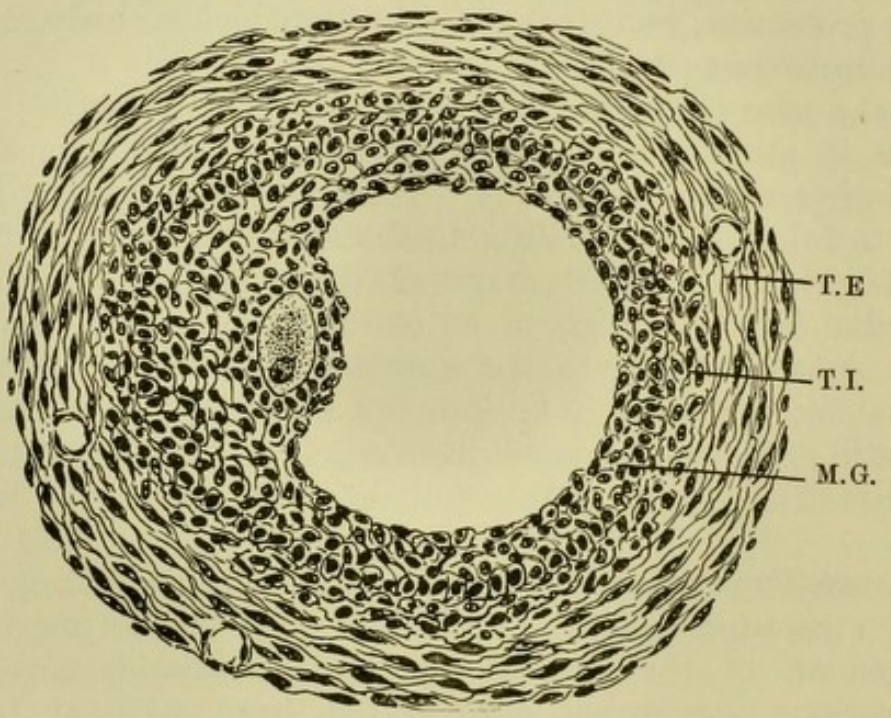


FIG. 24.—Human Graafian follicle with ovum.

T.E. Tunica externa. T.I. Tunica interna. M.G. Membrana granulosa.

The *membrana granulosa* consists of several layers of epithelial cells, more or less cuboidal in shape, with darkly staining nuclei. It surrounds the follicle proper, and at one point the cells are heaped up many layers deep into a little mass, which projects into the centre of the follicle. This is known as the *discus proligerus*, and in it is situated the ovum. The rest of the cavity of the follicle is filled with the *liquor folliculi*, a clear, slightly albuminous fluid.

The cells of the discus proligerus placed in immediate contact with the ovum naturally assume a more orderly arrangement, and this has given rise to the term "corona radiata,"

which is applied to them. These cells remain adherent to the ovum when it escapes after rupture of the follicle.

Inside the corona is a thin layer of structureless material—the *zona pellucida*. Fine striations are visible in it which are believed to be pores. Then comes a very fine space, the *perivitelline space*; and then the outer envelope of the ovum itself, the *vitelline membrane*.

The human ovum is about the $\frac{1}{120}$th of an inch (0·2 mm.) in diameter. The outer portion of its *protoplasm* is clear; the more central portion is full of fatty and albuminous granules, the *deutoplasm*. In the deutoplasm lies the *nucleus*, in a position always eccentric to the ovum. Inside the nucleus is the *nucleolus*.

The ovum in such a follicle is fully developed, but it is not capable of being fertilised until it has gone through the process of forming and casting off the polar bodies.

From the time of puberty to the menopause one such follicle comes to the surface of one or other ovary at each period of ovulation, and ruptures. Before rupture it protrudes on the surface of the ovary, and the actual rupture is caused partly by the increase of the liquor folliculi, partly by the increased congestion of the ovary and the contraction of the feeble muscular elements in its substance. At the summit of the swelling the ovarian tissue is cut off from its blood-supply, degenerates, and gives way at a point called the *stigma*. At the moment of rupture the liquor folliculi, and the ovum, surrounded by the corona radiata, escape into the peritoneal cavity, and are conveyed into the mouth of the Fallopian tube either by the current of lymph set up by the tubal cilia, or possibly by the action of the ovarian fimbria of the tube.

Formation of the Corpus Luteum.—We must now follow the changes in the ruptured follicle, which heals up in a unique fashion, one object of which is to prevent the formation of much scar tissue. Obviously if scar tissue were formed to any great extent every few weeks, the ovarian cortex would soon be converted into one large cicatrix.

As soon as the ovum and liquor folliculi have escaped the follicle becomes filled with blood. This is derived partly from the tearing of capillaries at the point of rupture, and partly from bleeding from the walls due to the sudden reduction of pressure inside the follicle, comparable to the bleeding that

may occur into the bladder after a too rapid evacuation in a case of distension. This blood forms a clot. There then occurs a rapid enlargement and multiplication of the cells of the tunica interna, now called the lutein cells.

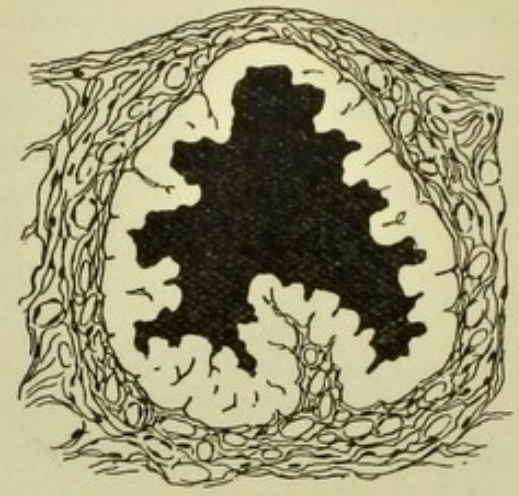


FIG. 25.—Corpus luteum of menstruation on tenth day. (After Bumm.)

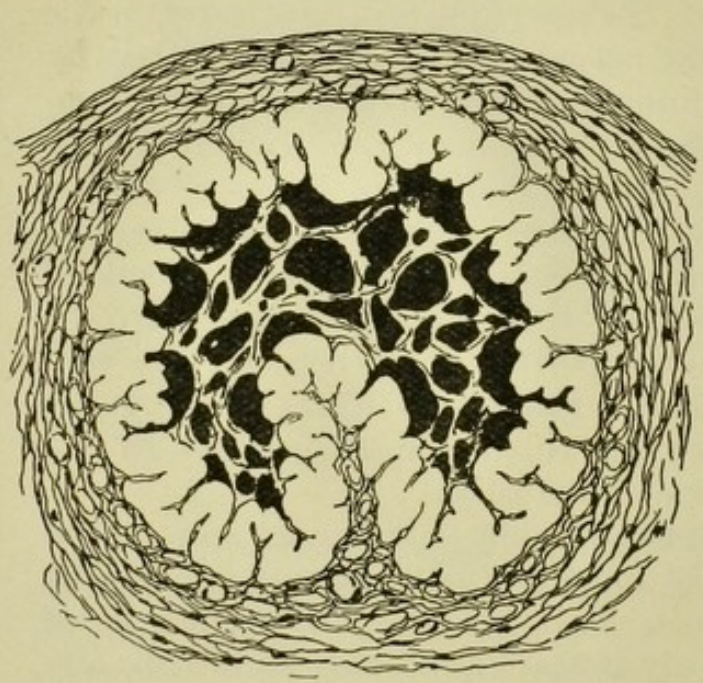


FIG. 26.—The same at end of three weeks. (After Bumm.)

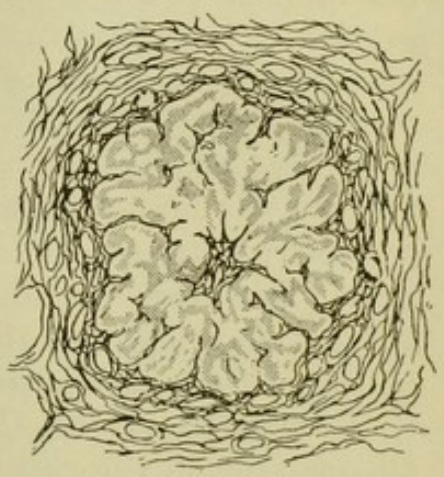


FIG. 27.—The same after eight weeks — corpus albicans. (After Bumm.)

So marked is their growth that the lutein layer becomes thrown into folds and convolutions to accommodate the cells. Buds of connective tissue and young vessels also grow in from the outside. The result is that the central clot becomes

squeezed into very small proportions, and decolourised and ultimately almost entirely absorbed. What is left of it becomes organised, and forms a minute scar in the centre. The lutein cells then undergo a hyaline and fatty degeneration, and gradually disappear. If the ovum is not fertilised, this process occupies in all about six to eight weeks, and the corpus luteum at its full development does not exceed half an inch (1 cm.) in diameter. It is spoken of as the "corpus luteum of menstruation," and formerly was erroneously designated the "false" corpus luteum. When pregnancy supervenes we have the "true" corpus luteum developed. The process is the same, but owing partly to the increased vascularity of all the pelvic organs during pregnancy the changes are more extensive. The corpus luteum of pregnancy does not come to its full development until about the end of the third month, and then disappears so very slowly that it is quite recognisable even as late as the eighth week of the puerperium. At its largest it may measure as much as one inch (2·5 cm.) across.

It is only right to state that the view given here as to the origin and development of the lutein cells does not meet with universal acceptance. It is what is called von Baer's view, and traces the origin of the lutein cells to the connective tissue cells of the tunica interna. It is accepted by most of the leading authorities, but recent research appears to favour the view of Bischoff and Sobotta, who regard the lutein cells as the enlarged and altered cells of the membrana granulosa, and give to the tunica interna only the function of supplying the buds of connective tissue that shoot inwards. It is interesting to note that Miss Lane-Claypon believes that the cells of the tunica interna are epithelial in origin, being derived from the germinal epithelium, so that in her view the lutein cells are of epithelial extraction, whatever be their immediate source.[1]

As we have stated, one function of the corpus luteum is to allow the healing of the ruptured follicle with the minimum of scar tissue. Recent observations and experiments, however, seem to indicate that it may also function as a ductless gland. The most of the work on this point has been done by Fraenkel, who suggests that the luteal tissue is really responsible for

[1] It is impossible to discuss the arguments on either side here, but senior students and those interested will find a full exposition of the different views in Marshall's *Physiology of Reproduction*.

the internal secretion of the ovary. The function of the secretion is, he believes, to control the nutrition of the uterus, and, if pregnancy occurs, to aid the attachment of the ovum to the wall of the uterus by causing the changes in the endometrium which characterise the decidua. If pregnancy does not supervene, it merely produces the hyperæmia of menstruation. Interesting and suggestive as this theory is, it is at present still merely a hypothesis, and nothing definite can be said about it.

CHAPTER V

MENSTRUATION

MENSTRUATION is the term applied to the series of changes characterised by a discharge of blood and mucus from the uterus, which recurs in woman from puberty to the menopause at regular intervals of about a month, except during pregnancy and lactation. Synonymous terms are the menses, the catamenia, or the monthly periods; and there are many euphemisms employed, such as "being unwell," "altering," etc.

The time at which menstruation first starts—sometimes spoken of as the *menarché*—is generally the signal that the girl has become, physiologically speaking, a woman, capable of conception and childbirth. It therefore corresponds to what is more often called *puberty*. The actual age at which it occurs varies in different individuals, in different races, and in different parts of the world. In this country the great majority of girls begin to menstruate between the ages of 13 and 19, the average being 15½. Differences of race and climate account for some differences, although perhaps not to the extent formerly believed. In Hungary, for example, there are slight differences in the average age of the onset of menstruation in the different races. Thus the Jewesses start at 13, while the Slavs do not start until about 16. Warm climates seem to cause the native girls to menstruate early, but English girls born and brought up in India do not menstruate any earlier than at home. Esquimaux, on the other hand, usually start to menstruate late. Social conditions have probably more effect upon the time of the onset. Rich food, luxury, and early mental stimulation bring it on early in the better classes. Dwellers in towns and cities start sooner than country girls.

The onset of puberty is accompanied by a number of other changes both bodily and mental. These are the growth of the pelvis and its assumption of the adult female shape; the development of the external genitals; the appearance of hair on the pubes and in the axillæ; the development of the breasts; and a general development of a graceful rounded contour. Mentally the changes are in the direction of an increasing reserve and shyness, and the awakening of the sexual sense. These changes come on gradually, and the body does not become that of a fully developed woman until the age of about 20. This latter age is known as that of *nubility*—the earliest age at which pregnancy and childbirth can *safely* take place.

Clinically the start of menstruation may be quite sudden, or may be preceded for several months by periodic headaches and general upsets of health, without any actual discharge of blood.

The **Menopause** is the time when menstruation ceases to recur. It is often spoken of as the "climacteric," or the "change of life." It usually occurs between 40 and 50, and rather oftener after 45 than before it. Before 40 and after 50 are quite unusual, although by no means unknown. There is no definite relationship between the age of the onset and the age of cessation of menstruation. As often as not an early start means a late menopause, and a late start an early cessation. The menopause is usually associated with other changes presumably due to the withdrawal of the ovarian internal secretion, as well as the stoppage of the monthly periods. There may be nervous, digestive, circulatory, and even mental symptoms. The cessation of menstruation may come on abruptly, or slowly. Frequently there is a certain amount of irregularity before it stops altogether. After the menopause has become established the sexual organs undergo retrogressive changes. The internal generative organs atrophy, and the breasts shrivel. Excess of fat is frequently deposited, or masculine characteristics may appear, such as the growth of hair on the face.

Clinically it is a time requiring close watching. Scrupulous attention should be paid to general hygiene, and any symptoms treated as they occur. *Particular care should be taken to investigate cases in which hæmorrhage returns after a definite absence of some months at this time.* Such cases are frequently

cases of early cancer of the uterus, and, if recognised at once, may be treated by operation with some considerable hope of permanent cure.

Menstrual Type.—This term refers to the interval between one period and the next. Such intervals should always be counted from the beginning of one period to the beginning of the next. The commonest type (75 per cent) is the twenty-eight day type, the whole cycle of changes occurring regularly every twenty-eight days. In other cases the interval is thirty days, in others only twenty-one. Usually, however, in a healthy woman the same type is adhered to throughout, and as long as it is regular it is generally perfectly consonant with good health. Irregularity usually indicates some pathological condition.

Menstrual Habit.—This term refers to the duration of menstruation, and indirectly to the amount of loss. The average duration is five days, but it varies greatly in different persons. The extremes are cases where it only lasts an hour or two, and cases where it goes on for eight or ten days. Anything below two and above eight days is abnormal. The duration is affected by the same influences as affect the time of first onset, being greater in hot climates, less in cold; greater in town dwellers, and in those living in luxury and eating stimulating food. Sexual stimulation and habits of thought tend to increase it—in short, "high living and low thinking."

Amenorrhœa.—This means the absence of menstruation during the active sexual period of life from puberty to the menopause. Amenorrhœa is one of the early symptoms of pregnancy, and it occurs in 60 per cent of women during lactation.

Menorrhagia means excessive hæmorrhage at the menstrual period.

Metrorrhagia means bleeding from the uterus in the intervals between menstrual periods.

Dysmenorrhœa means painful menstruation.

Leucorrhœa means a discharge of a white or yellowish nature —not blood.

Phenomena of the Menstrual Cycle.—As far as the changes in the generative organs, and in the uterus in particular, are concerned, the menstrual cycle may be divided into four stages. These are :—

1. Premenstrual Congestion—the constructive stage.
2. Actual Menstruation—the destructive stage.
3. Post-menstrual Involution—the reparative stage.
4. Quiescence—the resting stage.

Quiescence.—It is more convenient to take up this stage first, as the uterus during it is in what is regarded as the normal condition. The endometrium is therefore exactly as described in Chapter III. In its thickness the resting mucous membrane varies from $\frac{1}{20}$ to about $\frac{1}{8}$ of an inch (1-3 mm.) in different individuals, and even in different parts of the same uterus. The glands secrete only enough to keep the surface of the mucosa moist. The mucous surface is smooth and greyish-pink in colour. The resting stage lasts about twelve days.

Premenstrual Congestion.—This begins four or five days before the actual menstruation. It is characterised by changes in the stroma, in the glands, and in the blood-vessels of the endometrium, the combined effect of which is an increase in the thickness and the vascularity of the mucous membrane.

In the stroma we find an actual multiplication of the cells. They also become separated out from each other by œdema, the connecting processes becoming more apparent.

The glands become lengthened and distended, and in section present a corkscrew-like appearance. The cells lining them become swollen, and show traces of active secretion.

The capillary vessels all become very congested and full of blood. As a result of this serum passes out of them, and towards the end of the stage, blood corpuscles. The result of this is that the whole membrane becomes œdematous, and this explains the separation of the cells just mentioned.

As has been said, the combined result of the increase in stroma cells, the enlargement of glands, the œdema, and the dilatation of blood-vessels, is to produce a rapid thickening of the membrane. It may grow to as much as $\frac{1}{6}$ or $\frac{1}{4}$ of an inch (4-6 mm.) in thickness. In appearance the mucosa looks red and congested, and may be thrown into folds on the surface.

Actual Menstruation.—This stage lasts about four or five days. The first thing to be noted is a continuance and a great increase of the passage of blood from the capillaries, which began towards the end of the premenstrual congestion. The blood passes into the spaces between the separated stroma

cells. How it escapes is still a subject of some doubt, but there is reason to believe that it does so both by the bursting of the small capillaries, and also to a considerable extent by simple diapedesis. It must be remembered that the walls of the capillaries are extremely thin, and it is not difficult for the corpuscles to pass between the cells composing them.

The blood thus poured out into the stroma passes in the direction of least resistance, and comes to form little collections under the surface epithelium, and under the epithelium of the glands. Some of it passes into the lumina of the glands, and mixes with the mucus, and escapes into the uterine cavity. The blood collections under the surface epithelium are known as *subepithelial-hæmatomata*, and, according to Gebhard, they lift up the epithelium from its bed. It is thus cut off from its source of nourishment, and gives way, and the blood passes into the cavity of the uterus or into the lumina of the glands. Alternatively the blood passes out between the epithelial cells, and so escapes. The blood that has reached the uterine cavity by either of these routes is then expelled into the vagina, and so to the outside. In this expulsion of blood intermittent muscular contractions of the uterus probably play a part.

The question as to how much actual uterine tissue is lost during this stage has been a vexed question for many years, but with modern methods of histology it may now be regarded as practically settled.

The older authors held the view, usually associated with the name of Sir John Williams, that practically the whole of the mucous membrane was shed off at each menstruation. Most of their specimens were obtained from women who had died of acute febrile diseases, and we now know that in these diseases there may occur severe uterine hæmorrhages, associated with great destruction of tissue. Such cases cannot be regarded as normal.

Modern research has shown conclusively that there is comparatively little loss of tissue. Some observers go the length of saying that there is none at all. That, however, is in all probability an equally erroneous view. The truth would seem to be that there is a certain loss of the superficial epithelium. The epithelium over the little hæmatomata, for example, is in most cases cast off. Sometimes also portions of the stroma can be recognised in the discharge, but this is

rather unusual, and in a strictly normal case not associated with any excessive discharge the destruction of tissue is almost certainly confined to the epithelium.

The menstrual discharge thus consists of blood and mucus with cast-off epithelial cells. The blood does not clot, and this is believed to be due to its being mixed with mucus. Even menstrual blood that has been retained in utero for years remains as a thick tarry fluid. On the other hand, where the quantity of blood is excessive or is poured out very suddenly, then it clots, because there is too much blood for the quantity of mucus. In addition to this, it is possible that there is something in the constitution of the blood itself that prevents coagulation.

Menstrual discharge is usually dark or bright red, but it is paler at the beginning and end of the period, owing to the greater proportion of mucus and serum. It is alkaline in reaction, and has a characteristic heavy smell, faintly suggestive of marigolds. The quantity varies within the limits of normal from 4 to 8 ounces in different cases.

Post-menstrual Involution.—By the time this stage is reached the mucous membrane has shrunk greatly in thickness owing to the relief of the congestion and œdema. The cast-off epithelium is replaced by the growth and division of the neighbouring cells, and of the gland epithelium. The blood-vessels and glands return to their normal size, and the blood that still remains effused in the stroma becomes absorbed again. This stage lasts about seven days.

These changes are normally confined to the body of the uterus alone, the cervix, tubes, and even the fundus taking no actual share in them.

Associated with them, however, we find a definite congestion of the cervix, tubes, ovaries, and vagina, and an increase of the secretion in the cervix, vagina, and vulva. In some women there is even a slight congestion and transient enlargement of the breasts at the beginning of menstruation.

Clinically menstruation is accompanied by symptoms of a general nature in the majority of women — the so-called menstrual *molimina*. There is frequently a feeling of heaviness and weariness. Dark lines appear under or around the eyes. The nervous system is more susceptible, and reflex

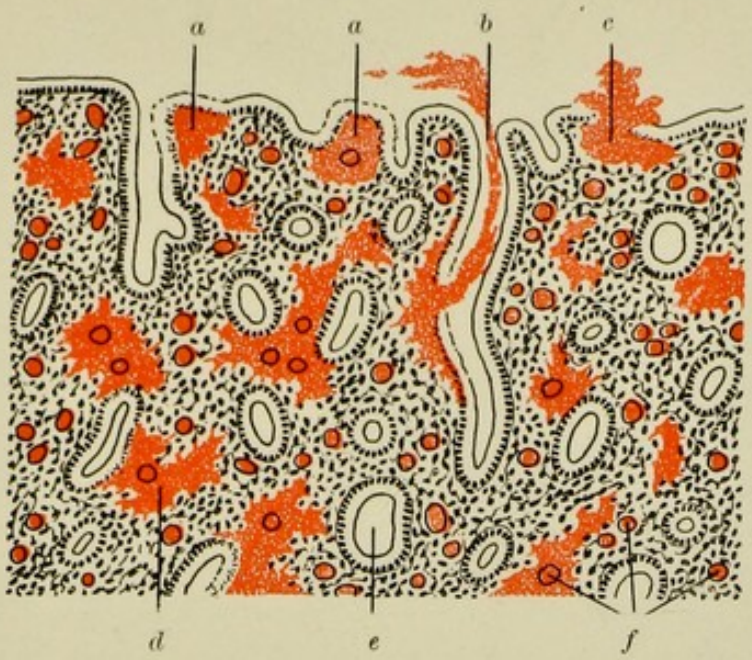


FIG. 28.—Section through the mucous membrane of the human uterus during menstruation. (Semi-diagrammatic.)

a. Subepithelial hæmatoma with degeneration of the overlying epithelium.
b. Blood escaping from lumen of gland.
c. Blood escaping from subepithelial hæmatoma.
d. Hæmorrhage into the stroma.
e. Gland on section.
f. Dilated and engorged capillaries.

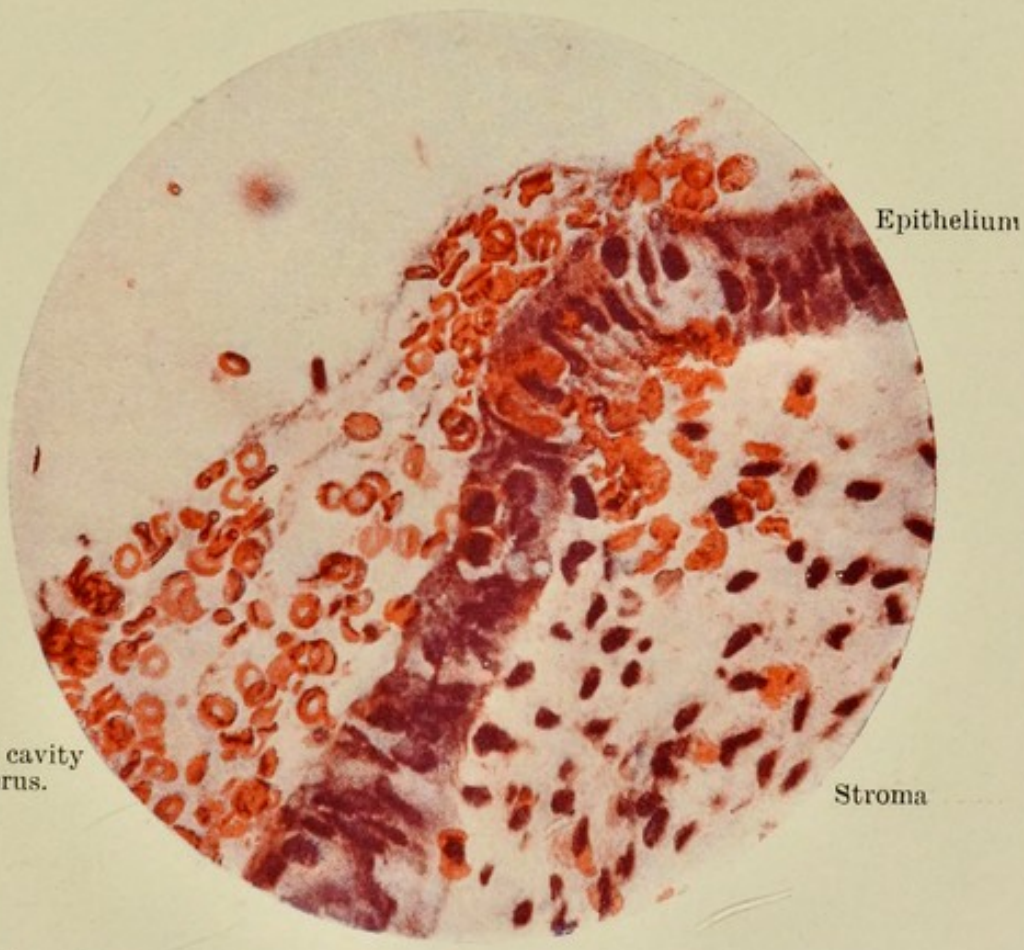


FIG. 29.—Colour-microphotograph of endometrium showing passage of blood corpuscles through the superficial epithelium into the cavity of the uterus during menstruation. (×750.)

irritability increased. The symptoms of other diseases tend to become exaggerated at the onset of menstruation.

The temperature is said to be slightly lower during the period, and there is often a feeling of chilliness. The excretion of urea is diminished and the blood pressure falls. There is also a diminution in the calcium content of the blood during the flow, which may conceivably have something to do with its non-coagulability.

From a purely clinical standpoint menstruation naturally divides itself up into the three periods of invasion, persistence, and decline. The period of invasion lasts only a few hours and is characterised by an increased flow of mucus as well as a feeling of heaviness and malaise. This is rapidly followed by the actual discharge of blood—the stage of persistence—which lasts for two to four days. Later the period of decline supervenes, characterised by a gradual diminution in the flow of bright blood, and a return to a mucus flow as at the beginning. This last phase usually lasts only one or two days, the whole period gradually coming to an end.

Relationship between Menstruation and Ovulation.—The bursting of a ripe Graafian follicle on the surface of the ovary is known as *ovulation*, as it involves the setting free of an ovum. Whether this phenomenon has any causal connection with menstruation, or *vice versa*, is a problem that has long exercised the speculative fancies of writers on obstetrics. The following facts must be taken into consideration before we can come to any conclusion :—

Pregnancy, and therefore *a priori* ovulation, has been known to occur before menstruation has begun, after menstruation has ceased, and during lactation when menstruation is in abeyance.

At operations performed between menstrual periods corpora lutea have been found in such an early state as to indicate that ovulation has just taken place.

From these facts we may draw the conclusion that *ovulation is not of necessity dependent upon menstruation.*

The next question is whether menstruation is dependent upon ovulation. The theory was long held that menstruation is caused by the ripening of the Graafian follicle, and that it is synchronous with ovulation. Some support has been given to this view recently by the experimental production of

"rut" in animals by injecting the ovaries with gelatine, and so raising the intra-ovarian pressure. Indeed it is upon this view of the simultaneous occurrence of the two that our routine method of calculating the date of confinement is based.

This theory was succeeded by the view that ovulation preceded menstruation, and that menstruation only occurred if pregnancy did not supervene. The premenstrual congestion was regarded as a preparation for the fertilised ovum, and only when the uterus was disappointed in this did it menstruate. "Women menstruate because they do not conceive" was the gist of it. The best arguments in support of this are to be found in those cases in which the calculation of confinement turns out to be wrong by three weeks. In these cases it must be supposed that the ovum fertilised was not the one discharged during the last period (as is assumed in our calculation), but the ovum discharged *just before* the next period, *i.e.* the first period missed. This view is also called in to explain the fertility of strict Jewesses, who regard themselves as unclean not only during the period of menstruation, but also, in accordance with the Levitical law, for seven days after its cessation.

The third view is that ovulation occurs immediately after the close of menstruation. We know that in most lower mammals ovulation takes place during the œstrus or period of "rut" or "heat." Moreover, as will be shown later, there is very strong evidence that menstruation corresponds with what in lower mammals is called pro-œstrum, or period immediately preceding the œstrus. This fact therefore lends strong support to the view that ovulation occurs at the close of menstruation. Further, there is a general consensus of opinion that intercourse is most likely to be fertile when it takes place just after a menstrual period. Again, the time immediately following a menstrual period is with most women the time of greatest sexual feeling, and it would be utterly contrary to Nature's principles of extravagant provision for the preservation of the race were this period of greatest natural feeling in the human female found *not* to correspond with that of greatest probable fertility. Lastly, the most recent investigations into the development of very early cast-off ova tend to show that these must have been discharged from the ovary just after a menstrual period.

The conclusion of the whole matter to which we are forced in the present state of our knowledge is, that while it is probable that the primitive and original arrangement is for ovulation to occur immediately after menstruation, just as in lower mammals it occurs during the œstrus, yet sometimes the two functions may, and do, occur at different times.

Theories as to the Cause of Menstruation.—This subject has to some extent been referred to in the preceding paragraphs, but there are other theories which have not been mentioned.

The view now most commonly adopted by competent observers is that menstruation is strictly analogous to the pro-œstrum of the lower mammals. The researches of Heape have shown that in them the breeding season may be divided into three periods.

There is first the pro-œstrum, in which the generative organs, and the uterus in particular, become congested, and in some animals there is actually a discharge of blood towards the close. This is the stage known to breeders as "coming in season." The second period is the œstrus or period of "heat," or "rut," properly so-called. It is the period of desire in the female, and only at this time will she admit the male. If pregnancy ensues, the puerperium and lactation are followed by a period of anœstrum in which no disposition towards mating is exhibited. But if pregnancy does not supervene, the œstrus is succeeded by a metœstrum during which the organs return to their normal state; or in some animals only by a short resting stage known as a diœstrum, which in turn is followed by another pro-œstrum, and so on.

In monkeys there is in many cases a regular monthly œstrous cycle, and the pro-œstrous period is characterised by an actual menstruation. Careful histological examination of the changes that occur during the pre-œstrum in animals make it practically beyond doubt that they are strictly analogous to those of menstruation in the human female.

In saying this, however, we have not explained menstruation, and it still remains to see if there is any explanation for the occurrence of the pro-œstrum.

The theory that "women menstruate because they do not conceive" is not tenable if we adopt the view that menstruation is the homologue of the pro-œstrum, because we know that

in mammals ovulation usually takes place during œstrus, that is *after* menstruation.

On the other hand, the theory that menstruation is in the nature of a preparation for the reception of the fertilised ovum is at least tenable. The known facts do not oppose it in any way, although we know that pregnancy and the embedding of the ovum in the uterine wall *may* take place without such preparation, as for example when pregnancy occurs before menstruation has begun, or during lactation, or after the menopause, all periods when menstruation is in abeyance.

There is some reason to believe that the general metabolism of women follows a definite monthly curve, the acme of which is just before menstruation. According to the "wave theory" of menstruation based on this, menstruation is, as it were, the culmination of the metabolic activities of the body—activities probably originally intended by Nature for the nourishment of the embryo.

The view that menstruation is caused by a reflex nervous stimulus was urged by Lawson Tait and others, but it is disproved by the occurrence of menstruation in animals in which the lumbar cord has been destroyed. There is every reason, however, to believe that menstruation is in some way dependent upon some form of stimulus arising in the ovary. The complete removal of all ovarian tissues by operation is always followed by the cessation of menstruation. Cases have been reported which seem to contradict this—cases in which menstruation has persisted after ovariotomy—but these may all be explained on the ground that some portion of ovarian tissue was accidentally left behind. Such tissue has, for example, been found in the ovarian ligaments; and that it is easily possible to leave some ovarian tissue behind is proved by the fact that pregnancy has been reported more than once after double oöphorectomies by highly competent operators.

What is the nature of the ovarian stimulus we do not know, but it is almost certainly of a bio-chemical rather than of a nervous type.

SECTION II

PHYSIOLOGY OF PREGNANCY

CHAPTER VI

THE EARLY DEVELOPMENT OF THE EMBRYO

Fertilisation

There is reason to believe that normally the human spermatozoon and ovum meet in the Fallopian tube, towards its ovarian end.

The human **spermatozoon** is a small cell, measuring only $\frac{1}{300}$th of an inch (·05 mm.) in length. It has a flat oval head, and behind this a cylindrical body ending in a long tail which constitutes four-fifths of its whole length. A long axial fibre runs the whole length of the body and tail, and outside this is a sheath arranged like a spiral spring. It is believed that the head is armed with a sharp edge whereby it can cut its way through the envelope of the ovum. The spermatozoon propels itself by rotatory lashings of its long tail, and is capable of attaining a speed of one-eighth of an inch per minute. It is killed by strong acids or alkalies and by high temperatures. At body heat, and in the faintly alkaline secretions of the uterus and tubes, it can exist for at least

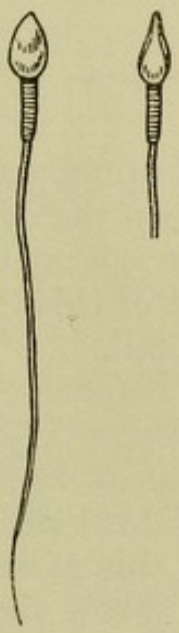


Fig. 30.—Human spermatozoon.

fourteen days. Whether it can retain its fertilising power as long is doubtful.

The human **ovum** is an almost spherical cell about $\frac{1}{120}$th of an inch (0·2 mm.) in diameter. As it escapes from the Graafian follicle at the time of rupture, it is probably surrounded by the cells of the discus proligerus immediately adjacent to it—the so-called corona radiata.

On its escape into the peritoneal cavity the ovum is either caught in the tentacles of the ovarian fimbria of the tube, or swept into the mouth of the tube by the ciliary lymph current. The cilia lining the tube and uterus all work in the one direction—from the ovarian end of the tube towards the os

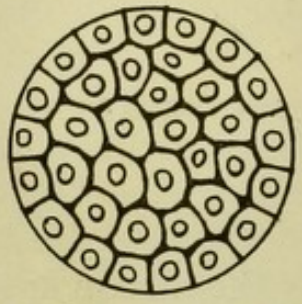


FIG. 31.—Diagram of the morula stage.

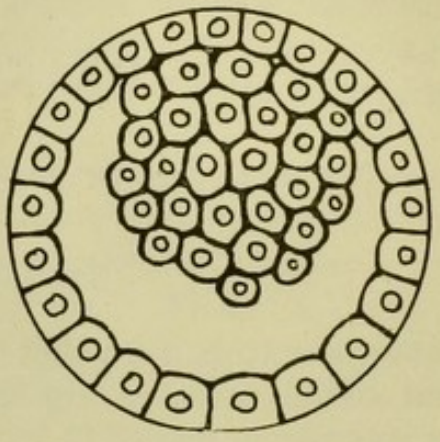


FIG. 32.—Diagram of the blastocyst.

externum—and hence there is a constant current tending to sweep the ovum into the uterus and through it to the vagina. The spermatozoon has to make its way against the current, but of this it is easily capable owing to the propeller action of its tail.

Before it is ready for fertilisation, the ovum has to go through a process of maturation—a process which the male element has passed through before it is set free. The ovum divides twice, giving off first one polar body and then a second. By this means it loses half its chromosomes.

When the spermatozoon meets the ovum it cuts its way through the zona pellucida and vitelline membrane by means of its head cap. The tail becomes absorbed, but the head and body pass in and fuse with the nucleus of the ovum, forming the so-called segmentation nucleus. In this way the fertilised

ovum is furnished with the characteristic number of chromosomes, each element, the male and the female, contributing half. Thereafter the process of mitosis goes on rapidly.

Formation of the Germinal Layers

The ovum now divides into two, four, eight, sixteen cells, and so on until a little ball of cells is formed like a bramble or mulberry, and known as the **morula** (see Fig. 31). Some of the cells in the inside of the morula then become vacuolated and run together to form a space full of fluid. In this way the solid morula is changed into the **blastocyst**, with the bulk of its cells projecting into the inside of the cyst like a knob. This knob is the **inner or formative cell mass** (see Fig. 32). The outer layer surrounding the blastocyst is destined to form the epithelial part of the **chorion**, and as it has nothing to do with the formation of the actual embryo, it is called the **extra-embryonic ectoderm.** It is also called the **trophoblast**, because its function is associated solely with the growth and nutrition of the ovum.

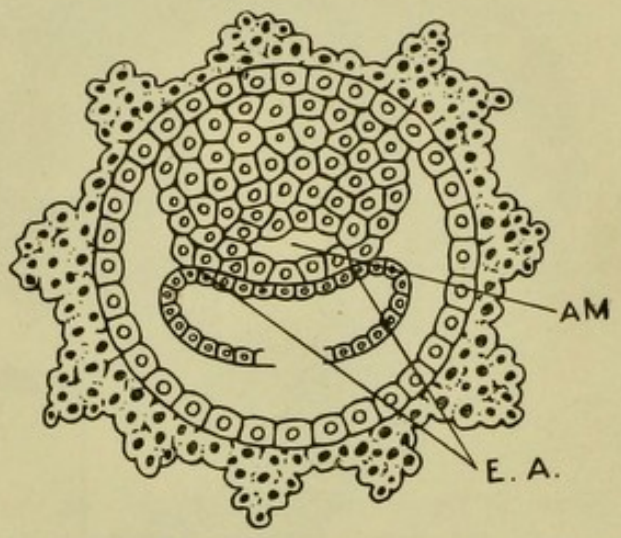


Fig. 33.—Diagram showing formation of endothelial yolk sac and earliest appearance of amniotic space (AM).

The early outgrowths of trophoblast are also indicated. E.A. marks the extent and position of the embryonic area.

The lower cells of the inner or formative cell mass now become flattened out and differentiated into a separate layer—the **entoderm**—which grows round in such a way as to form a little closed sac inside the blastocyst—the **yolk sac** (see Fig. 33).

The next step is that in the centre of the inner cell mass there appears a little space filled with fluid, very much as happened in the formation of the blastocyst. This space is the **amniotic cavity**, and the cells lining it become flattened out into a definite layer, especially over the floor of the cavity

where they form the **embryonic ectoderm.** The amnion is thus a closed sac from the very beginning.

It is in this embryonic ectoderm and the entoderm of the yolk sac immediately below it that the future embryo develops, and, therefore, this area is called the **embryonic area** (see Fig. 33).

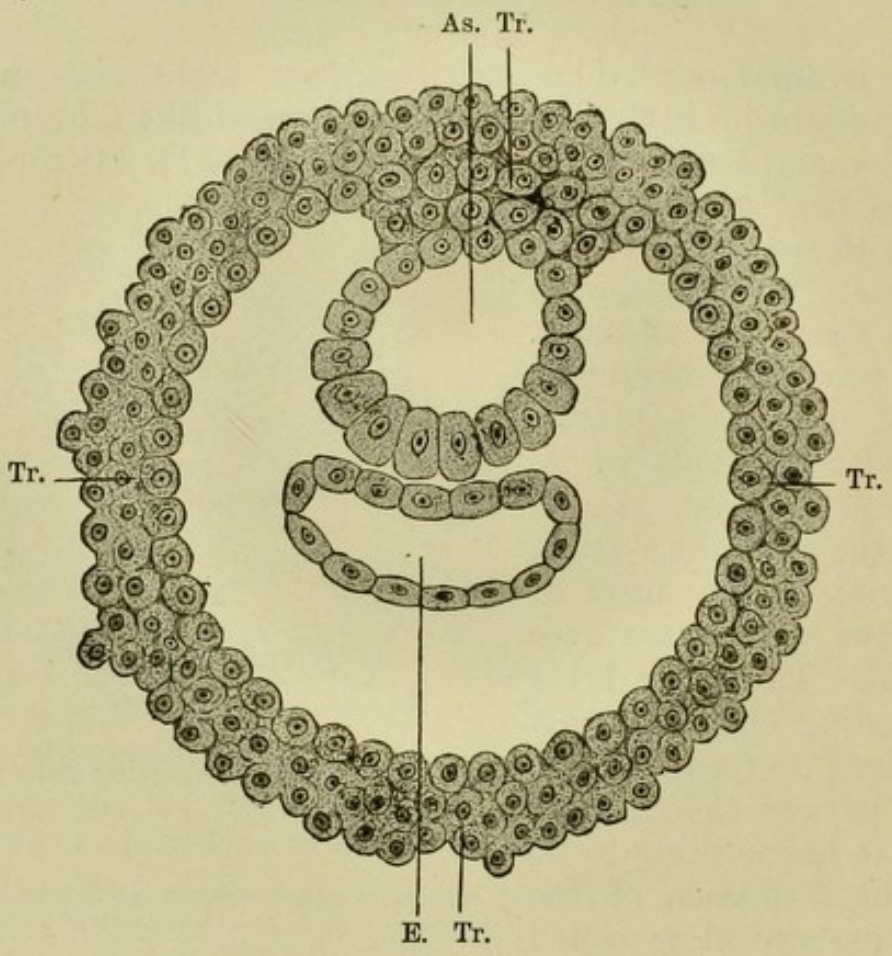


FIG. 34.—Diagram of later stage of the blastocyst. (After T. H. Bryce, *Quain's Anatomy.*)

As. Amniotic space. Tr. Trophoblast. E. Entodermal yolk sac.

The third germinal layer—the **mesoderm**—now begins to appear as a growth of cells starting from the sides of the embryonic area between the embryonic ectoderm and the entoderm. The mesoderm early divides into two leaves, one spreading over the entoderm of the yolk sac, the other growing round the inside of the extra-embryonic ectoderm. The inner leaf of mesoderm forms the **splanchnopleure.** The outer leaf is known as the **somatopleure,** and unites with the extra-embryonic ectoderm to form the primitive chorion. The space

between the splanchnopleure and the somatopleure is the origin of the cœlom or body cavity.

The mesoderm also forms a specially thick mass of tissue between the hind end of the embryonic area and the primitive chorion, known later as the **belly-stalk**, or **abdominal pedicle.** This is of importance in the formation of the umbilical cord, as the embryonic blood-vessels, afterwards to be the umbilical vessels, are developed in this mesoderm, while the tissue itself forms the so-called Wharton's jelly (see Fig. 35).

The chorion and the amnion, the fœtal membranes, are structures of such vast importance to the fœtus, that it is desirable to recapitulate what we have learned about them.

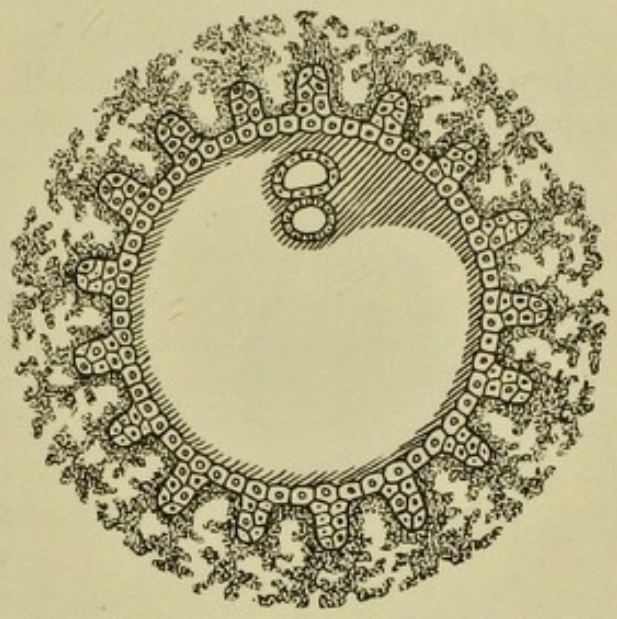


FIG. 35.—Diagram of blastocyst showing the outgrowths of the trophoblast.

The mesoblast (shaded) lines the inside of the trophoblast, thus forming the chorion, surrounds the outside of both amnion and yolk sac, and attaches the embryo to the chorion by the thickened part—known later as the "belly-stalk."

The chorion consists of two layers, the trophoblast outside and the somatopleure inside. The trophoblast is the outermost layer of the blastocyst, and is made up of the extra-embryonic ectoderm—that is to say, of Langhans' layer[1] and syncytium.[1] The somatopleure is the outer of the two leaves into which the mesoderm divides, and in the fully developed membrane is represented by connective tissue.

The amnion also consists of ectodermic and mesodermic layers, but their relative positions are reversed, the mesoderm being outside and the ectoderm inside. The mesoderm of the amnion is, in the fully developed membrane, represented by mucoid connective tissue. The ectoderm is true embryonic ectoderm, directly continuous with that of the embryonic area. In the fully developed membrane it is represented by a layer of cuboidal epithelium.

[1] These terms will be explained on p. 64.

Chorion	Trophoblast	Syncytium	Extra-embryonic ectoderm
		Langhans' layer	
	Somatopleure	Connective tissue	Mesoblast
Amnion		Connective tissue	Mesoblast
		Epithelium	Embryonic ectoderm.

The Early Development of the Embryo

If the ovum at this stage be looked at from above, the embryonic area appears as a small shaded oval. The shading is due to an increased growth of cells, because here the three germinal layers—embryonic ectoderm, mesoderm, and entoderm—are in contact. At one end a patch of darker shading indicates a still greater growth of cells. Running forward from this is a band — the **primitive streak** — in the centre of which lies a darker line—the **primitive groove**. At the far (anterior) end of the primitive groove there is a dark spot—Hensen's node—from which still another streak runs forward, the head process. Later in front of the primitive streak a thickened band of ectoderm appears, broadening out posteriorly. The edges of this band rise up to form two folds, which meet anteriorly. The groove between them is the **medullary groove**, and ultimately they fold over and unite to form the **neural canal** (see Fig. 36).

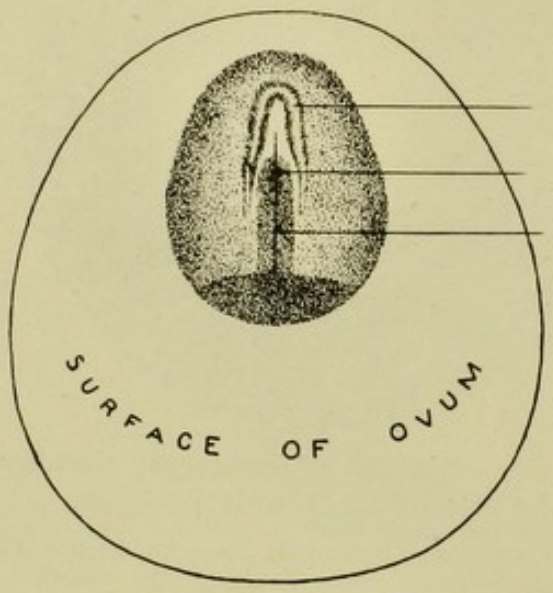


Fig. 36.—Showing embryonic area.

A. Primitive groove. B. Hensen's node. C. Medullary folds.

Along the line of the primitive streak all three germinal layers are in contact. Superficial to it is the amnion, and below it is the yolk sac. The embryonic area is the only part of the ovum which has to do with the subsequent development of the embryo; the other parts of the blastodermic vesicle become subservient as nutritive or supporting structures.

At this stage, and for the first three weeks of its existence,

the embryo is a "flat disc floating on the surface of the yolk sac" (M'Murrich). There then occurs the "folding off" of the embryo. The amniotic cavity enlarges, and dips down over the two ends of the embryo, forming a head and a tail fold. It also dips round the sides and bends them in so that the embryo forms a sort of tube, open along its lower side. The inside of this tube is of course just a portion of the original yolk sac folded off from the rest. As the "folding off" process goes on, the ventral surface of the embryo becomes entirely closed in, except at one point where the interior of the embryonic tube is in communication with the yolk sac. The part of the yolk sac thus included in the embryo forms the future alimentary tract. The yolk sac at this stage is termed the **umbilical vesicle**; and the canal joining it to the gut of the embryo, the **vitelline duct.**

As the vitelline duct is being formed by the constriction of the neck of the yolk sac, a small diverticulum appears in the hind part of the embryonic gut. This is the **allantois,** an entodermal tube that bores its way along the mesoderm of the belly-stalk, but fails to reach as far as the chorion (see Figs. 37-40).

In reptiles and birds the allantois is an organ of immense importance, and spreads round the inside of the trophoblast to form the placenta. Through it the respiratory exchanges between the embryo and the air take place. In man it is of little importance and never reaches any great development, being represented merely by this blind tube in the belly-stalk. Its intra-embryonic part becomes the bladder, and the urachus represents its original communication with the umbilical cord.

The steady advance of the amnion round the sides and front of the embryo causes the vitelline duct and yolk sac to be swung into contact with the belly-stalk, and ultimately they become incorporated with it in the **umbilical cord.** We see, therefore, that the umbilical cord consists of (1) the mesodermic belly-stalk (Wharton's jelly), with (2) the umbilical vessels developed in it, (3) the rudimentary allantois, and (4) the vitelline duct and what remains of the yolk sac. These all get bound together by the growth of the amnion, in a covering of embryonic ectoderm. The vessels are originally two arteries and two veins, but the veins fuse together into one, giving us

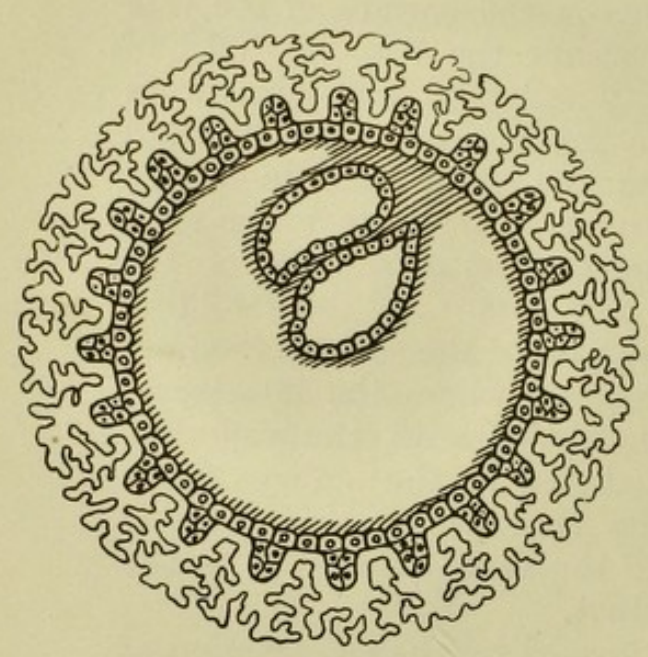


FIG. 37.

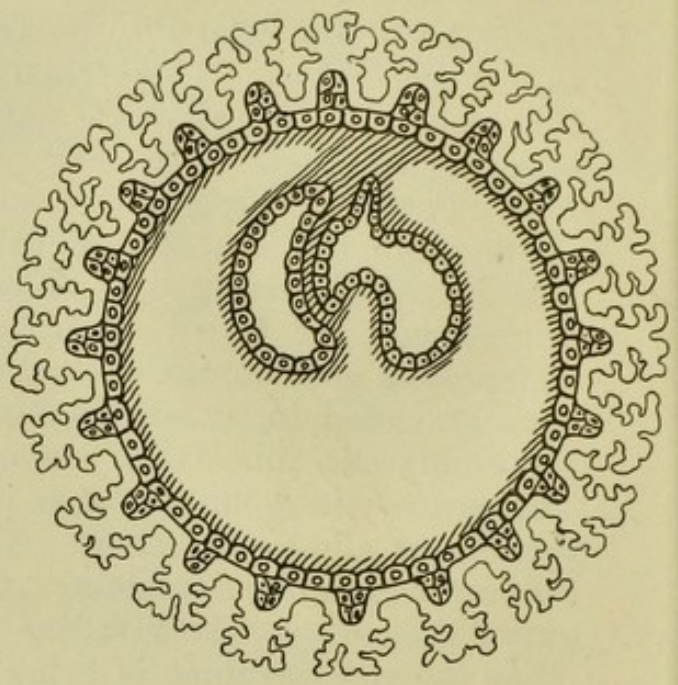


FIG. 38.

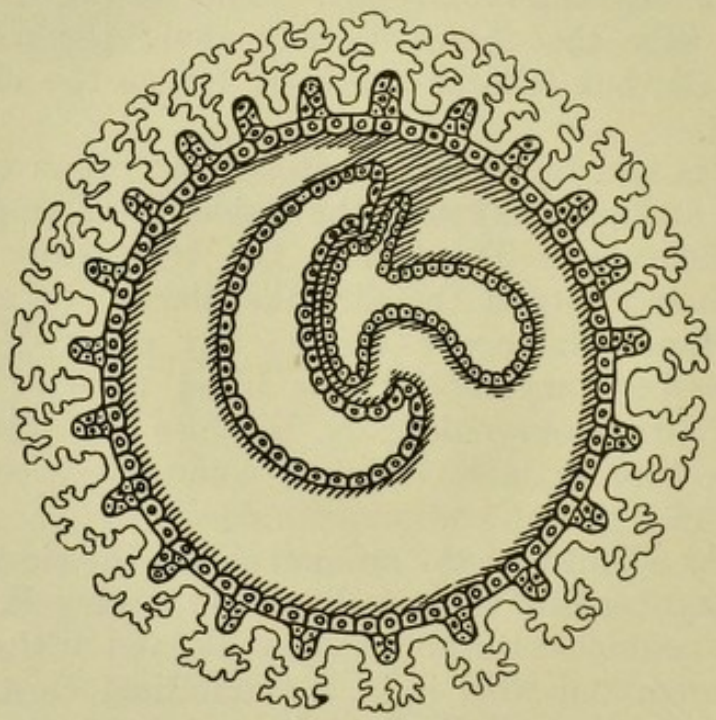


FIG. 39.

FIGS. 37, 38, and 39.—Diagrams showing the process of the "folding off" of the embryo.

The amniotic cavity is to the left, the entodermal cavity or yolk sac to the right. The yolk sac becomes partly constricted to form the primitive gut, from the hind end of which the allantois is observed growing out towards the chorion. The embryo in these diagrams is much too large in proportion to the size of the ovum.

the usual arrangement at birth of two arteries and one vein. At first the umbilical cord is attached to the embryo at the hinder end of its body, but later the caudal part of the embryo develops more rapidly, and at birth the umbilicus is situated at or near the middle of the body. The umbilical cord is generally fully developed by the sixth week.

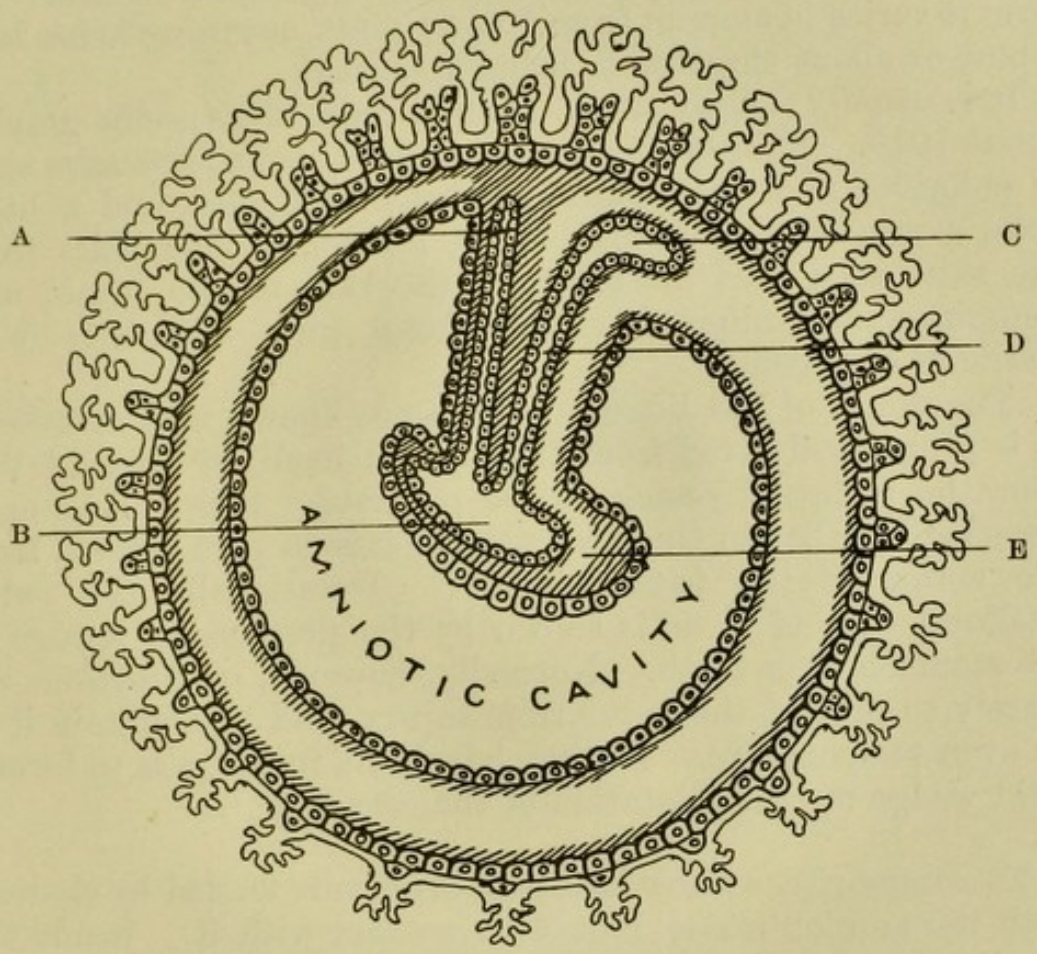


FIG. 40.

A. Allantois. B. Gut of embryo. C. Umbilical vesicle. D. Vitelline duct. E. Portion of body cavity being enclosed.

By the closing in of the sides of the embryo, a part of the space between the splanchnopleure and the somatopleure gets shut off to form the future pleuro-peritoneal cavity. The rest of the space between the amnion and the chorion soon becomes obliterated by the growth of the amnion, and the two membranes remain in contact thereafter. In most cases they can be readily separated at birth.

The growth of the amnion is in part due to its becoming

filled with a clear fluid—the **liquor amnii**. This fluid appears very soon after the amniotic space is formed, and in the second month it rapidly increases in quantity, and distends the amniotic sac.

At this time it is, relatively to the size of the fœtus, more copious than in the later months, although its absolute maximum in quantity is reached about the eighth month. At term it varies in amount from 1 to 2½ pints, anything below half a pint or above three pints being abnormal.

It is usually a clear straw-coloured fluid, of a specific gravity about 1010. Faintly alkaline in reaction, it contains salts such as chlorides and phosphates, a trace of albumen, and a little urea, along with epidermal scales, lanugo, or fine hairs from the skin, sebaceous matter from the skin of the fœtus, and sometimes meconium from the fœtal gut. Normally it is sterile of organisms.

The origin of the liquor amnii is not known with certainty. It is probably derived from the amnion itself, by transudation from the maternal vessels of the placenta. It is still an open question whether in the later months it is in part derived from the action of the fœtal kidneys. Occasionally the fœtus swallows some of it, as is shown by the presence of lanugo in the stomach after birth. Normally, however, its functions are merely to protect the fœtus from injury, and to maintain it in an even temperature. During labour its function is to form a fluid wedge for the dilatation of the cervix.

To summarise, we now have the ovum surrounded by chorion, with the amnion inside it and in contact with it. Inside the amnion, floating in the liquor amnii, is the embryo in the form of a bent tube, attached near its tail end to the chorion by the developing umbilical cord.

As it is not proposed to follow the development of the embryo further in detail, it may be as well just to summarise the destinies of the various layers.

The Ectoderm forms:—The epidermis, hair, nails, skin glands, dental enamel; the whole nervous system, the nervous parts of the sense organs, and the lens of the eye; the mucosa of the mouth, nose, and lower part of the rectum.

The Mesoderm forms:—The connective tissues, including bone and teeth, except the enamel; the muscles, striped and

unstriped; the circulatory system; the blood; the lymphatic system; the serous membranes; the kidneys and ureters; the internal organs of generation.

The Entoderm forms:—The mucosa of the alimentary tract, except the parts mentioned; the epithelium of the glands connected with it, such as liver, pancreas, etc.; the epithelium of the larynx, trachea, and lungs; the epithelium of the bladder and urethra.

CHAPTER VII

THE EMBEDDING OF THE OVUM AND DEVELOPMENT OF THE PLACENTA

We must now return to the ovum as it lies in the ovarian end of the Fallopian tube, where it has been fertilised by the spermatozoon. Its further passage along the tube into the uterus is believed to occupy seven days, and by the time it reaches the uterus it has developed to the stage of a small blastocyst. The outer covering of the blastocyst is the extra-embryonic ectoderm, or as it is usually called, the trophoblast (see p. 55). The term trophoblast is used to indicate that it has a nutritive function only, and is not engaged in the actual formation of the embryo.

We must now look more closely at the structure of this trophoblast. Even in the earliest known human ovum, which was just about seven days old, it was found to consist of two layers. The inner layer consists of cells with large pale nuclei, arranged more or less regularly like a cuboidal epithelium. This is known as the **cyto-trophoblast** or **Langhans' layer.**

Outside this is a thick investment of loose vacuolated undifferentiated protoplasm, with numerous small deeply-staining nuclei throughout it, but *with no divisions into cells*—the **plasmodi-trophoplast or syncytium.** The inner part of this layer has numerous spaces in it, formed by vacuolation, but in the outermost portions the vacuolations have become more numerous and larger, and have run together in such a way that the whole layer is, as it were, "spun out" into a sort of open sponge-work.

This syncytium has the power of destroying other tissues.

Probably it does so by secreting a ferment which digests them. The result is that when the ovum comes to rest in the uterus, it proceeds at once to eat its way through the surface epithelium into the substance of the endometrium.

The syncytium simply digests and dissolves the tissues in its immediate neighbourhood, and so the ovum eats its way deeper and deeper into the endometrium. Ultimately it is altogether buried, and the point of entrance becomes sealed up by blood-clot that later becomes organised. In the substance of the endometrium the ovum eats out a small "implantation cavity" for itself, which is filled with maternal blood escaped from the capillaries opened up by the destructive advance of the syncytium.

Thus we have the ovum completely embedded, lying free in a tiny cavity in the mucous membrane lining the uterus—a cavity full of blood, in which the ovum lies bathed, and from which it presumably absorbs nourishment by osmosis through its trophoblast (Fig. 41).

The Decidua

As a result of impregnation the mucous membrane of the uterus undergoes certain changes in structure, and is henceforth known as the **decidua.** Recent researches indicate that the fertilised ovum may enter the uterus at any stage of the menstrual cycle. The surface of the endometrium may not be quite smooth, and the ovum may possibly be arrested by some ridge or projection of the surface. Here it embeds itself, and the destructive and invasive action of the syncytium is soon followed by a reaction on the part of the uterus. This reaction is characterised by a rapid transformation of the small, primitive, connective tissue cells of the stroma of the endometrium into large oval or polygonal "epithelioid" cells with large pale oval nuclei. These are the **decidual cells**, and they are probably thrown out as a line of defence against the advance of the syncytium (Turner). The glands of the endometrium become enlarged and dilated, the capillaries distended with blood, and the whole membrane becomes markedly thickened and soft and œdematous.

Instead of being only about one-eighth of an inch thick, it swells until it may even be as much as half an inch in depth. In this growth the glands take a very active share, and increase so much in length that in order to accommodate themselves,

they become folded backwards and forwards in their middle parts. The effect of this is to make the middle portion of the

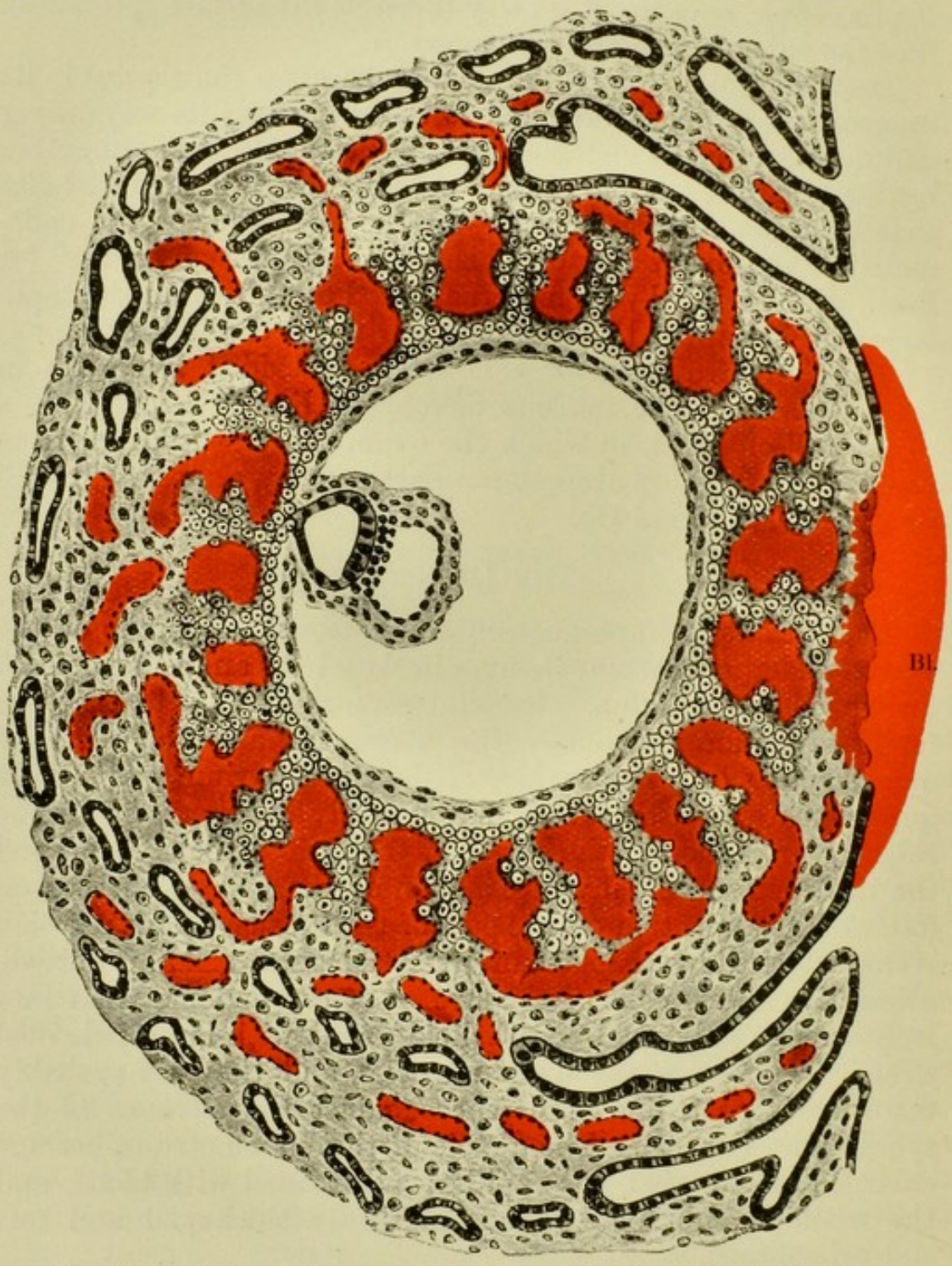


FIG. 41.—Diagram of human ovum embedding itself in the decidua. (*Quain's Anatomy*, T. H. Bryce.)

Bl. indicates the blood-clot at the point of entrance of the ovum. The extravasated blood occupies the spaces or blood lacunæ between the strands of trophoblast. The mesoblast forms the inner layer of the chorion and surrounds the amnion and yolk sac.

decidua full of distended gland spaces, whereas the more superficial portion contains only the mouths and necks of the glands supported in a stroma packed with the decidual cells. If a section be made through the decidua, it thus appears to be divided into three layers—the superficial part being compact in structure, and hence known as the **superficial compact layer**, while the deeper part is known as the **spongy layer.** The deepest part of all, immediately next the muscle wall, contains only the blind ends of the glands (many of which actually penetrate the muscle), and is sometimes described as a third layer —**deep compact layer** (Fig. 42).

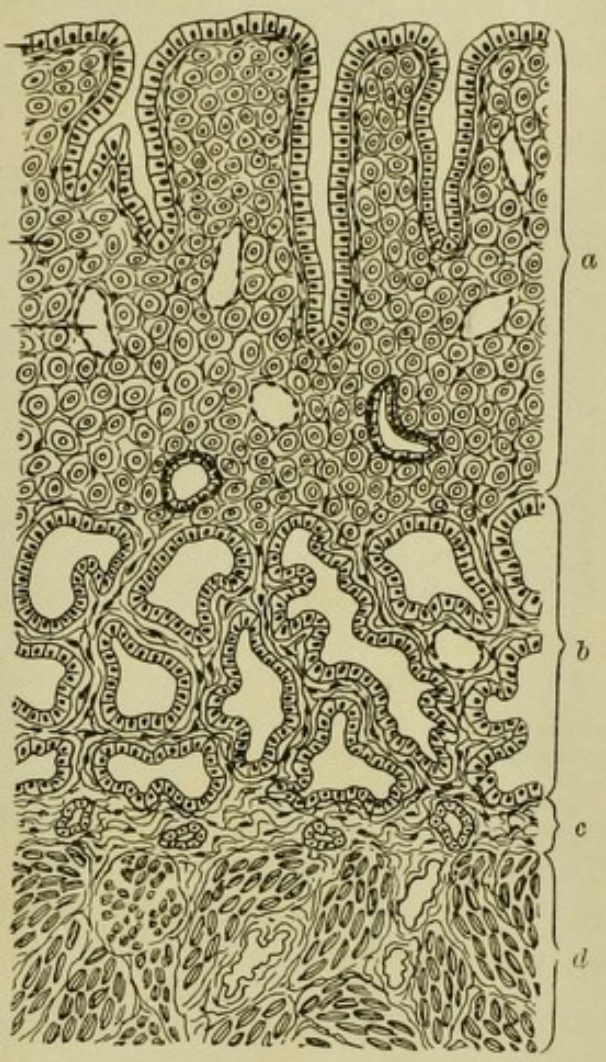


FIG. 42.—Diagram of section through decidua vera.

a. Superficial compact layer. *b*. Spongy layer. *c*. Deep compact layer. *d*. Muscle wall of uterus. *e*. Surface epithelium. *f*. Decidual cells. *g*. Blood-vessel.

For purposes of description the decidua is divided further into three parts according to its relationship to the ovum. The part on which the embedded ovum rests is called the **decidua basalis** (or, to give it the older name, the **decidua serotina**). The part superficial to it, *i.e.* shutting it off from the cavity of the uterus, is called the **decidua reflexa,** or the **decidua capsularis.** (Neither term is correct, and until a correct one is adopted, it is best to keep to the older name "reflexa".) Lastly, the decidua lining the rest of the cavity of the uterus is called the **decidua vera.**

The ovum embeds itself about the middle depth of the decidua, just where the superficial compact is passing into the

spongy layer; therefore the decidua reflexa only presents on section the appearances of the superficial compact layer, while the decidua basalis presents the spongy layer and the deep compact layer. The decidua vera, on the other hand, presents all three layers on section. Very early in pregnancy the glands degenerate and disappear, all except their blind ends. They therefore take no part in the formation of the placenta.

As the ovum grows and projects more and more into the cavity of the uterus, the decidua reflexa becomes thinned out, and ultimately, when the ovum occupies the whole of the cavity, as it does after the end of the third month, the reflexa and the vera fuse into one. Previous to this the columnar epithelium covering the decidua has given place to a layer of flatter cells. The further growth of the ovum causes a pressure atrophy of the fused membranes, and by the time of labour they constitute only a very thin membrane.

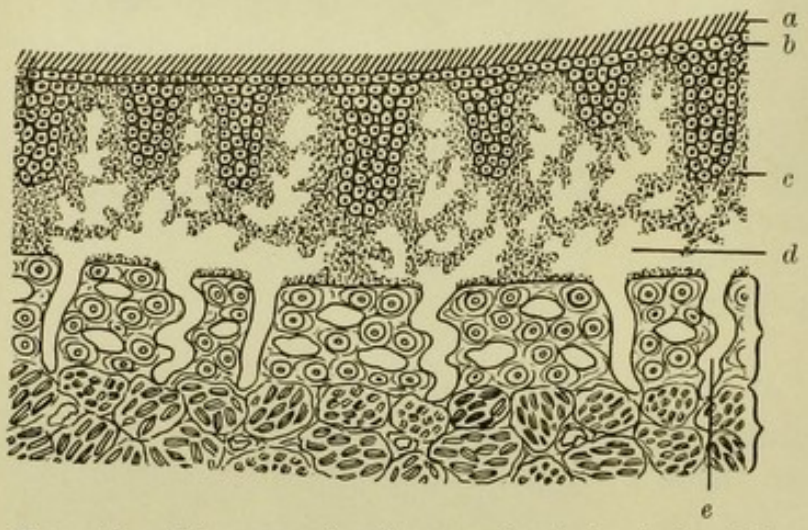


FIG. 43.—Diagram of early growth of chorionic villi.

a. Mesoblast of chorion. *b*. Cells of Langhans' layer. *c*. Syncytium. *d*. Chorio-decidual space. *e*. Maternal blood-vessel.

THE DEVELOPMENT OF THE PLACENTA

The first step in the development of the placenta is the formation of the chorionic villi by which the little ovum attaches itself to the walls of the implantation cavity. At first the cavity is filled with irregular outgrowths of the syncytium, with necrotic endometrium more or less dissolved by its action, and by effused maternal blood. Soon the necrotic endometrium disappears, and we find the ovum attaching itself to the walls of this blood-filled cavity by more or less regular moorings (Fig. 41). Langhans' layer sends out definite buds, which grow outwards through the syncytium, and in so

doing become invested with a covering of it (Figs. 43 and 44). These buds, consisting thus of the two layers of the trophoblast, grow out in all directions across the cavity to the surface of the decidua, and as they do so they give off lateral branches, until their structure becomes as complex as the branching of a tree. Next, the mesoblast lining the inside of the trophoblast sends out projections which grow along the inside of the epithelial branches and form what may be called a "core." This mesoblastic core grows out to the very tips of the epithelial branches, or, as they are now called, the **chorionic villi.** In the mesoblastic core the embryonic blood-vessels develop, and these become directly continuous with the vessels of the belly-stalk or future umbilical cord, and so with the circulation of the embryo (Fig. 45).

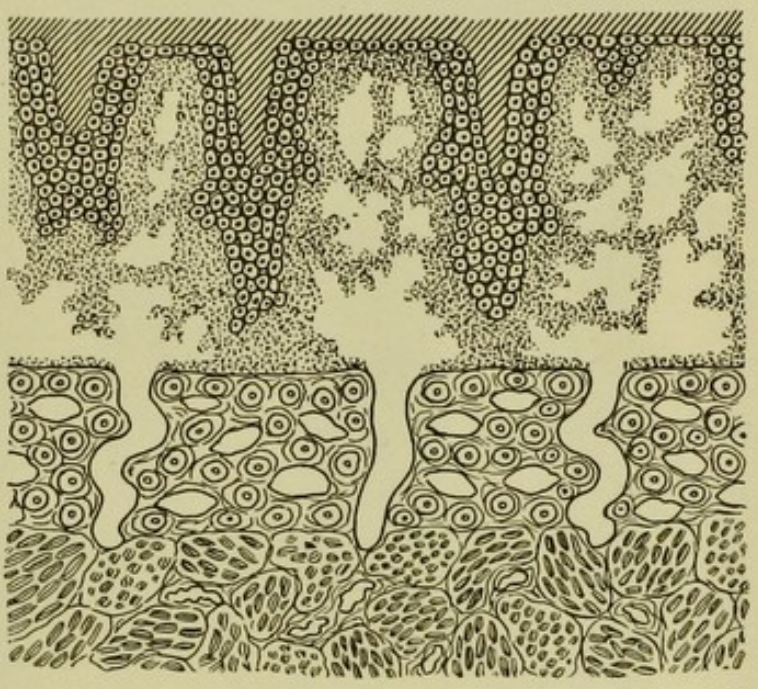


FIG. 44.—Diagram of early growth of chorionic villi. Mesoblastic core growing out into villi.

As they grow, the villi eat into and open many capillary vessels in the decidua, and the blood pours out of these into the spaces between the villi, and into the vacuolated spaces in the early trophoblastic sponge-work. Thus the space between the chorion and the decidua (**chorio-decidual space**) becomes by the growth of the villi subdivided into an enormous number of smaller spaces, the **intervillous spaces**, and through them the maternal blood very slowly circulates. These spaces are lined with syncytium—being, in fact, merely the spaces between the villi; but although it is not a vascular endothelium, the blood does not coagulate in contact with it (Fig. 45).

At first the villi develop all over the surface of the ovum, and attach it to the decidua reflexa as well as the serotina.

But as the ovum grows the reflexa becomes more and more thinned out, and the blood-supply to it more and more meagre. Hence the villi attached to it become gradually of less and less nutritive value to the ovum, and they gradually atrophy (Fig. 46). Ultimately they disappear altogether, and the surface of the chorion becomes divided into the two areas—the **chorion læve** or smooth chorion in contact with the decidua reflexa, and the **chorion frondosum** or shaggy chorion in contact with the decidua basalis. In this chorion frondosum the villi increase and multiply to a great extent, as the blood-supply to the decidua basalis is very free (Fig. 46).

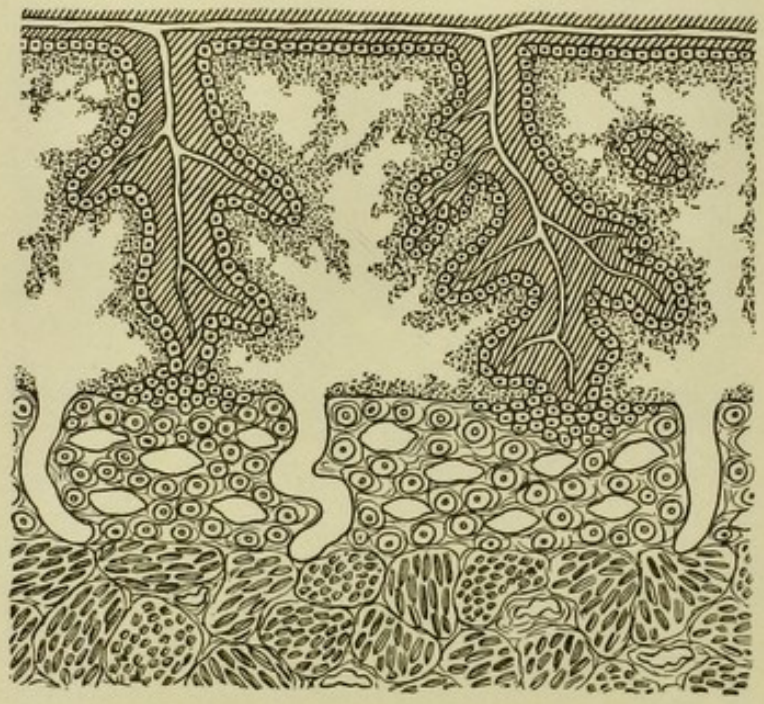


FIG. 45.—Diagram of early growth of chorionic villi. Villi becoming vascularised and fixed to surface of decidua.

The placenta consists of the chorion frondosum, the decidua basalis, and, between the two, the chorio-decidual space containing maternal blood. It will be observed from what has been said, that the placenta is in its earliest stages diffused all over the ovum, but that it later becomes restricted to one area—the decidua basalis. The diminution in area is, however, more than made up for by the greater specialisation of growth in that area.

The process of restriction to the basalis area is a gradual one, first becoming obvious about the middle of the second month. By the end of the third month it is complete, the placenta is purely discoidal in shape, and its mature structure fully developed. The placental area has grown to one-quarter or even one-third of the area of the uterine wall, and this proportion it maintains to the end.

The villi of the placenta are generally described as being of

two kinds. This division refers to the function only. Some are primarily "fastening" or "anchoring" in their function. These pass right down to the *surface* of the decidua. There they attach themselves firmly by an outgrowth of the cells of Langhans' layer laterally on both sides. The majority of the

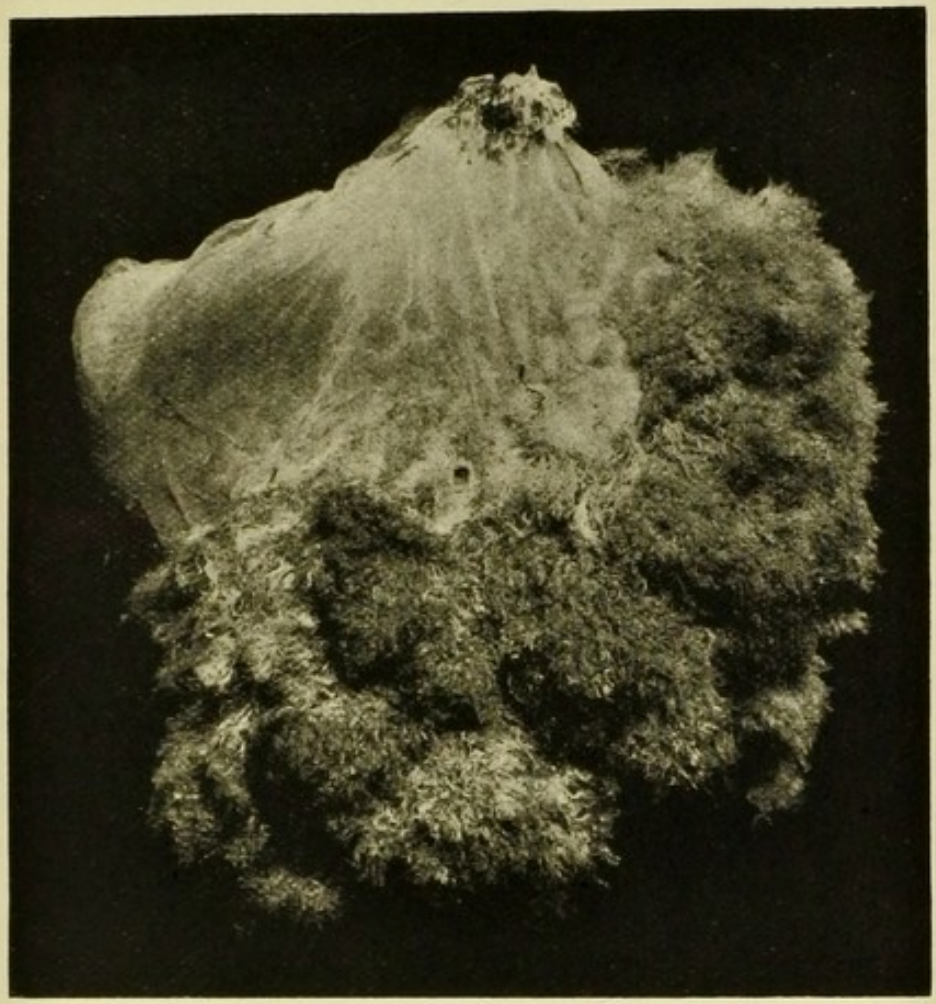


FIG. 46.—Photograph of injected human chorion showing the chorion frondosum and the chorion læve. (From a specimen in the Obstetrical Museum, University of Edinburgh.)

villi are nutritive in function (so-called "terminal" villi), and these do not, as a rule, reach the decidual surface, but divide and branch in a complex way, and lie bathed in the maternal blood slowly circulating through the intervillous spaces. The primary stems of the villi, where they come off from the chorion, are fairly thick by the time they are full grown; the terminal branches, on the other hand, are very delicate. The whole villus from trunk to tip is very freely vascularised, by

delicate capillaries for the most part, which communicate with the vessels on the surface of the chorion and so with the umbilical vessels (Fig. 49).

By the time the placenta is fully developed, the decidua basalis is reduced to a very thin and degenerated layer. The maternal blood enters the placenta by the small arteries of the decidua, which are continuous with the spiral arteries of the uterine wall, and leaves it by veins continuous with those in the uterine muscle. During the growth of the placenta these vessels enlarge greatly ; hence the large sinuses of the placental site that are a source of possible bleeding after the separation of the placenta. At the very edge of the placenta the decidua sends in a projecting shelf under the surface of the chorionic membrane. This "subchorionic decidua" greatly strengthens the attachment of the placenta to the uterine wall, as well as delimiting its area.

To recapitulate the structure of a villus—it consists of two layers of epithelium, the syncytium outside, and Langhans' layer inside. Within these the mesoblastic core consists of delicate connective tissue in which lie the fœtal blood-vessels (Fig. 47).

Under normal conditions there is **no mixture of fœtal and maternal blood.** The fœtal blood is developed within the fœtal blood-vessels, and all the metabolic and respiratory exchanges between it and the maternal blood take place through (1) the walls of the fœtal capillaries, (2) the delicate mesoblastic core, (3) Langhans' layer, and (4) the syncytium.

The placenta is separated from the uterine wall during labour through the deepest part of the spongy layer of the decidua basalis. The dilated gland spaces render this the weakest layer, like the row of perforations between postage stamps.

The placenta at term is a roundish, flat organ, about nine inches in diameter, and three-quarters of an inch in thickness at the centre. It becomes thinner at the edges where it passes with direct continuity into the chorion læve. The fœtal surface is covered with amnion, a smooth, shining membrane that can be stripped off up to the insertion of the umbilical cord. Below it is the somewhat roughened surface of the chorion, with the branches of the umbilical vessels. Frequently a large vein—the marginal sinus of Meckel—runs round the outer margin of the placenta ; more often it is only visible in parts of the circumference. The maternal surface

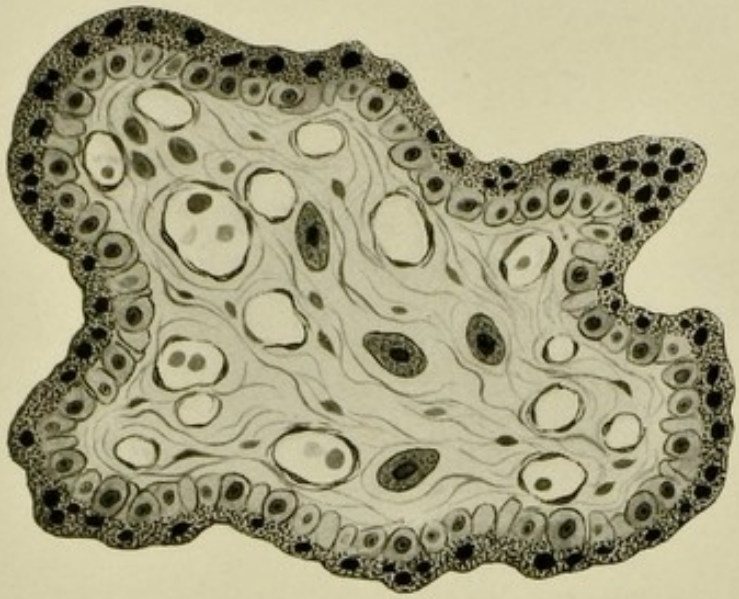


FIG. 47.—Transverse section of chorionic villus about the third month.

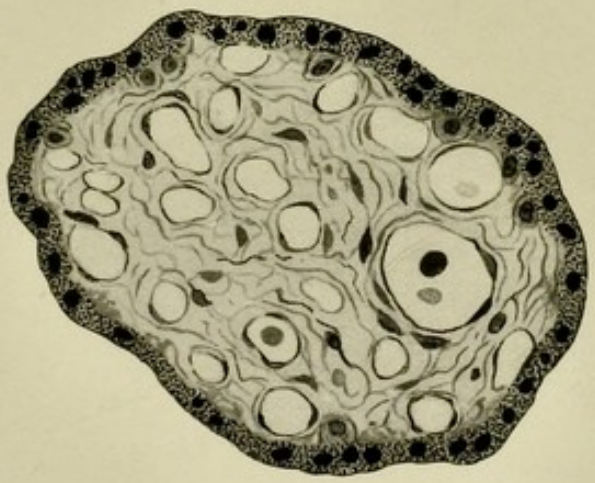


FIG. 48.—Transverse section of chorionic villus at full term.

is dark and fleshy in appearance, and divided into several "cotyledons." The surface consists of the attenuated layer of

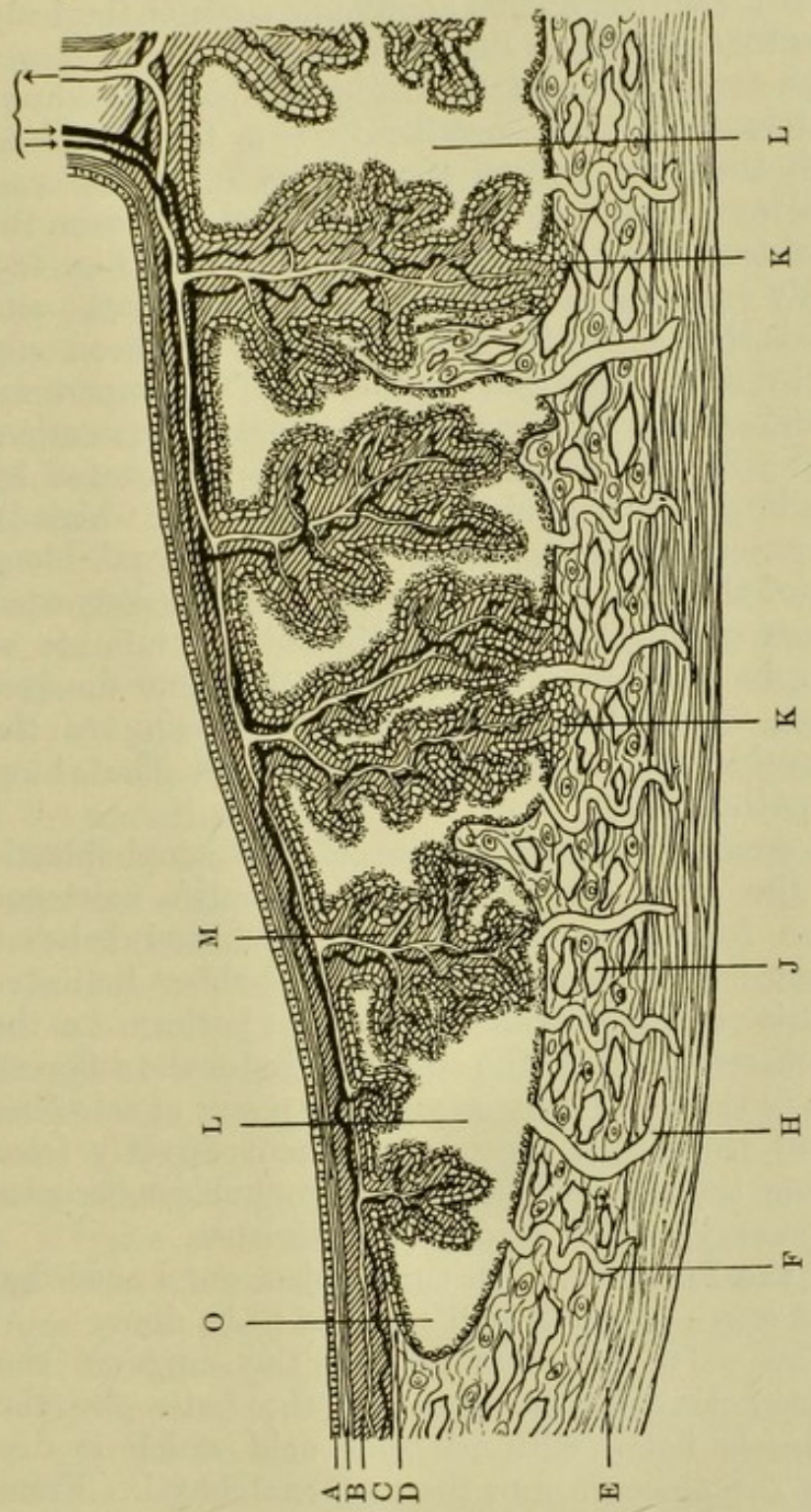


FIG. 49.—Diagram of section through placenta and wall of uterus.

A. Epithelium of amnion. B. Mesoblastic connective tissue layer of amnion. C. Mesoblastic connective tissue layer of chorion, with branches of umbilical vessels. D. "Subchorionic decidua." E. Muscular wall of uterus. F. Maternal artery. H. Maternal vein. J. Maternal blood sinus on section. K. Fastening villus attaching itself to surface of decidua by proliferation of Langhans' layer. L. Intervillous space—one of the innumerable subdivisions of the chorio-decidual space. M. Villus showing core containing vessels, covered by Langhans' layer and syncytium. O. Marginal sinus.

decidua basalis. If the placenta be torn open and held under a stream of water, its substance can be recognised as consisting of the innumerable branches of the villi. If the maternal

surface be examined closely numerous vessels will be seen opening upon it.

The placenta generally weighs about one-sixth of the body weight of the fœtus—usually a little over a pound.

Microscopical examination of the full-term placenta shows that it has undergone some degeneration, a fact quite in consonance with the very limited span of its functional use. Thus Langhans' layer has altogether disappeared, and even the syncytium is reduced to a thin covering to the villi (Fig. 48). Very occasionally even the syncytium disappears at parts, and the fœtal blood is then separated from the maternal blood only by the endothelium of the fœtal capillaries. The superficial part of the decidua has undergone a fibrinous degeneration. In many of the villi the vessels have become obliterated by endarteritis, leading to a necrosis of the epithelium, which in its turn has caused the coagulation of the maternal blood around the tips of the villi. These tiny clots become converted into little masses of fibrin, and form the minute infarcts so constantly seen in the placenta at term. In some diseases this process goes on much more extensively, leading to the infarction of considerable areas of the placenta. That, however, is always pathological.

The almost complete disappearance of the trophoblastic epithelium in the later months of the placenta's existence must have some functional significance. Lochhead believes that the exuberance of the early growth of trophoblast indicates that it has selective and metabolic functions to perform for the young cells of different sorts in the embryo. Later the different varieties of cells in the fœtal body acquire the power of selecting and metabolising their own special nutriment directly from the blood. Hence the intervention of the trophoblast becomes less and less necessary, and it gradually diminishes.

Functions of the Placenta.—On this subject our knowledge is still hazy, and much research still remains to be done.

(1) *Respiratory.*—The placenta acts as the lungs of the fœtus. The blood leaving the body of the fœtus by the umbilical arteries is laden with carbonic acid which it discharges through the placenta into the maternal blood. From the latter it receives oxygen which it conveys to the fœtus through the umbilical vein.

(2) *Nutritive.*—From the time of the appearance of blood

in the chorionic vessels, the fœtus obtains its food from the maternal blood by means of the placenta. Nitrogenous substances have been proved to pass through the placenta, although how they do so is not definitely settled. It may be that they pass through as soluble peptones, or it may be that the syncytium acts upon them by some enzyme, and transmits them in a simpler form. Fats also pass through the placenta, and inorganic substances like iron have been shown to be broken into simple compounds by the syncytium and passed into the fœtal circulation. The passage of carbohydrates is associated with what is called (3) the *glycogenic function* of the placenta. By this is meant that in the early months of pregnancy before the fœtal liver is sufficiently developed to functionate, the placenta takes on its work and stores up glycogen for the fœtal body. The glycogen is probably split up into glucose by the syncytium, and as such absorbed. This glycogenic function has been proved in some lower animals, and probably applies to the human placenta also.

From these statements it will be obvious that the syncytium is not a mere filter, but is probably gifted with considerable activities in the way of selecting and altering the constituents of the maternal blood.

That it has the power to reject undesirable substances is clear, and constitutes what is known as (4) the *barrier action* of the placenta.

It is found, for example, that usually maternal diseases are not communicable to the fœtus; that normally there is no passage of the maternal blood cells from the mother into the fœtus; that there is no passage of large parasites like that of malaria through the placenta; and that chemicals, except some that are highly diffusible, are not usually transmitted. It is quite true that sometimes the barrier is broken down, and some toxins or organisms, for example, allowed to pass. These cases may, however, quite legitimately be regarded as, in all likelihood, abnormal.

(5) *Excretory.*—The waste products of fœtal metabolism are carried to the placenta and passed through it to the maternal blood. These are not great in quantity, as the active metabolism of the fœtus is mostly constructive. It is possible that some urea may be excreted into the liquor amnii by antenatal micturition.

Umbilical Cord.—It has been shown how the umbilical cord is developed from the abdominal pedicle, and what it is composed of—two arteries and a vein which become continuous in the abdomen with the hypogastric arteries and the ductus venosus respectively, and relics of the vitelline duct and the allantois. These are bound up in a gelatinous connective tissue called Wharton's jelly, and covered by an epithelium consisting of several layers of stratified cells, continuous with the amnion at the insertion of the cord, and with the skin epidermis at the umbilicus. Morphologically it is continuous with the latter.

At term the umbilical cord is about 22 inches (54 cm.) long on an average, and $\frac{1}{2}$ an inch (1 cm.) thick. It is twisted spirally from left to right, and the arteries are coiled round the vein. Frequently it presents thickenings of the mucoid Wharton's jelly which form the so-called "false knots."

CHAPTER VIII

CHANGES IN THE MATERNAL ORGANISM CONSEQUENT UPON IMPREGNATION

Uterus. — During pregnancy the uterus enlarges in order to contain the rapidly growing ovum inside it. At the beginning of pregnancy it is an organ measuring externally 3 by 2 by 1 inches (7·5 × 5 × 2·5 cm.), and containing a potential cavity only. At the end of pregnancy it measures about 12 by 9 by 8 inches (30 × 22·5 × 20 cm.), and its capacity is reckoned to have increased over 500 times. In weight also it increases from about 1½ ounces to about 30 ounces (45 to about 1000 grams). All the component tissues of the uterus share in this growth—the serous, muscular, and mucous layers, the blood-vessels, nerves, and lymphatics. The changes in the mucosa have already been described.

The growth of the *muscular tissue* is in part due to enormous enlargement of the already existing fibres, and in part to the appearance of new fibres. The existing fibres have been estimated to grow to about 10 times their original length and 5 times their original thickness. As a result of the growth there is gradually evolved a somewhat indefinite arrangement of the muscle tissue into several layers. This arrangement may be stated briefly as—

A. Extrinsic layer—

A thin network of fibres passing in different directions over the surface, and passing out into the different ligaments.

B. Intrinsic layers—

(1) An outer layer whose fibres run mostly longitudinally from the cervix in front, over the fundus, to end in the cervix posteriorly.

(2) A middle layer of fibres running in an interlacing fashion in all directions, many fibres having a figure-of-eight course round a tortuous blood-vessel. This layer constitutes the greater part of the thickness of the uterus, and its fibres are the so-called "living ligatures," which close the blood-vessels after the separation of the placenta at labour.

(3) An inner layer of fibres having a more or less circular course, most marked at the openings of the tubes, and the internal os, where they form a sort of sphincter.

Blood-vessels.—The arteries become enlarged and thickened. Their tortuosities become more marked, especially in the case of vessels supplying the placental site, a circumstance which renders them the more easily occluded by the contraction of the muscle fibres at the close of labour. The veins become even more enlarged, particularly those near the placental area which open out to form the wide placental sinuses. They also run in a very tortuous or irregular way, occasionally turning sharply back upon themselves.

Lymphatics.—The whole lymphatic tract of the uterus becomes enormously increased during pregnancy in preparation for the active functions placed upon it during the puerperium. The collecting channels in the broad ligaments share in the growth. It is these facts which make sepsis in the puerperium so dangerous.

Nerves.—These also increase in size and number. It has been stated that the cervical ganglion increases to about double its ordinary size. Functionally the nerves become more active, and the uterus during pregnancy correspondingly more susceptible to reflex stimulation.

In the first three months the growth of the uterus is due almost entirely to the increase in its constituent tissues, and its walls become thicker. After this the enlargement is due in great part to the distension caused by the growing ovum, and the walls become progressively thinner. At term the walls of the uterus average about a quarter of an inch in thickness. As it grows the uterus loses the firm consistence characteristic of the non-pregnant organ, and assumes a soft, doughy, or elastic consistence. In the latter half of pregnancy

the fœtus can be readily palpated through the thin walls. It also alters in shape as pregnancy progresses. In the first three months it loses its pyriform shape and becomes more and more globular, while from the fourth month it again becomes more oval as it grows up into the abdomen.

Size of the Uterus at different Months.—Although there are considerable differences between individual cases, yet, broadly speaking, the uterus grows at a uniform rate, and its size may therefore be taken as a rough index to the period of gestation attained. At the end of the second month the uterus is about the size of a goose's egg. At the end of the third month it is about the size of a large orange, and its upper border is palpable above the symphysis. At the end of the fourth month it has risen above the brim of the pelvis, and come into contact with the anterior abdominal wall, the fundus being at a point about two inches above the symphysis. At the end of the fifth month the fundus is about two finger-breadths below the umbilicus, while at the end of the sixth month it is just

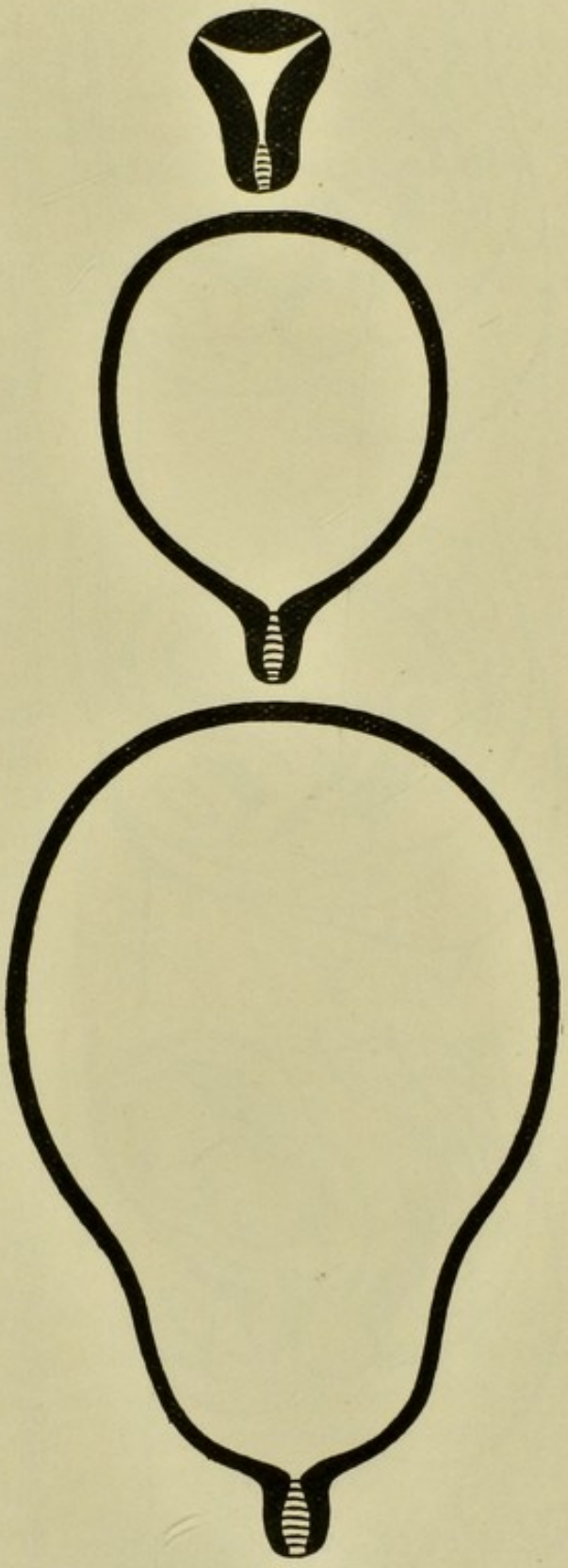
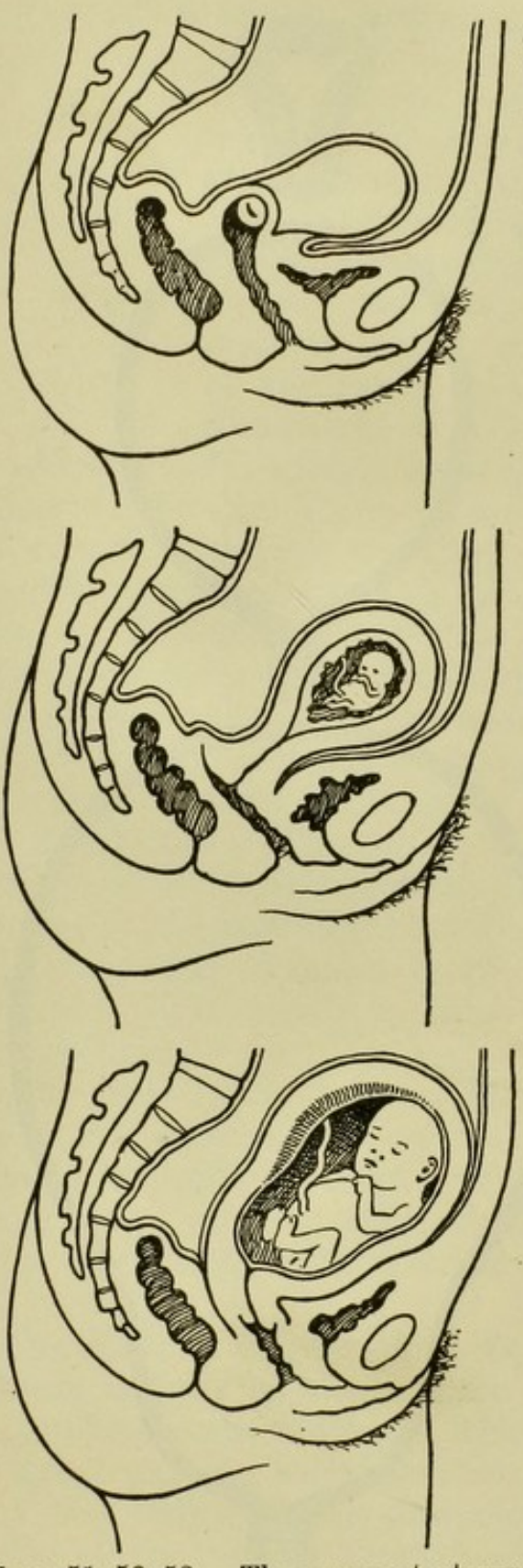


FIG. 50.—Diagram of the changes in size and shape of the pregnant uterus at the first, fourth, and ninth months.



FIGS. 51, 52, 53.—The pregnant uterus at the end of the second, third, and fourth months.

above the umbilicus. During the seventh, eighth, and ninth months it rises by about two finger-breadths a month until at the end of the ninth it is at the level of the ensiform cartilage. During the tenth month, or last two weeks of pregnancy, it sinks down again somewhat, so that it comes to lie one or two finger-breadths below the xiphisternum (see Fig. 54).

In the first weeks of its enlargement the uterus falls more forwards upon the bladder, its natural anteflexion being increased. Its growth in these weeks is also somewhat asymmetrical, and the portion containing the ovum may sometimes be felt to bulge, while in other cases a slight longitudinal furrow between that portion and the rest of the uterus has been detected.

Cervix.—The growth is very largely confined to the body of the uterus, although there is probably a slight hypertrophy of the tissues of the cervix. The increase of vascularity is, however, the more prominent change in this part. This causes a progressive softening of the cervix and an increase in its glandular secretion, resulting in the formation of a firm plug of mucus, which occludes the canal during pregnancy. The softening begins around the external os and spreads upwards and outwards

to involve the whole cervix. The cervix of the non-pregnant uterus has been likened in consistence to the tip of the nose, while during pregnancy it softens to the consistency of the lip. This softening and the increased succulence of the vaginal vault produce from the third month onwards what is known as the "apparent shortening of the cervix." The cervix as measured by the length of the canal is not shortened, but the vaginal portion feels less prominent to the examining finger owing to the filling out of the fornices by the softness of the vaginal wall, and to the increased anteflexion of the uterus.

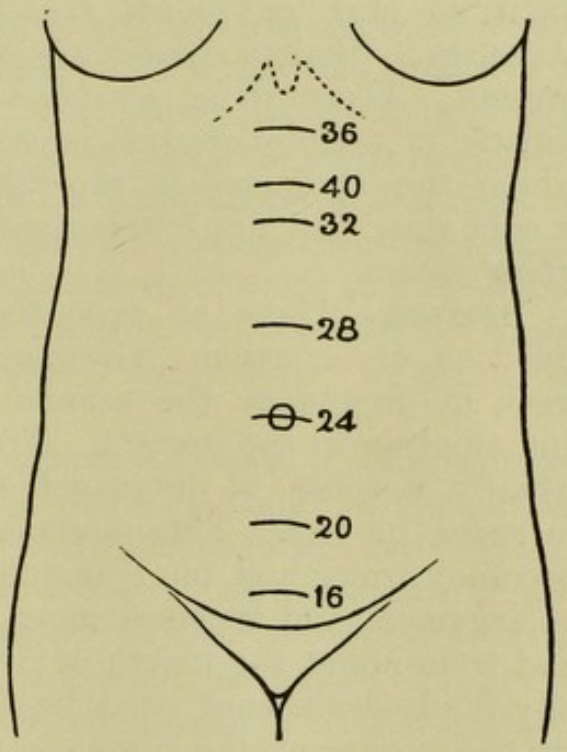


FIG. 54.—The level of the fundus of the uterus at different weeks.

Ovaries and Tubes.—These share in the increased vascularity, and the ovary on one side will be found enlarged owing to the presence of the corpus luteum of pregnancy. As the uterus rises up into the abdomen the tubes and ovaries come to lie almost vertically by the sides of the uterus. This is rendered possible by the widening out of the layers of the broad ligaments. Further, as the uterus grows and expands in the region of the fundus, the attachment of the tubes becomes relatively farther from the upper margin, and at term they are attached about one-third of the way down the sides of the uterus.

Vagina.—The increased vascularity causes an increase in the vaginal secretion. The walls also become darkened in colour to a bluish cyanotic shade, and occasionally the veins in the lower portion become varicose. There is a slight actual hypertrophy of the walls, which is most noticeable in the subepithelial papillæ. These sometimes become enlarged so as to project above the surface, giving the wall a feeling which has been compared to that of a calf's tongue.

Skin.—In many women, particularly brunettes, there are

deposits of pigment in the skin. These are seen characteristically in the linea alba, and sometimes as branching transverse lines springing from it. Irregular patches are sometimes seen on the face and neck, the so-called chloasma uterinum (uterine mask).

The rapid enlargement of the abdomen causes great stretching of the skin of the abdominal walls. This leads to the rupture of the deeper layers of the cutis, which shows itself as pink or bluish streaks in the lower part of the abdomen. Similar streaks are seen on the lower aspect of the breasts. These *striæ gravidarum* are not necessarily characteristic of pregnancy, and may be found in any condition in which the abdomen is rapidly enlarged. After pregnancy is over they heal up, but permanent traces remain as white or silvery scars.

Breasts.—These at once begin to prepare for their real function of lactation. Even as early as the second or third week of pregnancy the woman may be conscious of pricking and tingling in the breasts. From the second month there is usually a sense of increased fulness, followed by a visible increase in size. The mammary tissue at the same time becomes firmer and more nodular. The nipple shares in the enlargement and becomes more erectile and darker in colour, and from about the fourth or fifth month a few drops of thin oily fluid—colostrum—can be expressed. This fluid may dry on the surface of the nipple in the form of fine branny scales. During the third month there is a deposit of pigment in the areola around the nipple. The depth of colour varies from a deep pink in blonde women to a dark brown, almost black, in brunettes. At the same time Montgomery's tubercles make their appearance. These are paler raised spots scattered over the areola, fifteen to twenty in number. They are the enlarged and pouting mouths of sebaceous glands. In the later months a faint secondary areola may be seen outside the primary areola, but it is marked only in very dark women. The veins of the breasts early become more distended and prominent, and may be seen as dark blue lines coursing over the breast just under the skin. The striæ caused by rapid distension have been referred to already.

Blood.—Recent investigations by approved modern methods show that there are only very slight changes in the blood

during pregnancy. Towards the end of gestation there is a slight increase in the red cells and in their hæmoglobin content. There is also a slight leucocytosis, which rises rapidly just before labour, and persists during the first three or four days of the puerperium. After that it quickly disappears in normal cases. The alkalinity of the blood has been stated to be increased, but this has not been definitely proved.

Heart and Circulation.—Controversy has long existed upon the question whether there is or is not any hypertrophy of the heart in pregnancy. The modern view is that there is a tendency to dilatation of the right heart, and to some slight compensatory hypertrophy. This accounts to some extent for the frequently noted increase of cardiac dulness to the right of the sternum. But it must be remembered that the diaphragm and heart are displaced upwards towards the end of pregnancy, and the heart is thus brought more in contact with the chest wall, so that much of the increased dulness may be caused in this way.

The blood pressure is not noticeably raised during normal pregnancy, but during labour it rises as a result of the severe muscular contractions. There is no change in the arteries, but the veins often show varicosities due to the pressure of the growing uterus in the abdomen. These varices are most noticeable in the lower limbs and around the vulva.

The Ductless Glands.—There is normally a certain amount of thyroid enlargement during pregnancy, and it has been proved that pregnancy makes an increased demand upon that organ. The enlargement is therefore a true hypertrophy. Nicholson has advanced the theory that insufficiency of the thyroid secretion may be a cause of the toxic symptoms that sometimes appear in pregnancy.

The changes, if any, in the suprarenal bodies and hypophysis have not been determined with certainty. But in view of the stimulating effect of pituitary and suprarenal extracts on the uterus, it is likely that these organs do become modified in some way.

Kidneys and Bladder.—During pregnancy the quantity of urine is rather increased, but its chemical constitution should remain unchanged. Traces of albumen are often found. These may be due to vaginal secretion, but this should never be taken for granted. Even a very slight real albuminuria is of

the utmost significance, as will be shown in the discussion of the disorders of pregnancy. Small quantities of sugar are often found after the fourth or fifth month. In many cases investigation will show it to be lactose, reabsorbed from the breasts.

The bladder is pressed upon in the early weeks of pregnancy by the increased anteflexion of the uterus. In the latter half of gestation it may be drawn up into the abdomen by the ascent of the uterus, and become an abdominal organ. Towards term there may again be frequency of micturition, especially in primiparæ, owing to the uterus sinking down into the pelvis.

Lungs.—The depth of the chest is diminished by the ascent of the diaphragm, but the width is correspondingly increased. In the later months there is often some shortness of breath from the pressure on the diaphragm. There is an increased output of carbonic acid associated with the metabolism of the fœtus, but it has not been proved that the oxygen intake is increased.

Body Weight.—As the uterus and its contents grow, the body weight proportionately rises towards the latter half of pregnancy. A further gain in weight has been said to occur, and been put down to the deposit of fat and the increase of fluid in the tissues. It is very doubtful, however, if this additional increase is normal, or even frequent.

Nervous System.—There appears to be an increased susceptibility of the whole nervous system during pregnancy. This shows itself in various ways, most of which are on the verge of the pathological. The common "morning sickness" is an instance of the increased reflex excitability, and so also are the more occasional symptoms of salivation, neuralgias, perversions of appetite, and changes in temperament. These are more marked in women of naturally nervous temperament, and in the first half of pregnancy. During the early months the entire maternal organism has to readjust itself to the series of changes which have been indicated in this chapter, and it is not to be wondered at that the nervous system should suffer. Many women feel depressed and not in their usual health in the first half of pregnancy, but become quite restored to their ordinary health in the later months when the body has regained the proper balance of all its complex functions.

CHAPTER IX

THE DIAGNOSIS OF PREGNANCY

In the later months an uncomplicated pregnancy rarely presents any difficulty in diagnosis, but in the first two or three months it may be a matter of much difficulty to give a definite opinion. Absolute certainty is indeed impossible in these months, and unfortunately it is just at this time that a definite opinion is of most importance. In these months judgment must be based upon a number of symptoms and signs, none of which is certain, but the summation of which usually warrants a reasonably sure diagnosis. To the practitioner it is of the utmost importance to be right in his diagnosis, because the lapse of a few months will inevitably make the condition of affairs perfectly clear.

Pregnancy complicated with other conditions may at all stages present great difficulty in diagnosis, and probably all of even the most expert obstetricians and gynecologists have made mistakes in such cases in the course of their experience.

The signs and symptoms of pregnancy fall naturally into three groups, the *presumptive*, the *probable*, and the *positive*, according to the degree of certainty which they afford in the making of a diagnosis. They will be considered in order under these heads.

Presumptive Signs

These are largely the symptoms observed by the patient herself, and the more vague and indeterminate signs elicited on examination.

Suppression of Menstruation.—This is usually the first sign which leads a woman to think herself pregnant. It is a sign of the greatest value in married women who have hitherto been quite regular in their menstruation. It is, however, open to several fallacies. (1) Amenorrhœa may be due to other conditions such as chlorosis, early phthisis, or other general debilitating disease. (2) A short period of amenorrhœa may occur without pregnancy in newly married women; it may also be induced by the fear of pregnancy in unmarried women who have exposed themselves to the risk of it, and by the excessive desire for children in married women who are both barren and neurotic. (3) It may be due to the approach of the menopause.

On the other hand, (4) menstruation has been known to continue after the beginning of pregnancy. This is a very rare occurrence, but is theoretically possible during the first three months until the decidua vera and the reflexa have fused together by the ovum enlarging to fill the entire uterine cavity. Such menstruations are always very scanty compared with the usual periods. Less rarely there may be one scanty menstruation at the first month after conception. (5) Irregular bleeding due to threatened abortion may be mistaken for menstruation. This really explains most cases under the last heading. (6) Pregnancy may begin during lactation, even if, as is usual, there be amenorrhœa. Amongst women who menstruate during lactation, pregnancy may readily occur. (7) Pregnancy has been known to occur before the start of menstruation and after the menopause.

Morning Sickness.—Two out of every three women suffer from this in the early months of pregnancy. As a rule it begins in the second month and passes off at the end of the fourth. It is most commonly experienced when the woman first rises from her bed in the morning. In some there is simple vomiting of a glairy mucus; in others there is merely a feeling of nausea without actual vomiting; while others, more unfortunate, suffer from both. Normally it does not have any serious effect upon the health.

Mammary Changes.—The nature of these changes has been described in the last chapter. They are of very considerable significance in first pregnancies. In multiparous women, on the other hand, they are of less value, for the pigmentation of

the areola never entirely disappears after the first pregnancy, and milk, or a milky secretion, may remain in the breasts for years. Further, enlargement and the presence of milk may be observed in some cases of ovarian tumour.

Changes in the Abdomen.—The appearance of pigmentation and the *striæ gravidarum*, to which reference has been made in the last chapter, afford presumptive evidence of value as a confirmation of other signs. Of greater value is the progressive enlargement of the abdomen, which in any married woman during the child-bearing period is much more likely to be due to pregnancy than to anything else. It should be noted that in a number of cases there is an actual flattening of the lower part of the abdomen in the first two months. There is a French proverb which runs—"En ventre plat un enfant il y a."

In other cases there is an enlargement even in these early months from the accumulation of gas in the intestines or the deposit of fat. From the third month there is a steady enlargement due to the growth of the uterus, and from the fourth month the uterus can be palpated in the abdomen. The rate of its growth has been referred to (see p. 79). The shape of the abdomen varies in first and subsequent pregnancies. In the primigravid woman the abdominal muscles are more strong and taut, and the enlargement is not so noticeable. In the multipara the laxer muscles allow the uterus to fall forward to a greater extent and the enlargement becomes more prominent. If the patient lie on her back the uterus falls back on to the spinal column, and the tumour becomes diminished accordingly.

The state of the umbilicus should not be overlooked. In the first three months it is deepened and retracted. In the second trimester it gradually becomes shallower, and by the seventh month it is flush with the surface. In the last two months it becomes everted and protrudes above the skin surface. The uterine tumour is often slightly inclined to the right side of the abdomen. The intestines are massed above and behind it, so that it gives a dull note on percussion.

Quickening.—By this is meant the first conscious feeling by the mother of the movements of the fœtus in the uterus. Most commonly it occurs at the fourth and a half month, or just about mid-term. The reason for this is twofold. In the first place, it is not until then that the uterus comes to lie

closely in contact with the abdominal wall, and it is by the movements being transmitted from the uterine wall to the abdominal wall that the mother is made conscious of them. Secondly, in the earlier months the fœtus is probably less capable of movement, and the quantity of liquor amnii is relatively larger and prevents it from impinging upon the wall of the uterus.

The first felt movements are very feeble, and have been likened to the "fluttering of a bird in the closed hand." By the primigravid they may be mistaken for flatulence or colic, but the multipara will be able to recognise them. If the movements are not felt by the hand of the examiner little weight can be attached to this as a sign of pregnancy.

Irritability of the Bladder.—This is felt in the early weeks and in the last two or three weeks. At the beginning of pregnancy it is due to the increased anteflexion of the uterus. In the end of pregnancy it is due to the descent of the presenting part into the pelvis.

Various reflex nervous symptoms may appear, and may add some little confirmation to the diagnosis. They are of most value in second or subsequent pregnancies, when the patient has her previous experience to go upon. The more outstanding of these are the changes in temperament, despondency or peevishness, and the peculiarities, and sometimes depravities, of appetite. Thus women during pregnancy may feel longings for the most out-of-the-way articles of diet, particularly highly flavoured or spiced foods.

Probable Signs

These are all physical signs elicited by the physician on examination, and more or less directly connected with the uterus.

Change in Size of Uterus.—Nothing but pregnancy makes the uterus enlarge so rapidly, so steadily, and so uniformly. Therefore, while the progressive enlargement of the abdomen is only a presumptive sign, once it has been shown to be due to the growth of the uterus, the evidence is greatly strengthened. The rate of growth and the level of the fundus at different periods have already been discussed.

Changes in Shape of Uterus. — These have also been

mentioned in the previous chapter. They are important when taken along with the enlargement and consistency of the uterus. The globular shape of the uterine body in the early weeks, the asymmetry of growth (*Braun von Fernwald's sign*), and the possible detection of a furrow on the anterior or posterior wall must all be borne in mind.

Change in Consistency of the Body of the Uterus.—The fact that in the early weeks the uterus becomes more soft and elastic has been mentioned. This elasticity, or "early fluctuation," is known as *Rasch's sign.*

Hegar's sign is one of the most important of the signs to be elicited in the first few weeks. It consists in the detection by careful bimanual examination of a soft, compressible area between the cervix below and the elastic body of the uterus above. If the uterus is anteflexed, it is best felt by two fingers in the anterior fornix and the hand on the abdomen. If the uterus be retroverted, the fingers must be placed in the posterior fornix. Hegar's sign is due to the fact that usually the ovum is attached in the upper part of the uterine body, and that below it there is a portion of the uterus occupied only by the soft sponge-like decidua. In extreme cases it may feel almost as if there was a lack of continuity between the body and cervix, so compressible is this lower part of the body. This sign may be elicited from about the sixth week to the tenth week.

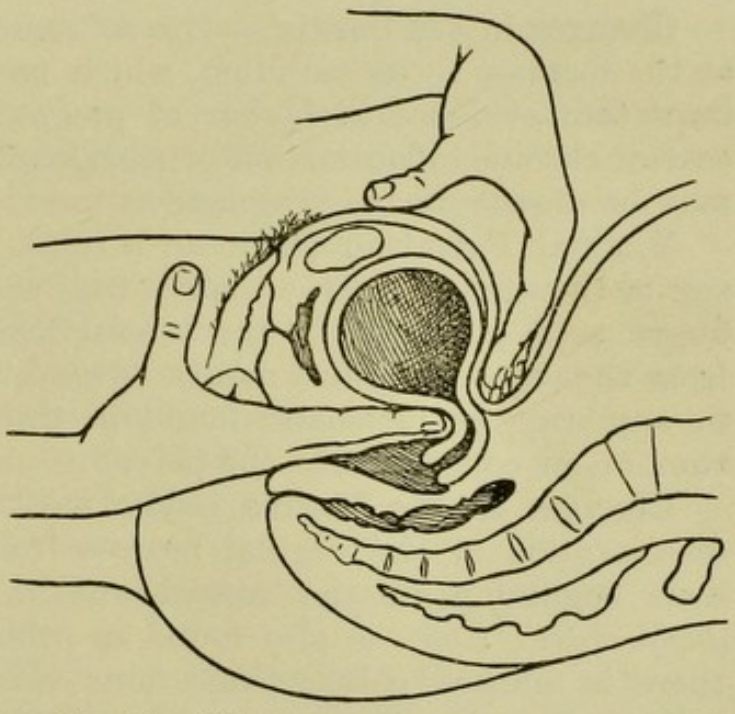


FIG. 55.—Method of eliciting Hegar's sign.

Intermittent Uterine Contractions.—This is sometimes spoken of as *Braxton Hicks' sign.* Early in pregnancy waves of contraction begin to pass over the uterus, and from the third month these may be felt on palpating the uterus bi-

manually. The contractions occur every five or ten minutes. After the uterus rises up into the abdomen they may be felt by the hand on the abdomen, the uterus growing hard and firm for a few moments during each wave of contraction. This is a very important sign, and very nearly a positive one. It may, however, be found in cases of hæmatometra, in which the uterus is full of retained blood; and in some cases of fibroid tumour of the uterus, in which there is a large amount of muscular tissue. In these latter cases the contraction is generally confined to one part of the tumour.

Changes in the Cervix.—The softening of the cervix as well as the increase in its secretion, which have been described, are important evidence in favour of pregnancy. In a cervix the seat of chronic inflammation or malignant disease these changes may be absent during pregnancy.

Vaginal Pulsation (*Osiander's sign*).—The increase in the size of the uterine arteries makes itself evident to the examining finger as a pulsation in the lateral fornices. It may be felt from the second or third month onward, but is not conclusive in any way, as it is also found in the case of any vascular tumour, or congestion of the pelvis.

Changes in the Vagina.—The most important is the blue discoloration of the vaginal mucosa from congestion, which is seen beginning in the second and third months. This—*Jacquemier's sign*—is also found in other conditions in which there is marked pelvic congestion. Associated with it is the occasional varicosity of the veins about the lower end of the vagina—*Kluge's sign*. There are also the increase of secretion and the papillary roughening of the mucous surface to be observed.

Ballottement.—This is a French word meaning the tossing of a ball, and is applied to a method of examination by which the fœtus is moved passively inside the uterus. There are two methods, external ballottement and internal ballottement, of which the latter is the more important and satisfactory. Internal ballottement is performed as follows. The woman is placed on her back with the head and shoulders slightly raised on pillows. Two fingers are introduced into the vagina and placed in front of the cervix, where the firm head of the fœtus may generally be felt resting. The other hand is placed firmly on the fundus of the uterus. The woman is asked to take a

deep breath and hold it for a moment or two. The fingers in the vagina then give a sharp jerk upwards, and the fœtal head is felt to rise up in the liquor amnii and leave its contact with the fingers. After a moment it is again felt settling down against the fingers, sometimes with a distinct tap suggestive of a ball stotting.

This is usually regarded as a positive sign of pregnancy, and to a careful observer is so. But mistakes have been made over similar signs given by a stalked fibroid tumour, or a stone in the bladder. Therefore, although it is all but an absolute sign, it cannot be classed along with the fœtal heart-beat or active movements.

Internal ballottement can be obtained from the fourth to the seventh month. Before that the fœtal head is too soft to be well felt, and later the quantity of liquor amnii is relatively too small.

External ballottement is obtained in a similar way by placing the hands on the abdomen at either side of the uterus. By sharply jerking the fingers of one hand inwards the fœtus may be felt to impinge against the fingers on the opposite side, and possibly back again to the first hand.

A pedunculated tumour floating in ascitic fluid may give a similar sign.

This is a valuable sign, but more open to fallacy than internal ballottement.

Uterine Souffle.—This is a soft, blowing murmur, synchronous with the mother's pulse, best heard low down on either side of the uterus from the end of the fourth month of pregnancy. Formerly it was spoken of as the "placental souffle," under the impression that it was due to the rush of blood through the placental sinuses. But as it can be well heard in the early puerperium, that idea is untenable. It is now believed that it is caused by the blood passing from the branches of the uterine arteries into the enlarged vessels in the wall of the uterus, the passage from the narrow into the wider part causing a murmur, just as in an aneurism. In anæmic women it is louder from a superimposed "hæmic" element. If a contraction of the uterus occur while one is listening to it, it may be noticed to increase in loudness and rise in pitch. It has been realistically compared in character to "the puffing of a goods engine going slowly in the distance."

The uterine souffle is a valuable sign of pregnancy which just falls short of being absolute, or positive. This is because a similar souffle is sometimes to be heard over fibroid tumours. In them, however, the sound never varies in strength or pitch.

It is of great value in the diagnosis of pregnancy, because it may be heard two or three weeks earlier than the fœtal heart.

Positive Signs of Pregnancy

These are :—

(1) Hearing and counting the fœtal heart-beat; and hearing the funic souffle, if present.
(2) Feeling the active movements of the fœtus.
(3) The recognition by palpation of the various parts, and the outline of the fœtus.

The Fœtal Heart.—It is usually possible to detect the fœtal heart-beat from the middle or end of the fifth month. It is a faint double sound often likened to the ticking of a watch under a pillow. In rate it varies between 120 and 140 per minute. It is said to be slower in larger children, and more rapid in smaller ones. Thus it is claimed that in boys it is more usually below 130, and in girls above that number. This, however, is a slender foundation on which to rest any prophecy as to the sex of the child !

The rate of the fœtal heart-beat is increased by active fœtal movements, and slowed by the rise of blood-pressure caused by uterine contractions, or by pressure upon the cord or placenta as in breech deliveries. A deficiency of oxygen or excess of carbonic acid, and exhaustion of the child, slow it. The rate is therefore a good index to the condition of the child, and as such is of great value in delayed or difficult labours.

Briefly it may be said that the child's life is in danger when the rate falls below 100 or rises above 160.

When first audible the heart-beat will be heard best by placing the stethoscope in the middle line above the symphysis. Later its point of greatest intensity varies according to the position and presentation of the child. The sound is transmitted through the ribs and scapula of the child, and is heard at the part of the uterine wall against which the shoulder is lying. In the commonest presentation and position of the

child—the vertex left occipito-anterior—the heart is best heard at a point about midway between the umbilicus and the left anterior superior spine of the ilium. The figure shows the corresponding points in the commoner head and breech cases.

In order to hear the fœtal heart it is essential to have perfect quiet in the room, and it is advisable to have as little as possible in the way of clothes between the stethoscope or the ear and the abdominal wall. It is also always advisable to count the fœtal heart-beat and compare it both with the mother's pulse rate and one's own, as both these may be heard and mistaken for the fœtal heart.

Detection of the fœtal heart-sounds is the most absolute and positive sign of pregnancy available. Not only does it prove the existence of pregnancy, but it proves that the fœtus is alive. A failure to detect it is no proof that pregnancy does not exist, as failure may be due to other reasons. Repeated failures to hear it, after having once heard it, are strongly presumptive of fœtal death.

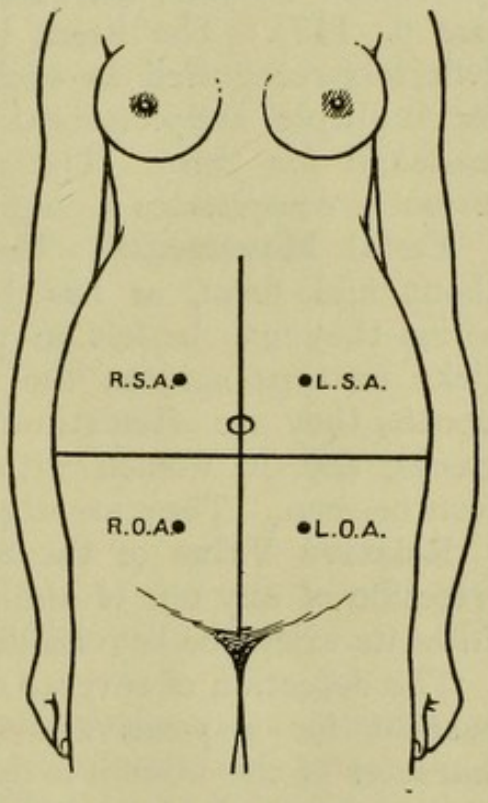


Fig. 56.—Points of maximum intensity of fœtal heart-sounds in head and breech presentations.

Besides the fœtal heart-beat and the uterine souffle, other sounds may be heard on auscultating over the pregnant uterus. Thus the movements of the fœtus may cause little thudding or scratching or splashing sounds to be heard. In some cases there is also audible what is known as the funic souffle.

The *funic souffle* is a blowing murmur synchronous with the fœtal heart-beat. It is produced by obstruction to the circulation through the umbilical cord, such as may be caused by knots in the cord or twists round the limbs of the child, or by pressure upon it. It is said to be audible in rather more than 10 per cent of cases at the end of pregnancy. Its persistence through the whole of a labour is of bad omen to

the child, meaning, as it does, pressure on the cord, or some obstruction to its circulation. It is indeed, strictly speaking, a *pathological* sign, but, when it is heard, it is absolutely diagnostic of pregnancy.

Recognition of the Fœtal Parts.—From the middle of pregnancy onwards it becomes progressively easier to feel and recognise the various parts of the fœtus by abdominal palpation. The palpation must be made in a careful and systematic manner, the rules for which will be discussed later (see p. 117). The head, back, breech, and limbs must be definitely recognised as such before a diagnosis can be made, for multiple subperitoneal fibroid tumours may easily be mistaken for them. The presence of such tumours always seriously complicates a diagnosis.

Fœtal Movements.—These are first felt by the mother about mid-term, as has been explained. From the same period they may be felt on palpation or auscultation as little kicks or taps against the wall of the uterus. In the later months they are often stimulated by the act of palpating the uterus, and in women with thin abdominal walls they may even be seen. They are absolutely diagnostic of pregnancy.

Relative Value of the Signs of Pregnancy.—The definite detection of any one of the positive signs of pregnancy establishes its existence beyond doubt.

The detection of several of the probable signs is sufficient warrant for a positive diagnosis, except where the moral character of the woman is dependent on the diagnosis. In all such cases a definite judgment should be delayed until a positive sign can be elicited.

The presumptive signs and symptoms are usually sufficient ground for a diagnosis with a reservation in ordinary practice, and most married women form their own diagnosis upon the strength of them long before any positive signs are obtainable.

It will be seen from the following table of the time incidence of the principal signs and symptoms that a positive diagnosis cannot be made before the middle of the fourth month.

TABLE OF THE PRINCIPAL SIGNS AND SYMPTOMS OF PREGNANCY IN THE ORDER OF THEIR OCCURRENCE.

	Months.								
	1	2	3	4	5	6	7	8	9
Suppression of menstruation	×	×	×	×	×	×	×	×	×
Irritability of bladder	×	×	?						×
Morning sickness	?	×	×	×	?	?	?	?	?
Enlargement of breasts		×	×	×	×	×	×	×	×
Changes in size, shape, and consistency of uterus	?×	×	×	×	×	×	×	×	×
Vaginal pulsation		×	×	×	×	×	×	×	×
Mammary areola			×	×	×	×	×	×	×
Softening of cervix			×	×	×	×	×	×	×
Intermittent contractions			×	×	×	×	×	×	×
Apparent shortening of cervix			×	×	×	×	×	×	
Discoloration of vagina			?	×	×	×	×	×	×
Progressive enlargement of abdomen				×	×	×	×	×	×
Uterine souffle				×	×	×	×	×	×
Ballottement				×	×	×	×		
Perception of active movements				?	×	×	×	×	×
Fœtal heart				?	×	×	×	×	×

Differential Diagnosis.—In the early months pregnancy may have to be diagnosed from subinvolution or chronic metritis, interstitial or submucous fibroids, and hæmatometra. In the last the uterus is more tense, and in the others more hard than the pregnant uterus. The history also is usually different. Small ovarian cysts or tubal swellings may generally be defined by careful examination. The most difficult cases are those in which pregnancy and ovarian or fibroid tumours co-exist. One of the two conditions is very apt to be masked by the other, and overlooked.

In any case of difficulty two good rules to follow are: (1) examine carefully with the patient under an anæsthetic, and (2) if still in doubt, delay making a final diagnosis for some weeks when more definite signs will probably be ascertainable.

Pseudocyesis or Spurious Pregnancy.—This extraordinary condition is met with sometimes in neurotic women who are

intensely anxious to have children. They experience all the subjective symptoms of pregnancy that they know, and not a few of the physical and objective signs. Thus the breasts and abdomen enlarge, and there may be more or less complete amenorrhœa, especially if the woman be near the menopause. The whole condition may be extremely like a genuine pregnancy, and often only an examination under an anæsthetic can clear up the case. Then the enlargement of the abdomen, which is usually due to distension of the intestines by gas combined with a hysterical fixation of the abdominal muscles, is seen to collapse, and vaginal examination shows the uterus to be normal in size. Owing to the difficulty of persuading the patient of the truth, it is well to have her husband or some trusted friend present during the examination.

Diagnosis between First and Subsequent Pregnancies.—The points may be put in tabular form as follows :—

In First Pregnancy.	*In Subsequent Pregnancies.*
Skin of Abdomen. Firm, tense. Striæ red.	Soft, easily wrinkled. Striæ white or silvery.
Abdominal Walls. Taut. Uterus and fœtus not easily palpated.	Flaccid. Uterus and fœtus easily palpated.
Breasts. Firm, roundish. Striæ red.	Less firm, pendulous. Striæ white or silvery.
Vulva. Does not gape much, if at all.	Gapes more or less. Bluish colour from varicose veins.
Fourchette. Intact.	Absent, or cicatrised from previous rupture.
Hymen. Recognisable. Torn and notched here and there.	Wart-like tags — carunculæ myrtiformes.
Vagina. Narrow, rugous.	Spacious, soft.
Cervix, vaginal portion. Fusiform, soft.	Soft. Does not project as a conical wedge, only hangs as a soft flap.
Os Externum. Circular, closed.	Anterior and posterior lips distinguishable, gaping.
In last month or six weeks. Head in true pelvis. Pushes down anterior vaginal fornix.	Head felt through os. Rarely descends into true pelvis, but remains movable at brim. Commencing pains fix it at inlet.
When head descends. Anterior lip of cervix distended.	Internal os open. Cervix like a funnel, narrow end up.

Diagnosis of the Life or Death of the Fœtus.—The only positive indications of the life of the fœtus are the heart-beat and active movements. Its life should, however, always be assumed until its death can be diagnosed with reasonable certainty. In the early months this can only be done by noting on repeated examinations that the uterus remains stationary in regard to growth, and that the breasts either cease enlarging or grow smaller again. In the later months, when once the heart-sounds have been heard or the movements felt, their absence on repeated examination is very suspicious. Very often the mother experiences after the death of the child some vague symptoms of heaviness, languor, a feeling of coldness, and the like. If with these there is retrogression of the breast conditions, the diagnosis is fairly certain. An offensive brown discharge, or the palpation of a macerated fœtus through the cervix, puts the matter beyond doubt.

CHAPTER X

THE DURATION AND HYGIENE OF PREGNANCY

It has been shown in an earlier chapter that we have no certain knowledge as to when ovulation occurs, nor can we ever hope to know the exact time of fertilisation. Coitus just before or after a menstrual period is more frequently fertile than at other times, and taking these facts as a basis, along with cases in which pregnancy followed a single coitus on a known date, the conclusion has been arrived at that pregnancy usually lasts about 273 days. In exceptional cases there may be considerable variations, fully developed children having been born as early as the 240th day, and as late as the 300th or 313th day. Indeed, cases lasting as long as the 320th day have been recorded. The cause of these variations is not understood, but it is generally thought that the length of the menstrual cycle has something to do with it, women with a menstrual cycle of only 22 or 24 days having a shorter gestation period than those having a menstrual cycle of 28 days. The most recent researches suggest that the cause of prolonged gestation may be a fatty and atonic condition of the uterine wall.

The subject has an obvious forensic bearing on the question of the legitimacy of children born after the death or departure of the mother's husband. In Scotland a child is considered a bastard if born more than ten calendar months after the death or departure of its reputed father. English law fixes no definite limit.

Estimation of the Probable Date of Confinement.—In women who have been menstruating normally the nearest approach to an accurate estimate is obtained by calculating from the last menstrual period. It is assumed that the fertile coitus occurred just after the last period. Therefore calculat-

ing *from the first day of the last period*, which is generally the date remembered by the patient, allowance of four days is made for menstruation, and another three days before fertilisation occurs, making in all seven days from the start of the last period. Adding these seven to the 273 of normal gestation, we conclude that labour is likely to ensue 280 days from the beginning of the last menstruation. The actual date is estimated roughly by adding the seven days and counting forwards nine calendar months, or backwards three months.

For example, supposing a woman began her last menstrual period on the 3rd of September, add to that 7 days, bringing us to the 10th, and count forwards nine months or backwards three. The date of probable confinement is the 10th of June.

It must always be remembered that this date is merely an approximate one, and many cases will be found to terminate a few days earlier, or as much as three weeks later. The explanation of the latter is that the fertile coitus occurred not just after the last period, as was assumed, but just before the first period missed.

Other Methods of Calculation.—An attempt to obtain greater accuracy has been made by basing the calculation on the lapse of ten menstrual cycles from the time of conception. In practice the results are not found to be more accurate.

If pregnancy supervene during a period of amenorrhœa, as during lactation, the above methods are unavailable. Attempts may then be made to estimate the date of confinement from the date of quickening. This is a variable sign, and is therefore of little value.

The size of the uterus as measured by the level of the fundus in the abdomen gives an approximate idea, but is subject to variations. Greater accuracy may be got by measuring the height of the fundus from the symphysis by tape measure or the length of the uterus by callipers, one foot of which is placed on the head of the fœtus felt through the lower pole of the uterus *per vaginam*, and the other on the fundus. Tables of the normal measurements so obtained have been drawn up by several authorities, and may be found in the larger treatises.

Cause of the Onset of Labour.—Why labour should in the great majority of cases ensue after the lapse of forty weeks of gestation is a question which is still unanswerable. The more

important views that have been put forward from time to time are the following :—

1. Reference has already been made to the heightened reflex irritability of the uterus during pregnancy. This grows progressively greater as pregnancy advances. It is suggested that ultimately the irritability, which is shown by the increasing frequency and strength of the intermittent contractions, leads to the violent contractions characteristic of labour.

2. The distension of the uterus at term may be enough to reflexly determine the onset of labour pains. Cases in which the uterus is unduly enlarged tend to end in premature labour, as in the case of twin pregnancy, or excess of liquor amnii (hydramnios).

3. Reference has been made to the fact that the irritability of the uterus is greatest at the times which correspond to the suppressed menstrual periods. Some authorities believe that at these times there is a tendency for the uterus to cast off the superficial part of its lining membrane. This, in the case of pregnancy, means the separation of the decidua.

4. It has long been held that possibly the prolonged pressure of the fœtus may eventuate in the dilatation of the cervix. Sometimes, however, the cervix is partially open for some time before labour begins.

5. Associated with this is the view that labour is set up reflexly by the pressure of the lower uterine segment on the cervical ganglion.

6. Labour can be induced experimentally by an excess of carbonic acid in the blood, but there is no evidence that this occurs to a sufficient extent naturally.

7. The senile changes in the placenta (infarct formation, etc.) must affect the nutrition and metabolism of the fœtus, and it is thought that possibly some of the metabolic products may stimulate the uterus. Apart from placental changes, the growth of the fœtus alone may lead to the formation of some metabolic product capable of acting in this way.

8. Children born at the usual time have the best chance of surviving. Natural selection would tend to perpetuate the characteristic of going into labour at the end of the fortieth week for this reason.

Such are some of the suggestions on this difficult point. Without trying elaborately to balance the different theories, it is sufficient to say that the trend of modern opinion is in favour

of the idea that some substance or substances are formed in the fœtus or placenta which stimulate the uterus to violent contraction. Possibly the substance may even be formed in the maternal organism, for we are only at the beginning of our knowledge of the changes in the ductless glands of the mother during pregnancy. We do know that the products of these glands (suprarenal, pituitary) act as powerful stimulants to the uterus, and have in some cases led to the onset of labour when injected. The cause is probably a complicated one, depending on many factors, and the explanation is still beyond our ken.

Hygiene of Pregnancy

Pregnancy is a natural and physiological state, but owing to the conditions of modern life it tends to border upon the pathological. The more artificial the conditions of life, the truer does this become. It is necessary for the physician, therefore, to see that his patients live as far as possible in the most hygienic way during pregnancy. If a woman's ordinary life be healthful, there is no need for any departure from it unless it be in the direction of a more strict moderation.

Exercise.—Labour is a great muscular feat, and must be prepared for by regular exercise. That is one reason why working women pass through labour with so much less trouble than women in luxurious surroundings. The more violent forms of exercise should be avoided as a general rule. Excessive fatigue is undesirable either of the body or mind, and all strains or shocks, either muscular or mental, must be guarded against. In the second half of pregnancy long journeys by railway or long drives over rough roads are to be avoided. Particular care should be taken at the times corresponding to the suppressed menstrual periods.

Diet.—This should be plentiful, nourishing, and simple. Overfeeding should be discouraged. Excess of meat and nitrogenous food is harmful. Fruit and vegetables are useful in helping to obviate constipation.

Bowels.—Constipation must be strictly avoided. Potent purgatives are risky, and only the milder laxatives or the drug that the patient is in the habit of using, should be employed. A daily motion should be secured.

Bathing.—The ordinary habits need not be interfered with,

but a warning should be given against the use of very hot or very cold water. Vaginal douches may be used if necessary, but with care and moderation.

Marital Intercourse.—This should be interdicted at the times corresponding to the menstrual periods, and during the later months. At other times the strictest moderation should be observed.

Clothing.—It should be the aim in regard to clothing during pregnancy to avoid any pressure on the breasts, and any constriction at the waist or round the lower limbs. Stays should be worn loose, or discarded altogether. Suspenders are preferable to garters, as there is already a tendency to varicosity of the veins. The lower limbs should be warmly clad.

Breasts.—In the later months the nipples should be drawn out by the fingers so that in shape they may become adapted for nursing. The skin may with advantage be slightly hardened by frequent bathing with equal parts of eau de Cologne and water, or 50 per cent spirit and water with some boracic acid crystals. If the breasts are heavy and pendulous they should be supported by a suspensory bandage.

Urine.—One of the most important duties of the physician is to examine the urine periodically. The possible presence of albumin is the most important point to attend to, but attention should also be paid to the quantity of urea and the presence of sugar and other abnormalities. The urine should be examined thus once a month in the first six months, and more and more frequently as pregnancy advances, so that towards the end a weekly examination is being made.

Examination of the Pelvis.—In all cases a preliminary examination of the abdomen should be made in the last few weeks before labour, and the lie and position of the child ascertained. In the case of all primigravid women external measurements of the pelvis should be made, and if they or any other signs indicate it, a careful examination of the pelvis by vaginal exploration should be made. This is necessary also in women who have had previous difficulty in labour. In such cases the exploration should be made not later than the seventh month. The importance of this can hardly be overestimated. It has been well said that the obstetrician who neglects pelvimetry is like a physician who attempts to treat pulmonary diseases without having recourse to auscultation or percussion.

CHAPTER XI

THE FŒTUS

The child becomes theoretically capable of living a separate individual existence about the sixth and a half month of pregnancy. The child is then said to be *viable*. In practice a child born at this period can only rarely be reared.

It is often of importance to be able to tell the age of a fœtus or embryo both for clinical and medico-legal reasons.

An exact determination requires very close examination, but a rough estimate may be formed from consideration of the following table :—

At the end of the Fourth Week.—The embryo is much curved, head and tail being close together. It measures about half an inch (12 mm.), and weighs twenty grains (1·3 grms.). The brain and cord are enclosed, and eye and ear vesicles are visible. The buds of the limbs are visible. The heart is prominent and is beginning to divide into four chambers.

At the end of the Eighth Week.—The embryo is about an inch (2·5 cm.) long in vertico-coccygeal measurement and sixty grains (4 grms.) in weight. The head has a human shape. The tail has nearly disappeared. The hands and feet are beginning to appear, and eyes and ears and nose are recognisable. The external genitals are visible, but sex is not distinguishable.

At the end of the Twelfth Week.—The embryo is about three and a half inches long (8·5 cm.), and weighs about 450 grains (30 grms.). The intestines are enclosed in the abdomen, and the umbilical cord is beginning to show spiral turns. Sex can be determined by the presence or absence of the uterus. Most of the bones are beginning to show centres of ossification.

At the end of the Sixteenth Week.—The fœtus is now five inches (12·5 cm.) long when measured from end to end, and weighs about four ounces (120 grms.). Sex is clearly defined. Lanugo, the fine downy hair on the skin, is appearing.

At the end of the Twentieth Week.—The fœtus is seven to eight inches (18-20 cm.) long, and the weight about eight and a half ounces (270 grms.). The head is relatively very large.

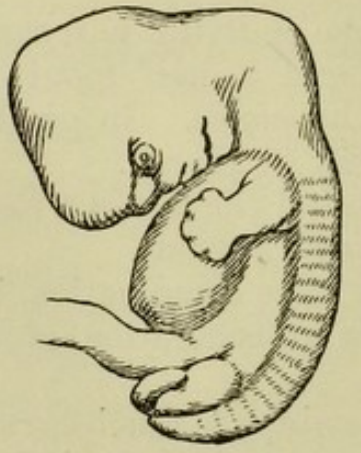


FIG. 57.—Embryo of the fifth week. (After His.)

FIG. 58.—Embryo of the eighth week. (After His.)

Vernix caseosa, a cheesy white sebaceous matter, may be seen on the skin. The cord is about a foot long.

At the end of the Twenty-fourth Week.—The fœtus is twelve inches (30 cm.) long, and weighs about one and a half pounds (680 grms.). Fat begins to be deposited under the skin. Hair appears on the head.

At the end of the Twenty-eighth Week.—The length is about fourteen and a half inches (36·2 cm.), and the weight about two and a half pounds (1100 grms.). The eyelids are open, and the pupillary membrane is disappearing. The body is covered

with fine hair—lanugo. The intestines contain a dark green tarry matter known as meconium.

A child born at this time very seldom survives, but every effort should be made to save it.

At the end of the Thirty-second Week.—The fœtus is nearly sixteen inches (40 cm.) long, and weighs about three and a half pounds (1570 grms.). The hair on the scalp is thicker. The nails do not reach the ends of the fingers.

A child born at this period may survive if very carefully reared.

At the end of the Thirty-sixth Week.—Length, seventeen and a half inches (44 cm.); weight, five and a half pounds (2640 grms.). The subcutaneous fat has increased, and the face is less wrinkled and the body more rotund.

A child born at this time has a very fair chance of survival if cared for.

At the Fortieth Week.—Length, twenty inches (50 cm.); weight, seven pounds (3200 grms.). The nails reach to the ends of the fingers, the skin is pink and smooth. There is less lanugo, but copious vernix caseosa. The diameters of the head are normal. In the male the testicles are in the scrotum.

More boys are born than girls, the proportion being about 106 to 100. Strangely enough the proportionate number of boys increases up to about 130 in the cases of elderly primiparæ. The reason of this is not known. Boys tend to be slightly heavier than girls at birth. The weight of the fœtus is, however, more dependent on the stature of the parents and their social conditions, the children of the well-to-do weighing more than those of the poor. The children of the coloured races also tend to be smaller at birth, and this applies particularly to the head. It has been found that the weight of the child increases in successive pregnancies, if these do not follow each other too rapidly, up to the age of about 35.

The head and abdomen of the newly-born infant are relatively very large. The latter is due to the relatively huge size of the liver. Many of the bones are incompletely ossified, and the spine has none of the later fixed curves. The heart contains the patent foramen ovale and ductus arteriosus. The wall of the right ventricle is proportionately very thick.

Fœtal Circulation.—The circulation before birth differs in

some important respects from that of the child after birth, the differences being due to the necessity of sending the blood purified in the placenta as directly as possible to the vital centres in the head and neck.

Purified arterial blood leaves the placenta by the umbilical vein, which runs along the cord to the umbilicus, and thence along the anterior abdominal wall to the lower surface of the liver. There it gives off several branches to the liver, and passes on as the **ductus venosus** to the inferior vena cava. The blood from the liver and from the portal circulation joins the inferior vena cava by way of the hepatic veins.

The blood then enters the right auricle, and is directed by the Eustachian valve through the foramen ovale into the left auricle. Thence it passes through the left ventricle into the aorta, and so to the great vessels of the head and neck.

Venous blood returning from the head and neck enters the right auricle by the superior vena cava and passes into the right ventricle. As it crosses the right auricle this blood stream passes in front of and across the stream of blood passing from the inferior vena cava to the foramen ovale and left auricle. From the right ventricle it enters the pulmonary artery, and a little passes through the lungs. But the most of it passes into the **ductus arteriosus,** and so into the aorta below the arch. Thence it passes into the vessels of the abdomen and lower limbs, the most of it passing into the hypogastric arteries, which are continuous with the umbilical arteries, and so reaching the placenta again.

The first thing a healthy child does after its birth is to cry. This expands its lungs and so throws open to the blood the enormous vascular area of these organs. Immediately, therefore, the greater part of the blood is diverted into the pulmonary artery instead of the ductus arteriosus, which gradually contracts until it is no longer patent. A second result is the immediate alteration of pressure in the two ventricles, the pressure rising in the left side and falling in the right, in which it has already been lowered by the stopping of the placental circulation. This causes the almost immediate closing of the foramen ovale. The ductus venosus and the hypogastric arteries soon become thrombosed and obliterated.

Fœtal Skull.—In relation to obstetrics the head of the fœtus is its most important part, because it is the most

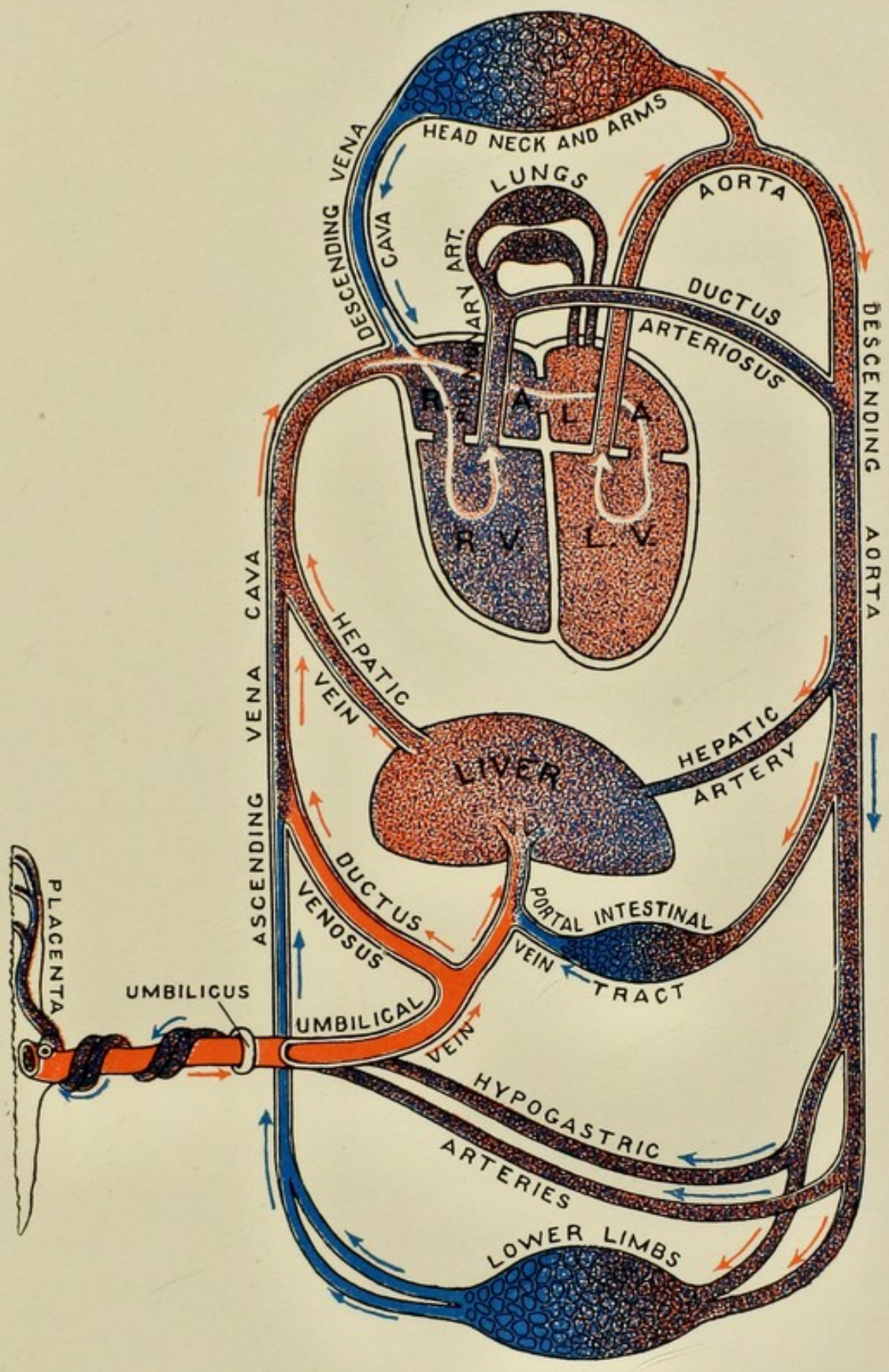


FIG. 59.—Schematic diagram of the fœtal circulation.

resistant part, and also in the great majority of cases the leading part during birth. Indeed, the mechanism of labour is simply the adaptation of the fœtal head to the pelvic passage; and most difficulties associated with delivery are due to some fault in this adaptation. The skull, therefore, needs further study.

The fœtal skull is more ovoid in shape than that of the adult, and the face is a relatively smaller part of the whole head. A line drawn from the orbital ridges to just behind the foramen magnum divides the skull into two parts, a solid lower part, and above that the more compressible vault. The comparatively substantial bone of the lower part protects the vital centres in the medulla and pons. The grey matter of the cerebral hemispheres under cover of the vault is exposed to more risk of injury, but in early infant life it is still underdeveloped, and can survive a good deal of pressure.

The bones of the vault are laid down in membrane, and at birth are not completely ossified. Thus it is usually found that the edges of the bones are membranous, and separated from each other by very definite spaces. These spaces—**the sutures**—are the same in number and name as in the adult skull with the important addition of the frontal suture which in the fœtus separates the two halves of the frontal bone. The others are the sagittal, running between the two parietal bones; the lambdoidal between the occipital bone and the two parietals; the coronal between the frontal bones and the parietals; and the temporal between the temporal and parietal bones on either side. The last named is the only one that cannot be felt during labour, as it is covered by the thick, soft parts.

At the junction of the coronal suture with the sagittal and frontal sutures there is a lozenge-shaped area of membrane, one of the sutures running out from it at each corner. This is the **anterior fontanelle** or **bregma.** It can be felt during labour, and its shape and the fact that four sutures can be felt passing off from it are the guides to its recognition. At the junction of the posterior end of the sagittal suture and the lambdoidal suture is a small triangular area—the **posterior fontanelle.** This is an important landmark on the head in normal labour. Its shape and the presence of three radiating sutures are characteristic. A similar space—the **temporal** or

Gasserian fontanelle—exists at the junction of the temporal and lambdoidal sutures, but as it cannot be felt, it is unimportant in relation to obstetrics. Additional fontanelles are very occasionally found in the course of the sagittal suture.

For convenience in description obstetricians define certain **regions** of the fœtal skull. Thus the **vertex** is the region bounded in front by the anterior fontanelle, behind by the posterior fontanelle, and on either side by the parietal bosses or eminences. The **occiput** comprises the whole area behind the posterior fontanelle and lambdoidal suture. The **sinciput**

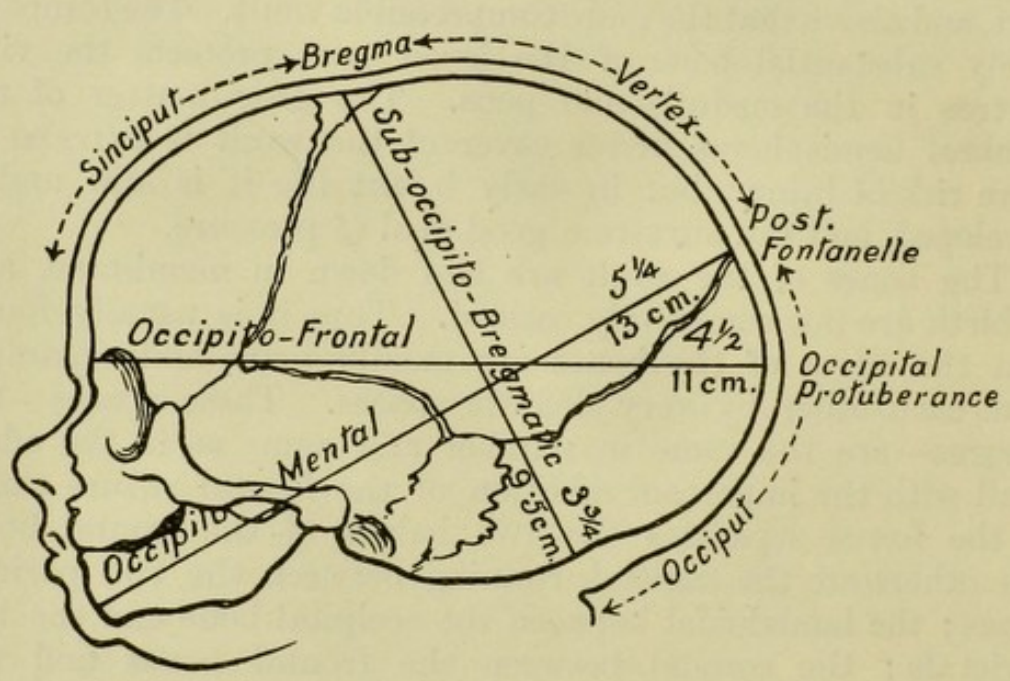


FIG. 60.—Fœtal skull. Regions and diameters.

or **brow** is the region in front of the anterior fontanelle and the coronal suture, as far down as the orbital ridges. Below these is the **face.**

The fœtal head is capable of a much greater range of movement than the adult head. It can be completely extended till the occiput is in contact with the back. It can also be rotated safely through a quarter of a circle, and it is said that in some cases no harm has followed rotation through as much as half a circle.

Its capacity for being moulded is of the utmost value in labour. This is rendered possible by the membranous sutures, which allow the edges of the bones to override; by the softness of the bones themselves; and by the fact that during labour

the cerebro-spinal fluid, and the blood in the cranial sinuses are squeezed out, the former into the spinal canal, the latter into the veins of the body.

Just as in the pelvis imaginary **planes** are defined in order to facilitate the description of labour, so also in the case of the fœtal head.

The *suboccipito-bregmatic plane* is one which passes transversely through the centre of the bregma (anterior fontanelle) and a point midway between the occipital protuberance and the posterior margin of the foramen magnum. On the head this latter point corresponds to the nape of the neck.

The *occipito-frontal plane* passes through the occipital protuberance and the glabella or root of the nose.

The *occipito-mental plane* passes through the posterior fontanelle and the tip of the mentum or chin.

The *biparietal plane* is a vertical plane passing through the parietal eminence on either side.

The *bitemporal plane* passes vertically through the lower ends of the coronal sutures.

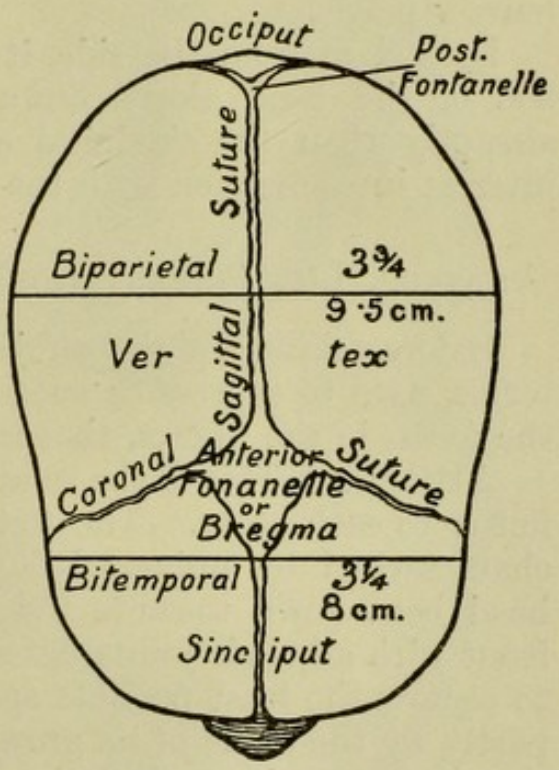


FIG. 61.—Fœtal skull, seen from above.

Corresponding to these planes are **diameters** and **circumferences** which it is important to bear in mind. The diameters are measured in each case from the points mentioned above.

Diameters of the Fœtal Skull

Suboccipito-bregmatic . .	$3\frac{3}{4}$	inches	(9·4 cm.)
Occipito-frontal . . .	$4\frac{1}{2}$	,,	(11·25 ,,)
Occipito-mental . . .	$5\frac{1}{4}$	,,	(13 ,,)
Biparietal	$3\frac{3}{4}$	,,	(9·4 ,,)
Bitemporal	$3\frac{1}{4}$	,,	(8 ,,)

Circumferences

Suboccipito-bregmatic .	.	11 inches	(27·5 cm.)
Occipito-frontal . .	.	13½ „	(34 „)
Occipito-mental . .	.	15 „	(37·5 „)

Wedges.—Looked at from behind, the skull is seen to be narrower at the base than at the vault. This "wedge" shape is the theoretical basis for the operation of version in cases of narrow pelvis.

Looked at from the side, it is noticeable that the occipital end of the head slopes down from the vertex much more abruptly than the sincipital end. This is a point of some interest in connection with the mechanism of labour.

Attitude, Lie, Presentation, and Position of the Fœtus

Before taking up the subject of labour, there are several terms, used to express as succinctly as possible the position of the fœtus in the uterus, that must be defined and explained.

Attitude.—This is the relation of the various parts of the fœtus to each other. The fœtus *in utero* adopts an attitude characterised by universal flexion. The back is arched, the head bent down towards the chest, and the limbs folded in front with all their joints flexed. In this way the child comes to occupy the least possible space. The attitude is produced partly by the mode of its growth, and partly by the shape of the uterine cavity. Sometimes the neck or limbs become more or less extended, but this is abnormal and leads to difficulties in delivery.

Lie.—By this is meant the relation of the long axis of the fœtus to the long axis of the uterus. The most common is a *longitudinal* lie where the two axes are parallel. Sometimes the lie is *transverse*, and rarely it may be temporarily *oblique*.

Presentation.—This means the part of the fœtus that occupies the lower pole of the uterine cavity. The *presenting part* is the actual part first and most prominently felt through the cervix on vaginal examination. The two terms are very commonly confused, and employed promiscuously. It will be evident now that, given a longitudinal lie, the presentation may be either the head (cephalic presentation) or the breech

(pelvic presentation). These are again subdivided because,

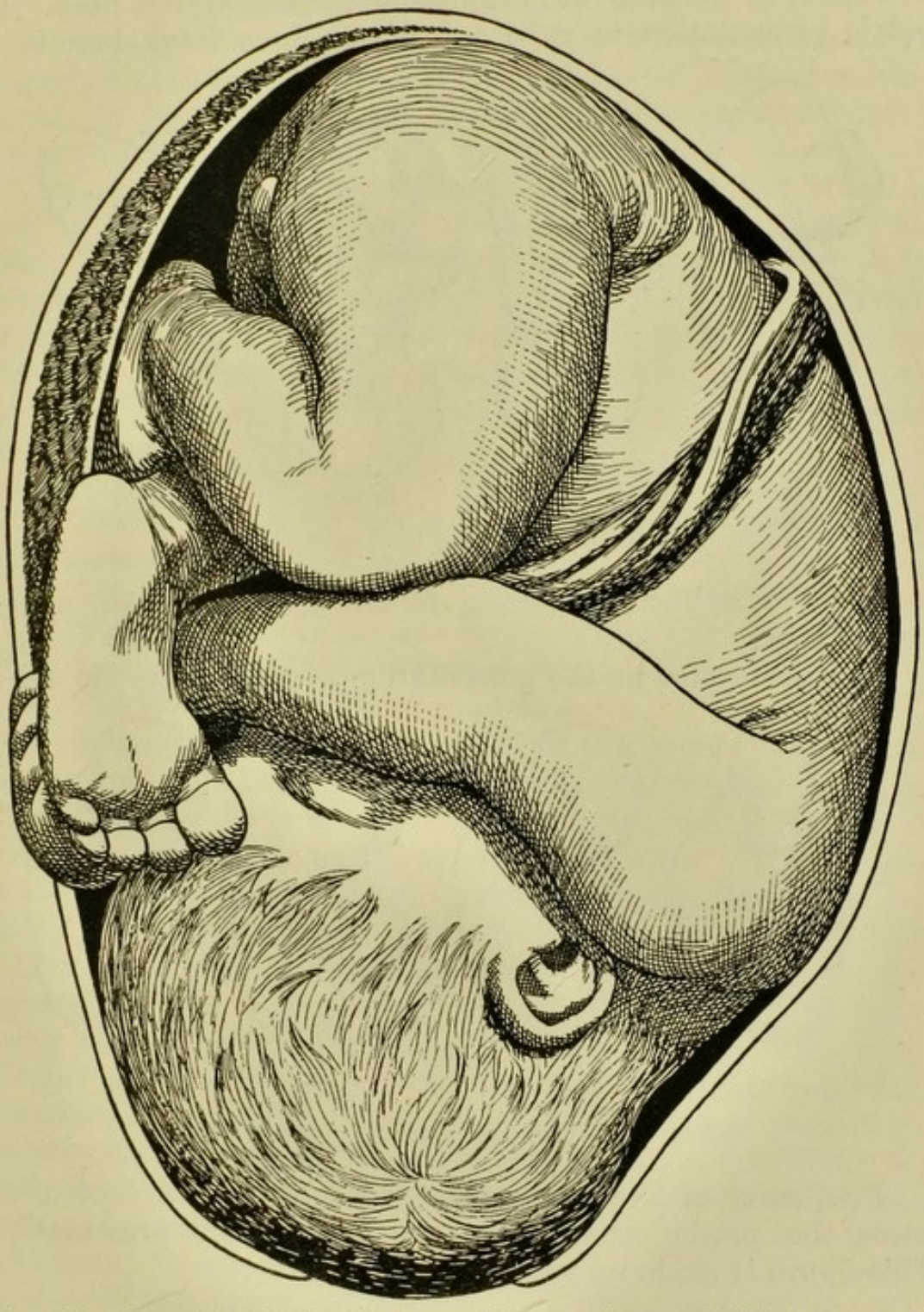


FIG. 62.—Normal attitude of fœtus. (From specimen of full-term pregnant uterus in Obstetrical Museum, University of Edinburgh.)

owing to differences in the fœtal attitude, the actual presenting part of the head or breech may vary. Thus a cephalic

presentation may be either the vertex, sinciput, brow, or face, according to the state of flexion or extension of the neck. A pelvic presentation may be a full breech, a frank breech, a

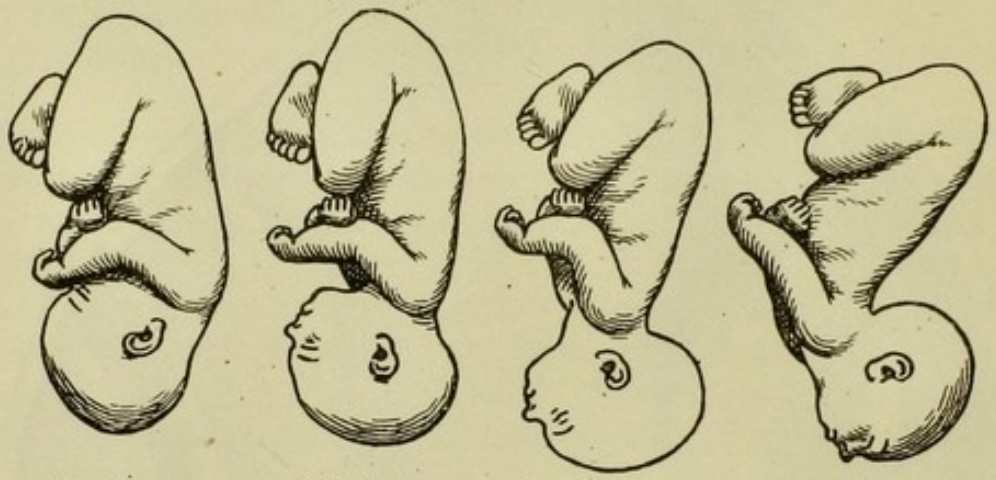


FIG. 63.—Varieties of head presentation.

footling, or a knee, according to the state of flexion of the lower limbs.

In a transverse lie the presentation is usually the shoulder.

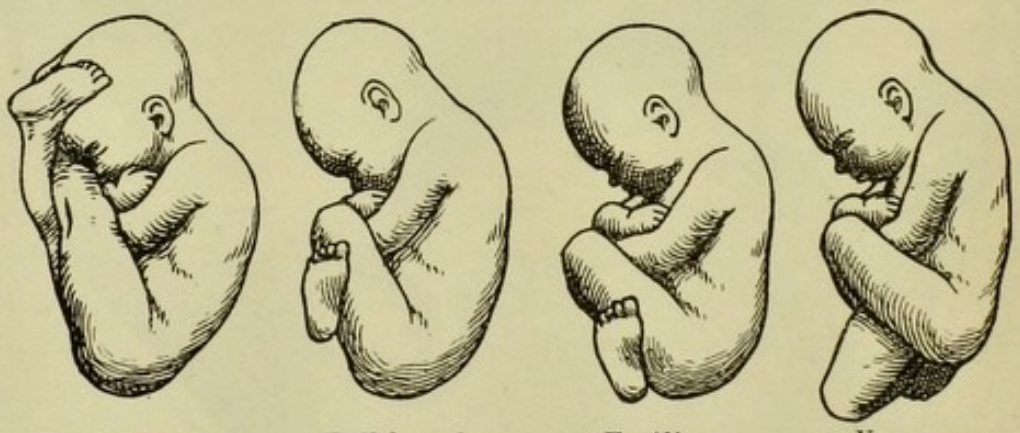


FIG. 64.—Varieties of pelvic presentation.

Frequency of Head Presentations.—In 96 per cent of all cases the presentation is a cephalic or head presentation. This figure is made up as follows:—

Vertex	95·5	per cent.
Face	0·4	,,
Brow	0·1	,,
	96	,,

Of the remaining 4 per cent, breech presentations form 3·5 per cent, and shoulder presentations 0·5 per cent.

Various theories have, from the earliest times, been advanced to explain this very striking preponderance of head presentations. Of these the only two that need be mentioned are: (1) the gravitation theory, and (2) the accommodation theory.

The gravitation theory is based on the fact that, when a dead fœtus is floated in fluid of the same specific gravity as itself, it does so with its head and right side down. This is certainly due to the greater weight of the head and of the liver on the right side. But it has been shown that if the fluid be lowered to the specific gravity of liquor amnii the reverse is true, the breech sinking lowest. The gravitation theory therefore cannot be accepted.

The accommodation theory, which is now regarded as the truth, was advanced by Sir James Simpson amongst others. Four factors are involved, namely:—

(1) The shape of the uterus—wider above, narrower below.
(2) The shape of the fœtus—breech wider than the head.
(3) The tonicity of the uterine walls.
(4) The life and tonicity of the fœtus.

The fœtus will accommodate itself to the uterus most easily when it lies with the wide breech occupying the wide fundus of the uterus, and the head in the narrower lower pole. It is further argued that if anything occurs to alter that position the fœtus will be more pressed upon by the walls of the uterus, that this pressure will reflexly excite fœtal movements, and that by these movements it will ultimately work itself back into its original position. The strongest proof of the truth of this view is to be found in the fact that anything that interferes with any of the four factors necessary to the production of this accommodation at once tends to produce a malpresentation. Two examples will suffice to show this. (1) In conditions in which the liquor amnii is either absolutely or relatively excessive (in hydramnios, or in early months) malpresentations are common because the child does not come into contact with the walls of the uterus. (2) In congenital hydrocephalus the head is often so swollen that it becomes larger than the breech, and in these cases the large head is, very frequently, found occupying the wide fundus, and the small breech the lower pole of the uterus.

Position.—The position of the fœtus is its relation to the pelvis of the mother. It is described in terms of a certain fixed point on the presenting part called the *denominator*. For each presentation there are four possible positions according as the denominator is in one or other quadrant of the pelvis—left anterior, right anterior, right posterior, and left posterior.

In the more frequent presentations the points chosen as the denominators are :—

Presentation.	*Denominator.*
Vertex . . .	Occiput.
Face	Mentum (chin).
Breech . . .	Sacrum.
Shoulder . . .	Acromion.

Vertex Presentation.—The four possible positions of a vertex presentation are as follows :—

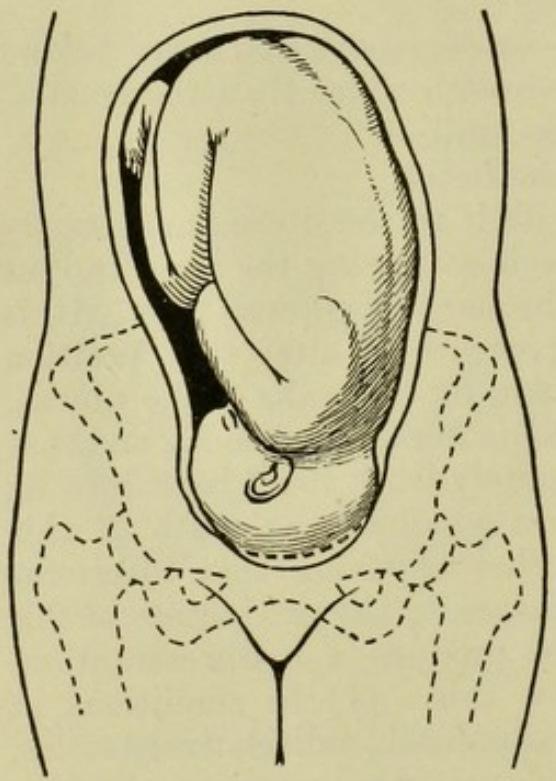


Fig. 65.—Vertex L.O.A.

I. Left occipito-anterior, or L.O.A. The head lies with its sagittal suture approximately in the right oblique diameter of the brim of the pelvis, the occiput opposite the left foramen ovale, the sinciput opposite the right sacro-iliac synchondrosis.

II. Right occipito-anterior, or R.O.A. The sagittal suture is approximately in the left oblique, the occiput opposite the right foramen ovale, and the sinciput opposite the left sacro-iliac synchondrosis.

III. Right occipito-posterior, or R.O.P. The sagittal suture lies approximately in the right oblique, the occiput at the right sacro-iliac synchondrosis, and the sinciput opposite the left foramen ovale.

IV. Left occipito-posterior, or L.O.P. The sagittal suture lies approximately in the left oblique, the occiput at the left sacro-iliac synchondrosis, the sinciput opposite the right foramen ovale.

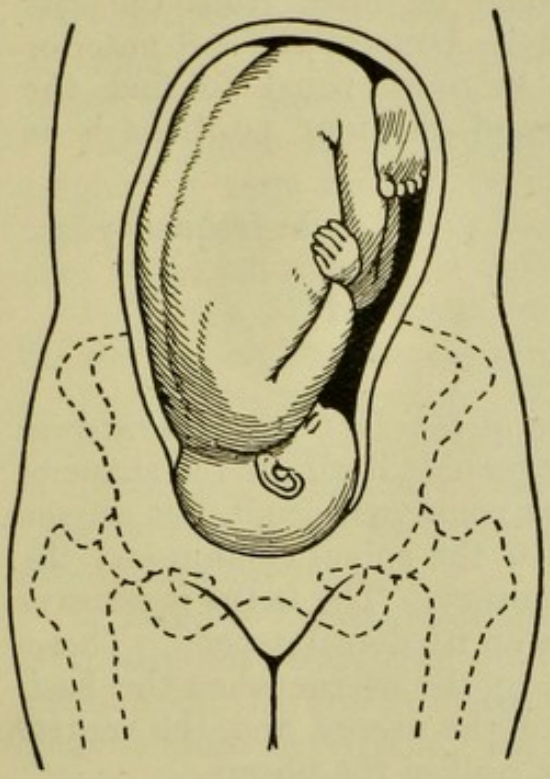


FIG. 66.—Vertex R.O.A.

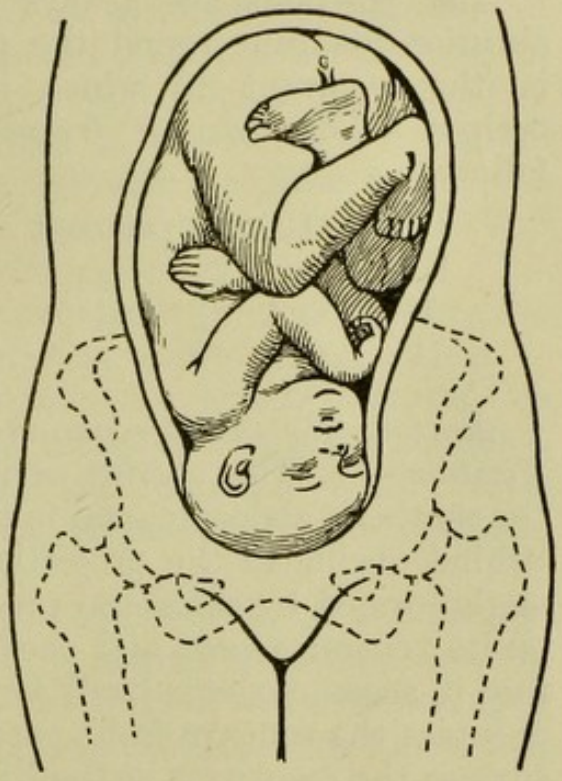


FIG. 67.—Vertex R.O.P.

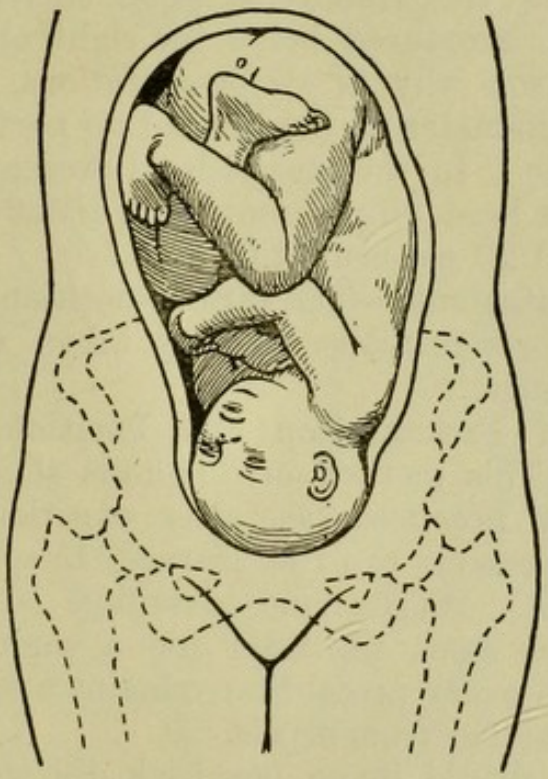


FIG. 68.—Vertex L.O.P.

The positions are always taken in order from the left anterior quadrant round the pelvis, because the left anterior is the quadrant in which it is most usual to find the occiput. The *order of frequency* of the four positions is as follows :—

I.	L.O.A.	70 per cent . .	1st in frequency.
III.	R.O.P.	20 „ . .	2nd „
II.	R.O.A.	8 „ . .	3rd „
IV.	L.O.P.	2 „ . .	4th „

Reasons for the Predominance of the Left Occipito-anterior Position.—1. The uterine cavity moulds itself to the shape of the mother's abdomen, and is thus concave in front, but convex behind, owing to the projection of the spinal column and the angle formed by the sacral promontory. The fœtus is concave on its ventral aspect and convex on its dorsal aspect. Therefore it accommodates itself best to the uterus when the back occupies the concave front part of the uterus, and the ventral surface the convexity of the back wall of the uterus.

2. The right oblique diameter of the brim is the longest available diameter. The left is shortened by the presence of the rectum, and the transverse is so encroached upon by muscles, that it is reduced below the right oblique in length. This is the reason why in all presentations, as will be seen later, the long diameter of the presenting part tends to lie in the right oblique. In the case of head presentations it should be noted that at least 90 per cent lie in this diameter—70 per cent L.O.A., and 20 per cent R.O.P.

Other Presentations.—The various positions in face, breech, and shoulder presentations will be taken up under these respective headings.

Diagnosis of Presentation and Position.—I. *Abdominal Examination.*—This method of diagnosis should be carefully and assiduously practised, as, after experience is obtained, all that is necessary can be learned by it—in a normal case at any rate. Its supreme advantage is that it obviates in many normal cases the need for a vaginal examination, which even with every precaution remains a source of possible danger to the mother from sepsis.

The patient should lie on her back, the shoulders slightly raised and the knees drawn up to relax the abdominal muscles,

The clothes must be so arranged as to allow free exposure of the abdomen. The physician should wash his hands in warm water, which increases the susceptibility of his sense of touch.

Inspection.—In longitudinal lies of the fœtus the uterine tumour at term reaches to just below the xiphisternum. In transverse lies the uterus looks broader than it is long, and does not reach so high in the abdomen.

Palpation.—This must be carried out systematically, the manipulations being suspended during uterine contractions.

1. Palpate the fundus. Normally the breech occupies this pole of the uterus. The breech is recognised as being rounded, fairly smooth and hard, but less so than the head. It is directly continuous with the back, there being no intervening groove like the neck.

2. Slip the hands down and palpate the sides of the uterus. Normally the back can be felt as a smooth resistant arch. Pressure on the breech increases the bend of the back and may make it more easily felt. On the opposite side the limbs may be felt as little knobs that easily slip about under the hand.

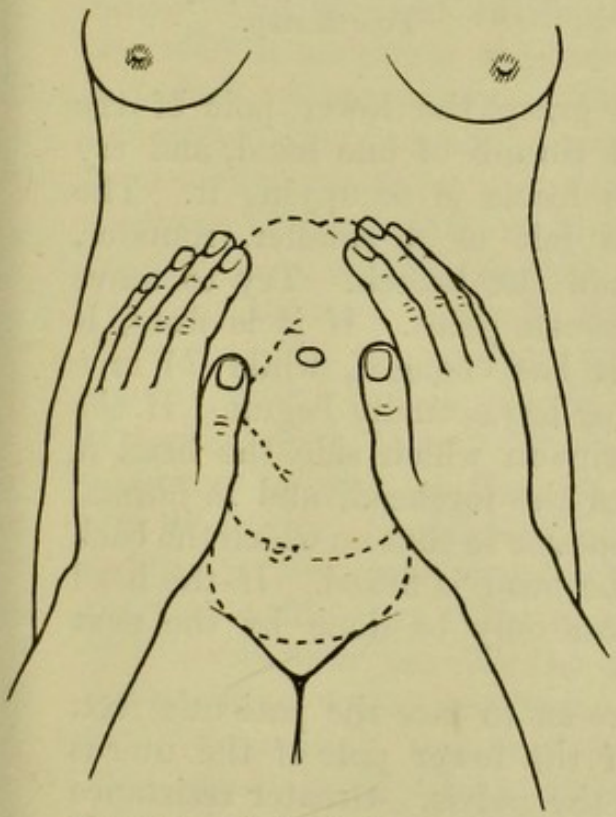


FIG. 69.—Abdominal palpation. First step.

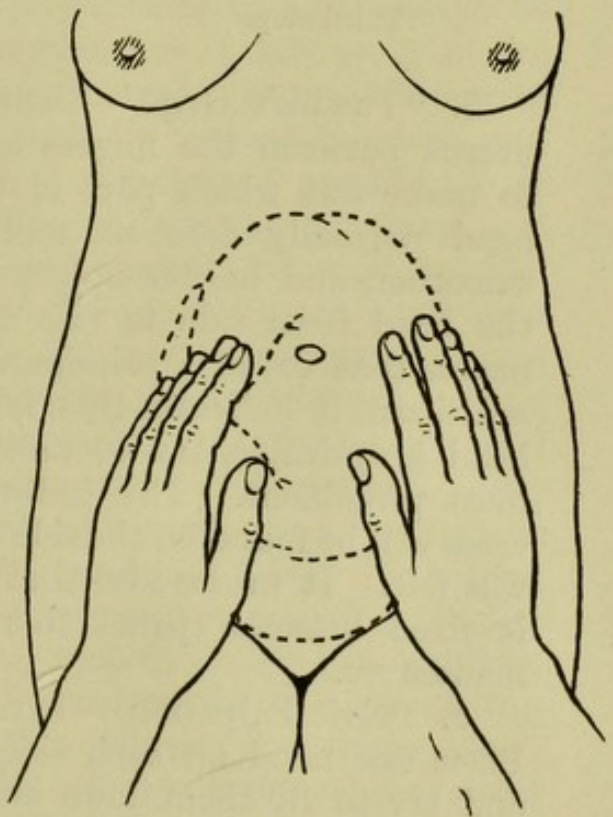


FIG. 70.—Abdominal palpation. Second step.

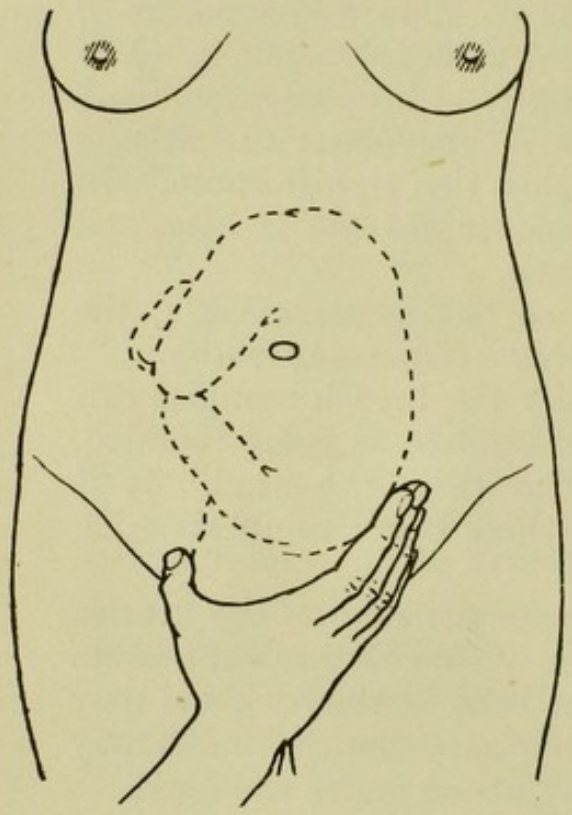


FIG. 71.—Abdominal palpation. Third step.

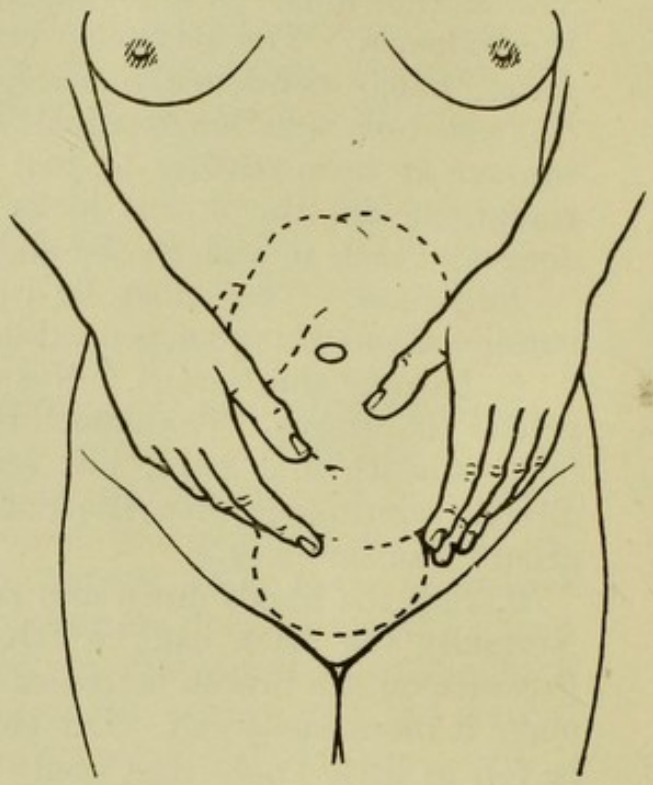


FIG. 72.—Abdominal palpation. Fourth step.

3. "Pawlik's Grip."—Gently grasp the lower pole of the uterus between the fingers and thumb of one hand, and try to make out which part of the fœtus is occupying it. The head normally does so, and is felt as a smaller, rounder, smoother, and harder object than the breech. Try to move the head from side to side between pains. If it is fixed, it means that (*a*) in a primipara it has engaged, while (*b*) in a multipara it indicates that labour has actually begun. If the head is movable, try to ascertain on which side the head is most prominent. This indicates the forehead, and in normal cases will be found on the side opposite to that on which the back was felt. It means also that the head is flexed. If the head is fixed between pains this can only be done by the next manœuvre.

4. Pelvic Palpation.—Turn so as to face the patient's feet. Place one hand on each side of the lower pole of the uterus and try to dip them down into the pelvis. Greater resistance will be offered on the side on which the forehead lies, as it forms a greater prominence. In this way one can find out

the position of the head, and form an opinion of how far labour has advanced.

It will thus be seen that by abdominal palpation one can learn the lie, presentation, and position ; whether labour has started, and approximately how far it has advanced. The only thing one cannot learn is the size of the os externum. This, however, in a normal case is not necessary.

Auscultation affords a means of confirming what one has learned by palpation. The fœtal heart is best heard over the back, the sound being transmitted by the ribs and shoulder blades. In the L.O.A. it is best heard on the left side of the abdomen below the umbilicus, at a point nearly midway between the umbilicus and the anterior superior spine. In the R.O.A. it is heard in a corresponding area on the right side. In occipito-posterior positions it is heard farther round the flanks. In breech cases the heart-sound is best heard above the umbilicus on the side on which the back is lying (Fig. 56).

II. *Vaginal Examination.*—Where necessary this must be done, but it should be an axiom in the conduct of labour to make such an examination as seldom as possible in normal cases. The strictest antiseptic precautions should always be observed in making a vaginal examination in labour or in the last days of pregnancy. The hand should be scrubbed with hot water and soap and a nail-brush for several minutes, and then soaked for three minutes in a solution of perchloride of mercury (1 to 1000) or biniodide of mercury in spirit. If possible a sterilised rubber glove should be worn. The patient's external genitals should be carefully prepared in a similar way by the nurse. The labia are then separated and the examining fingers passed into the vagina without coming in contact with them. The examination should be conducted in a routine way, so that no point may be overlooked. The size of the os should be determined by sweeping the fingers round it. In some cases it will be found high up behind the presenting part. Its size is frequently compared to that of some more or less familiar coin, such as a sixpence, shilling, florin, or crown. Determine the nature of the presenting part, recognising the head by the sutures and fontanelles; then ascertain in which diameter of the pelvis the sagittal suture is lying ; and lastly, pass the fingers from end to end of the sagittal suture and try to locate both fontanelles.

In normal cases, if the occiput is anterior, the posterior fontanelle can be easily felt.

These points should be sought for between the pains, and care taken not to rupture the membranes. After the membranes

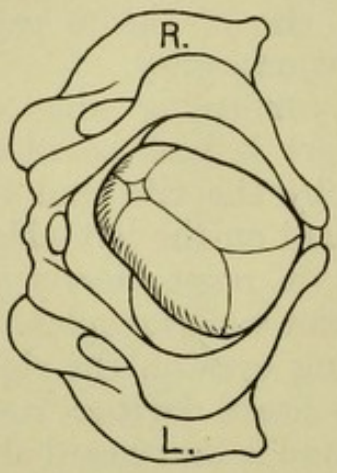


FIG. 73.—L.O.A.

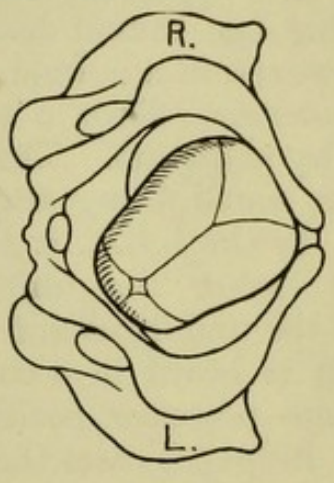


FIG. 74.—R.O.A.

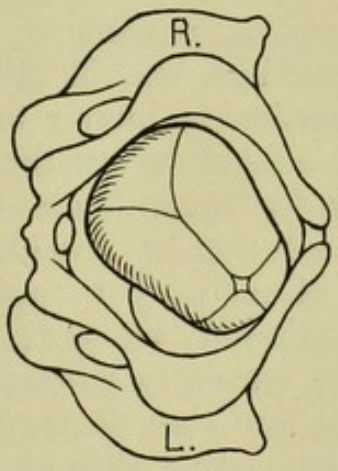


FIG. 75.—R.O.P.

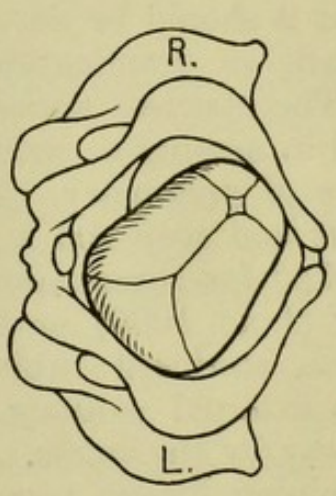


FIG. 76.—L.O.P.

FIGS. 73-76.—Varieties of vertex presentation—pelvis in left lateral position as in labour.

have ruptured, a vaginal examination naturally gives the information much more easily than before rupture. Later on in labour, again, the landmarks on the presenting part may be obscured by the caput succedaneum (*q.v.*). Accordingly the best time to make a vaginal examination is immediately after the rupture of the membranes.

SECTION III

LABOUR IN THE VARIOUS PRESENTATIONS

CHAPTER XII

THE CLINICAL COURSE OF NORMAL LABOUR

Labour, or Parturition, is the process by which the products of conception—the fœtus, liquor amnii, placenta, and membranes—are separated and expelled from the uterus. Amongst the laity it is usually spoken of as the "confinement."

There are two great groups into which all labours may be divided :—

1. Eutocia—normal or physiological labour.
2. Dystocia—abnormal or pathological labour.

What is a Normal Labour? This is not an easy question to answer, as individual labours differ so much in small details. It is, however, defined conventionally as a labour in which the child presents by the vertex of the head, in which there are no complications, and which is completed by the natural unaided efforts of the mother within twenty-four hours.

Clinical Course of Normal Labour

The advantage of the student is best consulted by considering briefly in the first place the actual phenomena observed during the course of labour. After that the various phenomena will have to be studied individually more fully.

Premonitory Signs and Symptoms.—Two or three weeks before the onset of labour the patient experiences a feeling of "lightening." The uterus sinks lower in the abdomen with the result that the waist becomes lowered; the pressure on the diaphragm is diminished, giving greater ease in breathing and a sense of lightness. At the same time there may be increased difficulty in walking, and a recurrence of the frequency of micturition experienced in the early weeks.

Careful abdominal examination will show that in the case of primiparous women the head is now fixed or "engaged" in the brim of the pelvis. In multiparæ, on the other hand, this engagement of the head does not usually occur until labour has actually begun. This difference is due to the greater tautness of the abdominal muscles in the primipara which force the child into the pelvis at an earlier date.

During the last week or two there is a marked increase in the secretions of the genital tract, and the vulva becomes moist and succulent, and more gaping than formerly.

Stages of Labour.—Labour is divided into three stages. The *first* stage is the *Stage of Dilatation*, and extends from the onset of true pains to the full dilatation of the cervix. The *second* stage is the *Stage of Expulsion*, and extends from the complete dilatation of the cervix to the expulsion of the child. The *third* stage is the *Stage of Delivery*, and extends from the birth of the child to the birth of the placenta.

First Stage.—The onset of labour is marked by the occurrence of periodic pains due to the contractions of the uterus. At first they are but slight, and may be mistaken for colic. As time goes on, however, they become more severe and more frequent, beginning in the back and passing round to the front of the abdomen and thighs. These contractions bring about the dilatation of the cervix, and this is usually accompanied by a slight discharge of blood-stained mucus from the separation of the fœtal membranes immediately inside the internal os, and from minute lacerations of the cervical mucosa. This discharge is called the "show." As the pains become more frequent and severe, the patient begins in most cases to cry out during the pains, and to seek relief by sitting bent forwards, or leaning against some piece of furniture. Pressure over the sacrum seems to give slight ease. Towards the end of the first stage she probably may prefer to lie down. This

stage may occupy from twelve to eighteen hours. At the end of it there is commonly a sudden gush of fluid, indicating that the fœtal membranes have ruptured, and the forewaters, or that portion of the liquor amnii lying in front of the head, have escaped. This rupture of the membranes usually synchronises with the full dilatation of the cervix, and therefore with the end of the first and the beginning of the second stage. Sometimes the membranes rupture earlier, particularly in cases of malpresentation; at other times they may remain intact until well on in the second stage, rarely even until the child is expelled, and require to be ruptured by the attendant.

Second Stage.—The pains often stop for a few minutes after the rupture of the membranes, and then begin again with greater vehemence and frequency. They gradually become more expulsive or "down-bearing" in character, and the abdominal muscles are brought into play to help the expulsive efforts. At first the abdominal muscles are under the control of the patient's will, but later their contractions become quite involuntary like those of the uterus.

As the pain comes on the patient braces herself by holding on to some solid object, or pressing her feet against the foot of the bed. She then takes a deep breath and holds it as long as possible. The diaphragm is thus fixed and the intra-abdominal pressure brought to bear on the expulsion of the child. As the pain passes off she relaxes the spasm of the glottis and diaphragm, and takes several deep breaths. The face during a pain becomes deeply congested, and the patient perspires freely.

The effect of these pains is to drive the head through the cavity of the pelvis. As it descends it presses upon the rectum, and unless that organ has been previously thoroughly emptied, the patient feels a desire to defæcate, and the fæces are squeezed out during each contraction. As the head comes farther down it presses on the perineum, which begins to bulge a little during the pains. The vulva also begins to gape more. In the intervals between the pains, which become shorter as the pains become longer and more frequent, the head recedes a little, but with each succeeding pain it is driven a little farther down. Thus the perineum bulges more and more, and the vulva gapes more and more, and after a time the scalp can be seen when the head is forced down during a

pain. As a larger and larger area of the head comes to lie in the vulvar opening during successive pains, that opening becomes transformed from a slightly gaping slit to an oval, and ultimately an almost circular opening. The perineum meantime has been so pressed upon that it becomes markedly stretched out and thinned, especially at its anterior margin. Here it is often no thicker than a piece of notepaper at the moment of birth. Behind it the anus becomes stretched into a large D-shaped opening, and the anterior wall of the rectum is seen bulging through it.

As the head advances the occiput becomes pressed against the under margin of the symphysis pubis. The alternate advance and recession of the head during and between pains go on until the largest diameter of the head is forced through the vulva by a strong pain. After that there is no recession, and the head is rapidly born by a movement of extension of the neck—the bregma, brow, and face of the child sweeping in succession over the perineum. This is the moment of most excruciating agony to the mother.

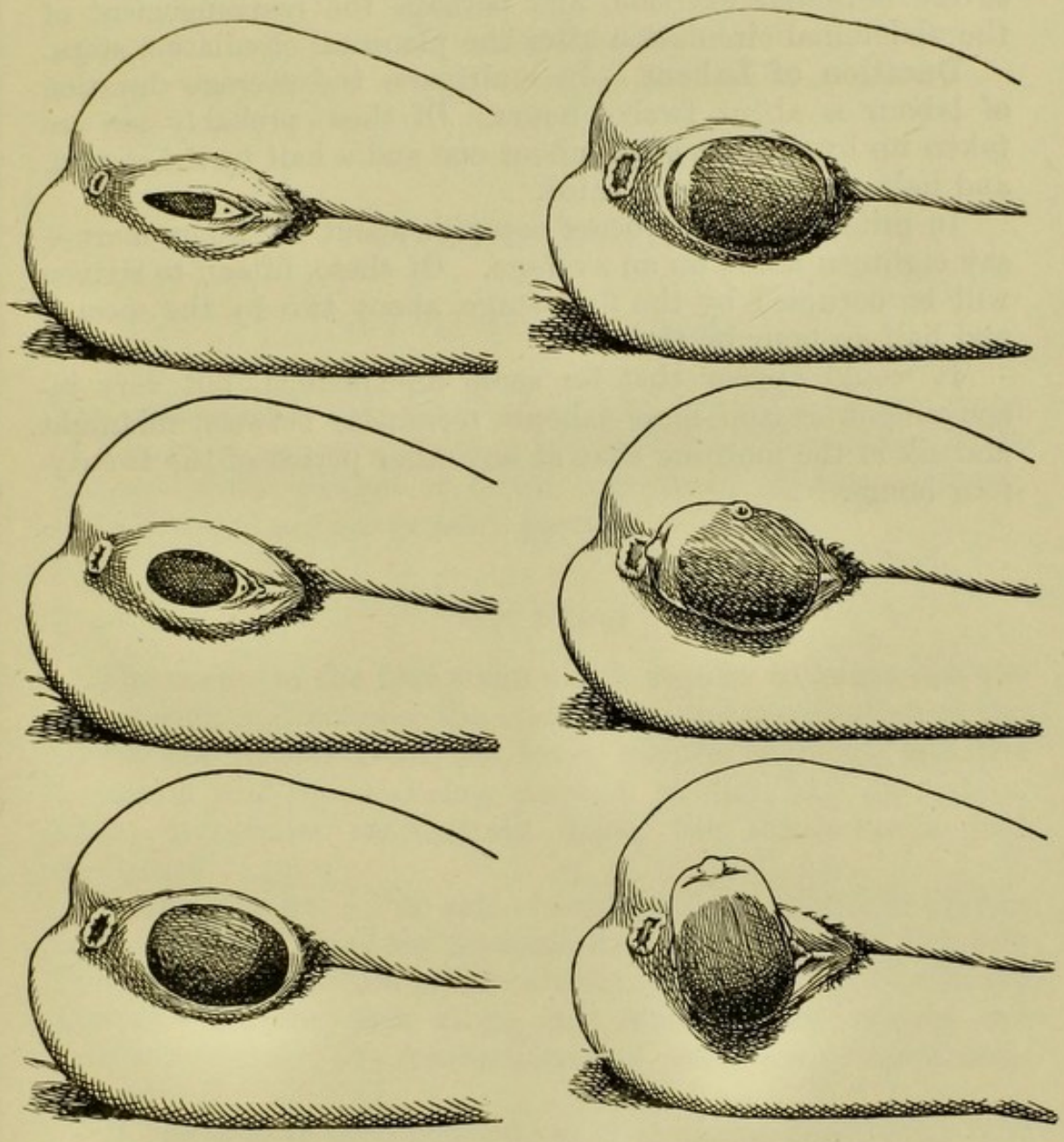
After the head is born there is a short pause during which the face of the child becomes congested. Very soon, however, pains recur, and the head rotates so that the face usually comes to look towards the mother's right—*i.e.* if she is on her left side, the face looks upwards. This indicates that the shoulders are coming into the long antero-posterior diameter of the outlet. The anterior shoulder is now pressed against the symphysis, and the posterior shoulder is born by being swept over the perineum. The trunk and lower limbs of the child follow almost at once, and then comes a gush of the remainder of the liquor amnii, which did not escape at the rupture of the membranes.

The second stage occupies two or three hours in a primipara, but in a multipara may be very much shorter.

At the end of the second stage the retracted uterus may be felt as a firm round tumour extending up to just below the umbilicus.

Third Stage.—There is now usually a short cessation of pains with a corresponding relief to the patient. Ultimately, however, the uterus begins to contract again, and may be felt by the hand to grow more hard and solid. In the intervals it becomes softer, but should never become at all flabby in

ordinary circumstances. Frequently there are little gushes of blood during the pains, indicating the separation of the placenta, but sometimes there is no bleeding. In the end the placenta



FIGS. 77-82.—Gradual birth of head and its external rotation.

is expelled by a strong pain into the vagina, where it may remain. More usually the uterine force is sufficient to expel it right through the vagina to the outside.

The third stage may occupy anything from a few minutes to an hour, or even more. The average is about twenty minutes.

During it the woman may have a shivering fit, the "physiological chill" of labour. This is due to the cooling of the body surface by the perspiration, combined with the effects of the severe muscular exertion, and perhaps the rearrangement of the abdominal circulation after the placental circulation stops.

Duration of Labour.—In multiparæ the average duration of labour is about twelve hours. Of these probably ten are taken up by the first stage, about one and a half by the second, and half an hour by the third.

In primiparæ the process occupies about six hours more—say eighteen hours on an average. Of these, fifteen to sixteen will be occupied by the first stage, about two by the second, and half an hour by the third.

It would appear that for some unexplained, but very inconvenient, reason more labours terminate between midnight and six in the morning than at any other period of the twenty-four hours.

CHAPTER XIII

THE FACTORS OF LABOUR

THE numerous factors involved in the process of each stage of labour may conveniently be grouped together under three heads—(1) the powers or forces concerned, (2) the passages, and (3) the passenger or body passing.

First Stage

The events of the first stage which require to be studied are the uterine contractions, the opening up and canalisation of the cervix, the formation of the lower uterine segment, and the formation and commencing descent of the bag of waters. These events we shall study under the three heads just mentioned.

I. **The Powers.**—Two sets of forces are brought into play in labour—the action of the musculature of the uterus or Primary Powers, and the action of the abdominal muscles or Secondary Powers. In the first stage only the primary powers are involved, namely, the *contractions and retraction of the uterine muscle.*

It has already been pointed out that during the greater part of pregnancy intermittent contractions are passing over the uterus from time to time. The contractions during labour are simply an exaggeration of these, increased to the point of being extremely painful, and modified inasmuch as the uterine muscle retracts as well as contracts. This faculty of retraction is a characteristic of the muscle of the uterus and bladder. It means that a certain amount of the shortening produced by

contraction is permanently retained, the muscle fibres becoming shorter with each contraction and never relaxing back quite to their original length. There is thus during labour a progressive diminution in the capacity of the uterus, which is one of the principal factors in expelling its contents.

The term "pain" has become almost synonymous with "uterine contraction," because the suffering is the most noticeable feature to the patient. The suffering is due to the muscle fibres squeezing the nerve endings in the uterine wall just as in cramp. In the second stage, especially as the head is being born, the pain is increased by the excessive stretching of the birth canal, and the most agonising suffering is at the moment when the head is passing over the perineum.

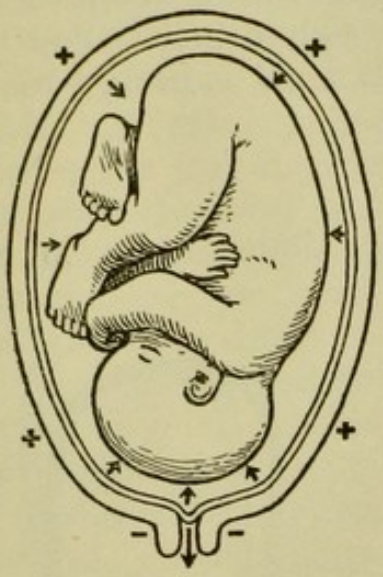
The amount of pain felt varies with different individuals, and very occasionally no pain is felt.

The contractions of the uterus are probably peristaltic in nature, passing from fundus to cervix, but this feature can rarely be made out in the human being. A typical contraction has, however, a very definite character. It begins gradually, and becomes more and more marked until it reaches its acme. This is maintained for a moment or two, and it then gradually ceases, and there is an interval, followed by another contraction. There is thus a sort of cycle—increment, acme, decline, interval. The value of this intermittent character is enormous, for it (1) gives rest to the mother, (2) relieves the pressure on the child and on the abdominal viscera, and (3) permits the restoration of the placental circulation, which is stopped at the acme of the pain. That the child is killed by a too prolonged contraction which stops the circulation, is seen in cases where the uterus undergoes a tetanic contraction as a result of the misuse of ergot or some other cause.

Another law which governs the contractions during labour is that as labour advances the pains become longer, stronger, and more frequent—the intervals between them becoming shorter. At the beginning of labour the contractions may last perhaps thirty seconds, and come at intervals of ten or twenty minutes, or even more. Towards the end they last for sixty to ninety seconds, and come every one or two minutes.

Nature of the Transmission of Force. — During the first stage the fœtus is entirely enclosed in the bag of membranes, and as long as the cervix is undilated, the force of the uterine

contractions is applied to it as a general fluid pressure—*i.e.* it is applied equally in all directions. Were such a state of



FIGS. 83 and 84.—General fluid pressure. Least resistance at the cervix.

affairs to continue, there would be no advance of the fœtus. This, however, is obviated by the cervix becoming an area of diminished resistance, and thereafter the fluid pressure acts downwards on the cervix.

After the rupture of the membranes much of the fluid is kept back by the accurate fit of the head into the lower segment of the uterus, and above this level the uterine force continues to be transmitted as a general fluid pressure. But if much of the fluid has drained away, the fundus of the uterus comes into direct contact with the breech of the child, and some of the force is then directed downwards through the axis of the fœtus itself.

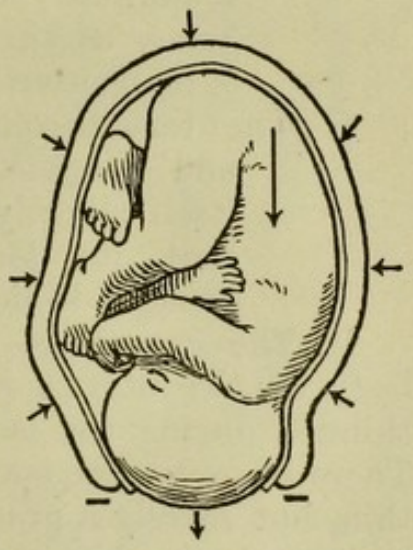


FIG. 85.—Fœtal axis pressure.

Force of the Uterine Contractions.—This was much exaggerated by some of the early writers, and Sterne in *Tristram Shandy* probably reflects opinions actually held in his day, when he refers quizzically to the force of strong labour pains as "equal, upon an average, to the weight

of 470 pounds avoirdupois acting perpendicularly upon" the head! Experiments by means of rubber bags placed in the uterus and connected to a manometer show that the pressure rarely rises above about 30 lbs. to the square inch. Possibly at the acme of the strong pains, as the head is being born, it may rise to nearly fifty.

Phenomena during a Contraction:—

(1) Arterial pressure is raised.

(2) Pulse is quickened, to become slower again in the interval.

(3) Respiration is slowed or stopped during the acme, to become more rapid afterwards.

(4) Intra-uterine pressure is raised.

(5) The fœtal heart-beat is slowed.

(6) The uterine souffle becomes louder and more high-pitched at the start, but inaudible during the acme, as the circulation is momentarily stopped.

(7) The uterus becomes narrowed and elongated, and rears itself slightly forward so that its long axis is brought to lie in the axis of the pelvic inlet.

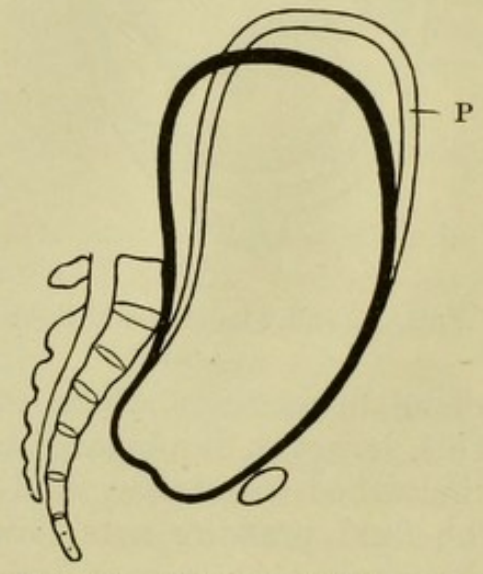


FIG. 86.—Uterus during and between contractions. See also Fig. 90.

P. Outline of uterus during contraction.

II. **The Passages.**—In many cases the lower portion of the body of the uterus, particularly the anterior wall, becomes thinned during the last two or three months of pregnancy. There is no definite boundary between the thick part and the thin, but merely a gradual diminution in the thickness which is most noticeable in the two inches immediately above the internal os. This thinned region is known as the **Lower Uterine Segment.** In other cases no lower segment is recognisable before the beginning of labour, and in all cases it becomes clearly and fully developed only after labour has begun.

The internal os remains closed until the beginning of labour

except in some few cases in which the painless contractions in the last few days or weeks of pregnancy result in the upper part of the cervical canal being expanded.

Normally, therefore, there is at the beginning of labour a narrow cervical canal closed above at the internal os, which leads into the cup-shaped lower pole of the uterine cavity. During the first stage of labour these two parts become opened out so as to form one continuous canal, and this process we must study more in detail.

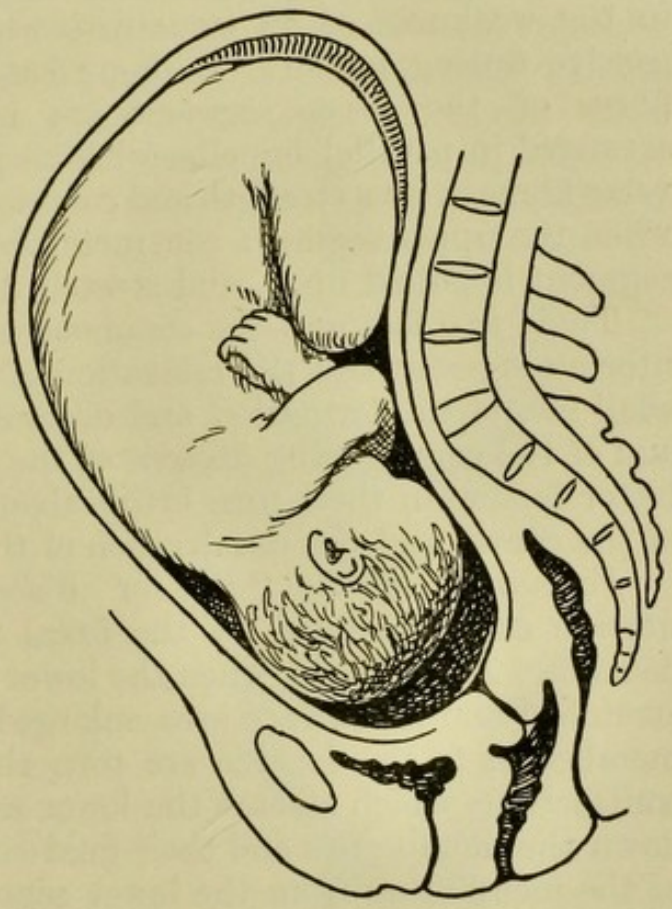


FIG. 87.—Condition of cervix before the beginning of labour. (After Leopold.)

In order that a hollow organ like the uterus may expel its contents it is essential that one part of it be weaker than the rest; otherwise the effect of the contractions would simply be to raise the intra-uterine pressure without leading to any expulsion of its contents. In the case of the uterus Nature provides that the point of exit shall be the weak spot by two means—(1) the polarity of the uterus, and (2) the formation of the lower uterine segment.

By the term polarity is meant that when the body of the uterus is in a state of contraction the cervix is in a state of relaxation, and *vice versa*. The same principle applies to other hollow organs like the bladder and rectum. During pregnancy the body of the uterus may be said to be in a state of relaxation (except for the slight intermittent contractions) and the cervix in a state of contraction. During labour the reverse obtains, the body contracting and the cervix relaxing. The principle is made use of in treatment when forcible dilatation of the

cervix is employed to set up contractions of the body of the uterus.

The lower uterine segment — the portion of the body immediately above the internal os — is also an area of diminished resistance. As has been indicated in a previous paragraph, this part of the uterus may actually be thinner than the rest before labour begins. But in any case it becomes progressively thinned after labour begins. This is largely due to the weakness of its structure, which makes it practically passive during labour. Barbour has shown that the muscle fibres of the lower segment are mostly longitudinal, and arranged in parallel lamellæ with no great proportion of transverse fibres to give strength and cohesion to it. The result is that when the upper segment contracts and retracts the weak lower segment is pulled upon, and stretched, and expanded.

These two factors—the commencing expansion of the lower uterine segment and the relaxation of the cervix—allow, as we shall see, of the formation and descent of the "bag of waters," and of the commencing descent of the uterine contents. These latter factors in their turn bring about the complete dilatation of the cervix and the canalisation of the lower uterine segment.

Formation of the "Bag of Waters."—The inside of the uterine cavity is lined by the fœtal membranes fused to the decidua. Accordingly, when the lower uterine segment becomes stretched and its surface area enlarged, the attachments of the membranes to the decidua are torn through, because the same contractions which stretch the lower segment tend also to push down the membranes and their fluid contents. This separation of the membranes from the lower segment is the origin of the slight bleeding early in labour known as the "show."

As soon as the internal os begins to open, this detached portion of the membranes and its contained fluid bulge into the opening. Each successive contraction makes them protrude more into the upper part of the cervical canal, and in this way they act as a fluid wedge for the forcible canalisation of the cervical canal. The accompanying diagrams make this quite clear.

In a primipara the whole cervical canal is expanded into a funnel before the external os begins to open. Sometimes, indeed, the cervix is so thinned out that the edge of the os externum feels no thicker than parchment. Ultimately, how-

ever, the os is dilated by the bag of waters like the rest of the canal.

In a pluripara the external os is usually partially open from the very beginning of labour, and its complete dilatation quickly follows upon the canalisation of the cervix.

During the first stage the bag of waters may be felt by the examining finger as soon as the external os begins to open. It is best felt during a pain, when it becomes tense, and shaped like a

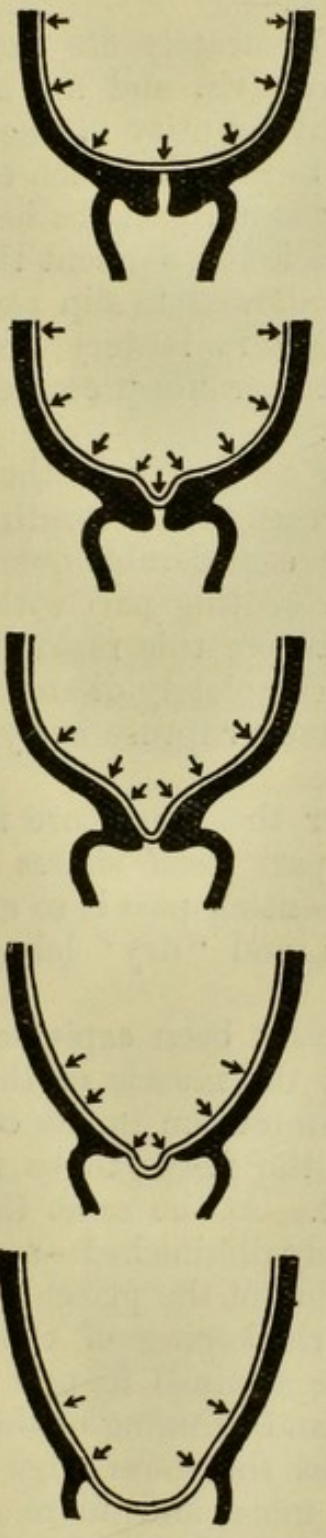


FIG. 88.—Stages in the dilatation of the cervix in a primigravida.

FIG. 89.—Stages in the dilatation of the cervix in a pluripara.

watch-glass. In malpresentations, and in cases where there is some abnormality of the pelvis or soft passages, the membranes often protrude in the shape of a sausage or the finger of a glove. The reason of this is as follows :—

In a vertex presentation the head accurately fits the lower uterine segment and the brim of the pelvis, and has a "ball valve" action in preventing any great quantity of the liquor amnii from getting past it. That is to say, that each contraction which tends to squeeze the liquor amnii past the head also forces the head so accurately into the lower segment that not more than a drop or two of fluid is allowed to slip past. In this way the quantity of the forewaters is very gradually increased, and the elasticity of the membranes preserves them intact until the cervix is fully dilated.

In cases of malpresentation or of deformity of the pelvic brim there is less accuracy of fit between the presenting part and the lower uterine segment, and a considerable quantity of the liquor amnii is forced past the presenting part with every contraction. The membranes yield before this rapid increase of pressure, and bulge through the incompletely dilated os in a sausage shape. Such membranes usually rupture early before the end of the first stage.

In all cases, but particularly after the premature rupture of the membranes, the presenting part itself shares in the dilatation of the cervix. But no presenting part is so effective as the fluid wedge of the forewaters, and "dry" labours are usually tedious.

The Retraction Ring.—It has already been explained that the faculty of retraction possessed by the muscle of the body of the uterus leads to a progressive diminution in the capacity of the uterine cavity, which causes the fœtus to be pressed down into the yielding lower segment. At the same time the surface area of the wall is progressively diminished—a process which ultimately leads to the separation of the placenta.

The progressive shortening and thickening of the upper segment of the uterus so produced is attained in part at the expense of a corresponding expansion and thinning of the lower uterine segment. As labour advances the lower edge of the thickened upper segment becomes more and more clearly demarcated from the thinned area below it. It becomes, indeed, distinctly recognisable as a circular ridge running round the

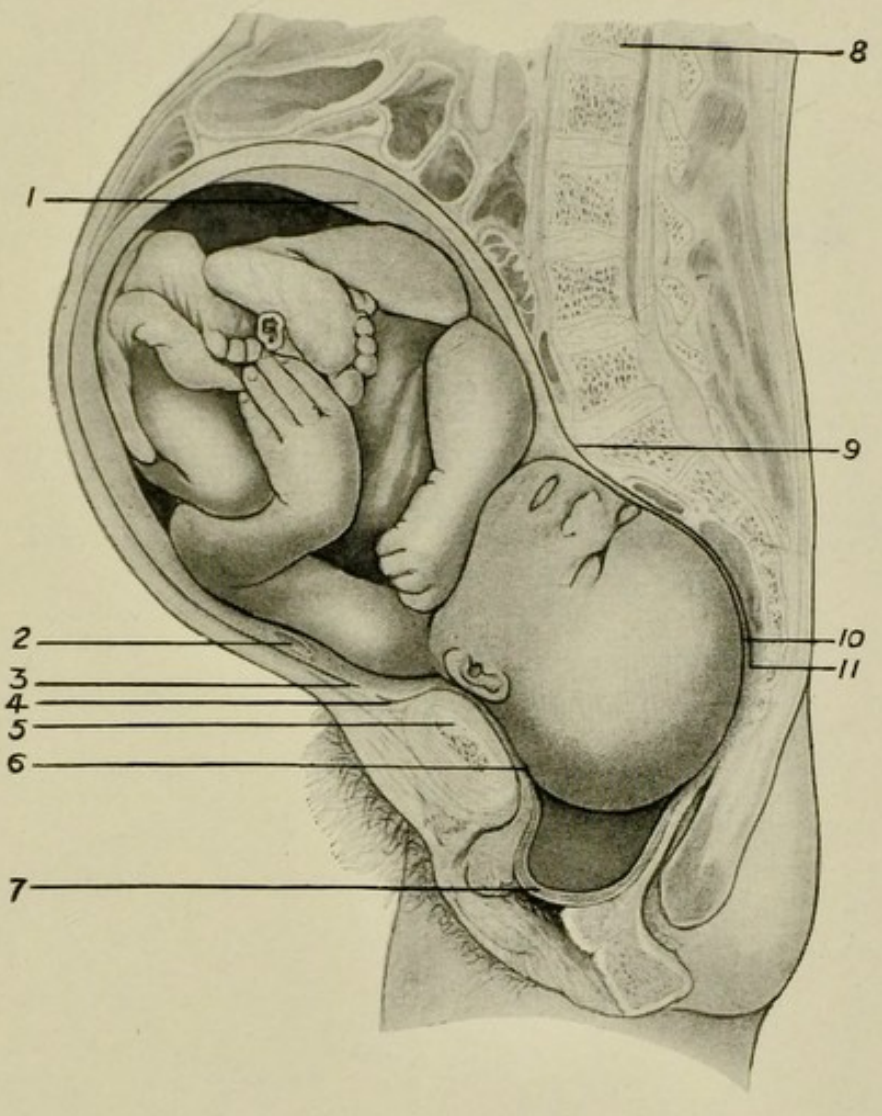


FIG. 90.—Braune's section of a primipara who drowned herself while labour pains were going on. (After Barbour.)

1. Placenta.
2. Coronary vein.
3. Utero-vesical reflection of peritoneum.
4. Bladder.
5. Symphysis pubis.
6. Os externum.
7. Bag of membranes.
8. First lumbar vertebra.
9. Promontory of sacrum.
10. Os externum.
11. Pouch of Douglas.

uterus, which can be palpated both inside and outside. This ridge is known as the retraction ring or Bandl's ring. It will readily be understood that the more the lower uterine segment is distended and thinned, the more prominent does the retraction ring become, and the higher does it rise in the uterus. In some cases of obstructed labour in which the lower segment is apt to be greatly expanded, the retraction ring may be seen as a transverse ridge on the abdomen, rising higher and higher as the labour proceeds. Such cases are of extreme danger, as it indicates excessive expansion of the lower segment with the probability of its rupturing unless delivery be speedily accomplished.

In structure and function the upper and the lower segments of the uterus afford an interesting contrast.

Upper Segment.	*Lower Segment.*
Peritoneum firmly attached all over.	Peritoneum loosely attached particularly in front, absent at sides.
Muscle arranged in several different layers running in different directions.	Muscle arranged principally in longitudinal lamellæ, easily separated.
Membranes firmly attached. Separation at end of labour.	Membranes loosely attached. Separation at beginning of labour.

Boundary between upper and lower segments marked by the retraction ring, and frequently by a vein running circularly round uterus.

Is active during labour.	Is relatively passive during labour.
Becomes by retraction progressively shorter and thicker.	Becomes stretched and expanded, and progressively longer and thinner.

Origin of Lower Uterine Segment.—The above description of the lower segment of the uterus is based on the work of Barbour, but it must be stated that there are other views as to its origin.

The existence of the two distinct segments during labour was first shown by Braune by means of frozen sections of the

bodies of women who had died during labour. He regarded the ring between the two as the internal os, and stated that during labour the upper part of the cervix was enormously expanded and drawn up, thus forming the lower segment. A few years later Bandl pointed out that it was difficult to imagine that such an expansion of the small cervix could take place in the course of a few hours. A great and prolonged controversy was thus started, which has recently been revived. As a result there may be said to be three main views on the subject :—

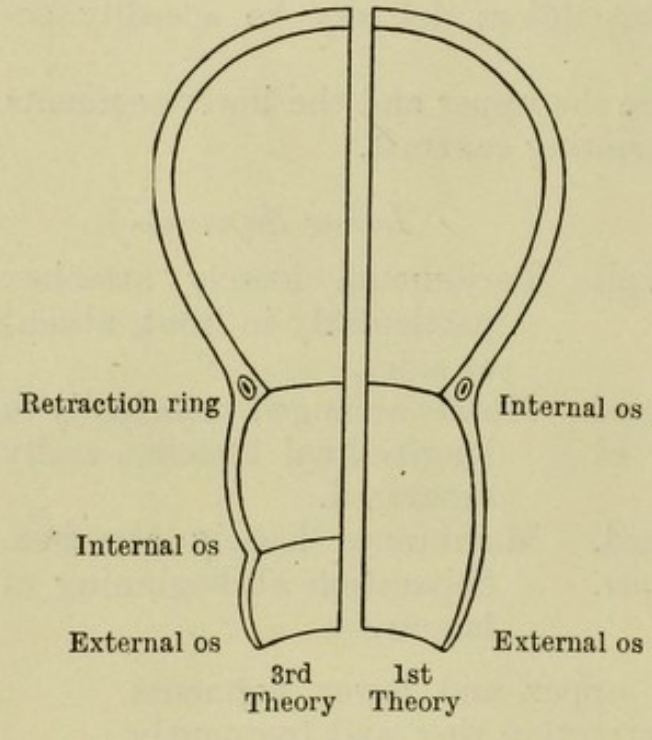


FIG. 91.—Illustrating theories as to origin of lower uterine segment.

1. That there is no lower uterine segment properly so called, and that what is so described is really the enormously expanded and thinned cervix.

2. That the upper part of the cervix becomes greatly dilated in the last month or two of pregnancy, and together with the lowest part of the body of the uterus forms the lower uterine segment.

3. That the cervix remains undilated in most cases until labour actually begins, and that the lower uterine segment is derived from the lowest part of the body.

The question can only be settled by the macroscopic and microscopic examination of the uterus in cases of death during labour. Unfortunately in these cases the tissues are often in a bad state of preservation by the time they can be brought to examination. The difficulty is increased also by the fact that the retraction ring, which is a clinical phenomenon depending on the activity of living muscle, tends to disappear after death ; and, further, by the fact that the uterus both before and after death moulds itself to the fœtus, and in this way rings and

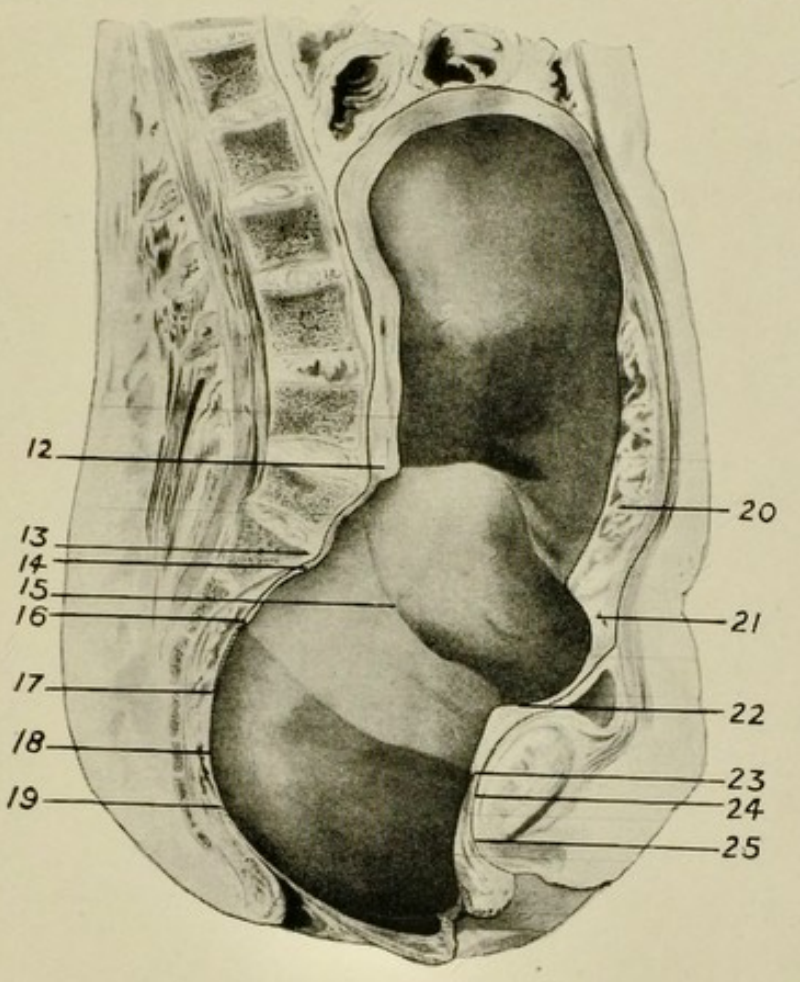


FIG. 92.—Section of a primipara who died of fatty heart during the second stage of labour. (After Barbour.)

12. Retraction ring.
13. Promontory of sacrum.
14. Level of os internum.
15. Bulging of wall into neck of fœtus.
16. Os externum.
17. Level of pouch of Douglas.
18. Posterior vaginal wall.
19. Rectum.
20. Placenta.
21. Retraction ring.
22. Os internum.
23. Os externum.
24. Lower limit of bladder.
25. Urethra.

ridges are produced, corresponding to the flexions of the fœtal body, which might be misinterpreted as the retraction ring or the os internum. Lastly, the histological determination of the internal os is complicated by the fact that occasionally the characters and arrangement of the cervical mucosa are, as in the infant uterus, carried up beyond the internal os into the body; and that in some rare cases the decidual reaction extends below the internal os into the cervix.

A complete discussion of all these points will be found in some of the large books. Here it must suffice to state that Barbour has produced strong evidence to support the third view as the correct interpretation of the facts in probably the great majority of cases. Exceptionally the formation may occur as mentioned in the other views, but the evidence of this is by no means so clear.

The Bladder during Labour.—During the first stage the bladder is gradually drawn up by the ascending cervix and lower uterine segment, and in the second stage the upper part of the organ is in the abdomen while the lower lies behind the symphysis.

This explains two well-known clinical facts: (1) that a full bladder obstructs and delays labour; (2) that prolonged compression of the bladder between the head of the fœtus and the pubes may lead to necrosis and fistula formation.

III. **The Passenger.**—In this stage the bag of waters represents the passenger, and it requires no further description.

Second Stage

I. **The Powers.**—In the second stage the uterus is aided by the *secondary powers*, namely, the contractions of the abdominal muscles. At first they are brought into play voluntarily, but towards the end of this stage their action passes beyond the control of the patient, and they act reflexly in concert with the uterus.

II. **The Passages.**—*Rupture of the Membranes.*—This very commonly occurs as soon as the cervix is fully dilated. The escape of the forewaters thus often indicates the beginning of the second stage. The rupture is brought about by the increasing force of the uterine contractions and the increasing fluid pressure inside the bag of waters on the one hand, and by

the diminished support offered by the dilated cervix on the other.

Canalisation of the Vagina.—This is effected by the descent of the presenting part, or by the bag of waters if not already ruptured. The vertex is a good wedge-shaped dilator, but other presentations are less effective.

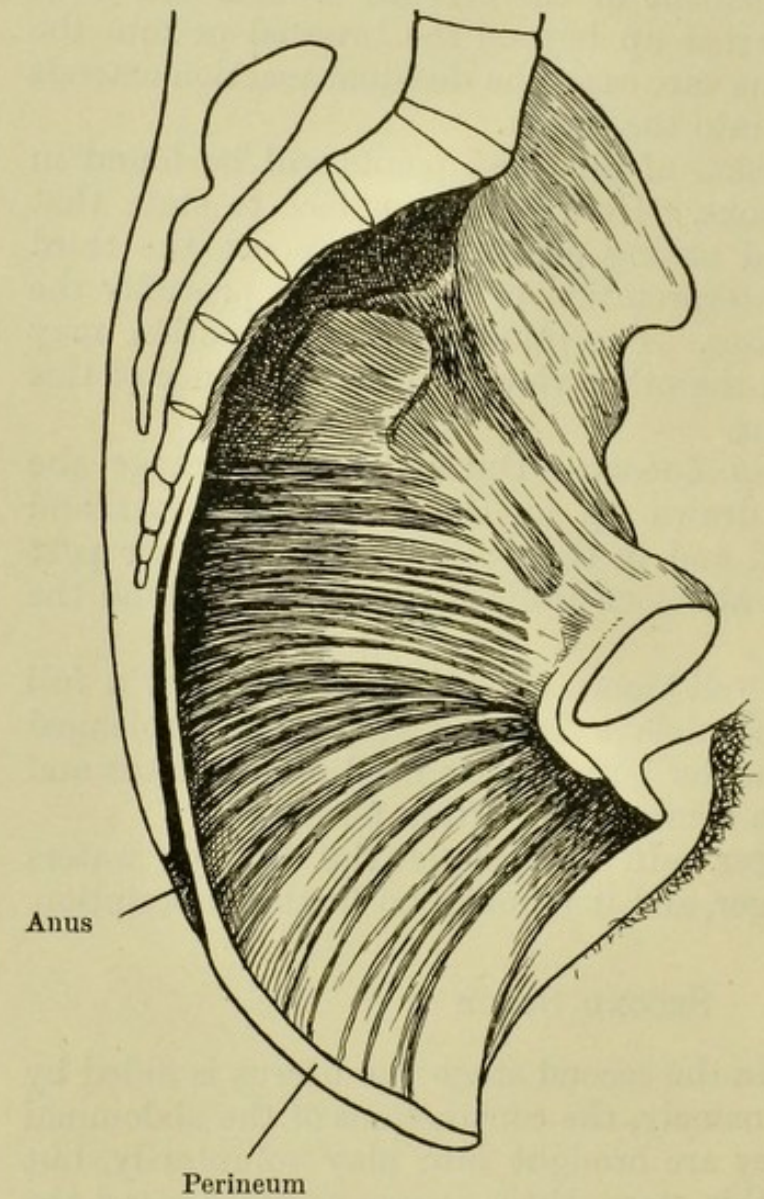


FIG. 93.—Genital canal fully dilated. (After Bumm.)

Displacement of the Pelvic Floor.—It will be remembered that the pelvic floor is made up of an anterior or pubic, and a posterior or sacral segment. In the last days of pregnancy both segments sag downwards owing to the increased succulence of their tissues.

During labour the pubic segment is drawn up by the ascent of the cervix, just like the bladder, which is really a component of this segment.

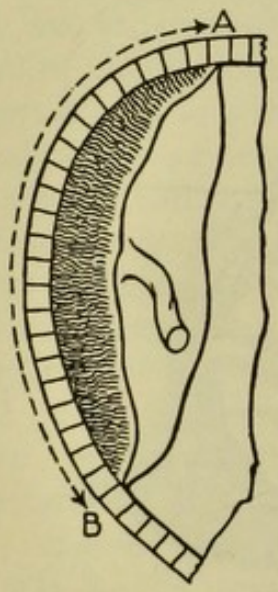
The posterior segment is, however, right in the line of advance of the fœtal head. It is therefore exposed to the full force of the uterine contractions with the result that, as it is firmly fixed above to the sacrum, it becomes stretched out and pushed downwards and backwards. Outwardly this shows itself in the elongation and bulging of the perineum. The distance between the anus and the posterior commissure of the vulva is lengthened

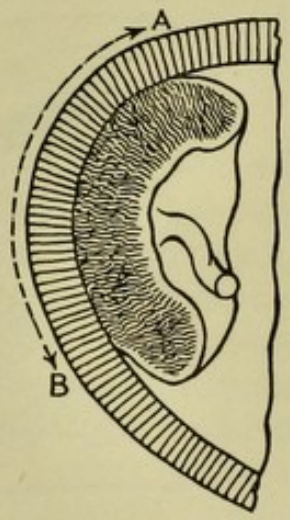
from about one and a half to three or four inches (3·75 to 7·5 or 10 cm.) just before the birth of the head. This displacement of the two segments of the pelvic floor has been likened by Hart to the displacement of two halves of a folding double door through which one passes by pulling in the one half and pushing out the other.

III. **The Passenger.**—During the second stage the passenger is the fœtus. Its movements in relation to the pelvis during labour constitute what is known as the "mechanism of labour," and are of such importance that they require a special chapter.

Third Stage

I. **The Powers.**—These are in the main the uterine contractions. The abdominal muscles may also act, but they do so at the will of the woman, and not necessarily in concert with the uterus. Amongst civilised races the hand of the





Figs. 94 and 95.—Separation of the placenta by retraction of uterine wall.

physician or nurse on the fundus may have to be invoked as an additional power, but that is, strictly speaking, not normal.

II. **The Passages.**—These are the dilated soft passages. The thin lower uterine segment collapses after the expulsion of the child, and becomes somewhat folded on itself by the body sinking down upon the cervix.

III. **The Passengers.**—These are the placenta and membranes.

Separation of the Placenta.—The resumption of pains after the birth of the child indicates still further contraction and

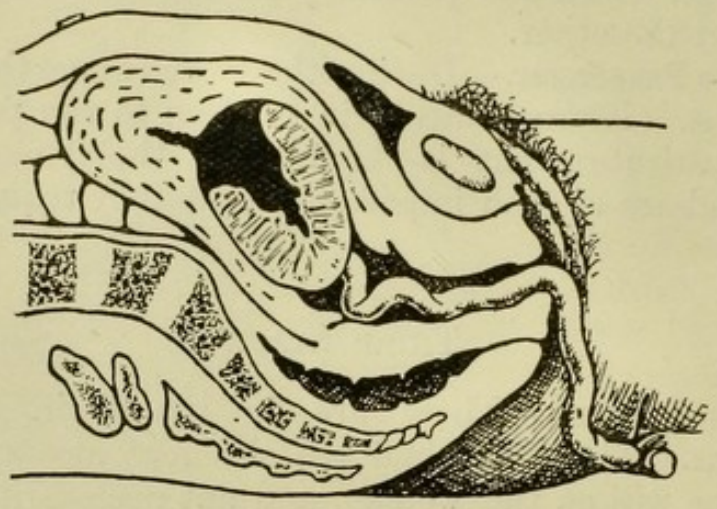


FIG. 96.—Expulsion of the placenta by Schultze's mechanism. Retroplacental clot. (After Whitridge Williams.)

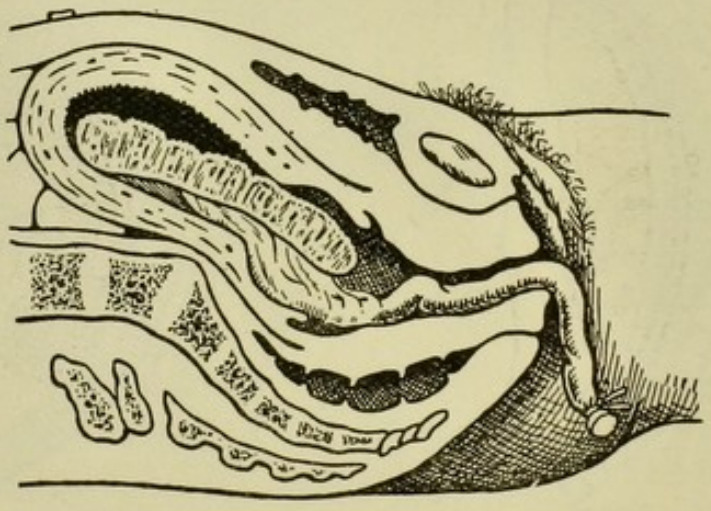


FIG. 97.—Expulsion of the placenta by Duncan's mechanism. (After Whitridge Williams.)

retraction of the upper segment. This brings about such a disproportion between the placental site and the placenta that the attachments between the two are torn through. Barbour has shown that the placental site may be reduced in area to $4\frac{1}{2}$ inches by 4 without separation taking place (11 by 10 cm.).

But the retraction necessary to reduce the placental site to such small dimensions has the important effect of so lessening the circumference of the uterine cavity, that the placenta is grasped by it on all sides. The result of this is that at the same time as separation is being effected, the uterus is also bringing an expulsive or detrusive force to bear upon the placenta. The separation is thus aided by the detrusion. A third factor in the separation is the bleeding that takes place behind the placenta as soon as any small part is detached. In some cases this would appear to be an important factor, a large blood clot forming behind the placenta—the retro-placental clot.

Expulsion of the Placenta.—In most cases this follows directly upon separation. Two methods of expulsion are known, and it is still rather an open question which is the more common. The first is generally known as Schultze's method. In this the placenta is expelled like an inverted umbrella, the fœtal surface coming first, and the membranes trailing behind. Where there has been the formation of a large retro-placental clot, this mechanism is probably common. The second method is usually known by the name of Matthews Duncan. In it the lower edge of the placenta is first extruded and the whole organ slides down folded longitudinally upon itself. In this country there seems to be evidence that this is on the whole the more common mechanism.

Arrest of Hæmorrhage.—As the placenta is separated from the wall of the uterus, the blood-vessels passing from the one to the other are torn across, and many of the large sinuses in the uterine wall thus laid open. Bleeding from these is, however, prevented by the very retraction of the uterus which causes the separation. The retracting muscle fibres are arranged in a sort of network around the vessels, which are tortuous and angular. Hence when the fibres retract they close up the blood-vessels in the manner of "living ligatures," and only a very little if any blood escapes. If, owing to exhaustion of the uterus, retraction fails to occur after the separation of the placenta, then free and alarming bleeding may take place—post-partum hæmorrhage.

CHAPTER XIV

MECHANISM OF LABOUR IN OCCIPITO-ANTERIOR POSITIONS OF THE HEAD

THE "mechanism of labour" comprises the various movements by which the head adjusts itself to the shape of the pelvis in the course of its passage. Some method of accommodation of the one to the other is necessary if the head is to pass through the pelvis under the greatest mechanical advantages. It will be recalled that it is the curve of the pelvic canal, and the fact that the longest diameter lies obliquely or transversely at the brim and antero-posteriorly at the outlet, that are the main difficulties to be negotiated; and these are increased by the relatively large size of the head compared with the pelvic canal.

In the following pages the mechanism in a Left Occipito-anterior Vertex presentation will be described in detail, both because it is much the commonest, and because it is the archetype of all other mechanisms.

Left Occipito-anterior Position. — At the beginning of labour the head lies with the occiput opposite the left foramen ovale, and the sinciput opposite the right sacro-iliac synchondrosis, the head thus lying approximately in the right oblique diameter with its occipito-frontal or suboccipito-frontal plane parallel to the plane of the pelvic brim. Its movements during labour resolve themselves into the following :—

Descent
- Flexion.
- Internal Rotation.
- Extension.
- Restitution.
- External Rotation.

Descent.—This movement is mentioned at the start once for all, but it must be remembered that it is going on *all the time*, and that the other movements are merely superimposed upon it.

Flexion.—*Its Nature.*—In flexion the occipital end of the head dips down in advance of the sincipital, so that the posterior fontanelle comes to lie at a lower level than the anterior. The chin is brought into direct contact with the sternum.

It must be borne in mind that flexion of the head exists in great part before labour begins, being characteristic of the natural attitude of the fœtus. In those cases in which the flexion is full and complete to start with, no "movement," properly so called, can be described. But in some cases the flexion is not complete, and in them there is certainly a movement of "increase of flexion."

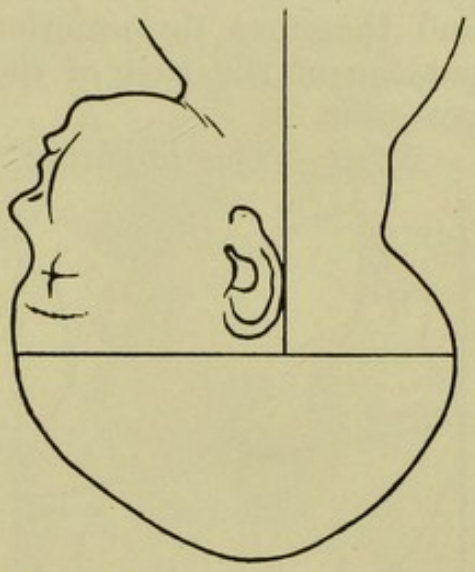


Fig. 98.—Diagram to illustrate lever theory.

Sphere.—The increase of flexion occurs where the head first meets resistance. This may be, and probably in most cases is, at the brim of the pelvis; or it may be as low down as the floor of the pelvis. The resistance may be due to the hard passages or to the girdle of contact of the soft passages.

Cause.—It is probably due to a combination of several factors.

(1) *Lever Theory.*—The spinal column is articulated to the head nearer the occipital end than the sincipital. Therefore supposing the resistance at the two ends of the head to be equal, any force transmitted through the spine to the head will cause the short occipital end to dip down in advance of the sincipital. This factor applies after the rupture of the membranes; but in cases where the head descends before the membranes have ruptured, the force is transmitted not through the spine, but as a general fluid pressure.

(2) *Wedge Theory.*—It has been pointed out that the fœtal head looked at from the side is unevenly wedge-shaped. In terms of theoretical mechanics it can be shown that the side of the head that makes the more acute angle with the side of the pelvis ought to descend first, *i.e.* the occiput.

(3) Whether such abstract mechanics are helpful to our ideas of the subject is doubtful. But it must be perfectly clear from a study of the accompanying diagram (Fig. 99) that if flexion exists even to a small extent before descent begins, the elastic resistance of the soft passages will act upon the two ends of the descending head as two forces acting in opposite directions in parallel lines. The effect of such a "couple" of forces must be to increase the existing flexion.

(4) Lastly, it is noteworthy that the anterior wall of the pelvis is short and smooth compared with the posterior, and therefore the anterior wall offers less resistance to the passage of the part of the head in contact with it than the posterior.

Effect.—The important result of flexion is that the head enters the pelvis with its small sub-occipito-bregmatic plane in engagement with the plane of the brim. In other words, it substitutes its suboccipito-bregmatic diameter of $3\frac{3}{4}$ inches for its occipito-frontal diameter of $4\frac{1}{2}$ inches, or some similar measurement. The mechanical advantage so gained is very considerable, as can be illustrated, for example, by the relative ease with which a small hat can be put on the back of one's head as compared with the top.

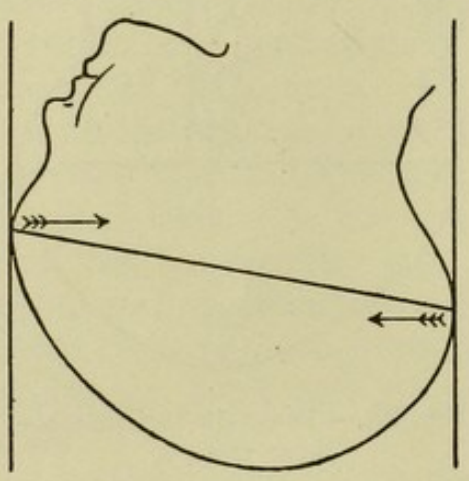


FIG. 99.—Couple of forces due to elastic resistance of passages.

The head and body of the fœtus are also more "compacted" so as to form one single ovoid mass upon which the uterine force can act to complete advantage.

In view of the next movement it is important to remember that one result of flexion is to make the occiput the leading part of the fœtus.

Internal Rotation.—*Its Nature.*—The occiput—the leading part—is rotated round to the front, so as to lie under the pubic arch. The sagittal suture then lies in the antero-posterior instead of the right oblique diameter.

Sphere.—This movement occurs when the head comes on to the pelvic floor, *i.e.* in the lower part of the cavity.

Cause.—Here again several factors are involved :—

(1) The absence of the bony wall makes the pubic arch the direction of least resistance.

(2) The shape of the lateral and posterior portions of the pelvic floor is such that they form a sort of gutter running downwards and forwards. The effect of this is to direct the advancing part forward.

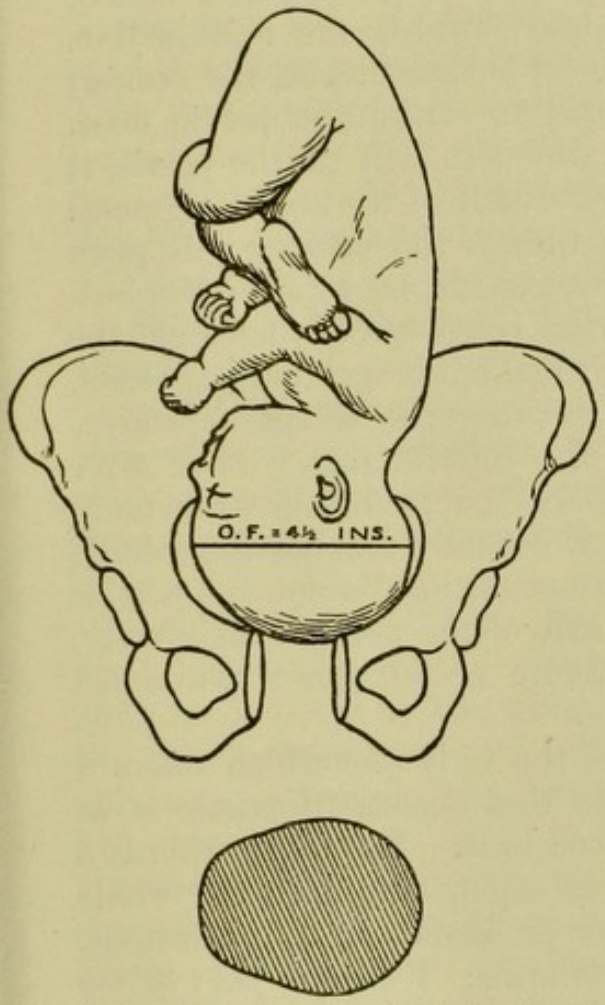


FIG. 100.—Engagement of occipito-frontal circumference in brim.

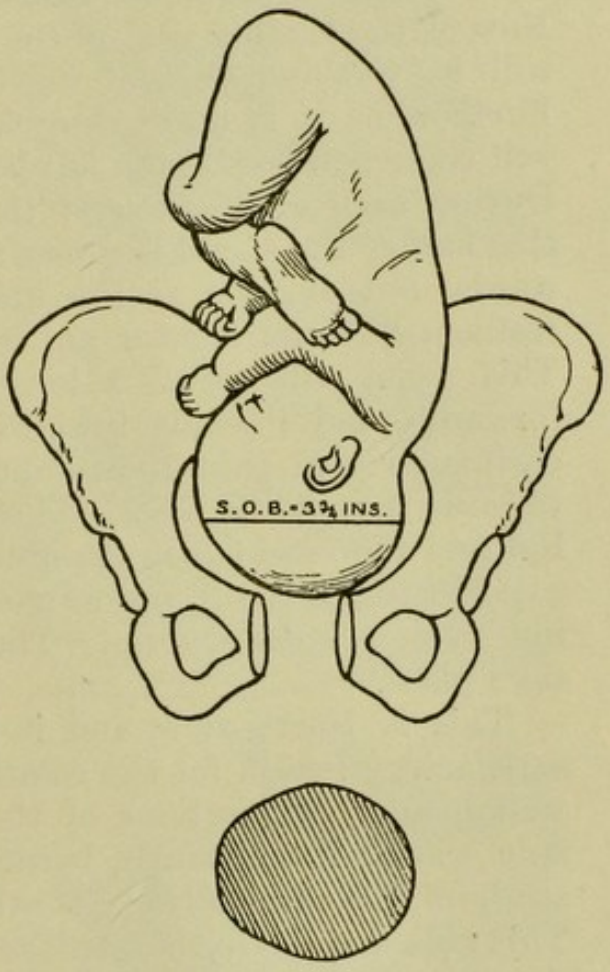


FIG. 101.—Engagement of suboccipito-bregmatic circumference in brim.

(3) It used to be taught that the "inclined planes of the ischium" were the effective cause of internal rotation. The ischium is divided by a line passing from the pectineal eminence to the ischial spine into two planes, the upper and posterior of which looks upwards, backwards, and inwards, while the lower and anterior looks downwards, forwards, and inwards. The anterior plane was supposed to direct the occiput forward, and the posterior plane on the other side to direct the sinciput

backward. Apart from the fact that these planes are often hardly recognisable, this theory entirely fails to explain the rotation in posterior positions of the occiput.

(4) The principal cause is to be found in the elastic recoil of the pelvic floor, the effective part of which is the levator ani. If the posterior or sacral segment of the floor be looked at from above, it is seen that it forms a sort of gutter, each side of which looks upwards, forwards, and towards the middle line. Now as the leading part of the head is the occiput, the occiput will be the first part of the head to strike the pelvic floor. Further, as it is descending in the left half of the pelvis, it will come down upon the left lateral half of the sacral segment. During each contraction of the uterus the occiput will push this half of the sacral segment downwards, backwards, and outwards, but as soon as the uterine contraction passes off, the resiliency of the levator ani will make the pelvic floor recoil. This recoil will act as a force pushing the occiput upwards, forwards, and inwards towards the middle line. Thus after each successive pain the occiput will be pushed a little more towards the middle line. When it actually reaches the middle line and the head lies in the antero-posterior diameter it will be exposed to the recoil, not of one side of the pelvic floor merely, but of *both sides equally*. Therefore no further rotation can take place.

This is Hart's view, and it is the only one which offers a satisfactory reason for the rotation that occurs in posterior as well as anterior positions of the occiput. Indeed, it affords a rule which, if constantly borne in mind, simplifies the whole study of the mechanisms in other presentations and positions. This rule may be formulated as follows: *Whatever part of the fœtus first meets with the resistance of one lateral half of the posterior segment of the pelvic floor will be rotated to the front.*

It will be found that this rule may be applied absolutely; that is to say, it applies to face cases or breech cases as well as to vertex cases.

Effect.—The effect is to bring the long diameters of the head into the longest diameter of the outlet, namely, the antero-posterior.

Extension.—*Its Nature.*—While the occiput is passing slowly under the pubic arch, the sinciput, having a greater distance to travel, sweeps more rapidly over the perineum. As

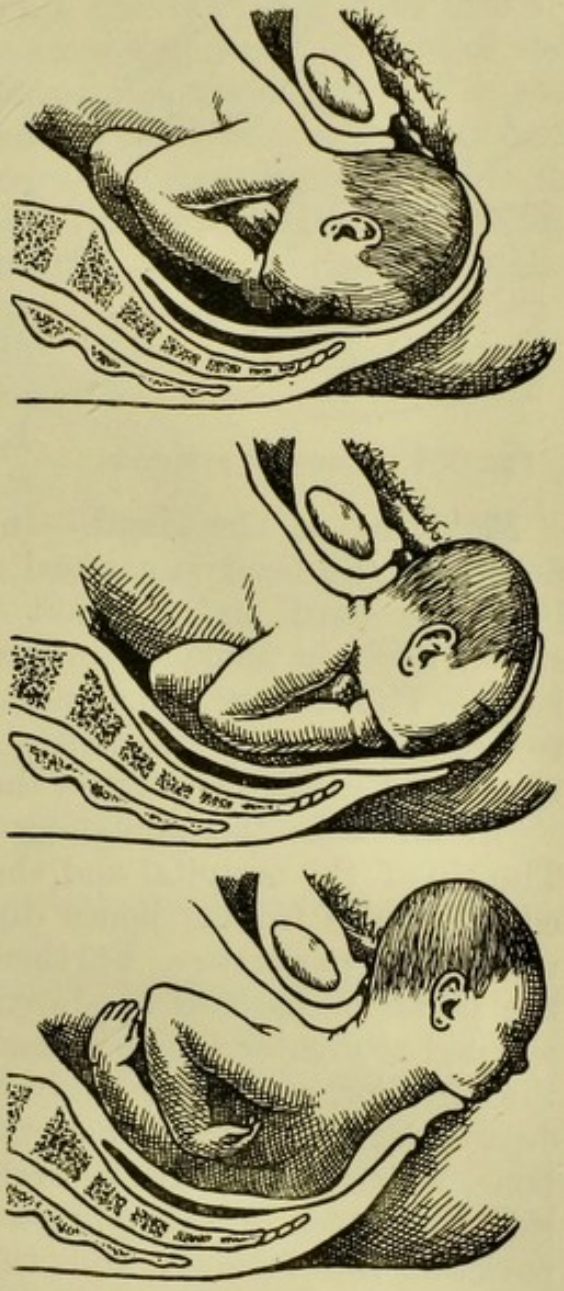
the bregma, forehead, and face pass over the perineum, the flexion is to some extent undone; hence this movement is termed extension.

Sphere.—It occurs as the head is passing through the vulva.

Cause.—The head is subjected to two forces — the uterine force acting downwards, and the resistance of the pelvic floor acting forward. The resultant of these two forces acts in a line directed downwards and forwards, and the head therefore passes in this direction.

Effect.—The occiput has already passed through the vulva before extension occurs. The effect of the extension is the escape of the rest of the head through the vulvar outlet.

Restitution. — When the head was lying in the right oblique diameter at the brim, the shoulders were in the left oblique; and while the head has been rotating into the antero-posterior diameter, the shoulders have been unaffected. There is therefore at the moment of birth of the head a slight twist of the neck. As soon as the head is born this is undone, the occiput passing with an almost imperceptible movement slightly toward the left side.



FIGS. 102, 103, 104.—Delivery of head by extension. (After Whitridge Williams.)

External Rotation.—*Its Nature.*—This is really a movement of the shoulders and trunk, and not in any sense a part of the mechanism of the head which is now born. The movement of the shoulders is, however, indicated externally by the rotation

of the occiput back towards that side of the pelvis which it originally occupied. (Fig. 82.)

Cause.—The shoulders and trunk rotate, the anterior shoulder passing to the front by a movement of internal rotation.

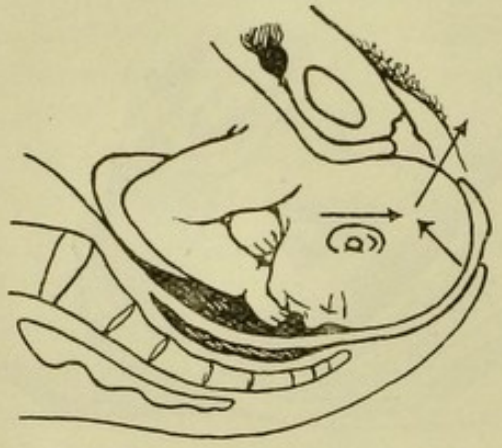


Fig. 105.—Cause of extension.

Effect.—The bisacromial diameter of the trunk is thus brought into the longest (antero-posterior) diameter of the outlet.

Mechanism in Right Occipito-anterior Position.—The head lies approximately in the left oblique diameter of the brim. The movements are exactly the same as in the L.O.A., the word "right" being substituted for "left," and *vice versa.*

Moulding of the Head.—In spite of the mechanism just described the head is exposed to a good deal of pressure from both the hard and the soft passages during labour. This shows itself in some distortion of the natural shape of the head. The factors which make it possible for this moulding to occur without permanently damaging the head have been mentioned in the chapter on the fœtus.

In all cases the moulding occurs on the same principles. The tip of the occipital and the edges of the frontal bones dip under the parietals. Further, the posterior parietal is always exposed to greater pressure than the anterior, and accordingly it dips under the anterior parietal bone, which thus comes to override the edges of the posterior parietal, the frontals and the occipital bone.

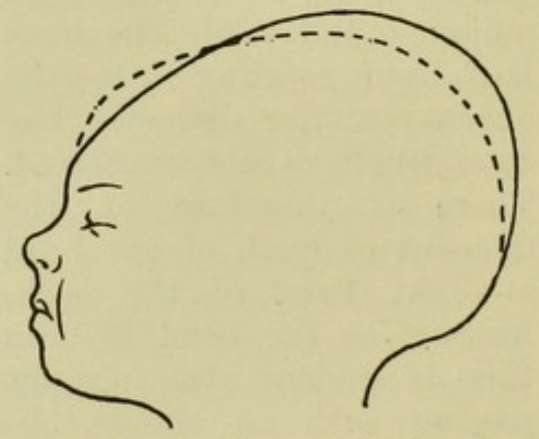


Fig. 106.—Head moulding in vertex presentation.

In addition the suboccipito-bregmatic and occipito-frontal diameters are diminished, while the head is lengthened from the vertex to the chin, and in the occipito-mental diameter.

Caput Succedaneum (Lat. *succedaneus* = secondary).—During labour the part of the scalp which lies within the circle of the

girdle of contact of the soft passages becomes the seat of a swelling. This is because it is exposed to less pressure than the surrounding areas of scalp which are pressed on by the soft passages. The swelling is a sero-sanguineous infiltration into the connective tissues of the scalp, and the position of this so-called caput succedaneum varies according to the position of the head. In occipito-anterior positions the presenting part in the early stages of labour is the vertex. Therefore the caput first forms on the vertex—on the right of the sagittal suture in L.O.A., and on the left in R.O.A. cases. As labour proceeds and flexion becomes more pronounced, the posterior fontanelle

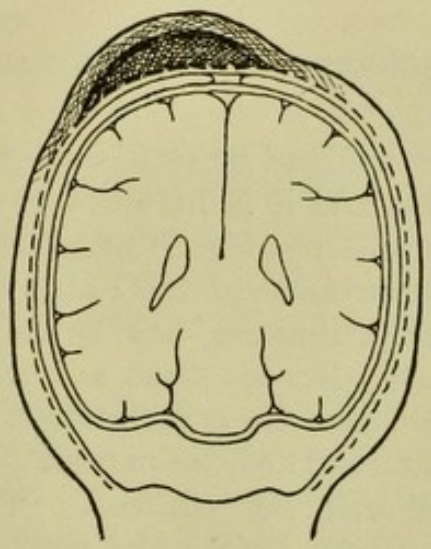


FIG. 107.—Section showing structure of caput succedaneum.

becomes the presenting part, hence the caput succedaneum is ultimately found in that region, a little to the right or left as before. It may therefore be said that in L.O.A. cases it is on the upper posterior angle of the right parietal bone, and in R.O.A. cases on the corresponding angle of the left parietal. The appearance of the caput is generally red and congested. The longer the labour lasts, the larger does the caput tend to become, and in some cases it may so obscure the landmarks of the head as to render the diagnosis of the presentation and position a matter of some difficulty.

The caput succedaneum begins to disappear immediately after birth, and has usually quite vanished after twenty-four hours.

CHAPTER XV

MANAGEMENT OF NORMAL LABOUR

The services of the medical practitioner are usually secured some time in advance, and it is his duty to keep a watch upon the patient's health and hygiene during what remains of her pregnancy. The importance of the examination of the urine, and of the pelvis in primiparæ, has already been referred to. The physician should also see that a nurse is engaged, and should satisfy himself that she is competent. Either the nurse or the physician must instruct the patient to have in the house certain articles that will be required. These should be in readiness at least a month before the confinement is expected. They comprise :—

2 mackintosh sheets 3 feet by 4 feet 6 inches.
2 sanitary (or wood wool) sheets.
2 packets absorbent cotton wool.
1 packet Gamgee tissue.
Lysol, 4 oz. (100 c.c.).
Castor oil, small bottle.
Olive oil, small bottle.
Chloroform, 4 oz. (100 c.c.).
5 white enamelled basins, 10 inches (25 cm.) across.
Bedpan, hot-water bottle, feeding cup.
3 binders—either made up to fit with straps and buckles, or merely stout roller towelling 4 feet long by 2 feet deep.
1 packet sterile gauze for cord dressings.
Starch and boracic powder for cord.

2 oz. (50 c.c.) glycerine and borax for cleansing infant's mouth.
1 yard fine flannel for binders for infant.

The nurse should take the following :—

Medicine and minim glass.
Douche apparatus.
Enema syringe.
Catheters.
Scissors.
1 bottle perchloride or biniodide of mercury tablets.
Linen threads for cord ligatures.
Clinical and bath thermometers.
Clinical charts.

On arrival she should thoroughly scrub all basins, ewers, and other utensils with a strong solution of lysol, and cover them up in clean sheets until required ; prepare cord ligature threads ; prepare a large bottle of 1-1000 perchloride or biniodide lotion ; cut up Gamgee into pads for use in the first ten days ; have a plentiful supply of cold boiled water in clean ewers carefully covered up with clean towels ; and prepare some boracic lotion for the child's eyes.

Obstetric Armamentarium.—The first requisite is a roomy hide bag—those usually sold as midwifery bags are too small—that will remain open by some form of stay. It must have a washable lining that can easily be taken out and boiled. It should have loops for bottles, etc. The following should be taken to every case :—

1. Stethoscope.
2. Soap.
3. Nail-brush (boiled in linen bag).
4. Lysol or similar antiseptic.
5. Tablets of perchloride or biniodide of mercury.
6. Chloroform (4 oz.).
7. Ether.
8. Hypodermic syringe with tablets of morphia, strychnine, ergotin.[1]
9. Male gum-elastic catheter.
10. Gauze (iodoform or bismuth gauze is very suitable) in sterile package.

[1] Glass phials containing sterilised fluid preparations of ergot are better, such as Ernutin, or "Aseptic Ergot."

11. Sterilised overall or gown.
12. Glass vaginal nozzle (sterilised).
13. Intra-uterine catheter (Fritsch-Bozemann).
14. Volsella.
15. Needles for injection of saline under the breasts.
16. Glass female catheter (sterilised).
17. Ligatures for cord—three-ply stout linen thread, sterilised.
18. Scissors.
19. Antiseptic absorbent wool.
20. Douche apparatus (sterilisable).
21. Enema syringe.
22. Axis traction forceps.
23. Pair sterilised rubber gloves.
24. Perineal needle.
25. Several curved needles.
26. Sterile silkworm gut or other suture material.
27. Tongue forceps.

If a trained nurse is attending the case, arrangements should be made with her to have several of these articles ready, such as Nos. 16 to 21.

Choice of Room.—Where there is a choice, this should have been settled some weeks before, and the room prepared by thorough cleaning, removal of unnecessary hangings and furniture, etc. Care must be taken to avoid too close proximity to a closet or fixed basin, unless the drains have previously been tested and certified. An airy, sunny room should be chosen if possible.

Calls to Confinements very often come during the night. They must be answered promptly, for by so doing many a disaster may be averted. Moreover, it is only what the physician undertook to do when he was engaged.

Surgical Cleanliness.—The great principle that should overrule and guide every move of both the physician and the nurse at a case of labour is that of strict surgical cleanliness. Asepsis should be aimed at in everything, and so far as instruments are concerned should be secured. In everything the strictest antisepsis should be carried out. These are the principles on which labours are conducted in hospitals, and in them puerperal sepsis is almost unknown. But it is a melancholy fact that in private practice the deaths in the United Kingdom

from puerperal sepsis far outnumber those from all the other complications of childbirth put together. Moreover, apart from actual mortality, sepsis is the greatest risk a woman has to run in childbirth from the point of view of her subsequent health and well-being. The next all-important point to bear in mind is that in all cases the infection is conveyed to the patient from without; and in nine cases out of ten is to be traced to some breach in the asepsis or antisepsis of the physician or nurse.

The vaginal secretion in a healthy pregnancy differs only in its increased quantity from that of a healthy non-pregnant woman. It is whitish in colour, containing epithelial cells, leucocytes and mucus, moistened by a serous transudate through the vaginal epithelium. It is intensely acid and contains, exclusively, numbers of large bacilli. These organisms are anaerobic, non-motile, and form lactic acid, thus giving the acid reaction to the secretion. Occasionally yeast and similar fungi are found, but in health no other organisms.

It has been shown demonstratively that the acidity of the vaginal secretion is inimical to the life of other organisms. Accordingly anything that diminishes the acidity of the secretion is at once followed by the appearance of organisms in the vagina. Thus during the puerperium the lochia—the discharges from the uterus after labour—are alkaline, and in the lochia many saprophytic organisms are found. But when the lochia disappear and the vaginal bacilli are able to reassert themselves, the secretion very soon becomes acid again, and the other organisms vanish.

Nature's Antiseptic Methods.—It should be noted how Nature follows the principles of antisepsis in labour. The birth canal may be divided into three parts. (1) The vulva, including the entrance to the vagina. This area swarms with organisms of various sorts. It may therefore be designated the Septic Tract. (2) The vagina, containing the vaginal bacilli with their acid secretion, a few fungi, and some leucocytes. This is the Antiseptic Tract. (3) The cavity of the uterus, separated by the plug of mucus from the vagina, is entirely devoid of any form of organism. It is therefore the Aseptic Tract.

Now all the natural processes in labour are from the aseptic, through the antiseptic, to the septic. All forms of interference must be from the septic, through the antiseptic, to the aseptic.

Nature is, however, not content with these advantages. She adopts safeguards. These are: (1) The increase in the vaginal secretion during the first and second stages of labour. (2) The flushing of the vagina by the sterile liquor amnii on the rupture of the membranes. (3) The second flushing of the *distended* vaginal walls by the liquor amnii that follows immediately on the child's birth. (4) The mechanical cleansing —the mop action—of the placenta and membranes in their passage through the vagina.

Our Antiseptic Methods.—There are three main lines by which we may endeavour to reduce the risks of interference, namely: (1) strict personal asepsis; (2) careful cleansing of the external genitals of the patient; (3) infrequency of vaginal examinations.

Strict Personal Asepsis.—This applies alike to nurse and physician. It includes a great deal more than the mere washing of hands. The physician in general practice cannot avoid coming into contact with infectious cases, or cases of septic wounds, ulcers, etc. Recent contact with such a case necessitates a complete bath and change of clothes before attendance on a labour. A further defence for the patient is the wearing of a sterile overall or gown.

The cleansing of the hands before a vaginal examination should be as carefully and scrupulously carried out as for a major operation:—

(1) 5-10 minutes scrubbing with hot water, soap, and lysol, and a nail-brush that has been boiled or soaked for some time in antiseptics. Particular attention must be paid to the nails and nail-folds.

(2) Thereafter three minutes soaking in an antiseptic solution, such as biniodide of mercury in spirit 1-1000, or a similar strength of corrosive sublimate aqueous solution.

Where the hands have recently been in contact with septic matter the best plan is to wash them as in (1), then soak them in a saturated solution of potassium permanganate till they are mahogany coloured. Wash this off in a warm solution of oxalic acid, and then soak them as in (2).

The routine use of rubber gloves that have been boiled and kept sterile adds much to the safety of the patient. If, however, gloves render one less careful in the cleansing of the hands, they are worse than none. For a glove may very easily

be torn, or burst, and then the perfunctorily cleansed fingers come into contact with the genital tract.

Cleansing the Vulva.—Wherever possible the patient should have a complete bath at the very commencement of labour. The nurse should then pay special attention to the genitals. The hair, if very abundant or long, should be cut or shaved. Before an examination is made the vulva must be well washed with soap and water and lysol. The labia minora must be separated and wiped with pledgets of wool soaked in 1-1000 biniodide, or 1 per cent lysol. The pledgets must always be drawn from before backwards to prevent carrying forward any septic matter from near the anus. No pledget must be used for more than one wipe. Previous to this the nurse should have seen to it that the rectum and bladder are emptied. It is well for her to give an enema in every case, irrespective of whether the bowels have acted naturally or not.

Infrequent Vaginal Examinations.—The use of abdominal palpation instead of this method of examination in normal cases has already been recommended. Where a vaginal examination is necessary it must be done with scrupulous care. The patient should be on her back rather than on her side, so as to diminish the risk of the hand coming into contact with the anus. The hands and the vulva having been cleansed as described, the labia minora are held apart by the fingers of the left hand, and the fingers of the right hand introduced without coming into contact with the vulva at all, or at least only with the inner surfaces of the labia minora which have been cleansed in the way described.

Before beginning to examine the patient try to reassure and cheer her. Feel her pulse, and ask when the pains began and so forth. Then ask her to lie down, wash your hands carefully, and proceed to make the abdominal examination. By this means try to ascertain—

(1) Presentation and position.
(2) Is the head engaged and fixed between pains?
(3) Is the head flexed, and how far has it passed into the pelvis?
(4) Rate and character of fœtal heart-sounds.
(5) State of fulness of the bladder.
(6) Duration and frequency of the pains. Are they true or false?

As already explained, this ought in most cases to suffice. But if necessary the vaginal examination may then be made, the hands and the patient being suitably prepared. It is well to introduce the fingers during a pain and prolong the examination until it has passed off, so that one can learn the state of matters both during and between pains. Points to be ascertained or confirmed are—

(1) Is she in labour?
(2) State of os uteri—how far advanced in labour?
(3) Presentation and position.
(4) Are the membranes ruptured? If not, be careful not to rupture them.
(5) State of os, vagina, and perineum as to distensibility or rigidity, moistness, or dryness, etc.
(6) Is pelvis normal? (if not previously ascertained, as it should have been).
(7) Is cord prolapsed?

Diagnosis of Labour.—There are three signs: (1) The pains are true pains, *i.e.* they are accompanied by hardening of the uterus felt by abdominal palpation, and by opening of the os and bulging of the membranes felt per vaginam. (2) The "show." (3) In multiparæ the head is fixed between pains.[1]

False Pains.—These are painful colicky contractions of the intestines, or bladder, or abdominal walls, or sometimes partial contractions of the uterus. They tend to come on before term, sometimes several days or even a week or a month before. They may be excited by some digestive upset, or by some purgative medicine that has failed to act properly, or by constipation. They are often extremely painful, but are characterised by irregularity of onset, by being situated more in front than in the back, and by the absence of any accompanying contraction of the uterus. They should be treated according to the cause—attention to the digestion, enemata, emptying a distended bladder, and if necessary, sedatives.

Having completed the examination, again reassure the patient if all is well. If there is anything wrong, do not alarm the patient but tell the relatives. Under no circumstances commit yourself definitely as to the time when the labour will be over. Prognosis of this kind is impossible.

Is it safe to leave the patient? The answer to this depends

[1] In primiparæ engagement of the head occurs *before* labour.

on a number of points: the distance from the physician's own house, the competence of the nurse to recognise the second stage without examination, whether the patient is a primigravida or multipara, and, if the latter, her experience in her previous confinements. In general it may be said that a primipara in the first stage may be left for an hour or two. A multipara should not be left if the head has sunk into the pelvic cavity, or the os is the size of a crown-piece. No woman should be left in the second stage, or after the membranes have ruptured.

If it is decided to leave, the nurse should be instructed to send at once if (*a*) the membranes rupture, (*b*) the second stage pains begin, (*c*) any bulging of the perineum appears.

If it is decided to wait, do not remain in the patient's room, but in some room downstairs or near at hand.

In the meantime, if the patient is in the first stage, she need not remain in bed, but may walk about or sit up as she pleases. Do not let her try to bear down. Do not give her chloroform at this stage.

See to it that the nurse's preparations are completed during this waiting period. She should give the patient an enema whether the bowels have acted or not, unless this has already been done. The bed, the room, and the patient's clothes also need attention.

The Bed.—This should be arranged as follows:—

(1) A narrow single bed is best, and should be accessible on both sides.

(2) The mattress should be firm. Soft spring mattresses may be stiffened by placing a broad board beneath them. Feather beds are an abomination, fortunately becoming rapidly extinct.

(3) Mackintosh sheeting.

(4) Binding blanket.

(5) Two clean sheets.

(These all to be tucked in under the mattress.)

(6) Mackintosh sheeting hanging over the edge on the right-hand side.

(7) Pad of absorbent wool.

(8) The upper bedclothes according to the temperature of the room. The sheet should always be folded over and safety-pinned to the counterpane, so that all the clothes may be raised easily and quickly.

The carpet at the side of the bed should be protected by waxcloth or stout paper, and a tin bath or large basin placed under it to catch any blood or liquor amnii that may escape over the side.

If the patient is unable to afford mackintoshes, etc., several clean newspapers or sheets of glazed brown paper may be used.

The Room must be kept well ventilated, but not cold. In this country a fire should always be lit for ventilating purposes if not for heating. Keep a kettle *boiling* on the fire. The nurse should complete her preparation of the necessary basins and tables. Five basins will be wanted—either ordinary wash basins or enamelled ware basins ten inches across the top. These must all be carefully scrubbed with strong antiseptics before use.

Three basins should have been already prepared for the physician's arrival. In one there should be hot water with lysol for the first wash. This can be emptied and refilled when necessary. In the second there should be warm sterilised water for rinsing the hands in to get rid of the soap. The third contains the biniodide or other antiseptic lotion for the hands.

The other two basins are—one for scissors, perineal needle, ligature for the cord, etc.; one for the placenta when it is born.

A small table near the bed for the chloroform, and the basin of instruments is a convenience. A hypodermic syringe and tablets may be placed on it. A douche apparatus should be ready for the immediate addition of the hot water.

Patient's Clothing.—This should be light, but sufficiently warm. When she lies down at the close of the first stage, her hair should be plaited, a pair of clean (preferably white) stockings put on, and two nightdresses. Both should be clean, but one old. The old one is put round the lower part of the body. The other is put on in the ordinary way, and then tucked up under the arms, so that it can be brought down after labour is over, and all the soiled clothing, etc., removed.

When the second stage begins the patient should retire to bed. She should now be encouraged to bear down. To this end it is helpful to place a stool on the bed at the foot, so that during a pain she can put her feet on it and so get her lower limbs fixed. A roller towel should also be tied to the foot of

the bed. To this she clings during a pain, and, holding her breath, bears down more effectively. Between pains she should straighten her legs again to avoid cramp. This cramp is easily excited by the muscular effort, plus the pressure of the head on the sacral nerves. Treat it by rubbing with hot cloths. The pain may be mitigated by the nurse pressing on the sacrum with her knee or fist.

When the membranes rupture it is frequently desirable to make a vaginal examination to see that everything is right, and that the cord has not prolapsed. This must be done with all due antiseptic precautions. In most labours this is the only vaginal examination necessary, and even it may often be done without and the progress gauged by pelvic palpation from the abdomen.

If the os is *fully* dilated, and the membranes still intact, it will hasten delivery to rupture the membranes artificially. This can sometimes be done by nipping them between the fingers, but it is easier to use a sterilised instrument such as the stilette of a catheter, or a hairpin straightened out and sterilised by heating it to red heat in the fire, and washing it in antiseptics.

Sometimes the anterior lip of the cervix becomes enormously thinned out over the head, while the partially opened os is situated high up behind the head. In such a case try to pull down the os and stretch it gently with the fingers.

Anæsthesia.—In this stage it is well to begin the administration of chloroform by letting the patient have a few whiffs of it *during the pains* only. It is undesirable to have the patient fully anæsthetised except at the end when the head is being born, or unless some operative interference is required. The diminished risk of chloroform during labour is to be explained by the lightness of the anæsthesia, the slight hypertrophy of the heart, and the fact that the blood is massed to some extent in the upper part of the body by the high intra-abdominal pressure. At the same time it must always be used with care and strict moderation.

In the last few years the use of scopolamine-morphine narcosis in labour has been tried successfully in hospitals. It must be understood, however, that it is not suited for private practice unless the physician is prepared to stay beside his patient throughout the labour, as untoward symptoms are not

unknown. The scopolamine (hyoscine hydrobromide) should be used in tablet form or in perfectly fresh solution. It is given along with the morphia by hypodermic injection, the dose being $\frac{1}{100}$th of a grain of scopolamine and $\frac{1}{6}$th of a grain of morphia. This should be given towards the end of the first stage. Its effect is to throw the patient into a light sleep, from which she wakens at the acme of each pain only. At the conclusion of labour she sleeps for an hour or two, and sometimes wakes up without any remembrance of her labour. The main risk is to the child, which may be partially narcotised when born, and require some resuscitation. This is particularly the case where the birth follows within three hours of the administration. There also seems to be a slightly increased risk of relaxation of the uterus and consequent bleeding.

Care of the Perineum.—A tear of the perineum is the commonest accident in the labour of a primiparous woman. Although not in itself dangerous, it may be a source of septic mischief in the puerperium, and later may cause much trouble and ill-health by favouring displacements of the uterus. Every effort should be made to avoid the accident, and if it does occur to repair it efficiently at once.

The causes of perineal tears are three :—

(1) Relative disproportion between the head and the outlet.

(2) Too rapid expulsion without the perineum having time to stretch.

(3) Faulty mechanism, whereby a larger circumference of the head than necessary passes through the outlet.

The means of combating these causes are as follows :—

(1) In all cases give the head plenty of time to stretch the perineum.

(2) When the pains are strong and the head tends to advance too rapidly, give more chloroform to diminish the strength of the pains ; try to prevent the patient from bearing down ; retard the head by pressing it back with the hand. *Never* press on the perineum itself.

(3) Try to favour the maintenance of flexion. Press the sinciput upwards and forwards, and so force the occiput well under the subpubic arch. In this way the diameters brought over the perineum are the suboccipito-bregmatic and the sub-occipito-frontal, and these are the smallest available diameters.

(4) Try to deliver between pains. By doing so we have

the advantage of dealing with a perineum whose muscles are relaxed instead of tightly contracted.

These maxims may be embodied in one or other of the following manœuvres. In all the patient should be placed on her left side with the thighs partly flexed and separated—not fully flexed nor fully separated as that stretches the perineum. In all cases give chloroform to full anæsthesia.

(1) Pass the left arm over the patient's upper thigh, and place the fingers of the left hand on the head. Thus simply retard the descent of the head.

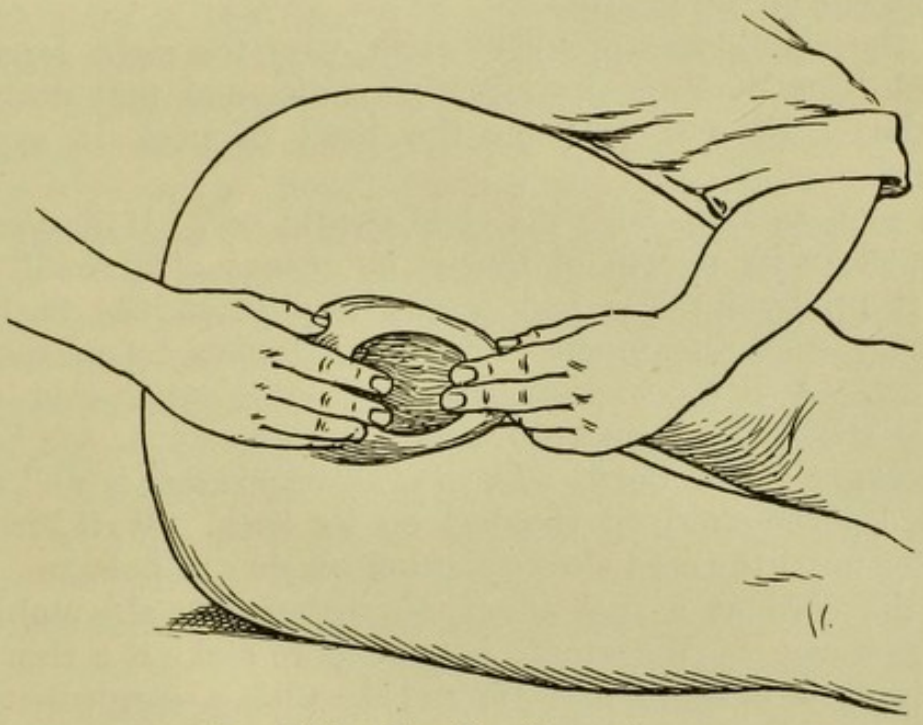


Fig. 108.—Guarding the perineum.

(2) With the left hand as before, push the sinciput up and forward with the right hand. Deliver between pains either in this way or by promoting extension of the head by pressure on the brow and face through the tissue at the sides of the coccyx.

(3) With the left hand controlling the head as before, press the skin of the labia backwards and towards the middle line with the fingers of the right hand. This gives the perineum more tissue to come and go on.

The operation of episiotomy is rarely necessary. In it postero-lateral incisions are made on the perineum.

When the head is born, support it in the right hand. Stop the chloroform. Do not unduly hasten the birth of the body

unless the child's face becomes very cyanosed, and it makes convulsive movements. Feel round the neck for the umbilical cord, and if it does happen to be round the neck, draw a loop of it down and slip it over the head. Wipe the eyes with a pledget of wool soaked in boracic lotion. It is a good plan to wipe out the mouth in the same way.

If the uterus does not within a moment or two proceed to expel the shoulders, place the left hand on the fundus and rub it so as to stimulate a contraction. If necessary aid the expression by pressure, and in every case follow with the hand the descent of the fundus.

If the shoulders appear to stick, pass the right forefinger in and hook it into the anterior axilla, and pull down the shoulder. Do not pull on the head or neck to expedite delivery.

As soon as it is born the child should cry. If it does not do so, clear its mouth of mucus by means of a small swab, hold it up by its legs and gently slap it on the back. If necessary suck the mucus out of its trachea by means of a catheter. A little friction and sprinkling with cold water usually stimulates it to inspiration.

Ligature of the Cord.—As soon as respiration is well established, lay the child on the bed on its back. Wait for a few minutes until the cord shows signs of ceasing to pulsate. Then take the cord at a spot about two inches from the umbilicus, squeeze away the Wharton's jelly so as to make it a thin cord, and apply a ligature, and tie tightly with a surgical or reef knot. Apply a second ligature about three inches from the vulva. The second ligature is not necessary unless there is a second child in the uterus, when it may save its life if the circulations of the two children communicate. In any case, however, it is a cleanly habit, and should always be done. Cut the cord between the ligatures half an inch from the umbilical ligature. Take care to hold the cord up on the fingers when cutting, otherwise you may easily injure the infant. Hand the child to the nurse to be wrapped in a warm flannel, and laid aside in a safe warm place until she is ready to bath it. Before handing it take a second look at the cord to see that it is not bleeding. If it is, put on a second ligature.

The moment the child is born the third stage is begun. The great rule for the conduct of this stage is to keep control

of the fundus of the uterus by the hand on the abdomen during the whole stage, and for some time after it. This is done so that one may feel at once if the uterus becomes very flabby or enlarged, which means bleeding inside it. Remember that the uterus must become somewhat soft in the intervals between contractions, but there should always be sufficient permanent retraction to prevent it from feeling actually *flabby*. Do not rub or knead the fundus unless you think it is becoming too soft, but if you do think so then grasp and knead it to stimulate it to contract again. Unnecessary and over-zealous rubbing up of the fundus is apt to lead to retention of the placenta by an irregularly contracted uterus, and that may mean serious and dangerous hæmorrhage.

The correct way to keep control of the uterus is to sink the ulnar edge of the hand into the abdomen above and behind the uterus, and just keep it there in light contact with the uterus. As long as the outline of the uterus can be felt there is not likely to be any risk of serious hæmorrhage.

The placenta usually comes away within twenty minutes. It helps matters to have the patient on her back, so she should be rolled round from her side in the beginning of the third stage. The placenta sometimes remains in the vagina, whose muscular walls are too weak to expel it. When this occurs it should be removed from the vagina.

Signs that the Placenta has left the Uterus.—(1) The outline of the uterus becomes a trifle narrower, and the fundus rises in the abdomen due to the uterus being perched upon the placenta in the vagina.

(2) More of the cord passes outside the vagina. This can be seen at once if the second ligature was tied about three inches from the vulva.

(3) Perhaps the most reliable sign is as follows: Straighten the cord outside the vulva. Grasp the fundus and press it down. The length of cord outside the vulva will increase as the uterus is pushed down. Release the uterus and let it slip up to its original place. If the placenta is in the uterus the cord will be drawn in again. If the placenta is in the vagina the cord will remain lengthened.

If the placenta is in the vagina, knead the uterus to a contraction; and then grasp the uterus and press it gently and steadily downwards and backwards in the axis of the

pelvic inlet. It will push the placenta out before it without the necessity of using any force.

As the placenta rolls out through the vulva it should be grasped by the hand to prevent its weight tearing the membranes. It should then be turned round several times so that the membranes are twisted into a sort of rope. This is generally sufficient to draw them gently out without tearing.

Retained Placenta.—Where the placenta is still in the *uterus* after the lapse of forty minutes it may be expelled by Crede's method. The uterus is grasped through the abdominal wall by placing the fingers behind it and the thumb over the anterior wall. *When it contracts* it should be squeezed from before backwards, and at the same time pressed downwards and backwards in the axis of the inlet. This manœuvre should not be repeated more than once or twice, and *never attempted unless during a contraction.* Care should also be taken to grasp the uterus from back to front, not from side to side, as otherwise the ovaries may be squeezed and severe shock produced.

Pulling on the Cord should never be employed under any circumstances.

Examination of the Placenta.—The placenta should be received in a clean basin, and later floated out in water to see that it and the membranes are quite complete. Hold the placenta in both hands, maternal side up. The various lobes should fit each other accurately, or if any tear has occurred the edges come together with a little gentle pressure. If a piece of the placenta has actually been left behind, the gap will remain obvious even after trying to press the edges together. Then place it in the basin and hold up the membranes. They should look large enough to have contained the fœtus and liquor amnii. Look for any tears in the amnion, and if there is such, note if any vessels pass from the edge of the placenta to the tear. Such a condition indicates a secondary or succenturiate placenta (*q.v.*).

Retained Membranes.—If much is left in the uterus it may cause bleeding. Therefore look out for any symptoms of this, and give a good dose of ergot. The membranes will probably come away with the lochia. Occasionally it may be wiser to explore the uterus with the fingers and remove them, but remember the risk of sepsis in such an operation.

Examination of the Perineum.—In every case the perineum

should be examined carefully for tears. Every tear should be stitched up at once. If you have not the materials for suturing with you, it may still be done within about twelve hours. But the chances of its healing by first intention diminish with the length of time it is left. In order to look for lacerations the perineum must be freely exposed in a good light and the labia separated. Cleanse the parts with a pledget of wool soaked in biniodide or other antiseptic, and pass your gloved finger into the vagina and feel for tears in the posterior wall. This inspection and repair of the perineum can often be made best while waiting for the placenta to be expelled, as immediately after labour the parts are numbed, and the patient still partly under chloroform. The stitches, however, should not be tied until the after-birth has been expelled.

Ergot.—After the placenta is born, but never until then, ergot may be given to favour uterine contraction and retraction. It is desirable to do so when the uterus is not contracting well, but in a normal case it is not necessary. It may be given by the mouth (half drachm of the liquid extract), but preferably by a hypodermic needle passed directly and deeply into the gluteal muscles. There are several good preparations sold in glass capsules of sterilised and standardised solutions ready for injection.

Cleaning up the Patient.—The vulva and surrounding parts must now be cleaned up. This must be done with care, the patient being laid on her side, and the thighs not too far separated, especially if the perineum has been torn. Pledgets of sterile wool soaked in weak lysol solution ($\frac{1}{2}\%$) are used. All wiping is done from before backwards, and no pledget used for a second wipe. Note that if the labour has been conducted on aseptic principles, as described, it is not necessary to wash the inside of the labia minora. All washing may then be done over the closed labia.

The absorbent pad upon which the patient has been lying is removed before the final washing, and the buttocks and thighs dried. The draw sheet and upper mackintosh sheet are then withdrawn, a vulvar pad placed on the vulva, and the binder slipped under the patient, who is again turned on her back. The vulvar pads are best made of Gamgee tissue, about ten inches long and four wide, sterilised, or scorched brown at

the fire. Before fastening the binder feel the uterus to make sure that it is firm.

Binder.—A binder is not necessary, but it is a great comfort to the patient, and gives a grateful and comforting support to the pelvic joints and muscles, which are strained and weary. The lower edge of the binder must come about two inches below the trochanters. Fasten the lower part first and make it fairly tight. The part over the abdomen should never be so tight that you cannot slip your closed hand under it perfectly easily. The lower edge keeps the vulvar pad in position. Fix the binder with stout pins or safety pins.

Pulse.—Before finishing with the mother count the pulse. It is usually slow—below 80. If it is above 100 make sure that there is no sign of hæmorrhage from or into the uterus. Anæsthetics, especially scopolamine, may cause a slight quickening of the pulse, that is not of any bad significance.

Temperature.—This also should be taken at the close of labour. It should be below 99°. Frequently it is subnormal from the loss of body heat.

Wait one hour from the time of the birth as various accidents, hæmorrhage, etc., may occur. In the meantime superintend the baby's toilet, but keep a careful eye on the mother from time to time, watching particularly for pallor or a quickening pulse or other sign of bleeding.

The Baby has meanwhile been lying wrapped in a flannel in some warm corner. The bath is now prepared with a little water at a temperature of about 100° F. Two or three inches of water is ample. First gently smear the child with olive oil. This softens the vernix caseosa, or white cheesy stuff covering it. Then gently wash it all over with soap, beginning at the face and head. The child should never be immersed, and its face should never come in contact with water that has been used for the body. After drying it, examine it for congenital defects such as imperforate anus, cleft palate, etc. If there is any suspicion of the mother's having had a vaginal discharge, it is very important to guard against a disastrous ophthalmia by dropping two drops of 1% solution of silver nitrate into each eye. This makes the eyes red for a day or two, but may be the means of saving the child's sight.

Pay particular attention to the cord. Dry it very carefully, see that it is not bleeding. Powder it with some boracic and

starch powder, and wrap it in a small dressing of dry sterile gauze. Lay this flat on the abdomen, and put on the binder, not too tight. This should be sewn, not pinned, together. The flexures of the groins and the cleft of the nates may be dusted with starch and boracic.

If possible have the child weighed before it is dressed. Weigh it in a flannel wrapper, and weigh the flannel afterwards and subtract it.

CHAPTER XVI

MECHANISM AND MANAGEMENT OF OCCIPITO-POSTERIOR POSITIONS

THE right is much more common than the left occipito-posterior position owing to the greater space in the right oblique diameter.

Normal Mechanism of R.O.P.—The head lies with its sagittal diameter approximately in the right oblique, occiput opposite the right sacro-iliac synchondrosis, brow opposite the left foramen ovale.

The movements superimposed upon *Descent* are (1) *Flexion*, whereby the occiput becomes the leading part of the head, and therefore first meets the resistance of the pelvic floor. According to rule it must therefore rotate to the front. In this case the rotation is a (2) *Long Internal Rotation* through three-eighths of a circle. As it rotates it comes to occupy the R.O.A. position, and its subsequent movements are the same as if it had been in the R.O.A. to start with, namely, (3) *Extension*, (4) *Restitution*, and (5) *External Rotation*.

It will be seen that the only difference is in the length of the rotation—one-eighth in occipito-anterior, and three-eighths in occipito-posterior cases.

Abnormal Mechanism.—In about one case out of twenty occipito-posteriors the flexion of the head remains imperfect. As a result of this (1) *Imperfect Flexion* the sinciput remains the leading part of the head. Therefore the sinciput first meets the resistance of the pelvic floor, and is rotated to the front. This (2) *Internal Rotation of the Sinciput* to the

front means that the occiput passes into the hollow of the sacrum. The sinciput may not be actually the lowest part of head in these cases, but the pelvic floor is higher in front than behind, and hence the sinciput is the first part to meet its resistance—in other words it is *relatively* and *functionally* the leading part of the head.

After this malrotation has occurred, the remaining steps are so difficult that the head rarely goes through them unaided. There is—(3) *Flexion.* Either the brow, or more commonly a part of the head just in front of the bregma, becomes fixed under the pubic arch, and the head rotates round this as a relatively fixed point, the vertex and then the occiput sweeping over the perineum. The face then slips down behind the symphysis; and, lastly, (4) *Restitution*, and (5) *External Rotation* occur, the occiput passing to the right side.

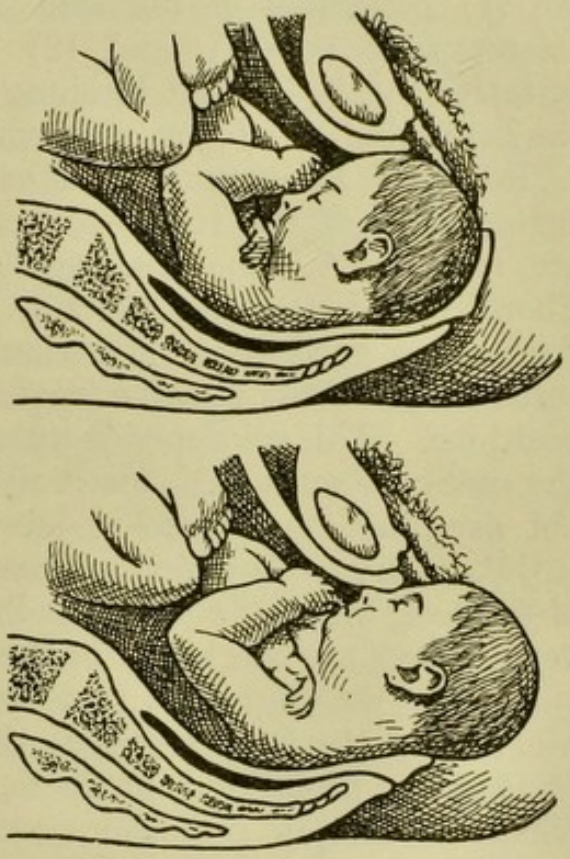


Fig. 109.—Birth of head in persistent occipito-posterior position by flexion at the outlet. (After Whitridge Williams.)

When the head goes through this abnormal mechanism it becomes what is known as a **Persistent Occipito-posterior case.** It is impossible to be quite sure whether an occipito-posterior case is going to go right or become persistent until the head has been some time on the pelvic floor.

These mechanisms may be summarised as follows :—

Normal Mechanism—

Descent. { Flexion. / Long Internal Rotation of Occiput. / Extension. / Restitution. / External Rotation.

Abnormal Mechanism—

Descent. { Imperfect Flexion (Extension).
Short Internal Rotation of Sinciput.
Flexion.
Restitution.
External Rotation.

Other Possible Terminations—fortunately extremely rare—are (1) *Impaction of the head on the ischial spines* when it attempts to rotate; and (2) *Conversion into a face presentation* by the occiput hitching on the brim of the pelvis at the beginning of labour, and complete extension occurring.

Relative Frequency of Mechanisms. — It is universally agreed that of the thirty per cent or so of vertex cases that are not L.O.A., the majority are either R.O.P. or R.O.A. There is no doubt that the L.O.P. is the least frequent. But there is a good deal of variance between different sets of statistics as to the relative frequency of the R.O.P. and R.O.A. positions. This all depends upon the stage of labour at which the cases are examined, for it will be obvious that if cases are not examined until late in labour, there will be recorded as R.O.A. many cases which are really R.O.P. cases in the process of the long internal rotation. Probably at least 20 per cent of vertex cases are originally in the R.O.P. position.

Taking that figure, it may be said, speaking generally, that nineteen of the twenty will go through the normal mechanism, *if they are given time to do so*, and only one will become a persistent occipito-posterior.

Why does one Occipito-posterior Case out of twenty become a Persistent Occipito-posterior? The determining factor has just been shown to be the absence of complete flexion.

There are several factors which may cause the flexion of the head to be incomplete in both anterior and posterior positions of the occiput.

(1) A small head, or, what comes to very much the same thing, a large pelvis. In these cases the head is apt to descend on to the floor of the pelvis without having encountered sufficient resistance at the pelvic inlet to flex it completely.

(2) Weak uterine contractions, or a pelvic floor weakened by previous lacerations, may also diminish respectively the

force of the descent and the resistance to it, and so lead to incomplete flexion.

There are also other factors which apply only to posterior positions of the occiput.

(1) When the fœtus lies with its spine against the spine of the mother, its natural convexity is undone and is replaced by a straightening of the spine, with which a certain amount of extension of the head is inevitably associated.

(2) In posterior positions the wide biparietal diameter of the head lies behind the oblique diameter of the pelvis where there is less room, instead of in front of it, as in anterior positions, where there is more room. In this way the occiput may meet with more resistance than the sinciput (Fig. 110).

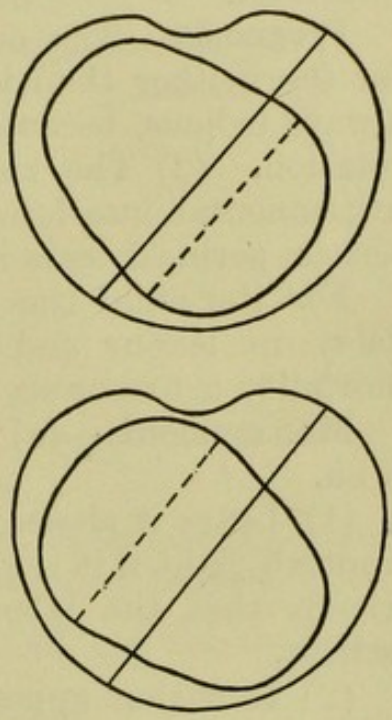


Fig. 110.—Relative positions of biparietal diameter in anterior and posterior positions of the occiput.

If any of these factors is sufficiently pronounced to make the sinciput relatively the leading part of the head, it will then be rotated round to the front.

Increased Risk to the Perineum in Persistent Occipito-posterior Cases.—The diameters, that pass through the outlet when the occiput is posterior, are measured from in front of the bregma, and are larger than the suboccipito-bregmatic. If the occipito-frontal diameter has to pass through, the tear of the perineum is likely to be severe, as it measures $4\frac{1}{2}$ inches compared with the $3\frac{3}{4}$ inches of the suboccipito-bregmatic.

Diagnosis.—On abdominal examination the striking features are the ease with which the small parts of the fœtus can be felt in front, and the fact that the back can either not be made out, or is made out well to the right flank. By the fourth manœuvre the hand will meet less resistance on the right side of the pelvis. Auscultation is apt to be very unsatisfactory. Usually the heart is heard round towards the right flank, but owing to the damping down of the sound by the thick muscles, it is but poorly heard. Occasionally it is

heard also in front and to the left owing to the throwing forward of the child's thorax.

On vaginal examination one is frequently struck by the ease with which the anterior fontanelle can be felt. The sagittal suture is found in the right oblique, but the posterior fontanelle is high up behind the head if the flexion is imperfect.

Prognosis.—The outlook is always rather less favourable for the mother than in anterior positions. (1) The labour is always tedious, because the head has to go through the long rotation. (2) The risk of sepsis is increased if manual or instrumental interference is needed. (3) There is a risk of serious perineal tears if the occiput remains posterior.

For the child the prognosis is more serious owing to the delay in labour and the risks of interference. The fœtal mortality is five or six times as great as in anterior positions.

Management.—(*a*) When diagnosed while the head is at the brim.

(1) Leave it alone. The occiput will probably rotate to the front all right if it is given plenty of time. Warn the patient's friends that the labour will be tedious, and encourage the patient.

(2) If flexion appears to be deficient, try to increase it by pushing up the sinciput with the fingers in the vagina during a pain, at the same time pressing down upon the fundus with the other hand.

(3) The head may be rotated by passing the hand into the vagina and grasping it between the fingers and thumb. At the same time the shoulders must be rotated by abdominal palpation, or else the head will at once go back to its original position. This manœuvre generally requires an anæsthetic.

(*b*) When diagnosed after the head has entered the pelvis.

(1) Leave it alone. After exercising the patience of all concerned, it will probably rotate spontaneously. Only about one case out of twenty fails to do so.

(2) An attempt may be made to increase flexion as before. An old instrument used for this purpose is the vectis or lever, but it has fallen into rather undeserved desuetude. It is like a single blade of a forceps with a more marked concavity, and was passed up behind the occiput, and used to pull the latter down.

(3) Manual rotation may be attempted as before, but the head must first be flexed and gently pushed back out of the pelvis.

(4) If the pains are weak, forceps should be applied well back on the head, so that when traction is applied, flexion will be promoted. The head should then be pulled well down on to the pelvic floor. If it begins to rotate, take off the forceps and leave the rotation to nature, merely keeping the head on the pelvic floor by pressure on the fundus. After rotation the forceps may, if necessary, be re-applied and delivery completed.

(*c*) When the occiput has definitely rotated into the hollow of the sacrum, and the case has become a *Persistent Occipito-posterior.*

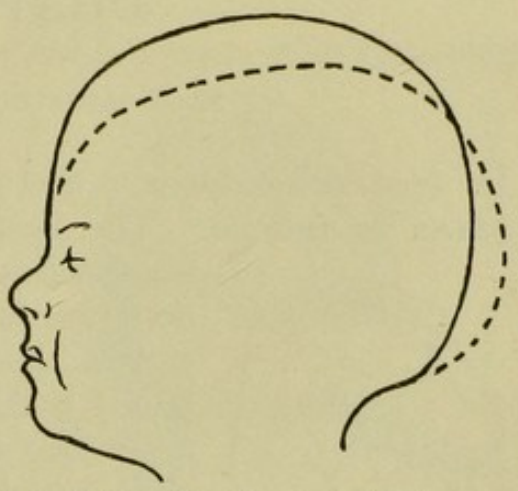


FIG. 111.—Head moulding in persistent occipito-posterior case.

Forceps should be applied and the head delivered with the occiput posterior. The perineum should be guarded as much as possible, and any tears stitched up at once.

In extreme cases craniotomy and pubiotomy may require to be considered.

Head Moulding.—When the occiput rotates to the front, the head moulding does not differ from that of a normal occipito-anterior case.

Where the occiput remains persistently posterior, the chief pressure is exerted upon the head in the occipito-frontal diameter. This is accordingly shortened, and a compensatory lengthening takes place in the suboccipito-bregmatic. The head looked at from the side is very square, rising steeply both in front and behind. The caput succedaneum is usually situated over the anterior fontanelle.

CHAPTER XVII

FACE AND BROW PRESENTATIONS

In face presentations the normal attitude of flexion of the fœtus is undone. The head is extended so that the occiput approaches the spine, and the face looks downwards. The extension of the spine also causes the chest to be thrown out and the back hollowed. There are four positions according to the situation of the mentum or chin, which is the denominator:—

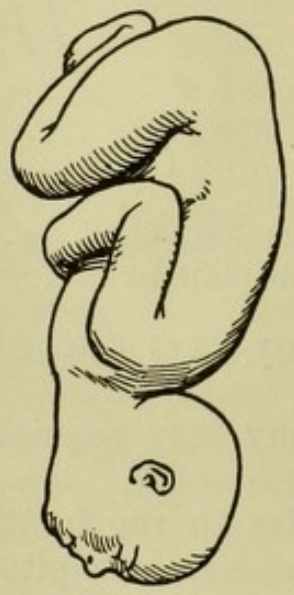


Fig. 112. — Fœtal attitude in face presentation.

I. Right mento-posterior (R.M.P.) is produced by the complete extension of the head in the L.O.A. The fronto-mental diameter lies in the right oblique, the chin at the right sacro-iliac synchondrosis, the brow at the left foramen ovale.

II. Left mento-posterior (L.M.P.). The fronto-mental diameter lies in the left oblique, the chin at the left sacro-iliac articulation, the brow at the right foramen ovale.

III. Left mento-anterior (L.M.A.). The fronto-mental diameter lies in the right oblique, the chin at the left foramen ovale, the brow at the right sacro-iliac synchondrosis. This corresponds to full extension of the R.O.P.

IV. Right mento-anterior (R.M.A.). The fronto-mental diameter lies in the left oblique, the chin at the right foramen ovale, the brow at the left sacro-iliac synchondrosis.

These positions correspond exactly to the four positions of the vertex, with the simple difference that the head is extended. In frequency we find that they also correspond, for the first or right mento-posterior position, which corresponds to the L.O.A. position of the vertex, is the commonest face position, while the

left mento-anterior, corresponding to the R.O.P., is the second in frequency. There is, however, much less difference in the relative frequency of the two face positions than between the two vertex positions, owing to the fact that when the child's back is towards the mother's back there is a natural tendency to extension which makes face presentations frequent.

Frequency.—The frequency of face presentations is about 1 in 250.

Causes and Varieties.—Face presentations are called *primary*

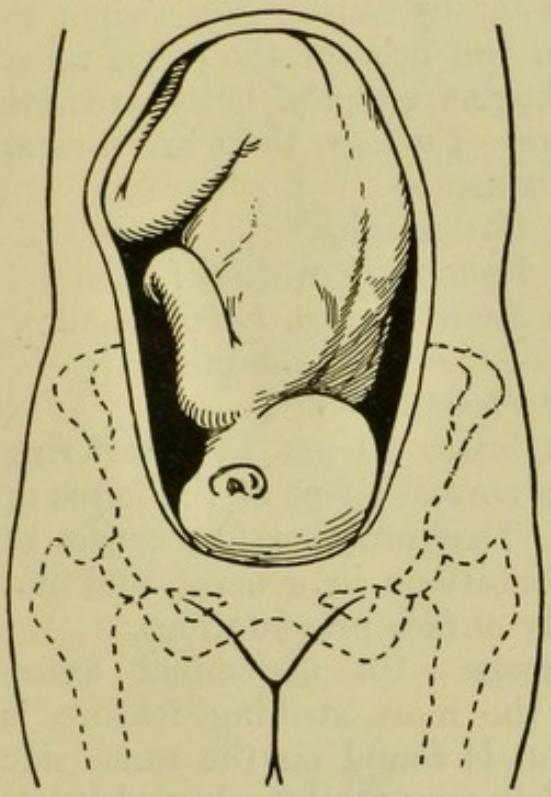


FIG. 113.—Face R.M.P.

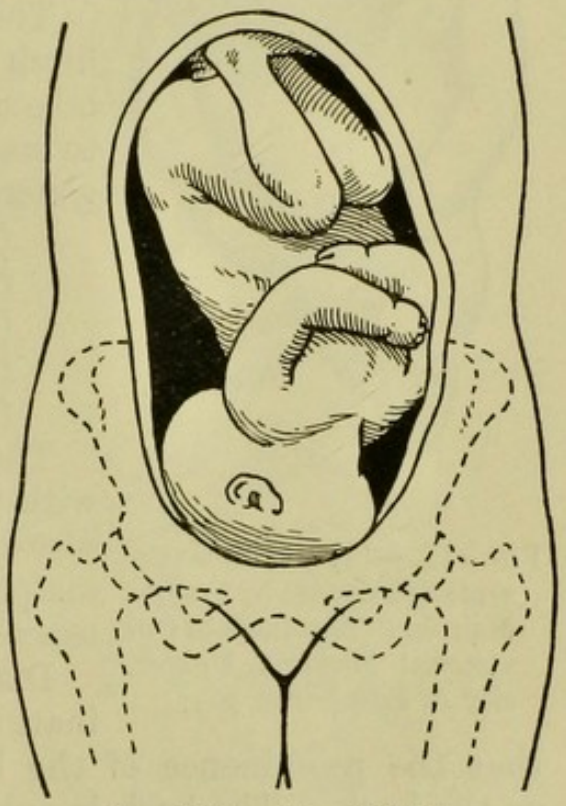


FIG. 114.—Face L.M.A.

when the extended attitude is present before the beginning of labour, and *secondary* when the presentation is brought about during the descent of the fœtus at the beginning of labour. The former is rare, most face cases falling under the second category.

Primary face presentations are produced by fœtal conditions which either actually cause extension or at least prevent flexion of the head. Amongst these are—

Tumours in the front of the neck (Fig. 115).
Spasm of the muscles at the back of the neck.
The arms folded immediately under the chin.
Several coils of umbilical cord around the neck.

These are all very rare conditions.

The causes of secondary face presentations are much more important. In general they are produced by anything that obstructs the descent of the occiput.

(1) Contracted pelvis.
(2) Obliquity of the uterus (*e.g.* pendulous belly).
(3) Long narrow (dolichocephalic) head.

These act by causing the occiput to hitch on the brim of the pelvis when labour begins and the head attempts to engage. Further, there are several general causes—

(4) Hydramnios.
(5) Premature or dead fœtus.
(6) Monsters (*e.g.* Anencephalic).
(7) Tumours of the uterus.
(8) Placenta prævia.

These latter all act by interfering with the normal shape of the fœtus or uterus. They are therefore causes of malpresentations in general, and not especially of face presentations.

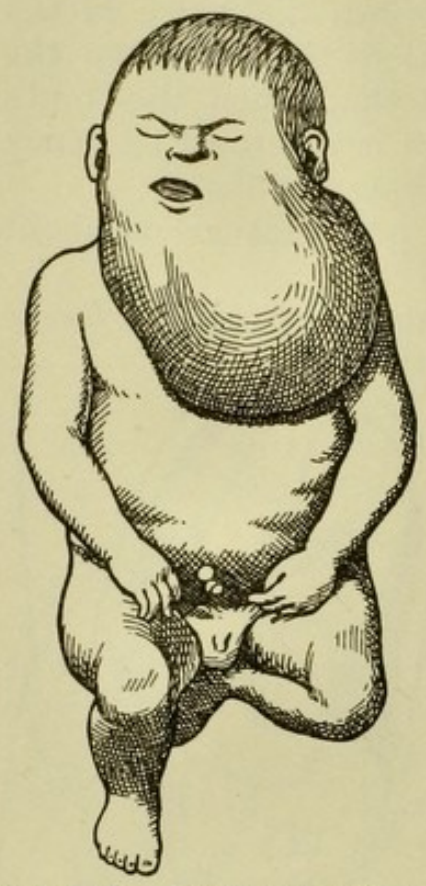


FIG. 115.—Primary face presentation caused by tumour of neck. (Specimen in Obstetrical Museum, University of Edinburgh.)

Diagnosis.—On abdominal examination the most striking feature is that the prominence of the head is found on the same side as the back. The back is only felt near the breech, and below that there is a gap between it and the head. If the back lies posteriorly, the limbs are felt with great ease, and the heart easily heard over the chest. When the back is to the front the heart is not well heard.

If the examination is made at the beginning of labour the palpation of the head will show that it is movable at the brim, and that it has not engaged. This is a very significant sign of a malpresentation.

Vaginal examination should always be practised in an abnormal case like this. Early in labour two other signs that are very significant of a malpresentation will probably be present. One is that the presenting part will be very high up in the pelvis. The other is that the membranes will probably

present in a sausage shape, and are very liable to early rupture. Every care should be taken to preserve them during the examination. The diagnostic landmarks are the orbital

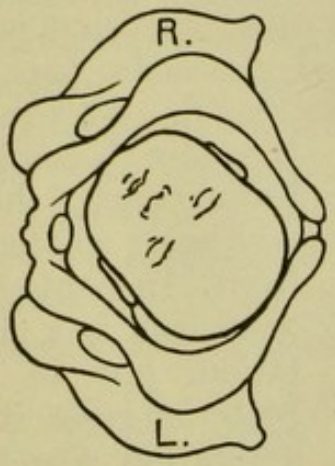


FIG. 116.—R.M.P.

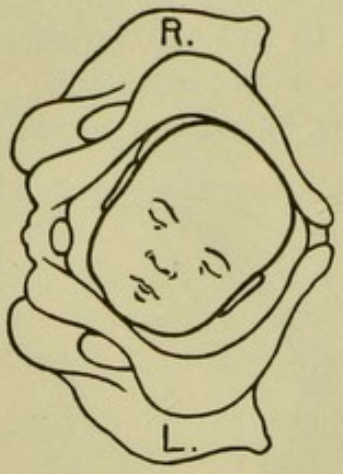


FIG. 117.—L.M.P.

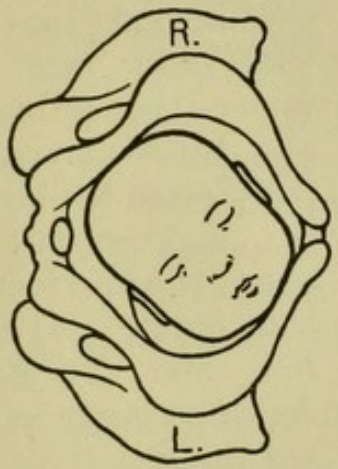


FIG. 118.—L.M.A.

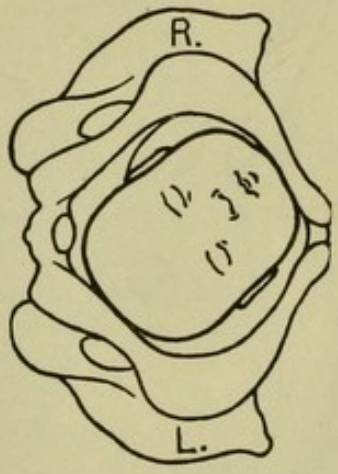


FIG. 119.—R.M.A.

ridges, the nose, mouth, and chin. The diagnosis is often difficult—early in labour owing to the parts being so high up; late in labour owing to the caput succedaneum forming over the soft face and obliterating the landmarks. In such cases it may be mistaken for a breech, the mouth being taken to be the anus. To distinguish the two, pass in the tip of the finger. In the mouth the gums will be felt. In the anus the finger is felt to be grasped by the sphincter, and on withdrawal it is covered with meconium.

Mechanism.—It should be noted that although the R.M.P. position corresponds to the L.O.A., yet in regard to the

possibilities of mechanism it corresponds to the R.O.P. The various movements are as follows :—

(1) *Complete Extension.* This is the first movement, corresponding to the increase of flexion in a vertex case. It is due to the continued action of the cause that first produced the face presentation. As the head descends, the already existing extension tends to become increased. This results in the chin becoming the leading part of the fœtus, and being rotated to the front. In mento-anterior cases this is a short rotation, but in mento-posterior cases it means a rotation round three-eighths of a circle. (2) *Internal Rotation* is thus the second movement. The chin now passes under the pubic arch, and by a movement of (3) *Flexion* the brow, vertex, and occiput sweep over the perineum in that order. (4) *Restitution* and (5) *External Rotation* occur as in vertex cases.

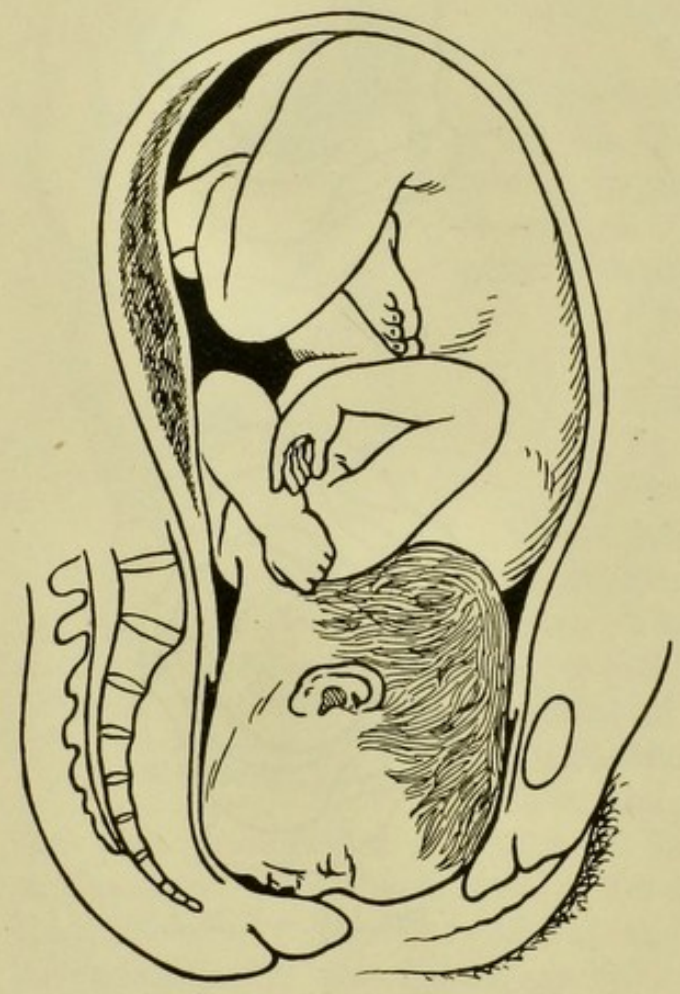


Fig. 120.—Persistent mento-posterior case.

As the face is being born, the long diameter passing through the outlet is the submento-bregmatic, which usually measures about the same as the suboccipito-bregmatic, viz. $3\frac{3}{4}$ inches (9 cm.).

Persistent Mento-posterior Case.—It will have been noted that in mento-posterior positions the chin has to go round a long rotation. Just as in occipito-posterior positions of the vertex there is a risk of a malrotation through lack of proper flexion, so here there is a risk of a malrotation of the chin through lack of proper extension. If the extension is not sufficiently increased as the head descends, the brow may

remain the leading part of the head, either absolutely or functionally. If so, it will be rotated to the front and the chin will pass into the hollow of the sacrum. This is known as a *Persistent Mento-posterior Case.* In theory the subsequent mechanism would be increased extension of the head, so that the chin might slip over the perineum. But for this to occur the chest must enter the cavity of the pelvis behind and along with the head, which with any normal child is impossible (Fig. 120). Therefore in practice labour comes to an "impasse," and usually requires to be terminated by craniotomy, or in hospital and with a living child perhaps by pubiotomy. These mechanisms may be summarised as follows :—

L.M.A. and R.M.A.

1. Extension.
2. Internal Rotation of Chin to Front.
3. Flexion.
4. Restitution.
5. External Rotation.

R.M.P. and L.M.P.

1. Extension.
2. Long Internal Rotation of Chin to Front.
3. Flexion.
4. Restitution.
5. External Rotation.

Or

1. Imperfect Extension (Flexion).
2. Internal Rotation of Brow to Front (Persistent Mento-posterior).

Moulding of the Head and Caput Succedaneum. — The face bones do not mould, but the aftercoming part of the head is considerably altered in shape. The greatest diminution is in the suboccipito-bregmatic and vertical diameters of the head. The compensatory increase is in the occipito-frontal and the occipito-mental diameters.

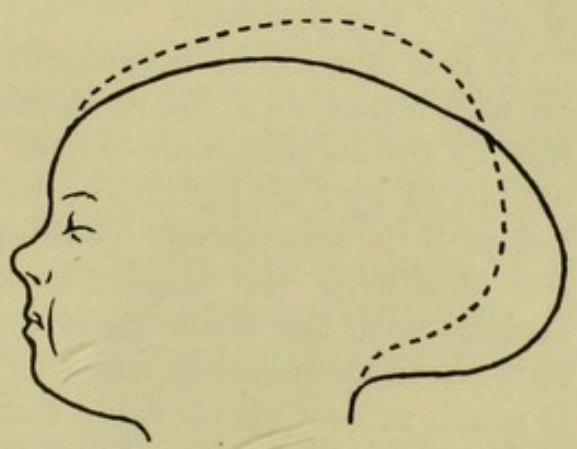


FIG. 121.—Head moulding in face presentation.

The caput succedaneum is usually well marked, the eyelids and lips being often hideously swollen and discoloured. Conjunctival hæmorrhages may be found. The caput ultimately forms near the angle of the mouth.

Causes of Delay in a Face Case :—

(1) The membranes present in a sausage shape—bad dilator—and rupture early.
(2) The face is not wedge-shaped, and is therefore a bad dilator.
(3) The face bones do not mould.
(4) There is a long internal rotation in many cases.
(5) The uterine force is transmitted to the head at a disadvantage owing to the angle between the neck and the face.
(6) Unless the head is fully extended, large diameters engage, *e.g.* vertico-mental of about $4\frac{1}{2}$ inches.

Prognosis.—To the mother the outlook is not serious where delivery is spontaneous, but the risks are increased from the delay, the more numerous examinations and greater handling, and perhaps instrumental delivery. To the child the risks are considerably increased from the delay and pressure. Serious damage may be done to the eyes, nose, or mouth by careless examinations, and the life endangered by instrumental delivery. The maternal mortality is about 3 per cent, and the fœtal about 25 per cent in cases requiring interference.

Management.—Nine out of ten face cases will terminate spontaneously and successfully for both mother and child if they are left to nature. It is most important, therefore, not to interfere until definitely compelled to do so in the interest of one of the patients.

If it is decided to interfere early, especially if the membranes are still intact, an attempt should be made to *correct the presentation* by the Baudelocque-Schatz manœuvre. This is sufficiently explained by Fig. 122. The patient must be fully anæsthetised before it is attempted. Failing this, one may try to push up the chin with the fingers in the vagina, and push down the occiput with the other hand on the abdomen. If this fails, or only partially succeeds, one is left with a brow presentation which is much more unfavourable than a face. It is safer, therefore, to be content with pressing up the brow during pains, or hooking down the chin, both means tending to promote extension.

After the chin has rotated to the front, the labour may be finished by forceps if the condition of mother or fœtus calls for it.

If the chin does not rotate or rotates into the hollow of the sacrum, attempts at traction (not rotation) may be made with the forceps. This is not devoid of danger, as the trachea and vessels and nerves of the neck are likely to be damaged. Failure to deliver thus will in private practice usually need to be followed by craniotomy.

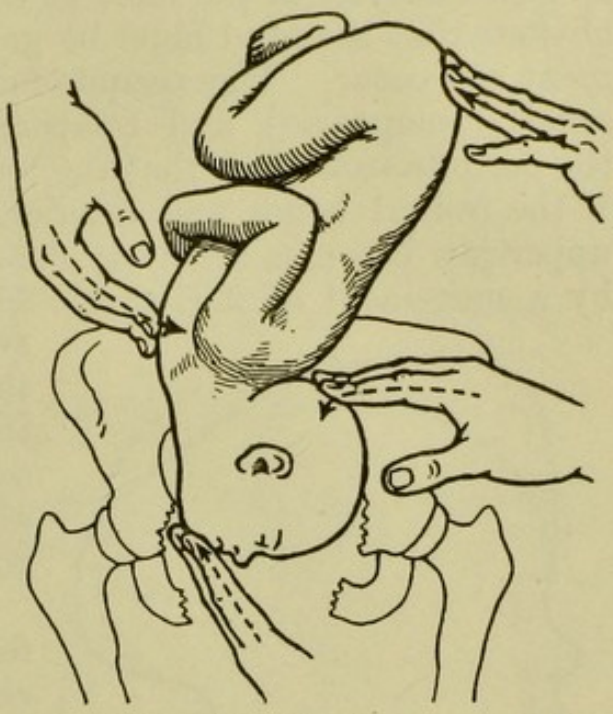


Fig. 122.—Combined manœuvres to rectify presentation.

In all malpresentations an attempt should be made to discover the cause of the malpresentation. Thus if the face presentation is caused by a flat pelvis, or by placenta prævia, the treatment would be at once modified in favour of early bipolar version. Similarly, if the cord is found to have prolapsed, version might be the best treatment in the interest of the child.

Brow Presentations

About once in 1500 cases the brow presents, the head being in a position exactly half-way between flexion and extension—in other words, half-way between a vertex and a face presentation. A moment's consideration will show that all secondary face cases pass through the stage of being brow presentations. The causes of the two conditions are therefore identical. Brow presentations are rarely recognised before the rupture of the membranes, and after that may be greatly obscured by the formation of a large caput. The diagnostic points are the frontal suture with the anterior fontanelle at one end and the orbital ridges at the other.

Spontaneous conversion into a face case (or a vertex) almost always occurs; but when it does not, the head tries to go

through a mechanism. The diameter with which the head attempts to engage is the occipito-mental $5\frac{1}{4}$ inches. As the longest diameter of the inlet is not more than 5 inches, it is obvious that the head must be greatly moulded before engagement can occur. The occipito-mental diameter becomes very greatly compressed, and compensatory lengthening occurs in the occipito-frontal, so that the forehead bulges very markedly. If the frontal bones are anterior, the brow descends and the upper jaw becomes relatively fixed under the pubic arch, and by a movement of flexion the brow, vertex, and occiput are swept over the perineum, and the face then slips down behind the pubes. The caput forms over the forehead. This mechanism is only possible with a small head.

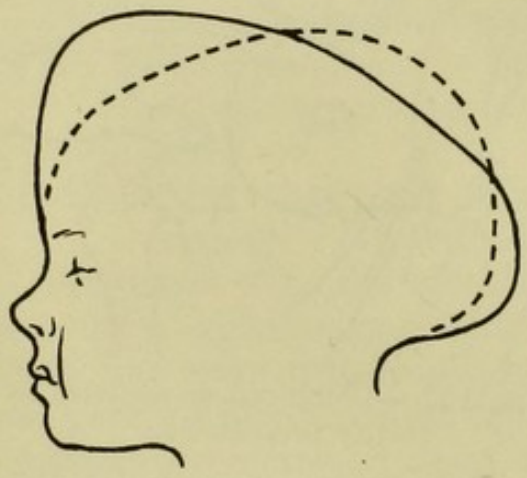


FIG. 123.—Head moulding in brow presentation.

Prognosis.—This is the worst form of head presentation. The risks are similar to those in face cases, but greater. The delay is greater, and the diameters engaged are longer. The maternal mortality amounts to 5 per cent in cases that do not rectify themselves spontaneously, and the fœtal to as much as 30 per cent. Rupture of the uterus may occur.

Treatment.—(1) If diagnosed early, while the membranes are still intact, try to convert it into a face (or a vertex) case, by manœuvres exactly similar to those used to promote the extension of the chin or to convert a face case into a vertex. It is said to be an advantage to keep the mother lying on the side opposite to that to which the chin points, so that the obliquity of the uterus may aid the manœuvre.

(2) If this effort fails, and the membranes are still intact, or recently ruptured, do a bipolar version and bring down a foot. The risks of a breech case are less to both mother and child.

(3) If the head is fixed, or the uterus too contracted down on the fœtus to allow of version with safety, apply forceps and attempt delivery. Do not persevere too long, especially if the uterus shows any sign of passing into tonic contraction. Failing to deliver with forceps, perform craniotomy.

CHAPTER XVIII

BREECH OR PELVIC PRESENTATIONS

Pelvic presentations may be divided into four varieties according to the attitude of the lower limbs of the child (Fig. 64).

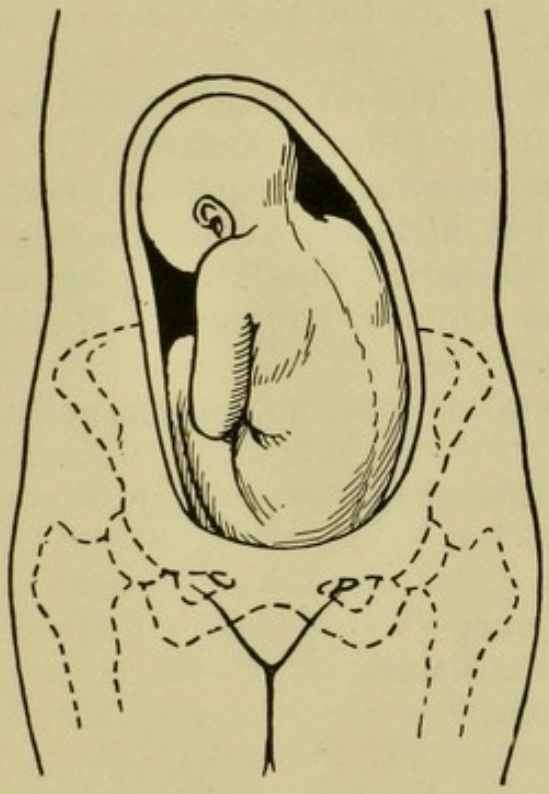


Fig. 124.—Breech L.S.A.

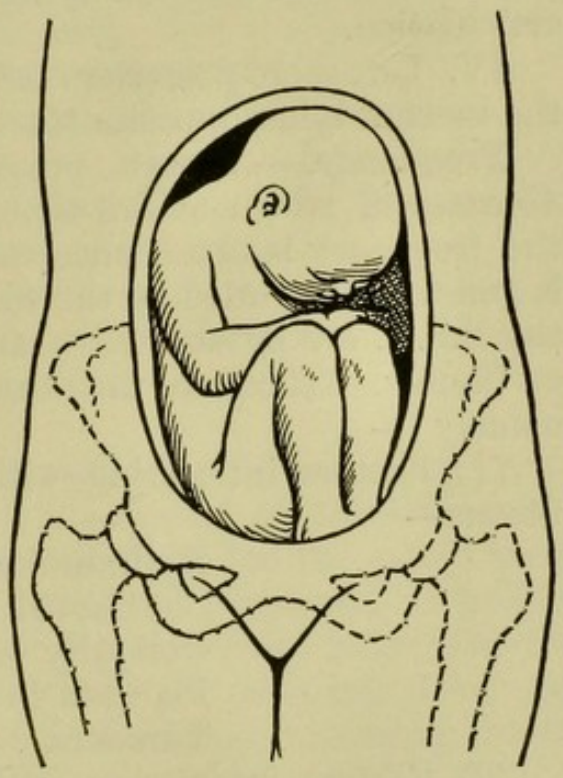


Fig. 125.—Breech R.S.P.

In a Complete or Full Breech the thighs are flexed on the abdomen and the legs are flexed on the thighs.

In an Incomplete or Frank Breech the thighs are flexed as before, but the legs are extended over the front of the abdomen.

Where a foot or a knee is the lowest part of the fœtus, we speak of a Footling or a Knee presentation.

Positions.—The denominator, or part in terms of which the position is described, is the sacrum. The four positions are as follows :—

I. Left sacro-anterior (L.S.A.). The sacrum lies opposite the left foramen ovale ; the cleft of the buttocks is in the right oblique diameter ; the bitrochanteric diameter of the fœtus is in the left oblique. Owing to the crouched attitude of the child the antero-posterior diameter of the fœtal ovoid is longer than the bitrochanteric, and therefore usually occupies the right oblique diameter of the pelvis.

II. Right sacro-anterior (R.S.A.). The sacrum lies opposite the right foramen ovale, the cleft of the buttocks in the left oblique, the bitrochanteric in the right oblique.

III. Right sacro-posterior (R.S.P.). This is the reverse of the L.S.A., the sacrum lying opposite the right sacro-iliac articulation.

IV. Left sacro-posterior (L.S.P.). The reverse of the R.S.A., the sacrum lying opposite the left sacro-iliac articulation.

Frequency. — Breech presentations occur once in about 45 cases of labour at full time, but including premature cases the frequency is about once in 30 cases. The L.S.A. position is generally regarded as the most common, but the R.S.P. and the R.S.A. are by no means rare.

Causes.—These are the causes of malpresentations generally, namely :—

(1) Factors interfering with the shape or tonicity of the uterus—

Hydramnios.
Contracted Pelvis.
Obliquity of the Uterus.
Placenta Prævia.
Tumours.

(2) Factors interfering with the shape or tonicity of the fœtus—

Premature or Dead Fœtus.
Monstrosities.
Hydrocephalus.
Multiple Pregnancy.

Diagnosis.—On abdominal palpation the hard, round, freely

movable head is found at the fundus, the back to one side, the limbs to the other. The softer, more irregular breech is either movable over the brim of the pelvis, or else the pelvis is filled up with it so that pelvic palpation cannot be done. Auscultation gives the maximum intensity of the fœtal heart at a point on one or other side above the umbilicus.

The membranes are frequently sausage-shaped, and tend to early rupture. The liquor amnii is often stained dark greenish brown from mixture with meconium. Vaginal examination may reveal the three bony points—the sacrum and coccyx, and the ischial tuberosities. The anus and external genitals may be felt, and it may be possible to pass a finger into the fold of the groin. One or both feet may be felt. The anus is distinguished from the mouth by the absence of gums and the muscular grasp of the sphincter ani. The groin differs from the axilla in the absence of ribs, and the foot from the hand in the absence of a thumb, all the toes being of nearly the same length, and in the presence of the heel.

Mechanism of Left Sacro-anterior Case :—

(1) Corresponding to flexion there is a movement of *Compaction*, which accompanies the *engagement* or beginning of *descent*. The result of this is that the *anterior hip* usually becomes the lowest or leading part of the fœtus.

(2) The anterior hip, therefore, first meets with the resistance and recoil of the one lateral half of the posterior segment of the pelvic floor, and becomes rotated to the front—*Internal Rotation of the Anterior Hip.*

(3) Corresponding to the *extension* in head-first labours there is now a movement of *Lateral Flexion of the Breech on the Trunk.* The anterior hip passes down under the pubic arch, while the posterior hip sweeps over the perineum. The feet escape close to the buttocks, and if interference is avoided the trunk passes down with the shoulders rotating into the antero-posterior of the outlet, and the arms remaining folded over the chest.

(4) *External Rotation of the Trunk* then occurs owing to the internal rotation of the head. The head enters the pelvis in the transverse diameter, or slightly towards the right oblique. As it descends it rotates into the antero-posterior of the outlet, the occiput almost always passing to the front and coming under the pubic arch, while the face passes into the

hollow of the sacrum. The chin, face, brow, and vertex then appear in that order over the perineum.

It should be carefully noted that in the normal mechanism of a breech case it is the anterior hip that becomes the leading part and rotates to the front, and not, as in all other *normal* mechanisms, the denominator. In the L.S.A. the anterior hip rotates from a point opposite the right foramen ovale through $\frac{1}{8}$th of a circle to the middle line. This means that the sacrum, which is the denominator, actually passes backwards and to the left.

In regard to the birth of the aftercoming head, the all-important point is that the head be kept in a flexed condition all the time. Naturally this is secured by the uterus contracting down upon it, as it is expelled. After the head passes out of the active upper uterine segment its further descent is apt to be delayed, as the powers now acting upon it are only the weak vaginal walls and the secondary powers or abdominal muscles. It is this delay which constitutes the main risk in uncomplicated breech cases.

Moulding. — The "caput" forms over the anterior hip mainly, but also affects the external genitals, the scrotum in the male being sometimes greatly distended with fluid. The aftercoming head is rather more rounded than usual and deepened in its vertical measurements.

Prognosis.—The outlook for the mother is quite good, the only additional risks arising from the delay in labour, and any interference on behalf of the child.

For the child, on the other hand, the outlook is bad. The mortality varies greatly according to the skill and presence of mind of the accoucheur. It is usually said that the mortality is about 1 in 11, but it may easily be as high as 1 in 5.

The principal risk to the child is from asphyxia. This may be produced in several ways. (1) When the body is born the umbilical cord may be compressed between the aftercoming head and the pelvis, and the circulation stopped. (2) The uterus by contracting down powerfully on the head may so compress the placenta as to stop the circulation through it. (3) The retraction of the uterus, after the head has passed into the vagina but is not born, may cause separation of the placenta. (4) The cold outer air playing upon the trunk and lower limbs of the child may stimulate it to make respiratory

efforts while the head is still in the birth passages. This results in the child sucking in liquor amnii and secretions, while at the same time the placental circulation is interfered with. Prompt delivery of the head is essential in these cases, as the child passes beyond hope of resuscitation if it is cut off from both aerial and placental respiration for more than a very few minutes.

In addition to these risks the fœtus is liable to injury during the efforts to deliver the head or breech.

Management.—In the majority of malpresentations there is some discoverable reason why the vertex does not present. In making the diagnosis of breech presentation it is well at the same time to try to find out the cause. If the presentation be discovered in the last weeks of pregnancy and the cause be neither contracted pelvis, nor hydrocephalus, nor placenta prævia, in all of which a breech presentation is favourable, an attempt may be made to convert it into a vertex presentation by external version (*q.v.*). This may be easy to do, but it is very difficult to maintain the child in its new position until labour ensues. In view of the risks to the child of a breech labour, however, it may with advantage be tried.

Where the diagnosis is not made until the beginning of labour, it is better not to try to alter the presentation.

Having recognised that the case is a breech one, be particularly careful to have everything ready for prompt treatment of emergencies. Remember that the dangers to be faced are principally (1) that insufficient dilatation of the passages by the breech may lead to delay in the birth of the head; (2) that displacement of the arms may lead to the same result; (3) that the head may be delayed owing to inefficiency of the powers after it leaves the upper uterine segment; and (4) that while the head is delayed from any such cause the cord may be pressed on and the circulation stopped, or the child may try to breathe. (5) Almost any form of interference, especially pulling on the legs, will tend to undo the flexion of the head and throw larger diameters across the outlet of the pelvis, and so cause delay.

The principles of treatment are therefore to avoid interference in the early stages, and so secure full dilatation; to maintain flexion of the head; and to be fully prepared to interfere promptly if the necessity arise.

Details of Treatment.—*First Stage.*—Keep the patient in bed and at rest, so as to preserve the membranes as long as possible. Warn the relatives of the risk to the child.

Second Stage.—Prepare warm towels to wrap around the child's body and limbs, and a warm bath, and everything likely to be required for the treatment of asphyxia. Allow the breech to be born without hurrying it. Support the perineum as in a vertex case. As soon as the body is born as far as the umbilicus, draw down a loop of the cord, at the same time manœuvring it to the corner of the pelvis where it is least likely to be compressed. This loop by its pulsations is an index of how it is faring with the child. Wrap the limbs and trunk in a warm towel, and hold them slightly towards the mother's abdomen so as to aid the lateral flexion of the body. At the same time exert suprapubic pressure upon the fundus, which aids expulsion and promotes flexion. When the elbows appear the hands may be gently disengaged with the finger. Meantime carefully watch the pulsations of the cord. Provided it is beating regularly and the child is not making convulsive movements, there is no need for anxiety. Wait for the next pain and with the aid of suprapubic pressure expel the head in a fully flexed attitude.

Extraction of the Head.—*If the head be delayed* more than a few minutes after the birth of the trunk as far as the umbilicus, it will almost certainly require to be artificially aided. The two best methods of doing this are (1) the Prague seizure, and (2) the Mauriceau-Smellie-Veit grip. Both are designed to extract while at the same time promoting flexion. Therefore aid the latter by making the nurse or assistant exert suprapubic pressure while the extraction is being performed. Either method is more easily performed if the mother is in the cross-bed position on her back. This position can only be maintained by the aid of assistants, but if such aid is available it is often desirable to place the mother in this position as soon as the breech reaches the vulva. Anæsthesia is also required.

Prague Seizure.—Seize the feet and legs by one hand and carry them well forward between the mother's thighs. Place the first and second fingers of the other hand over the child's shoulders to steady the head. Pull upon the legs in a direction at right angles to the mother's abdomen. This forces the occiput against the pubes and so increases flexion, while it also

effects extraction which is controlled by the fingers over the shoulders. In a primipara this method may require such force that the head comes out with a suddenness that causes severe tearing of the perineum. In these cases the second method is perhaps better.

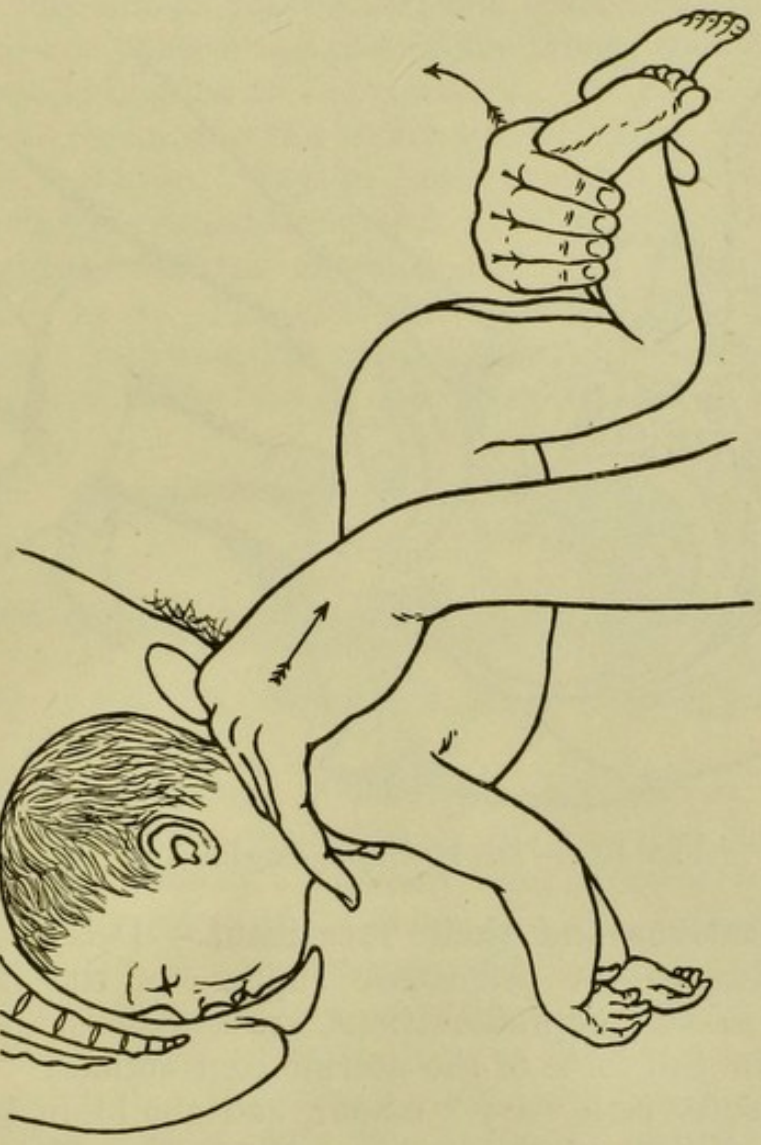


FIG. 126.—The Prague seizure.

Mauriceau-Smellie-Veit Grip.—Place the child astride upon the left forearm, and slip the two first fingers of the left hand into the vagina and apply them to the superior maxilla on each side of the nose. With these fingers try to draw down the chin and nose, and so promote flexion. At the same time the two first fingers of the right hand are passed over the shoulders and traction made by them in an upward direction.

An alternative is to pass the left forefinger into the mouth, but this is apt to cause injury to the jaw.

The Application of Forceps to the aftercoming head is very successful, but requires more time than these other methods. It is therefore rarely called for.

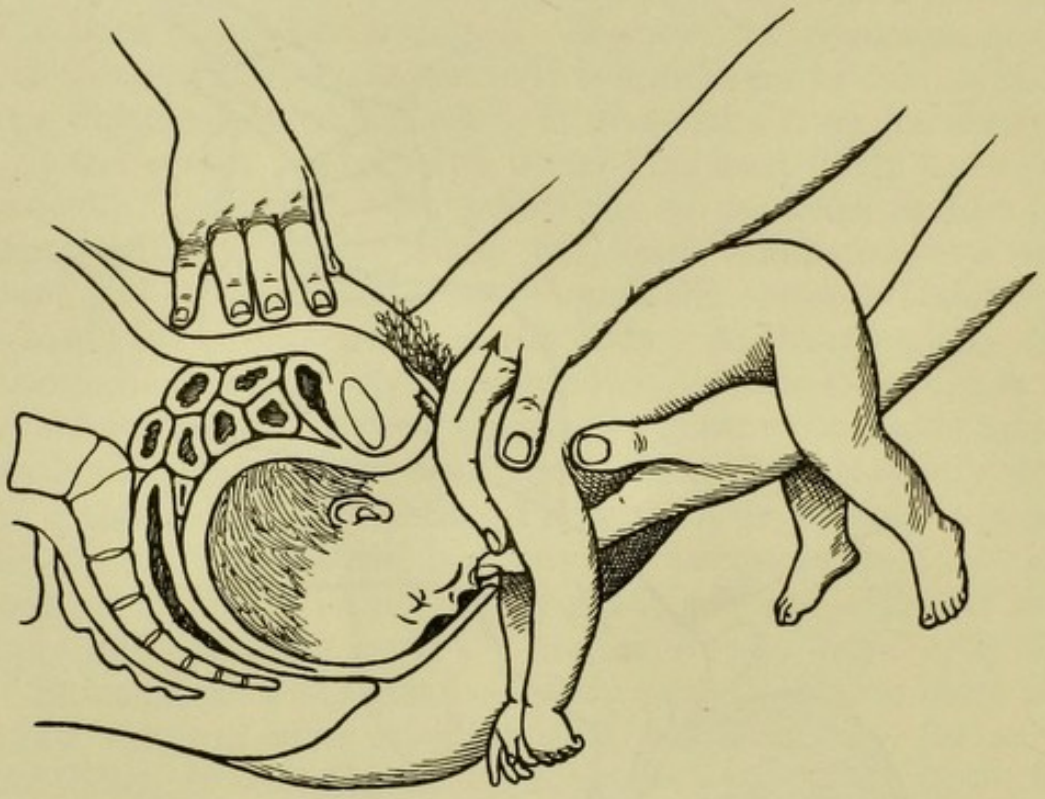


FIG. 127.—The Mauriceau-Smellie-Veit grip.

Complications and their Treatment.—Delay in the first stage is due to the premature rupture of the membranes, which, as in all malpresentations, are sausage-shaped and exposed to the full force of the uterine contractions.

This results in a "dry" labour, and the blunt breech is a very poor dilator of the cervix. Warm douching may help dilatation, but in a few cases artificial dilatation of the os may be required (*accouchement forcé*, q.v.).

Second Stage.—Impaction of the Breech.—This may occur from the large size of the breech or the small size of the pelvis. It is peculiarly apt to occur with a frank breech, the legs being extended over the front of the abdomen.

Impaction is recognised by failure of the breech to advance in spite of strong pains. The "caput" over the buttock becomes very marked.

Treat by giving an anæsthetic and, with full antiseptic precautions, passing the hand into the vagina and bringing down a foot. Where the legs are both extended this will require skill and care. The fingers should be passed along the anterior thigh to the knee; the knee should then be gently abducted and bent; this brings the foot within reach, and it can then be pulled down. Leave the rest of the labour to nature unless there is some indication to the contrary.

Where the breech fills the entire pelvis, it may be impossible to pass the hand up. Try to hook it down by passing one or both forefingers round the groin. Failing this, a blunt hook may be guided over the anterior groin by the fingers, and traction made by it. Powerful traction will lead to fracture or dislocation and bruising, but careful steady and gentle traction leads to no harm. The forceps have been applied to the breech,

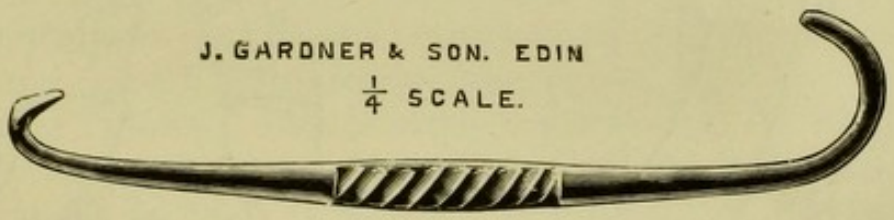


Fig. 128.—Breech hook and crotchet.

but they do not obtain a good grip. The use of a fillet of sterilised gauze passed over the groin has also been recommended, but it is usually a waste of time to try to apply it.

Upward Displacement of the Arms.—In the majority of cases where this occurs it has been caused by pulling upon the breech in delivering it, and omitting suprapubic pressure. One or both arms pass up by the side of the head and prevent its further passage. Treatment must be directed to bringing down the arms. As a rule the posterior arm is the more accessible. To reach it swing the child's body forward, pass the hand into the vagina, and gently slip the fingers over the back and along the outside of the humerus to the elbow. Gently flex the arm and sweep it down over the front of the face and chest, and so deliver it. The trunk may then be swung in the opposite direction and the other arm freed in a similar way. Great gentleness must be observed, and the arm must always be brought over the *front* of the child, otherwise the shoulder will be dislocated. There is risk of

fracture of the humerus and clavicle, especially a separation of the upper epiphysis of the humerus (Fig. 129).

Very occasionally one arm passes behind the neck, the so-called *nuchal position.* This is a serious complication, and is to be met by rotating the body in the direction in which the

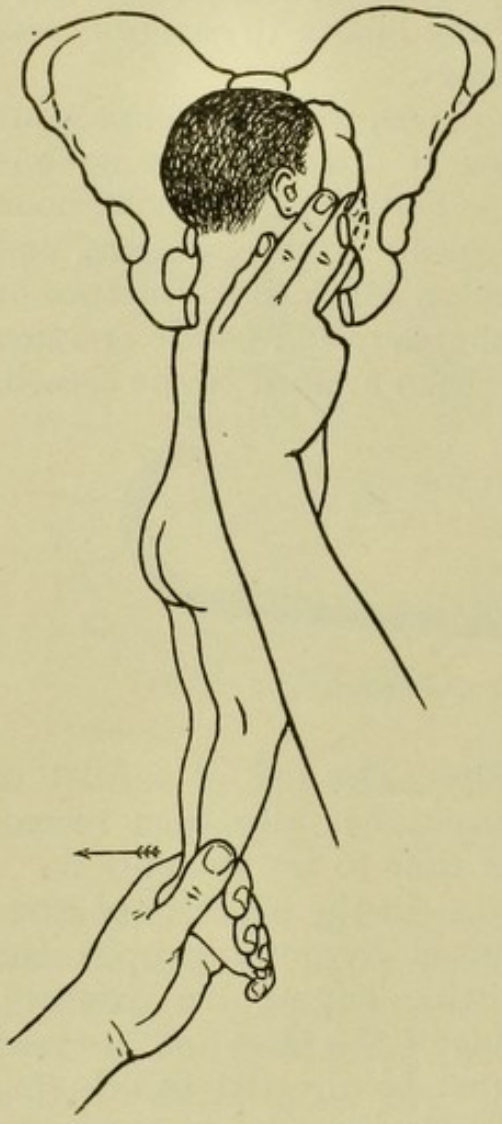


FIG. 129.—Reduction of upward displacement of the arm.

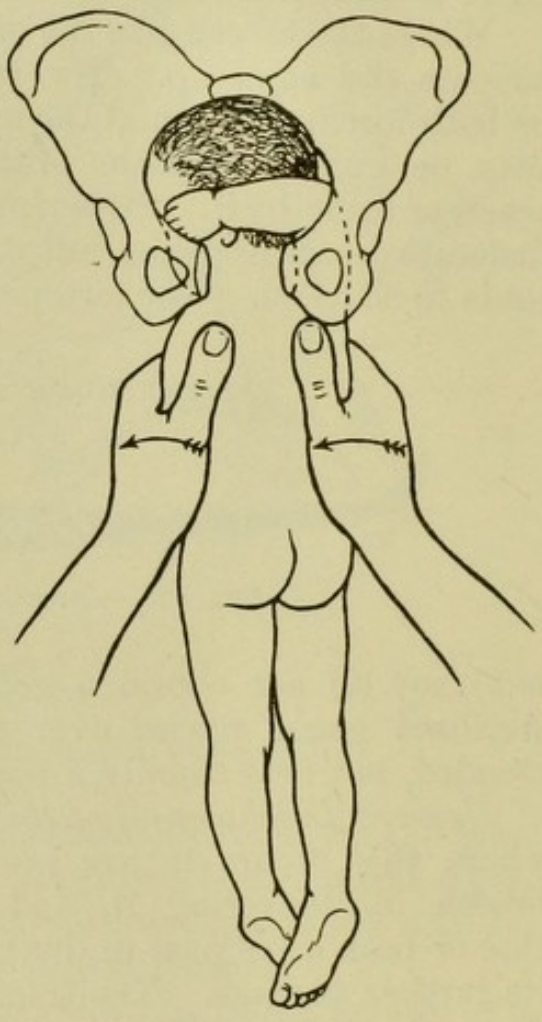


FIG. 130.—Nuchal position of arm and its treatment.

hand behind the neck is pointing. This brings the arm to the side of the head, when it may be delivered as before (Fig. 130).

Impaction of the Aftercoming Head.—In most cases this accident, like the displacement of the arms, is due to traction on the breech, and the omission of suprapubic pressure. Occasionally it may be due to the large size of the head or the small size of the pelvis. The Prague seizure or the Mauriceau

grip must first be tried as described. If they fail, swing the child's body forward and apply the forceps. A good grip from the chin to the occiput is obtained, and delivery is usually easy. If this fails, or if the child is already dead, perforate through the roof of the mouth and deliver by forceps or the cephalotribe.

Gripping of the Head.—The retraction ring or the incompletely dilated os uteri sometimes closes upon the neck. This is a serious accident as far as the life of the child is concerned. Treat by free administration of an anæsthetic to relax the spasm, or by craniotomy. If the child is alive incisions into the cervix may save it, but this is a serious operation for the mother.

Malrotation of the Head.—This is a rare but difficult complication, the occiput passing into the hollow of the sacrum, and the face coming to lie behind the pubes. The natural mechanism in such circumstances is for the chin and face and forehead to slip down behind the pubes, and then the rest of the head follows. This is easily remembered by the rule that *in all head last labours the chin should be born first.* Every effort must be made to secure this mechanism, the head being extracted by the Prague seizure with the body swung backwards instead of forwards.

Remember, in dealing with complications connected with the arms or head, that unless the child can be delivered within *ten minutes* at the very most from the time of the birth of the umbilicus, it will probably be beyond resuscitation.

CHAPTER XIX

TRANSVERSE LIES OF THE FŒTUS

(*Synonyms*—Shoulder Presentations, Cross Births)

In these cases the long axis of the child lies across the long axis of the uterus. The fœtus usually lies more or less upon its side, so that the shoulder is the most common presenting

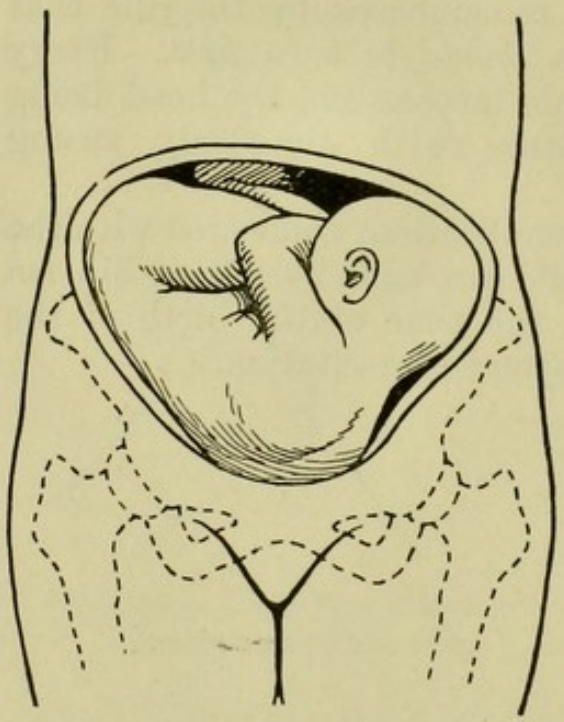


Fig. 131.—Transverse, L.A.A.

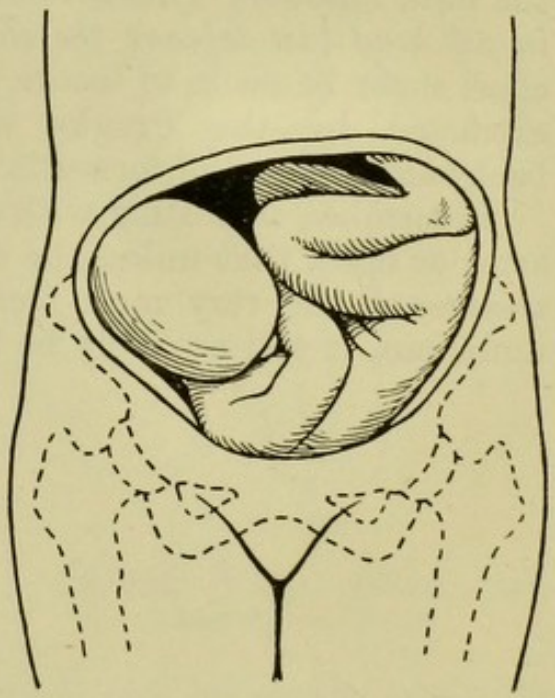


Fig. 132.—Transverse, R.A.P.

part, and the acromion process has been chosen as the denominator. Sometimes the hand or elbow presents, or even the ribs. Usually the head lies in one iliac fossa, and the breech at the opposite side on a slightly higher level. The two main varieties of position are the dorso-anterior positions in

which the child's back is to the front of the mother, and the dorso-posterior in which it is to the back of the mother. Of these the dorso-anterior are much the commoner positions. Further, according to the side on which the head lies, we have the following four positions :—

I. Left acromio-anterior (L.A.A.). This may be regarded as a transverse modification of the L.O.A., the head lying in the left iliac fossa, the back to the mother's front, the shoulder presenting opposite the left foramen ovale.

II. Right acromio-anterior (R.A.A.). This is the corresponding position with the head in the right iliac fossa.

III. Right acromio-posterior (R.A.P.). This is like the R.A.A., except that the child's back is to the back of the mother.

IV. Left acromio-posterior (L.A.P.). This is like the L.A.A., with the child's back turned towards the mother's back.

Of these positions the left acromio-anterior is the most common.

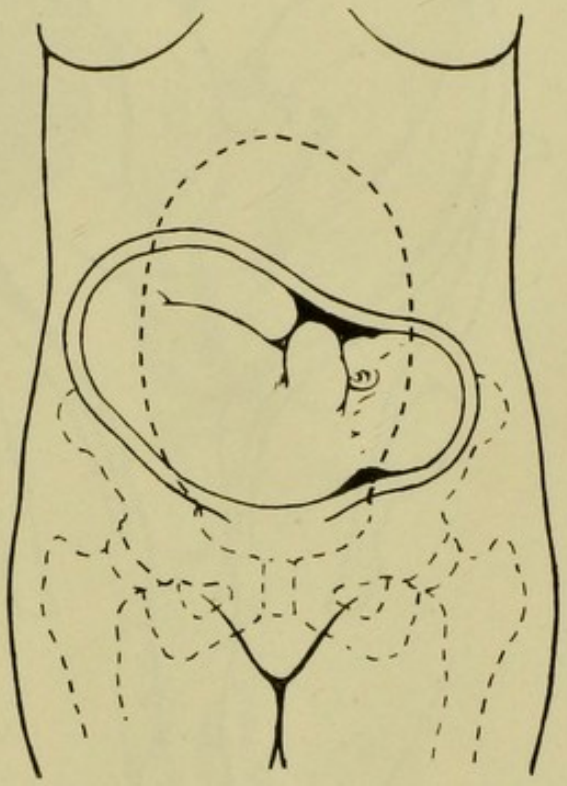


FIG. 133.—Shape of uterus in shoulder presentations.

Frequency.—Shoulder presentations occur about once in two hundred cases. Excluding premature cases, the frequency is considerably lessened. They are about six times more common in multiparous women than in primiparæ. This is due to the laxness of the abdominal and uterine walls, and the obliquity of the uterus so common in multiparæ.

Causes.—The same as for other malpresentations. (See under Breech cases, p. 184.)

Diagnosis.—Inspection of the abdomen frequently leads to the suspicion of the condition, for the uterus is much wider from side to side, and does not extend so high in the abdomen.

Palpation confirms the suspicion, the head and breech being

found at opposite sides of the pelvis, the head in the iliac fossa, the breech more often at a higher level. This palpation is only possible before labour has begun, or in the early stage before the membranes have ruptured, as after that the uterus contracts down too firmly over the fœtus to permit of a diagnosis being made by palpation.

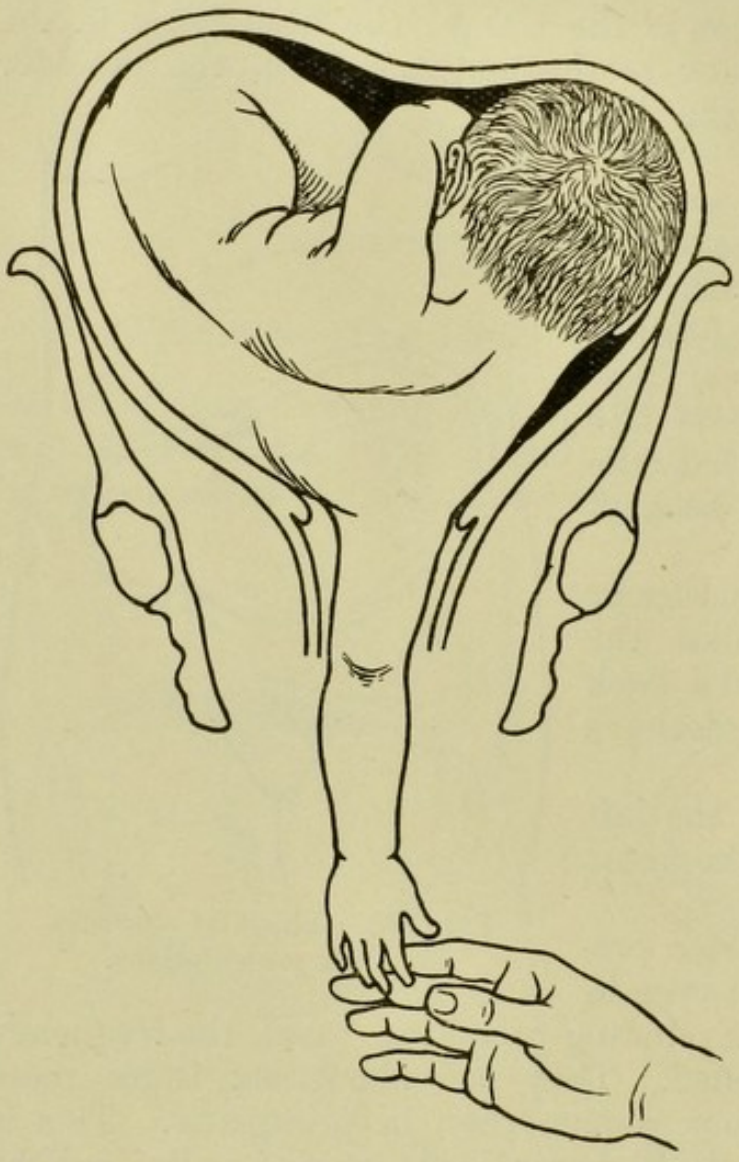


FIG. 134.—Diagnosis of position by "shaking hands" with the fœtus.

Vaginal examination should always be practised in a case where the presentation is suspected to be abnormal. The cardinal signs of a malpresentation will be present—sausage-shaped membranes, and the extremely high level of the presenting part. The presenting part will feel soft and irregular, but will probably not be recognised as long as the membranes are intact, unless, as sometimes happens, the arm prolapse inside the membranes. After the rupture of the membranes a careful vaginal examination should be made, under an anæsthetic if necessary. If the arm lies in the vagina the diagnosis is settled, but determine the position by shaking hands with the fœtus so as to find out whether it is the right or the left arm. Further, place the arm in a position of moderate supination, and the thumb will point towards the head, and the palm correspond to

the ventral surface of the child. The exact diagnosis of the position can thus be made.

If the arm be not prolapsed, the examining fingers will feel the ribs, which give an unmistakable "gridiron" sensation, or the scapula or clavicle. If the finger can be passed into the pit of the axilla, it will indicate the position of the head. Careful abdominal examination will then probably determine the position.

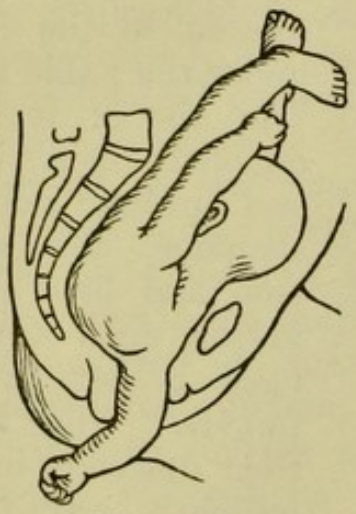


Fig. 135.

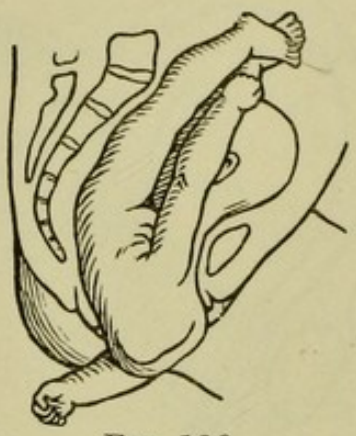


Fig. 136.

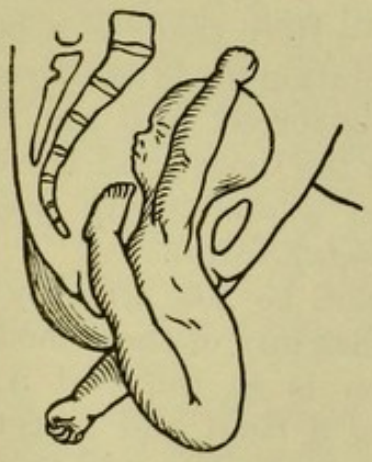


Fig. 137.

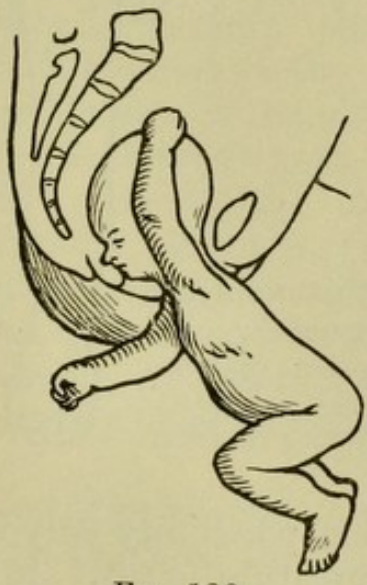


Fig. 138.

Spontaneous evolution.

Mechanism. — With a normal full-time child natural delivery is impossible. Given a roomy pelvis and a premature or a dead and macerated fœtus, natural expulsion is an occasional possibility in one of the three following ways :—

(1) *Spontaneous Version, or Spontaneous Rectification.*—Before the membranes rupture, the body may by some unknown means change its position so that the head or breech comes to be the presenting part. This was first described by Denman in the eighteenth century.

(2) *Spontaneous Evolution.*—This was first described by Douglas. After the rupture of the membranes the shoulder is pushed down on to the pelvic floor and is rotated to the front under the pubic arch. The thorax is then doubled upon itself and squeezed past the shoulder, the abdomen and breech following, until only the head is left in the pelvis. The head then descends in the ordinary way (Figs. 135-138).

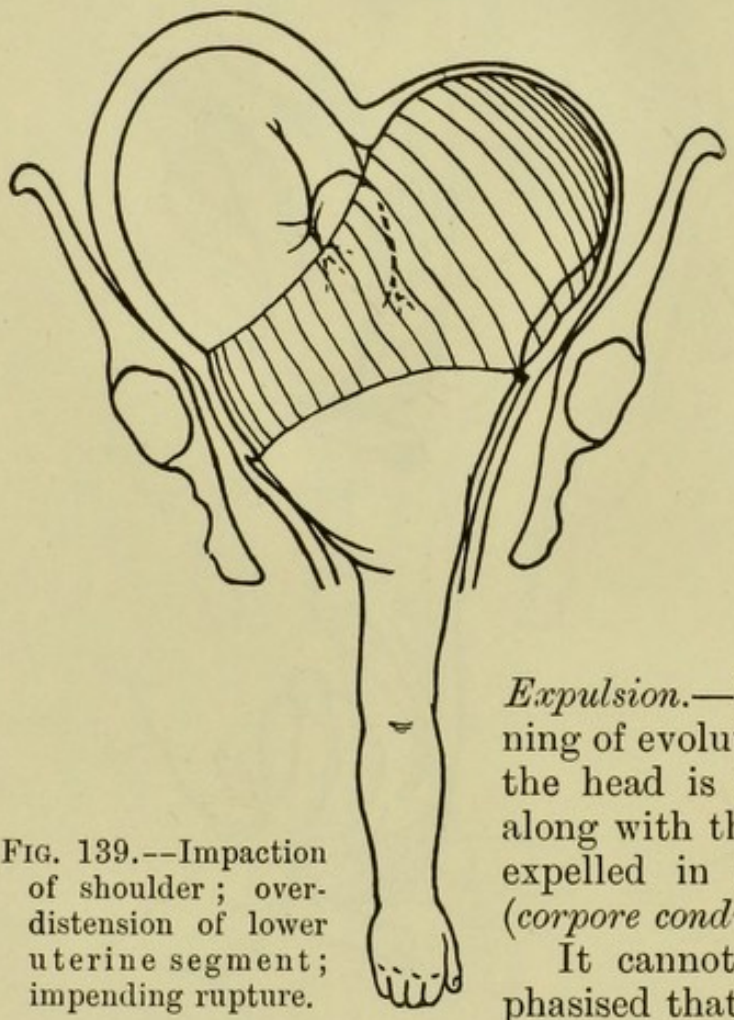


FIG. 139.—Impaction of shoulder; over-distension of lower uterine segment; impending rupture.

(3) *Spontaneous Expulsion.*—Here there is a beginning of evolution made as above, but the head is forced into the pelvis along with the body, and the child expelled in a doubled-up position (*corpore conduplicato*).

It cannot be too strongly emphasised that any of these modes of termination is at the best a conceivable possibility only in the case of a dead and macerated or premature fœtus. In all ordinary cases there is only one possible termination, if the condition is not relieved by the obstetrician. That termination is *Impaction.*

If **Impaction** occurs, the fœtus will inevitably die from compression within a comparatively short time, while for the mother there are three possibilities: (1) The upper uterine segment will go on trying to expel the fœtus, and will so stretch out the lower uterine segment over the child that the latter will

give way—*Rupture of the Uterus.* (2) The uterus may become exhausted before it reaches the point of rupture, and cease contracting—*Inertia of the Uterus.* If assistance is not at hand, this is practically the mother's only chance of surviving, as it may delay the crisis until help is available. Unfortunately it is rare and never to be counted on. (3) *The mother may die from sheer exhaustion* before either rupture or inertia occurs.

Management.—If the condition be recognised in the later weeks of pregnancy, convert it to a vertex presentation by *external version* (q.v.), and try to maintain the new presentation by an abdominal binder. Watch the patient from day to day until labour ensues. If recognised early in labour, while the membranes are still intact, perform either *external* or *bipolar podalic version* (q.v.), rupture the membranes, and bring down a foot so as to maintain the changed presentation.

If not recognised until after the membranes have ruptured, determine first by careful auscultation whether the child is still alive, and, further, whether its condition is such that it is likely to survive its birth. If its condition is fairly good, put the patient *deeply* under chloroform, and with extreme care do *internal version* (q.v.), bringing down a foot or knee. The risk of doing this is rupture of the lower uterine segment, and the greatest judgment is required to know whether, in cases where the membranes have been ruptured for any length of time, the risk to the mother may be justifiably undertaken. If Bandl's retraction ring is palpable about the level of the umbilicus, or any symptom of impending rupture is present, the risk should not be taken, as the introduction of the hand will almost inevitably rupture the uterus. The child, moreover, is usually dead or moribund in these cases.

If a decision is made against version, *decapitation* must be performed, if the neck is accessible. Otherwise the bulk of the child must be diminished by *spondylotomy* or *evisceration.*

After any of these operations the trunk is extracted by traction on the arm or leg. The management of the decapitated head is described under the operation of *Decapitation.*

Summary of the Course of a Shoulder Presentation

I. *Untreated.*—

Termination—(A) Impaction, resulting in—

(1) Rupture of the uterus,

or

(2) Inertia of the uterus,

or

(3) Death of the mother from exhaustion.

(4) Inevitable death of fœtus from compression.

(B) Conceivable terminations when fœtus is premature, or dead and macerated—

(1) Spontaneous version or rectification.

(2) Spontaneous evolution.

(3) Spontaneous expulsion.

II. *Treatment.* — Version, external, bipolar, or internal, according to circumstances. Decapitation, spondylotomy, or evisceration if impacted.

Compound Presentation

Occasionally a hand or a foot presents along with the head, or hands and feet may present together. Usually there is some abnormality in the shape or size of the pelvis or in the size of the head. In most cases labour is not interfered with, but at the same time it is advisable to push back the hand or foot if possible. If the condition seems likely to cause dystocia, version should be performed.

CHAPTER XX

PLURAL BIRTHS

The simultaneous development of two, three, four, or five embryos in the uterus is spoken of as a twin, triplet, quadruplet, or quintuplet pregnancy. Reports of the birth of more than five children at once must usually be regarded as apocryphal. For practical purposes twin pregnancy alone need be considered.

Frequency and Cause.—The average frequency of twins is 1 in 80. It varies in different countries according to the fertility of the races. In Ireland it is about 1 in 60, while in England it is only 1 in 110. The tendency to plural births appears to run in certain families, usually descending through the mother, but occasionally through the father. The frequency of triplets is only 1 in 6000, while quadruplets are still rarer.

Varieties.—Twins may be developed from two separate ova, one ovum coming from each ovary, or both from the one ovary. In other cases they are developed from one ovum—either from the fertilisation of an ovum with two nuclei, or by the cleavage of the blastodermic vesicle. The former variety is known as *Binovular* twins, the second as *Uniovular* twins.

Binovular twins are five or six times more common than uniovular twins. They may either be of different sexes, or both of the same sex. Each fœtus has its own complete placenta and membranes. Sometimes, where the two ova have been implanted near each other, the placentæ look as if they formed one large single placenta. But investigation always shows that in such cases there is no intercommunication between the two circulations.

Uniovular twins are always of the same sex, and frequently strikingly like each other. They must be regarded as de-

generates, having in all probability narrowly escaped being a double monster. They have only one placenta, and only one chorion, but each fœtus has its own amnion. Very occasionally the adjacent amniotic membranes fuse and atrophy, leaving both embryos in the one space. In the case of uniovular twins there is a certain area of the placenta common to both, in which the two circulations intercommunicate. This may lead to disaster to one of the twins, because, if one fœtus is larger and has a stronger heart than the other, it will monopolise the greater part of the placental circulation, and may actually cause a regurgitation through the umbilical arteries of the weaker one. In such cases the weaker one does not develop, and is born as an *acardiac fœtus*—a shapeless mass with traces of the structures in the lower part of the body only, and with neither heart nor head. In other cases a somewhat similar derangement of the circulation leads to hydramnios coming on early in pregnancy, and usually terminating in abortion or premature labour.

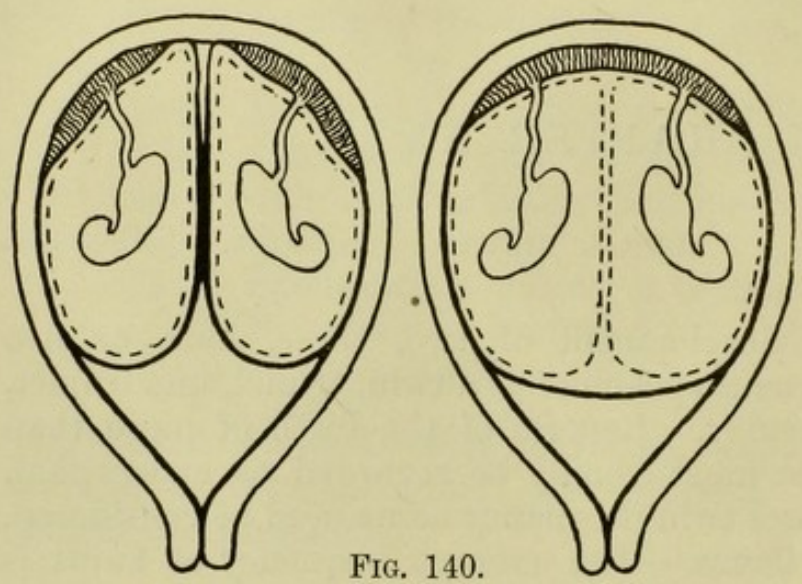


FIG. 140.

Binovular twins. Uniovular twins.

Size.—Twins are often, as might be expected, smaller than single children. In many cases this may be due to the fact that they are often born rather prematurely, owing probably to the greater distension of the uterus which they cause. Frequently they differ considerably in size, and cases are on record where one was twice the weight of the other.

Not infrequently one fœtus in a twin pregnancy dies early. It may be cast off while the other continues to develop; but more often it is retained. In these circumstances it usually becomes dried up and mummified, and flattened against the wall of the uterus by the pressure of the other.

At labour it comes away in this dried and flattened state, and is known as a *papyraceous fœtus*.

Diagnosis.—A certain diagnosis can be made only under very exceptionally favourable circumstances. It is therefore unwise of the obstetrician to commit himself to more than the probability of twins being present in the uterus. During pregnancy twins may be suspected if the uterus is larger than usual. Similar early enlargement may be due to hydatidiform mole, or to hydramnios. But early hydramnios, again, is usually, though not invariably, associated with twins, most commonly uniovular.

A positive diagnosis may be made by palpation only if two heads, and two breeches, and at least one back can be definitely made out. By auscultation a certain diagnosis may be made if two fœtal hearts can be heard beating at two well-separated areas, with a difference of at least ten beats per minute as observed over more than one minute's listening. A simultaneous counting by two observers is still safer.

In a great many cases the diagnosis is not made until the first child has been born, when the still considerable size of the uterus leads to investigation, and the presence of the second fœtus is discovered.

Course of Pregnancy.—The increased size of the uterus leads to increased severity of reflex symptoms, such as vomiting, and to greater pressure on the bladder and rectum. There is also an increased tendency to albuminuria and eclampsia. Owing to the distension of the uterus the pregnancy often terminates a little before full time.

Twin Labour.—The order of frequency of the combinations of presentations is (1) two vertices; (2) vertex and breech; (3) two breeches; (4) vertex and transverse; (5) breech and transverse; (6) two transverses.

While the generally smaller size of the fœtuses tends to make a twin labour easy, this is apt to be more than counterbalanced by a greater tendency to complications. Of these the most common is primary inertia of the over-distended uterus. Hydramnios is also often found associated with twins, which in like manner tends to make the labour tedious. Prolapse of the cord and unfavourable presentations may also affect the course of labour.

Prognosis.—Twin children are less robust at birth and less fit to survive any complications of their birth. The mortality is thus greater, being as much as 1 in 20. The maternal prognosis is also more serious owing to (1) delay from inertia, hydramnios, etc.; (2) post partum hæmorrhage favoured by inertia and large placental site; (3) increased septic absorption from large placental site; (4) interference on behalf of the children.

Course of Labour.—Usually fœtus A is born, then fœtus B, and then the two placentæ. Sometimes the order is fœtus A, placenta of A, fœtus B, placenta of B. More serious is the order fœtus A, placenta of A, placenta of B, fœtus B. In the last case fœtus B will perish before its birth unless it is extracted very soon after its placenta.

The birth of the first child is usually normal, but tedious in the first stage. After it is born the uterus rests for some time, but as a rule the second child is expelled easily through the dilated passages within half an hour of the first. In other cases it may be delayed hours, or even a day or two.

Management.—Conduct the birth of the first child as an ordinary labour. After it is born the size of the uterus will probably call attention to the presence of the second child, even if not previously suspected. Be careful to tie the umbilical cord in two places before cutting it, as the circulation of the second twin may communicate with that of the first. Make a vaginal examination to clinch the diagnosis, and to find out the presentation of the second child. At the same time rupture the membranes. This is almost always followed by the rapid and easy expulsion of the second child; but if not, suprapubic pressure should be exerted to stimulate the uterus. If the presentation of the second child be a shoulder, it must be turned by internal version and a leg brought down. In all cases if after the lapse of three-quarters of an hour the second child has not been delivered, it should be extracted by suprapubic pressure, forceps, or version; otherwise the passages begin to contract, and have to be dilated again.

Massage the fundus to favour retraction, and be ready to deal with hæmorrhage. Give ergot hypodermically the moment both placentæ have been born. Examine the placentæ with care, as abnormalities are not uncommon, and, owing to their extent, portions are more liable to be left in the uterus.

Locked Twins.—This rare complication may arise where the first child presents by the breech and the second by the head, the chins being locked during the descent of the first. If the second is lying transversely, and the first is a breech, the chin of the first may hitch upon the body of the second. The treatment is to decapitate the first, which is born to the shoulders before the complication is recognised. The second must then be delivered; and lastly, the loose head of the first removed.

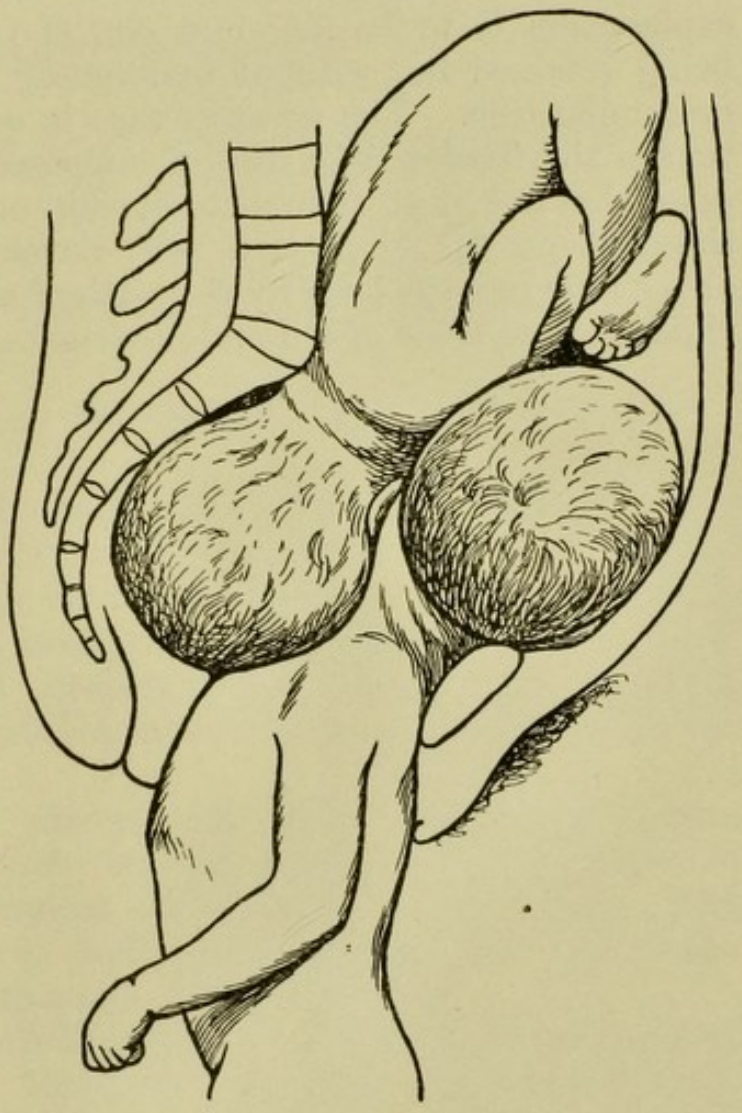


FIG. 141.—Locked twins. (After Bumm.)

Superfecundation.—By this is meant the fertilisation of two separate ova during one intermenstrual period at two separate acts of coitus. This is probably a frequent explanation of the occurrence of binovular twins, but it can rarely be proved. A much quoted case is that of a woman who had connection with a white man and a black man within one intermenstrual period, and was subsequently delivered of twins, one of which was white, the other black.

Superfœtation.—By this is meant the fertilisation of two ova during different intermenstrual periods—that is to say, the second ovum is fertilised after the first, which was set free at a previous ovulation, has been developing for at least a month. This must be admitted as a conceivably possible occurrence in the first two or three months. It is known that ovulation may sometimes

occur during pregnancy. It is also known that the decidua reflexa does not fuse with the vera till the end of the third month, so that up to that time there is space both for the passage of the spermatozoon, and for the passage and implantation of the ovum. At the same time it must be regarded as an extremely unlikely occurrence. Most cases, if fully investigated, turn out to be either cases of double uterus, or cases of twins showing marked differences in size. In other cases the explanation is to be found in one of twins having died and being retained but without undergoing either putrefaction or mummification. The greatest care is needed in the examination of the fœtuses in a case of supposed superfœtation. The cases that are most difficult to explain on any other theory are those where the birth of a fully-developed child is followed about four months later by the birth of another fully developed child, and no trace of a double uterus can be found.

SECTION IV

PHYSIOLOGY OF THE PUERPERIUM

CHAPTER XXI

THE PHYSIOLOGY AND MANAGEMENT OF THE PUERPERIUM

The puerperium is the period immediately following labour during which the maternal organs return to their normal condition. In ordinary circumstances it lasts for six to eight weeks. The processes involved are all physiological in nature, but their number and complexity makes the whole condition one that is rather unstable, and readily convertible into the pathological.

Involution. — The uterus and other generative organs become reduced to their normal condition by a series of processes that are known collectively as *Involution.* The involution of the uterus is the most striking and one of the most important phenomena in the puerperium.

Size and Weight.—At the close of labour the uterus is about 6 inches long by $4\frac{1}{2}$ broad and $3\frac{1}{2}$ thick ($15 \times 11 \times 9$ cm.). From this it becomes reduced to very nearly the 3 by 2 by 1 ($7{\cdot}5 \times 5 \times 2{\cdot}5$ cm.) of the virgin uterus after the lapse of six weeks. At the close of labour it weighs over two pounds (about 1000 grams). At the end of the puerperium it is reduced to practically two ounces (about 50 grams). This reduction takes place at a fairly uniform rate, which can be watched clinically by observing the level of the fundus above the symphysis. In making such observations from day to day the patient's

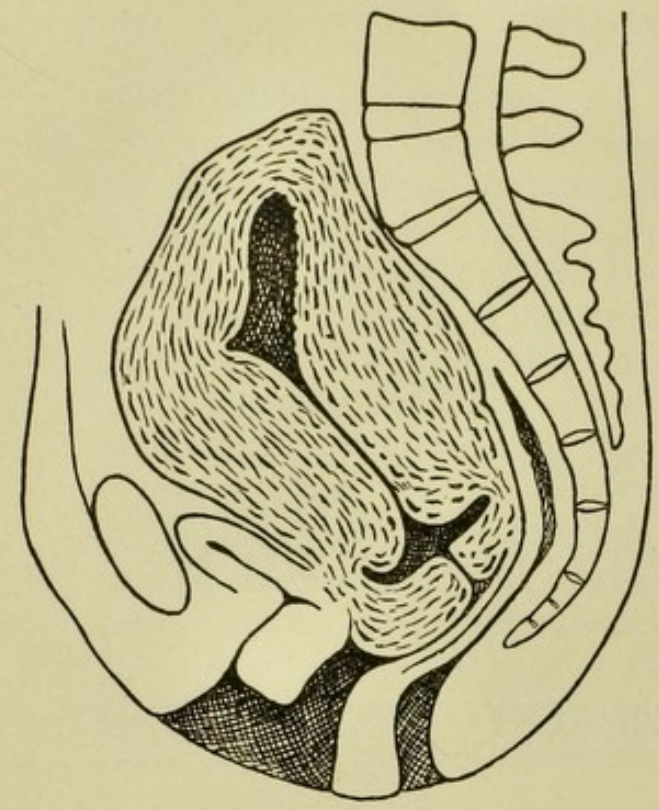


FIG. 142.—Uterus immediately after delivery. (After Webster.)

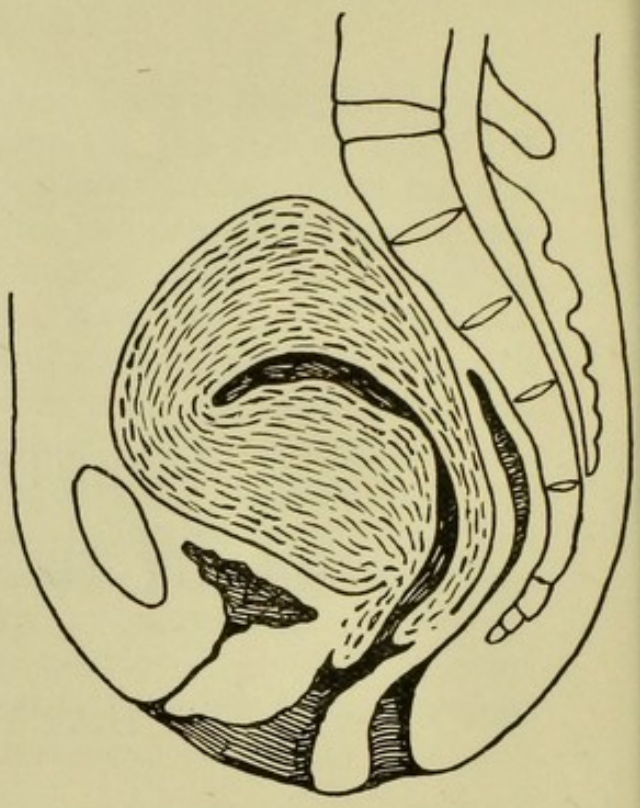


FIG. 143.—Uterus at fifth day of the puerperium.

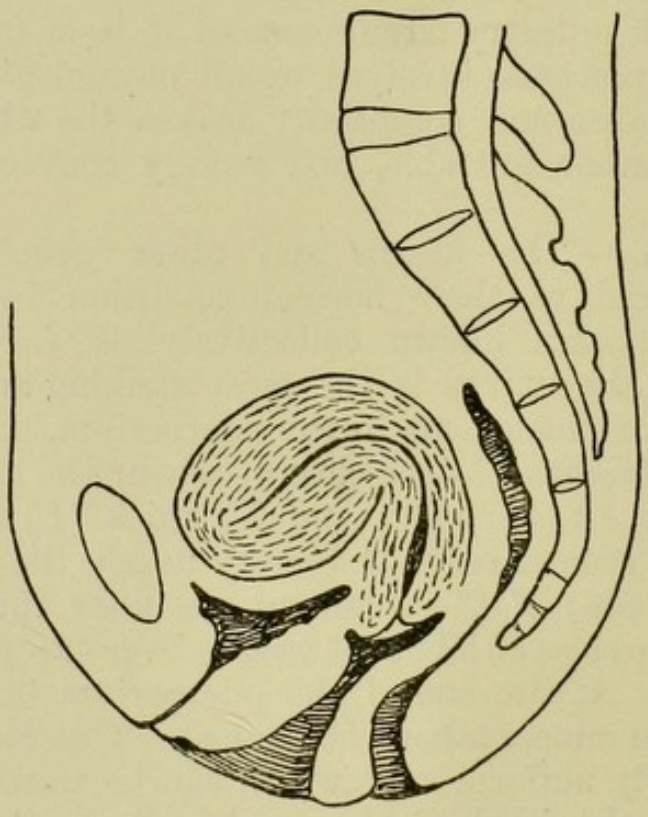


FIG. 144.—Uterus on the twelfth day of the puerperium.

bowels and bladder must first be emptied ; otherwise erroneous measurements may be made, as a full bladder or rectum raises the level of the uterus.

At the close of labour the fundus is about half-way between the symphysis and umbilicus. At the end of the first day it is frequently higher owing to the condition of the bladder and rectum, and to a partial relaxation of the muscle. By the eleventh day the fundus is commonly below the level of the pelvic brim, and not palpable from the abdomen. Provided the diminution is steady and progressive, the exact level of the fundus on any particular day is not of great significance. Any sudden diminution suggests a displacement, and arrest of progress indicates some pathological condition. In average cases the level of the fundus descends about a finger-breadth a day for the first few days, and then more slowly.

Frozen sections have enabled us to form some idea of the changes in the *form* of the uterus. A striking feature is the collapse immediately after labour of the lower uterine segment. The retraction ring sinks down upon the external os, and this accounts for the sudden diminution in length of the uterus at the close of labour (Fig. 142). The external os very soon begins to contract, but remains soft and dilatable for several days. At the end of a week it still admits one finger.

For some days after labour the *intermittent contractions* of the uterus are still to be felt, and in the case of multiparous women they give rise to the so-called *after-pains*. In primiparæ the walls of the uterus come completely together, and empty the organ of all blood-clot. But the multiparous organ is less active, and a small space is left inside it which becomes filled with blood-clot. This reflexly stimulates expulsive contractions of the uterus, which may cause a great deal of real suffering. As a rule after-pains cease after a day or two. They are increased by the stimulation of the breasts in suckling.

Peritoneum.—In the early days after labour the peritoneum is thrown into folds and wrinkles over the contracted uterus. Later the excess is absorbed and it becomes smoothly arranged again.

Muscular Wall.—It is in this that the greatest reduction occurs, as this constitutes the greatest bulk of the uterus. The retraction and contractions after the expulsion of the fœtus render the uterus relatively anæmic, and this leads to

changes in the muscle fibres. The changes are autolytic in nature, and result in the protoplasm of the enormously enlarged muscle fibres being digested into a soluble peptonoid substance, which is absorbed and carried away by the open lymphatic channels. There is normally no fatty degeneration of the muscle fibres. In the end the individual fibres are reduced in length and thickness to what they were before pregnancy began.

The *arteries* become contracted and their walls thickened. It used to be held that this thickening remained permanent, the connective tissue in the vessel walls undergoing a slow hyaline degeneration. The latest observations rather indicate that this is the case in pathological cases only (from which most specimens are obtained). It is said that in a strictly normal case the old vessels become obliterated by this thickening, and that thereafter new vessels are formed inside the old ones. Some such formation of new vessels is more what one would expect in an organ characterised by such repeated rejuvenation as is the uterus in successive pregnancies.

The *veins* and large sinuses of the placental site become filled with thrombi which gradually become organised and disappear. There is a characteristic thickening of their walls also.

The *nerves* and *lymphatics* share in the general involution, and return to their normal.

Decidua.—When the membranes separate from the decidua with which they have become blended, the separation occurs through the deeper portion of the spongy layer of the decidua. The decidua superficial to that may be seen as shreds or tags on the outside of the chorion. After labour the remaining part of the spongy layer and the superficial part of the deep compact layer degenerate and slough off, coming away in the lochia. From what remains, including the epithelium of the blind ends of the old glands (many of them embedded in the superficial part of the muscle layer), are regenerated the various elements of the new endometrium. The regeneration begins about ten days after labour and is complete at the end of a month except over the placental site. This area is marked by the presence of many large thrombosed sinuses. It appears as a circular patch raised above the surface of the rest of the

cavity, and stained dark with altered blood. It is not covered with epithelium until at least six weeks after labour, and is recognisable until the end of the third month.

Lochia.—The discharge from the uterus for the week or two after labour is called the lochia. During the first four days or so it consists of almost pure blood, frequently clots, and is dark red in colour. From about the fifth day, sometimes sooner, sometimes later, the colour becomes gradually paler. This is due to a decrease in the blood, and an increase in the amount of serum, leucocytes, shreds of decidua, cervical and vaginal secretion, etc. After the first week the quantity diminishes steadily, and the discharge becomes more creamy or purulent in appearance.

Normal lochia have an unpleasant heavy odour, but do not smell putrid. It is important to become acquainted with the normal odour, as a putrid smell indicates danger.

The quantity varies much within normal limits. It is greater in women who menstruate profusely, and in women who do not nurse their children. A return of blood after the second week usually indicates that the patient has been too active, or that involution has been delayed by some cause.

The lochia are alkaline in reaction, and this gives the organisms in the lower part of the vagina a chance to multiply and spread, which they are quick to seize. As the quantity diminishes, however, the vaginal bacilli begin to reassert themselves, and the vaginal discharge becomes more and more acid. Ultimately it merges into the ordinary vaginal secretion.

Involution of the other generative organs, the *vagina*, *ovaries*, *tubes*, and the *ligaments* of the uterus, takes place *pari passu* with that of the uterus.

Skin, Kidneys and Bowels.—The skin is active as long as the patient remains in bed. The kidneys are exceptionally active for the first few days, large quantities of urine being passed. Peptone is found in it, indicating the excretion of the products of involution. Traces of glucose and acetone are common, and immediately after labour a trace of albumen and casts may be found. So much fluid is lost by the skin and kidneys, and in the milk, that the bowels always tend to be constipated.

Pulse.—The pulse at the close of labour very soon returns to its normal frequency, or becomes slower than usual. Pulses

of 60 or 50 are not uncommon in the first day or two. The reason for this slowing, which is a good sign clinically, is not well understood. It is probably due to the rest in bed and a combination of other factors. It is easily upset by any disturbance either physical or emotional.

Temperature.—It is common to find the temperature at the end of labour as much as a degree above normal. It comes down very soon, and a few hours later should be normal or below. There it should remain in a strictly normal puerperium, but transient rises may occur from very trivial causes. Any rise above 99°, or as high as 99° but maintained for more than twelve hours, requires investigation.

The Secretion of Milk.—Along with the involution of the uterus this is the most striking phenomenon of the puerperium.

It will be remembered that each breast consists of a number of lobes, composed of smaller lobules. Each lobule is made up of a number of alveoli lined with large epithelial cells. Each alveolus opens into a duct, and the alveolar ducts from each lobule unite to form larger lactiferous ducts, fifteen to twenty in number, which open on the surface of the nipple. During pregnancy the breasts enlarge in preparation for lactation, and *colostrum* may be secreted in small quantity. This is a sticky yellow fluid containing large leucocytes gorged and bloated with fat droplets. True milk, on the other hand, consists of a very fine emulsion in a proteid solution of tiny fat droplets, the reflection from which gives it its white colour. It is probably a true secretion, the lining cells of the alveoli forming the constituents and pouring them into the ducts.

During the first two days of the puerperium there is little change in the breasts beyond a slight increased congestion. On the third day they usually become markedly congested and full, and the patient feels them very sensitive. The true milk then rapidly replaces the colostrum in steadily increasing quantity, and thus lactation is established. The milk is thin and faintly bluish-looking, and slightly alkaline.

The cause of the enlargement of the breasts and their subsequent secretion is still open to speculation. Recent work suggests that the original stimulus is ovarian; that the anabolic building up of the tissue in pregnancy is maintained by the circulation of some fœtal or placental elements; and

that the withdrawal of these at labour leads to the katabolic process of milk secretion.

Management of the Puerperium

General Management.—As soon as labour is over and the patient has been made comfortable as described under the management of the third stage, the first essential to secure for her is *Rest*. To this end she should be left to sleep, the baby being removed to another room, and the blind being drawn. The room should not be made so dark that any undue pallor of the face will not be observed.

Visitors, except the patient's husband or mother, should be rigorously excluded for two or three days, and after that the nurse must exercise her discretion as to the admission of other friends, the safe rule being that the fewer there are the better. Sleep is of the first importance, and the mother should be encouraged to sleep for two hours every afternoon during the lying-in period. *Insomnia* should make the physician awake to the possibility of some mental derangement ensuing.

The *vulvar pads* for the absorption of the lochia must be changed at frequent intervals, depending on the amount of discharge, but not less than every four hours for the first few days. Each time a fresh pad is applied the vulva should be gently cleansed.

Strict *asepsis* must be the inviolable rule in the management of the puerperium. The nurse must carefully wash her hands and soak them in an antiseptic before she handles the patient's genitals. In cleansing the vulva, pledgets of sterile or antiseptic wool soaked in biniodide or weak lysol must be used, one pledget for each wipe, and all wiping being done from before backwards. The same care must be observed when the patient uses the bed-pan. In a normal case it is unnecessary and undesirable to employ antiseptic vaginal douching.

The physician should see the patient again within twelve hours of the end of labour. Thereafter a daily visit should be paid for the first week, and after that every second day for a fortnight. Where the nurse is untrained or incompetent more frequent visits are necessary in order that the *temperature and pulse* may be kept under efficient observation.

It has already been explained that these are liable to variation from comparatively slight causes. That, however, must not lead one to neglect the significance of any departure from normal, as sepsis is by far the most common cause of such abnormality. To simplify matters various standards have been suggested. Thus, according to the British Medical Association's standard, a puerperium is to be regarded as morbid in which the temperature rises to 100 on two occasions between the second and the eighth day. The temperature is taken in the mouth at 8 A.M. and 5 P.M. In practice any temperature over 99, and any pulse over 90, requires to be investigated and the reason found. In all cases attended by a trained nurse a chart of the pulse and temperature, etc., should be strictly kept.

Bladder.—There may be difficulty in passing water, partly from the fact that for the first twenty-four hours the patient should, if possible, do so while lying on her back on a bed-pan. If there has been bruising of the urethra, or if the perineum has been stitched, there may be a reflex inhibition of the bladder muscles. The usual adjuvants, such as hot water in the bed-pan, hot (antiseptic) fomentations to the perineum, etc., should be tried. Failing these the patient may be gently turned round on her hands and knees. If this fails, and *if the bladder is distended* so as to form a palpable tumour above the symphysis, the catheter must be passed. This requires the most scrupulous asepsis in its performance. The patient must be placed on her side, the vulva exposed with clean hands, and the vestibule wiped free of lochia with an antiseptic swab. The catheter must be boiled before use, and *passed by sight.*

Bowels.—It is advisable to give a brisk laxative on the evening of the second day. Half an ounce or more of castor oil is probably the best, but may be replaced by liquorice powder, or an aloin and nux vomica pill. If the patient is not going to nurse, the laxative should be given on the second morning, and should take the form of a brisk saline purge—Henry's solution, for example.

Diet.—If the patient feels so inclined she may have a cup of warm milk, weak tea, or gruel immediately after labour. For the first twenty-four hours the diet should be quite light and mainly fluid—milk, tea, coffee, cocoa, gruel, etc., with toast or bread and butter. Custards and soups may be added

the following day, and after the bowels have been moved the ordinary diet may be gradually and rapidly resumed. It is a mistake to keep a healthy puerperal woman on a low diet. The best diet for a nursing mother contains much milk food, with no spiced foods or other indigestible articles.

After the first day the patient should be propped up with two pillows to nurse her child, and after lactation is established she may take her meals in the same posture. After the fifth day she may be allowed to sit up, but it is best to keep her in bed until at least ten days have elapsed. If the patient can stay in bed for a fortnight, so much the better. After that she should be allowed up on a couch, one hour the first day, two hours the second day, and so on. By the end of the third week she may be allowed out for a drive, and in the following week for short walks.

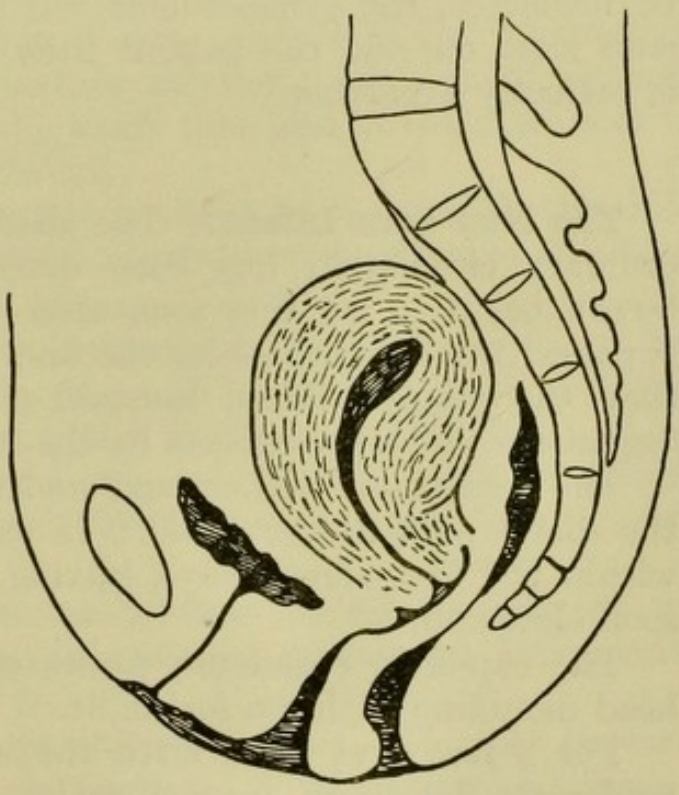


FIG. 145.—Retroflexion of the puerperal uterus.

In recent years the ancient plan of allowing women out of bed on the second or third day has been revived. Every advantage is claimed for this plan by the few who have adopted it. Most women are, however, quite pleased to have a long rest after the strain of pregnancy and labour, and for working women it is almost the only chance for such a rest. It is generally believed that in the long-run early rising must tend to the more frequent production of displacements of the uterus, and several disasters due to the dislodgement of a clot from the uterine sinuses have been recorded. The one advantage which is unanimously accorded to it is that the abdominal and other muscles do not become slack and atonic. To meet this, however, it is easy, and safe, and desir-

able to encourage the patient to indulge in gentle exercises for the limbs and abdominal muscles while in bed—every day after the third day.

Before completely discharging the patient a *final vaginal examination* should in every case be made. It is not uncommon to find that the uterus at the close of the puerperium is in a position of retroversion or retroflexion. This should be and can easily be remedied, and the proper position maintained for a few weeks by a pessary. If this precaution be neglected, the displacement will be much more difficult to cure later on, and the patient thus exposed to suffering that is perfectly avoidable.

The New-born Infant.—The change from the fœtal to the ordinary circulation has been described. The kidneys and bowels begin to act very soon after birth. Sterile meconium is passed from the bowel for the first two days or so, but after that the stools become mustard-coloured, and swarm with organisms which gain access by the mouth and anus.

The cord stump withers and undergoes a dry necrosis from the distal part to the navel. It usually drops off any time within the first eleven days, leaving a granulating area which soon closes up.

The caput succedaneum passes off within a few days; the head moulding within a fortnight.

For a few days after birth the skin is very red, and the epidermis flakes off in fine scales. Sometimes the breasts become congested and may even exude a colostrum. Later the child may become slightly jaundiced from the breaking down of excess of blood pigment. Real hepatogenous jaundice may occur, and is serious in significance.

The Care of the Infant.—A healthy infant should spend the first few weeks of its life in sleeping and feeding. Habits begin to be acquired from the first day, and it is most essential for the welfare of the child, as well as for the comfort of the mother and other members of the household, that from the very outset the child should be trained to the utmost regularity in regard to its sleeping and its meals. Disregard of this point in respect of feeding has been well said to be sowing the "wind," and is certainly followed by reaping the whirlwind!

The child should be put to the breast three or four times the first day. This teaches the child to suck, and it swallows some colostrum which has a beneficial laxative effect upon it. After the milk comes, the child should be put to the breast regularly every two hours during the day and every three hours at night. The most usually convenient hours are 8, 10, 12 noon, 2, 4, 6, 8, 11 P.M., and 2 and 5 A.M. The breasts should be used alternately, and great care must be taken to preserve the nipples from cracking. They should be wiped with a clean handkerchief dipped in sterile water before each feed, and, after the feeding is done, should be lightly smeared with boroglyceride, or boracic solution. The child's mouth should be wiped out at the same time and in the same way to avoid the occurrence of thrush.

In the first two days before the milk is secreted, the child should be given occasionally a teaspoonful of warm sterilised water, preferably without sugar.

The infant loses several ounces in weight during these two days without food, but by the end of the first week it should have made them up again, and be the same weight as at its birth. After that it should put on from 5 to 7 ounces a week, and this should be checked by its being weighed once a week regularly.

A healthy infant has about four to six motions of the bowels in the twenty-four hours, and micturates about twice as often.

The cord must be kept strictly aseptic. It must be carefully dried after each bath, powdered if necessary, and dressed in sterile gauze or lint. After the cord drops off, the umbilical scar should be dressed in the same way, no pads being used, but merely a piece of aseptic dressing kept in place by the binder.

In fine weather the child may be taken out on the third or fourth day, and may with great advantage be trained to sleep outside. In winter the first outing should be delayed until a favourable day occurs.

SECTION V

PATHOLOGY OF PREGNANCY

CHAPTER XXII

CONCURRENT AND INTERCURRENT DISEASES

In this chapter brief references will be made to some of the more important diseases liable to affect the course of pregnancy, or to be particularly affected by the co-existence of pregnancy.

The effect of pregnancy upon chronic diseases is, speaking generally, bad. Increased demands are put upon all the maternal organs, and any diseased one is likely to suffer. In acute diseases the effect is more variable, but on the whole less prejudicial than in chronic diseases.

Treatment should be carried out on ordinary general principles, with due regard to the effect of the treatment on the uterus and its contents.

Acute Infections

It used to be thought that pregnant women enjoy a certain immunity from the acute infectious fevers, but there is no substantial evidence of this. They are no more, but no less, liable to incur infection than ordinary women. Puerperal women, on the other hand, are peculiarly liable to take all manner of infections, and must be rigidly guarded against such risks. This is due to their having lost blood, and to the large

raw absorbent surface inside the uterus which forms an ideal nidus for organisms.

The effect of pregnancy on acute infections is variable. It never improves the prognosis, but frequently does not make it more grave unless the pregnancy terminates in premature labour or abortion during the disease.

The influence of the diseases on the pregnancy also varies. Speaking generally, they increase the risk of abortion or premature labour. This they do in one of several ways. A temperature above 104°, or one frequently up to near that point, kills the fœtus. Again, the fœtus may be killed by the toxins of the disease circulating in the mother's blood, or it may take the disease itself and die of it *in utero*. Lastly, in some fevers the increased tendency to hæmorrhage may lead to uterine bleeding with expulsion of the fœtus.

The "barrier action" of the placenta is not insuperable, and in a number of diseases the organism has been recovered from the blood of the fœtus. The organisms of syphilis, tuberculosis, enteric fever, and pneumonia have been demonstrated in this way, while in others the child has borne evidences of the disease at its birth.

The occurrence of abortion is particularly dangerous in the case of those diseases in which the infecting organism is one that may cause a local infection in the genital tract. Erysipelas, diphtheria, enteric fever, and pneumonia are the worst in this connection, and the occurrence of abortion in them is of serious prognostic significance.

Smallpox.—Severe cases in pregnancy tend to take a hæmorrhagic form, and lead to abortion. Milder cases are not affected by the pregnancy. The child, if born during the disease, may be actually suffering from it, or may develop it immediately after its birth. If born later it may show healing pustules, and be resistant to vaccination. Pregnancy is no contra-indication to vaccination being done, but it should not be done in the puerperium, when the introduction of even a mild infection is undesirable.

Scarlet Fever.—It used to be believed that scarlet fever had a peculiarly long incubation period in the pregnant woman, not appearing until the puerperium in some cases, even though the exposure to possible infection occurred many weeks earlier. It was also regarded as peculiarly virulent in

the puerperal woman. It is very probable that confusion has arisen from many cases so diagnosed being in reality cases of puerperal septicæmia with a scarlatinaform rash and throat infection. Since the introduction of antiseptic treatment in obstetrics, experience has shown that true scarlet fever does not appear to be so gravely affected by the existence of either pregnancy or the puerperium.

Erysipelas.—There is a serious risk of a streptococcal infection of the genital tract if premature labour occurs. The most scrupulous care must be taken to avoid conveying infection to the vulva if this happens, and it may be well to keep the vulva covered with a moist antiseptic pad.

Enteric Fever.—Abortion is very common from the high temperature. The prognosis is impaired, and puerperal infection must be guarded against. The mortality is about 15 per cent.

Measles and Influenza.—Abortion is common, but there is not the same risk of puerperal infection.

Diphtheria.—A diphtheritic membrane may form over the vagina and vulva if the disease spreads to these regions, and particularly if labour supervenes.

Cholera.—The cramps may induce abortion. In other cases the mother dies before abortion can occur. Patients who abort have more chance of recovery, not because of the abortion, but because they are probably milder cases from the start.

Acute Lobar Pneumonia.—Interruption of the pregnancy is apt to follow the high temperature and the impaired aeration of the blood, particularly in the later months. A serious pneumococcal puerperal infection may follow. The strain of labour may be too much for a failing heart, and precipitate a fatal issue. Therefore premature labour should be prevented if possible; but if it does occur, it should be terminated as quickly as possible, and with the minimum of strain. The mortality in the later months is very high—nearly 50 per cent.

Malaria.—Pregnancy tends to upset the usual periodicity of the attacks. The disease may reappear during pregnancy in women who have been free from it for years. Whitridge Williams states that quinine may be given safely, as its oxytocic action appears to be in abeyance in presence of malaria.

Gonorrhœa.—The vascularity of the pelvic organs makes an attack of gonorrhœa in pregnancy very severe. It may spread to the cervix, and thence to the decidua, and cause abortion. A more serious risk is a puerperal infection of the uterus, which is very apt to spread to the tubes and lead to pyosalpinx. Gonorrhœal puerperal infection in the uterus is never very acute, but this last risk makes it necessary to regard it with caution. The risk of gonorrhœal ophthalmia in the child after birth is a very grave one, and the most rigid prophylaxis should be observed (p. 166).

Chronic Infections and General Diseases

Tuberculosis.—There is a popular impression that phthisical women improve during pregnancy. Observation of the physical signs in the lungs shows this to be quite unfounded, the disease being often injuriously influenced, although the outward appearance may improve and the patient feel better.

During the puerperium, and more especially during lactation, such patients are very liable to grow rapidly worse. The children of such women are usually healthy, and only very rarely is there any evidence of actual congenital tuberculosis (cf. Tuberculosis of Placenta, p. 268). A phthisical woman should not marry on account of the risk of infection to her husband; if married, she should be warned of the risks of pregnancy; if pregnant, she should be treated on ordinary lines for phthisis. The labour should be made as short as possible, straining being avoided, and forceps applied as soon as the second stage begins. Above all, she should not be allowed to nurse the child, and the condition of the lungs should be very carefully watched during, and for some time after, the puerperium.

In this country phthisis is regarded as only rarely a justification for the induction of abortion.

Syphilis.—The influence of syphilis upon pregnancy varies according to the time when the disease is acquired.

(1) If acquired before conception, the pregnancy ends in abortion or premature labour in 75 per cent of cases. As the poison becomes diluted by the lapse of time each pregnancy tends to endure longer than the preceding one, until at last a full-time living child may be born. The condition of the child varies. In early cases it is usually dead and diseased; later it may be born alive but diseased. Still later it is born alive

and apparently healthy, but develops the disease shortly after birth. Ultimately a child may be born that never shows any signs of the disease.

(2) If the disease is acquired at the time of conception the fœtus is always syphilitic, being infected either through the mother, or directly by the fertilising spermatozoon. The pregnancy almost always ends prematurely.

(3) If syphilis is acquired *early* in pregnancy the fœtus usually becomes infected, and the pregnancy terminates prematurely.

(4) If the disease be contracted *in the latter half* of pregnancy, the child may escape infection altogether, or it may become infected. The later the disease is acquired, the better the chance of the child's escaping. Infection acquired during any stage of pregnancy is characterised by very severe primary lesions owing to the local vascularity of the pelvis. Secondary manifestations are often very slight.

(5) A man with tertiary syphilis may procreate a syphilitic child without apparently infecting the mother. In such cases the mother can nurse the child without acquiring the disease, whereas a wet nurse cannot do so. This is known as Colles' Law. The explanation is either that the mother has had a very mild attack without any external manifestations, and so acquired immunity ; or that an immunity has been transmitted from the fœtus to the mother.

Syphilis is the commonest *constitutional* cause of the interruption of pregnancy, and must always be suspected where a satisfactory explanation of repeated abortions is lacking. Wassermann's test should be made in doubtful cases. Where the condition is diagnosed, both parents should be put upon a thorough course of treatment for a year, and if after that pregnancy occurs, the mother should be kept under treatment during pregnancy for the sake of the child. If a living child is born, the mother should nurse it, or it should be put upon artificial feeding. A wet nurse should never be employed, as she is very liable to contract the disease.

Circulatory Disease.—The increased demands put upon the heart during pregnancy may be disastrous in cases of chronic valvular disease, which are in ordinary circumstances just compensated. Unknown weakness of the heart may also become manifest for the first time during pregnancy.

The effect of heart disease upon pregnancy is not appreciable provided perfect compensation is maintained. If compensation breaks down, the "backward pressure" in the venous system causes an increased risk of abortion or premature labour. Obstructive lesions are naturally worse in this respect.

Labour in a woman with an uncompensated heart lesion is fraught with serious danger. The great danger is sudden acute dilatation of the right side of the heart, with stoppage in diastole. The most dangerous lesion is mitral stenosis, in which the tendency to pressure on the right side of the heart is already great. Aortic stenosis is also a grave danger, and next in order of seriousness come multiple lesions and aortic incompetence. The moments of gravest danger are (1) the end of the second stage when the muscular straining is at its greatest, and (2) when the placenta separates, and the blood in the placental circulation in the uterus is thrown back into the systemic circulation. Another danger at this time is post partum hæmorrhage.

A woman with a serious heart lesion should be advised not to marry, or at least not to undergo the risks of a pregnancy. If she does become pregnant, she must be treated on general principles. In some serious cases it may be necessary to induce abortion or premature labour. During labour spare the patient as much as possible. Keep her at rest in bed during the first stage, and when the pains become severe prevent straining by giving an anæsthetic, ether for choice.

As soon as the cervix is sufficiently dilated, apply forceps, and deliver. Throughout the labour keep a close watch on the heart, and be prepared to give a hypodermic injection of strychnine, strophanthin, or other stimulant at a moment's notice, or to do a venesection and so relieve the right side of the heart. This may be necessary when the placenta separates. There is often post partum hæmorrhage, and a certain amount of bleeding is beneficial, and relieves the heart. It is apt, however, to go too far and become in itself a menace. The patient should have a long rest in bed in the puerperium, and should avoid the strain of nursing.

Renal Disease.—Nephritis will be referred to in the chapter on the Toxæmias of Pregnancy.

Exophthalmic Goitre.—The effect of pregnancy on this disease is variable, but on the whole it may be expected to be injurious.

The general nervous instability associated with the disease, and particularly the excitability of the vasomotor system, lead to an increased risk of abortion. There is a considerable risk of post partum hæmorrhage. The dangers of heart failure must be remembered in labour, especially in connection with an anæsthetic.

Surgical Emergencies.—Speaking generally, these must be dealt with as if the woman were not pregnant. The risk of interrupting the pregnancy is a 20 per cent one in abdominal operations, but less in most other operations. Operations that can with reasonable safety be delayed should be postponed till the close of the puerperium.

Appendicitis is one of the most dangerous complications of pregnancy. In the early months the operation should be done without hesitation. In the later months the operation is still probably better done. But it is complicated by the presence of the gravid uterus in front of the appendix area. The risk of leaving the operation till after labour is that the intra-abdominal movements during labour may so break down adhesions as to precipitate a general peritonitis in a case where a localised abscess had formed.

Pathological Conditions dependent on the Existence of Pregnancy

Pressure Symptoms.—*Varices.*—The mechanical pressure of the gravid uterus makes distension of the veins of the lower limbs a common occurrence in pregnancy, particularly where there was a previous tendency to varicosity. Operative interference is useless during pregnancy. In some cases the veins of the vulva may become so overfilled as to constitute a danger in labour. Rest in the horizontal position is helpful.

Hæmorrhoids.—For the same reasons as above, hæmorrhoids are apt to develop, or to become more marked during pregnancy.

Œdema.—Œdema limited to the lower limbs may be the result of pressure alone. This should never be taken for granted, but a urinary examination made in all cases. General anasarca and puffiness of the face are either renal or toxæmic in origin, and demand a prompt examination of the urine.

Rest in bed is beneficial, no matter what the cause be, but renal and toxæmic cases demand suitable treatment as well.

Constipation.—This is almost the rule during pregnancy, partly as the result of pressure. The importance of avoiding it should be explained to every patient, and suitable diet and drugs recommended. Compound liquorice powder (with cream of tartar in place of sugar) is very useful; or the patient may take the drug she is accustomed to. Strong purgatives should be avoided for fear of their inducing abortion.

Pyelitis of Pregnancy.—Pyelitis is not infrequently associated with pregnancy. It usually occurs about the fifth or sixth month. It is rather more common in the right kidney than in the left, and is only rarely bilateral. The onset in acute cases is sudden. The patient is seized with pain in the side, and the temperature shoots up. Rigors are frequently noted. After some days or hours a large quantity of turbid urine is passed and the pain is for the time relieved. The condition is apt, if not treated, to go on to pyelonephrosis. Associated with this condition there is often a dilatation of the ureter on the affected side above the brim of the pelvis. The infecting organism is almost always the *Bacillus coli communis*, but there may be a mixed infection. The infection would appear to be conveyed by the blood in some cases, while in others there is evidence of an ascending infection from the bladder. The condition must be carefully diagnosed from appendicitis, which it closely resembles, but there is usually a very suggestive tenderness posteriorly over the kidney. Examination of the urine confirms the diagnosis, pus and swarms of organisms being found. In *B. coli* cases the urine is usually acid. Renal and biliary colic, pleurisy and pneumonia must also be excluded. The treatment is rest in bed with copious supplies of bland fluids, and large doses of the citrates and acetates of the alkalis, with or without some antiseptic, such as salol, or urotropin. The use of autogenous vaccines is helpful in many cases. In very bad cases the pregnancy should be interrupted without undue delay. This is usually followed by rapid recovery.

Diabetes and Glycosuria.—Sugar may be found in the urine of pregnant women in from 5 to 25 per cent of cases after the fifth month or so. It is important to realise that there are other conditions besides diabetes which may

account for this. The following four conditions may be distinguished :—

(1) Diabetes mellitus.
(2) Lactosuria.
(3) Alimentary Glycosuria.
(4) "Idiopathic" Pregnancy Glycosuria.

True Diabetes must be diagnosed where the condition existed prior to pregnancy, or where the glycosuria is accompanied by symptoms such as polyuria, emaciation, etc. It is a very grave complication of pregnancy, leading in many cases to premature labour, and in about a quarter of the cases to the death of the mother from diabetic coma either during pregnancy or very soon after delivery. The fœtus in many cases is born dead.

Lactosuria.—If the urine gives a reaction to Fehling's or some other simple test for sugar, steps should at once be taken to find out whether the sugar is glucose or lactose. This can be done by the polariscope or the fermentation test. In the majority of cases it is lactose, reabsorbed from the milk in the breasts. In the same way lactose is found in the urine of puerperal women who do not nurse. Lactosuria is of no significance.

Alimentary Glycosuria.—This is apparently more easily induced in pregnant than in non-pregnant women. A diminution in the carbohydrates in the diet will probably lead to its disappearance.

Idiopathic Pregnancy Glycosuria.—Under this head are included unexplained cases of glycosuria in pregnancy, unaccompanied by any symptoms, and unaffected by diet. The sugar is rarely present in any quantity, and disappears shortly after labour. It is probably due in some way, not yet understood, to the altered balance in the secretions of the ductless glands.

Dental Caries.—This is very common in pregnancy, and should be attended to by a dentist. Alkaline mouth-washes are indicated.

Conditions possibly Toxæmic in Origin

Certain diseases may conveniently be described under this heading, since our knowledge of them does not warrant their being placed definitely in the class of Toxæmias.

Neuritis.—Neuritis associated with pain, wasting and paralysis may occur during pregnancy. It must be distinguished from the neuralgic pain due to the pressure of the child's head on the pelvic nerves, which sometimes causes severe sciatic pain. The neuritis is said to be frequently associated with the toxic form of hyperemesis.

Skin Diseases.—Various forms occur, but herpes gestationis and impetigo herpetiformis only need be mentioned. Both may be extremely serious, and should be treated with prompt attention. Chloasma uterinum—the pigmentation of pregnancy—may be very marked in some cases, and may persist for two or three years afterwards.

Salivation.—This is a rare but very troublesome complaint met with in pregnancy. It may be a pure neurosis, or it may be a toxæmic symptom. Several pints of saliva may be secreted in the twenty-four hours, the patient "drooling" continuously. Toxæmic cases are benefited by strict milk diet, and purgation. Neurotic cases are apt to be very intractable.

Chorea Gravidarum.—When pregnancy occurs in women who are choreic, the movements become worse, and the condition more serious. Occasionally, however, chorea develops for the first time in a woman during pregnancy. These cases are regarded as possibly toxæmic in origin, and they are extremely serious. The movements become very marked, affecting both sides, and persisting through sleep, so that the patient grows weak and emaciated. Many cases end in spontaneous abortion. Late in the disease the temperature rises, a sign sometimes indicative of endocarditis. The mortality is about 20 per cent. In toxic cases ordinary treatment is unavailing, but sedatives and free eliminative measures may cause an improvement. Induction of abortion is not uniformly followed by recovery. Non-toxic cases should be treated on the ordinary lines.

CHAPTER XXIII

TOXÆMIAS OF PREGNANCY

The following pathological conditions are believed to be due to toxæmic states of the blood associated with pregnancy :—

Hyperemesis Gravidarum (Toxic variety).
Acute Yellow Atrophy of the Liver.
Pre-eclamptic Toxæmia (Albuminuria of Pregnancy).
Eclampsia.

Along with these we may class, from its clinical similarity, Nephritic Toxæmia due to primary kidney disease.

It must be frankly stated at the outset that this is the most obscure subject in obstetrical pathology. We do not know the cause of any of these conditions, nor do we know what is the connection, if any, between them. In order to make the subject as clear as possible we shall, to start with, postulate a theory which is at present widely accepted—namely that these conditions are the result of a metabolic auto-intoxication. It must be understood, however, that, so far as actual proof goes, it is much on a level with several of the other hypotheses to be mentioned later.

Metabolic Auto-intoxication.—The whole of the metabolic activity of the body is accompanied by the formation of waste products that are more or less toxic, whether we regard only the more obvious changes that occur in the processes of digestion in the alimentary tract, or the more obscure and intricate changes that are always going on in the individual cells of the whole body. Against these toxic products the body is provided with an elaborate system of defence. In the first place they are dealt with chemically, and altered or split

up into less toxic substances. Secondly, they are filtered out of the circulation. The first function is probably shared in by all the internal organs—liver, intestines, spleen, pancreas, thyroid, adrenals, and pituitary. The second is most prominently carried out by the liver and kidneys, which are the great filters of toxic materials from the blood. These organs therefore bear the brunt of any extra strain put upon the defences of the body.

In pregnancy the processes of building up a fœtus of six or seven pounds weight, as well as providing a suitable lodging for it by the growth of the uterus, must inevitably lead to increased metabolism. The liver and kidneys and thyroid and other organs have therefore increased demands put upon them, and in a perfectly healthy woman they are able to respond to the call, and deal successfully with the extra work. Any little failure on the part of any one of them is however apt to disorganise the whole. This can best be illustrated in the case of the liver, although it probably applies to some extent to all the organs involved. For example, if the liver is unable to cope with its increased work it allows some toxic product to pass through it without being split up or oxidised into harmless elements. This passes to the kidney where it damages some of the cells, and so reduces the excretory power of that organ. This diminished excretory power of the kidneys leads to a gradual accumulation of the toxic material in the blood, which poisons the cells of the already inefficient liver, and so makes it still more inefficient. In this way a vicious cycle is established, and the blood becomes increasingly loaded with toxins.

An auto-intoxication of this nature may, in its effects upon the different systems, be quite enough to explain many of the minor symptoms attributed to it, such as the albuminuria of pregnancy, salivation, neuralgia, neuritis, temporary insanity, amblyopia, depraved appetite, and the like. There are, however, graver and more acute disorders, closely connected clinically with some of these minor symptoms, in regard to which it is difficult to state how far they may be the outcome of auto-intoxication. This is particularly the case with eclampsia which sometimes (though exceptionally) comes on with great suddenness and an absence of any very marked symptoms of auto-intoxication previously, and is characterised

by such profound nervous affections as convulsions and coma. The question therefore remains, whether such acute symptoms are precipitated by some element which is either different from, or at least superimposed upon, the auto-intoxication; or whether they are merely the result of the toxins reaching a certain stage of accumulation—like the boiling over of a kettle when it reaches a certain temperature. This is a point which is quite unsettled, but several of the more important theories that have been propounded in the attempt to explain eclampsia will be briefly discussed later.

Another question which is still unsettled is whether such very different clinical manifestations as toxic vomiting and eclampsia should be regarded as arising from one and the same form of toxæmia, or whether they are as distinct in their etiology as they are in their clinical symptoms. There is much similarity in the morbid anatomy of the two conditions, but until we know more about their cause or causes, it is probably safer to regard them as due to separate but allied forms of toxæmia.

Hyperemesis Gravidarum

This is a condition of excessive and uncontrollable vomiting in the pregnant woman. It usually arises out of the "morning sickness," which is so common in the second, third, and the beginning of the fourth months. Occasionally the morning sickness comes on at other times of the day and is very troublesome, but provided the woman does not suffer in her general health the condition can hardly be called hyperemesis.

Hyperemesis may be divided into three varieties according to the cause underlying it:—

(1) Reflex—due to the presence of some pelvic abnormality or some gastric or intestinal disorder. Pelvic tumours, and displacements of the gravid uterus are amongst the possible causes. This variety is commonly early in its period of onset.

(2) Neurotic—occurring in very neurotic women with no other discoverable cause. This form may occur at any period of pregnancy.

(3) Toxic—a manifestation of the toxæmia of pregnancy.

It will be observed that although the whole subject of hyperemesis is taken up in this chapter, not every case of hyperemesis is toxic in origin.

Frequency.—Hospital statistics give this as 1 in 1000, but it is probably commoner amongst better-class patients. It is commoner among neurotic peoples, as in France and the United States.

Symptoms.—It usually begins by the ordinary morning sickness becoming more and more troublesome. The vomiting occurs at all times of the day or night, until the patient can retain nothing on the stomach. She becomes emaciated, and may die of actual starvation. According to Whitridge Williams the severity of the symptoms is not in itself any guide to the variety of vomiting from which the patient is suffering.

In the toxic variety, however, the condition tends to persist in spite of medical treatment. Ultimately the patient begins to vomit coffee-ground matter, and passes gradually into a condition of nervous intoxication ending in coma, or convulsions, and death. Towards the end the pulse-rate and temperature frequently begin to rise higher and higher. The urine meantime has become greatly diminished in quantity, and contains albumen, blood, bile, casts, and leucin and tyrosin, which latter can be isolated as crystals by appropriate methods.

Morbid Anatomy of the Toxic Form.—The liver shows areas of complete necrosis in the centre of the lobules—exactly similar to, but less marked than the changes in acute yellow atrophy.

The kidneys show degeneration, sometimes amounting to necrosis, in the epithelium of the convoluted tubules.

Diagnosis.—A very careful and extensive physical examination should be made, and any pelvic or abdominal abnormality put right in the hope that it is the cause of reflex vomiting. In these cases the excessive vomiting usually occurs early in the third or fourth months, while the toxic variety is more often seen about the fifth or sixth months. If no such lesion be discovered the diagnosis rests between the neurotic and the toxic varieties. Formerly it was impossible to diagnose between the two in the early stages, and the case was allowed to drift on in the hope of recovery, until the pulse and temperature rose, and leucin and tyrosin appeared in the urine. These were regarded as diagnostic of toxic cases, and abortion was induced, but frequently the patient was too far gone, and died in spite of this treatment.

Whitridge Williams has now given us what appears to be in many instances an aid to diagnosis between neurotic and toxic cases at a comparatively early stage of the disease. It depends on the estimation of the ammonia coefficient of the urine. Normally the total amount of nitrogen excreted in the urine is made up, roughly speaking, of about 90 per cent urea, about 5 per cent ammonia salts, and 5 per cent various nitrogenous bodies difficult to isolate, and usually grouped together as the "undetermined" or "rest" N.

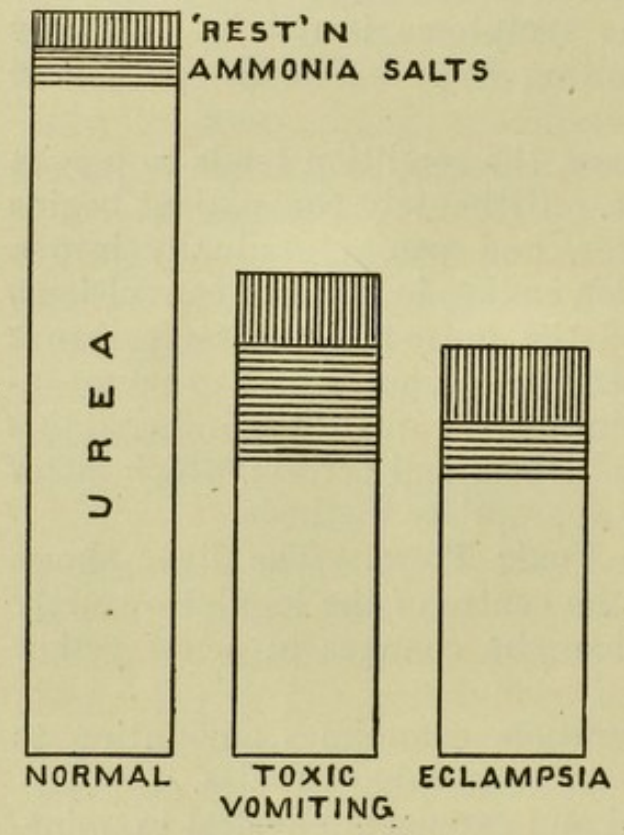


FIG. 146. — Diagram illustrating the ammonia coefficient of the urine in different conditions.

The ammonia coefficient, or the proportion of N excreted as ammonia to the total N, is therefore normally about 5 per cent. In toxic vomiting the total N becomes greatly diminished in amount, and the ammonia coefficient rises to 10, 20, or even 40 per cent. If, under appropriate treatment, the ammonia coefficient remains high, the case may be regarded as in all likelihood toxic in origin.

Unfortunately this estimation requires elaborate chemical methods, and cannot be made by the practitioner. But wherever the diagnosis is in doubt, a large specimen of the urine should be sent to the nearest laboratory, together with a note of the total quantity passed in twenty-four hours.

Prognosis.—In reflex cases the prognosis is good, if they are recognised and treated early. In neurotic cases the prognosis is more guarded, as they are very capricious in character. In toxic cases the prognosis is grave. If diagnosed early and treated promptly, the prognosis is improved, but frequently the liver and kidneys are seriously damaged before the case is seen.

Treatment.—In reflex cases remove the cause, and the vomiting will cease spontaneously. In neurotic cases the best treatment is on the same lines as for hysteria—isolate the patient, put her upon rectal feeding, and endeavour to exert "moral suasion." Treatment by suggestion may be useful, or the threat to operate and empty the uterus.

In cases that have been clearly proved to be toxic, evacuation of the uterus ought to be seriously considered. Meantime treat the patient by free elimination, washing out the bowels, and stimulating the kidneys and the skin. Subcutaneous injections of saline solution may be helpful. If no improvement follows, empty the uterus without delay—preferably after consultation with a colleague.

Acute Yellow Atrophy of the Liver

This rare disease is not confined to pregnancy, but has been found in non-pregnant women, and even in men. At the same time it is most frequently found in pregnant women. It usually comes on swiftly, and runs to a fatal termination in a week. Sometimes it is more slow in onset. It is characterised by a typhoid state, with low delirium, or coma; sometimes convulsions. There is usually jaundice and vomiting of blood-stained matter. The liver is tender, and in slow cases may be noted by percussion to diminish daily in size. The urine becomes scanty, and contains albumen, bile, blood, casts, and leucin and tyrosin.

Pathology.—The liver is greatly diminished in size, bright yellow from bile staining, and its capsule wrinkled over it. There is acute and widespread necrosis of the lobules, spreading from the centre as in toxic vomiting. In very severe cases the greater part of the liver tissue is necrotic. The kidneys show the same changes as in toxic vomiting.

Diagnosis.—If sudden in onset it must be distinguished from acute phosphorus poisoning.

Treatment.—Induce labour rapidly, if it does not come on spontaneously. Support the strength as far as possible. The disease is almost invariably fatal, and it is obviously due to some very intense intoxication.

What may be regarded as a second group of toxæmic mani-

festations is formed by pre-eclamptic toxæmia and eclampsia. The former includes the condition sometimes known as the "kidney of pregnancy," and for the sake of convenience we may also take up alongside it the "nephritic toxæmia," which is clinically very similar.

Pre-Eclamptic Toxæmia (Albuminuria of Pregnancy)

This is the most common manifestation of the toxæmia of pregnancy, occurring once in every twenty to thirty patients. It is more frequent in primigravid women, and usually first shows itself about the fifth month, though sometimes earlier. The term covers a very wide range of symptoms, from the mildest right up to the most severe, just short of the convulsions and coma that characterise eclampsia itself. To cases only exhibiting the mildest symptoms, slight albuminuria, lassitude, slight headache, and perhaps a little swelling of the ankles, the term "the kidney of pregnancy" was given by German authors. Rest, laxatives, and a less nitrogenous diet will put matters right, and the importance of the condition lies merely in the fact that it is the earliest sign that the kidneys are suffering from the strain put upon them, and are liable to give way further if not watched, and, if need be, relieved.

Apart from these very mild cases pre-eclamptic toxæmia may show itself in symptoms of varying severity—general malaise, headache, either frontal or occipital, lassitude or irritability, disturbance of vision varying from slight dimness to complete blindness, œdema of ankles, lower limbs and vulva, and possibly of other parts as well, somnolence, dizziness, sickness, and severe pain in the epigastrium.

In many cases the child is poisoned too, and dies, and is expelled in a premature labour. Such a termination is usually beneficial to the mother. In others the condition, if not promptly and thoroughly treated, may pass on into eclampsia, or more rarely into coma and death (so-called eclampsism).

The condition of the urine in pre-eclamptic toxæmia is of the greatest importance. In the slighter cases the quantity is not greatly affected, but it contains albumen, and hyaline and granular casts. In more marked cases the quantity is always diminished, and it contains a considerable quantity of albumen,

casts, and some blood corpuscles. The total quantity of nitrogen is diminished; the proportion of urea is lowered, while the ammonia, and undetermined or "rest" nitrogen is proportionately increased. A marked drop in the urea output, along with a large amount of albumen, indicates a severe case liable to go on to eclampsia, if not treated at once.

In cases in which the œdema is marked, the urinary changes are usually less distinct. There is generally a very noticeable pallor and anæmia in such cases—strictly speaking, a hydræmia or watery state of the blood.

Another feature of great significance is the arterial pressure. It is usually raised, and in severe cases it becomes markedly high—a point of importance in making a prognosis.

The **diagnosis** of pre-eclamptic toxæmia can always be made from the examination of the urine, if the clinical picture leaves any doubt. The condition most likely to be confused with it is nephritic toxæmia. The distinction is of importance in regard to prognosis rather than treatment, and the points of difference will be discussed later.

The **prognosis** depends on the severity of the symptoms, but still more upon the promptitude of the treatment and the response to it. A large quantity of albumen with a low urea reading is ominous. Persistently high arterial pressure is also a bad sign. Severe epigastric pain and vomiting are often the immediate precursors of eclamptic convulsions. If the symptoms disappear and the state of the urine clears up after a few days of treatment the outlook is fairly good, although the patient will require watching and treatment to the end, not merely of her pregnancy, but of her puerperium. Fortunately, the condition rarely recurs in a subsequent pregnancy.

It is impossible to state the exact proportion of cases of pre-eclamptic toxæmia that develop eclampsia. With the increasing recognition of the serious significance of pre-eclamptic symptoms the number must be steadily diminishing. The vast majority of cases respond to treatment, but a few do not. In the latter the pregnancy should be terminated after treatment has had a fair trial. The life of the child need not be greatly considered, as in marked cases the fœtal mortality is about 50 per cent—owing largely to the presence of extensive infarcts in the placenta, which throw much of that organ out of function.

The **treatment** is the same as for nephritic toxæmia, and will be discussed in the next section.

Nephritic Toxæmia

This includes all cases in which the kidney lesions cause the toxæmia, instead of *vice versa*. In practically every case there has been pre-existent renal disease, or an acute nephritis occurs accidentally during pregnancy from one of the ordinary causes.

A chronic organic change in the kidneys must be suspected in all cases of albuminuria occurring in repeated pregnancies, for it is one of the most interesting facts about pre-eclamptic toxæmia that it only rarely recurs.

The symptoms may appear at any stage, and, where due to chronic kidney disease, are very similar to those of pre-eclamptic toxæmia—malaise, headache, œdema, dizziness, and interference with vision. Actual organic changes in the retina are of bad omen as regards the prognosis, but there may be great interference with vision without actual lesions of the retina. Acute Bright's disease in pregnancy runs an ordinary but more severe course, and the diagnosis may be made from the usual urinary findings. In chronic cases the quantity of urine is not diminished, and may be actually increased. It contains albumen and casts, but the total nitrogen output and the proportion of urea are usually normal.

The **diagnosis** is to be made from pre-eclamptic toxæmia by means of a careful urinary examination. In the pre-eclamptic state the quantity is usually diminished, and the total nitrogen as well as the proportion of urea is diminished. In nephritic toxæmia the opposite is frequently the case. It is also said that the nature of the albumen in the urine differs in the two conditions, being serum albumen in nephritic cases, and largely paraglobulin in pre-eclamptic cases. If uræmic convulsions or coma supervene, the diagnosis of eclampsia will probably be made, unless the patient has been under observation beforehand.

The **prognosis** of the nephritis is increased in gravity by the existence of pregnancy. The possibility of uræmia must be borne in mind, but true eclampsia is not common as a termination. In about 50 per cent of cases the child dies, and is born prematurely.

Treatment of Pre-eclamptic and Nephritic Toxæmia.—It is fortunate that the treatment of these two conditions is the same, since the diagnosis between them requires a rather elaborate examination of the urine.

Prophylaxis is of the first importance. The urine should be examined every month in the first six months of every pregnancy, no matter how normal it may seem, and every fortnight in the last three months. If albumen is present, the amount should be estimated in an Esbach tube, and the urea in a Doremus ureometer. The total quantity of urine per diem should also be ascertained.

The principles of treatment are to relieve the kidneys by free elimination by the bowels and skin, and by diminishing the nitrogenous part of the dietary; and at the same time to prevent any further interference with the renal functions by guarding against cold.

In mild cases where the albuminuria is the sole symptom, the patient should be warned to rest and guard against cold. The diet should be restricted to milk food, with bread and butter, and a little fish or chicken once a day, and the bowels should be made to act freely once every day.

Where there are, in addition, symptoms such as œdema or headache, the patient should be kept in bed, the diet even more rigidly restricted, and nothing but milk foods given for some days. The bowels should be briskly purged by a hydragogue, such as jalap, and the kidneys flushed out with diluent drinks. This treatment must be continued until the symptoms have disappeared, although it is rare for the urine to clear up altogether. A little fish and chicken, and some light fruits and vegetables may then be added to the diet, but the regular free action of the bowels must be continued.

In more severe cases the skin functions must be stimulated in addition by the use of hot packs. The diet also should be nothing but plain milk and diluent drinks. Hot salines per rectum help to flush out both bowels and kidneys.

If the condition grows worse in spite of treatment, it argues either a very severe toxæmia, or severely damaged kidneys. The outlook in either case is so bad owing to the probable onset of eclampsia, that the pregnancy should be terminated, particularly as the prospects of obtaining a healthy living

child are remote. This interference becomes urgent if signs of drowsiness indicate approaching coma, or sickness and epigastric pain suggest the near onset of eclampsia.

The *obstetric* treatment then consists in emptying the uterus. Where there is no great urgency this should be done by Krause's method of induction of premature labour (*q.v.*). In urgent cases some method of *accouchement forcé* must be employed, the choice depending upon the condition of the cervix, and on the degree of urgency.

An opportunity may be taken here of emphasising the immense prophylactic importance of recognising pre-eclamptic toxæmia early, by the simple routine practice of urinary examinations. The great majority of cases are amenable to treatment, and it is not too much to hope that the frequency of actual eclampsia will by this means be enormously diminished in the future.

Eclampsia

Eclampsia may be defined as an acute toxæmia occurring during pregnancy, during labour, or in the puerperium, characterised by convulsions and coma. It must be borne in mind, however, that convulsions and coma may occur during pregnancy from other toxic conditions, such as hyperemesis, as well as from uræmia and epilepsy.

Frequency.—This is usually placed at 1 in 500, but that is by no means an exact figure. Hospital statistics give an exaggerated idea of its frequency, and many practitioners in the country have never met a case.

Period of Onset.—Eclampsia occurring in pregnancy is called *ante partum*, that occurring for the first time in labour *intra partum*, while that originating during the puerperium is known as *post partum* eclampsia. Ante partum eclampsia is rare before the sixth month of pregnancy, but becomes increasingly common after the seventh month. The relative frequency of the three varieties may be stated as

Ante partum . . .	20 per cent.
Intra partum . . .	60 „
Post partum . . .	20 „

Discrepancy on this point is noted in different statistics, and it must be remembered that probably in many cases recorded

as *intra partum* the labour ensued simultaneously with the onset of the eclampsia, and was really a premature labour.

Etiology.—Although we do not know the cause of eclampsia with any certainty there are some facts with regard to its predisposing causes that are definitely proved.

Primiparity.—About 80 per cent of all cases of eclampsia occur in women pregnant for the first time. Presumably the organs of such women are less able to adapt themselves to the altered and increased demands put upon them. The disease, further, is particularly common in very young and very old primiparæ. It is possible that increased intra-abdominal pressure may be an element, because primiparity has that in common with the next two predisposing causes, viz. *Hydramnios* and *Multiple Pregnancy.*

Eclampsia is frequently found in association with these conditions. Whether the connecting cause is the increased intra-abdominal pressure, or the over-distension of the uterus, it is impossible to say. In the case of twins the increased metabolism may be a factor.

Thyroid inadequacy is also to be regarded as a predisposing factor. Women, in whom there is a definite hypertrophy of the thyroid during pregnancy rarely develop toxæmia. There is some evidence, too, that the administration of thyroid is beneficial in cases of toxæmia. It is probable that inadequacy or perverted function of other glands acts in a similar way, but the thyroid has a more intimate connection with proteid metabolism, and changes in it are more readily detected, so that attention has been confined to it up to the present.

Constipation must also be regarded as predisposing to eclampsia, tending, as it always does, to increase a state of auto-intoxication.

Theories as to the Cause of Eclampsia.—These are legion in number, and only some of the more important can be discussed or even mentioned here.

Mechanical Theories.—The almost universal association of albuminuria with eclampsia was the earliest noted fact about the disease, and naturally the cause was first sought in the kidney. One view was that the kidney condition was due to *compression of the renal veins* by the gravid uterus. In many cases, however, there is no evidence post mortem of such compression. In cases of hydramnios this may partly explain the albuminuria, and in twin

cases. The frequency of albuminuria in primiparæ lends it significance, but it cannot be regarded as a constant element in the production of eclampsia.

Compression of the Ureters has also been regarded as a primary cause. Post mortem this is found in about 25 per cent of cases.

Associated with these views as to the primary failure of the kidneys, it was thought that the actual toxin might be some one or more of the urinary constituents, such as *urea, or carbamate of ammonia.* There has been no confirmation of this view, and it is now generally believed that the kidney changes are secondary, not primary.

Bacterial Theory.—The occasional sudden onset, and the occurrence of cases in groups made it inevitable that a bacterial theory should be propounded. An organismal decidual infection was claimed as the cause, but repeated careful investigations have shown that there are no specific organisms to be recovered from the uterus or the blood in a case of eclampsia.

Fœtal Products Theory.—It was suggested that the products of imperfect fœtal metabolism might lead to damage to the maternal liver and kidneys, and so cause an intoxication. The tendency to recovery after the death of the fœtus supports this view, but against it are several cases where eclampsia has occurred in the absence of a fœtus—cases of "hydatid mole"—and the numerous cases of post partum eclampsia. This view was the precursor of the more recent view, that the underlying cause is a *metabolic auto-intoxication.* This view has been elaborated at the beginning of this chapter as a working hypothesis, on the basis of which to describe toxic vomiting and the other conditions.

Syncytial Theory.—Small portions of syncytium from the placenta often pass into the maternal circulation, and form emboli in the capillaries of the different organs. It was suggested that these secreted hæmolysins, and that the body attempted to antagonise them by forming antibodies—syncytiolysins. When the body failed to do so, the haemolysins produced the hæmorrhages and areas of necrosis characteristic of eclampsia. This theory awaits proof, and has been largely abandoned.

Placental Secretions.—Much experimental work has been done in an effort to find an internal secretion in the placenta, which might cause the condition, either directly, or by anaphylaxis. So far, the evidence has been inconclusive.

Placental Ferments.—The placenta is known to be very rich in autolytic ferments, and there is reason to believe that it actually undergoes autolysis before it is cast off. The suggestion has been made that in certain circumstances these ferments may pass into the maternal circulation during pregnancy. Their arrival in the liver and kidneys would stimulate autolysis in these organs, and so cause the characteristic changes.

Mammary Theory.—On the analogy of a disease known in cows, attempts have been made to find an internal secretion in the mammæ, which might explain the symptoms.

Conclusions as to Etiology.—The diseases discussed in this chapter are of the nature of a toxæmia. The earlier and minor symptoms may reasonably be explained by an auto-intoxication such as that outlined at the beginning of this chapter. On the other hand, this intoxication may from the very first be due to some undetermined poison, originating in the placenta, which disturbs the functions of the liver and kidneys. In any case the progressive interference with these organs, however originated, will lead to the establishment of a vicious cycle and an accumulation of toxins that may possibly explain the whole range of symptoms.

On the other hand, many authorities consider it more probable that the fulminant conditions—eclampsia, and acute yellow atrophy, for example—are precipitated by a second poison being superimposed upon the first intoxication. This second toxin is believed to be the product of the autolysis of the cells (particularly of the liver) which is caused by the first intoxication (*e.g.* autolytic ferments from the placenta). These toxins are various and complex, and different varieties or combinations of them may explain the occurrence of such different conditions as eclampsia, and toxic vomiting.

The sequence of events may, on this hypothesis, be sketched as follows :—

(1) Toxæmia—either (*a*) metabolic auto-intoxication, or (*b*) of placental origin.

(2) Minor symptoms of pre-eclamptic toxæmia, *e.g.* "kidney of pregnancy," etc.

(3) Autolysis of cells in liver, kidneys, etc., as a result of the continued action of (1).

(4) Secondary toxin of autolytic origin thrown into the maternal circulation.

(5) Sudden onset of eclamptic convulsions or coma as a result of the latter or both poisons.

Pathology.—There is a great lack of uniformity found in the morbid changes in the different organs, but this is presumably due to different degrees of intoxication at the time of death. Taken together, the changes form a constant pathological complex met with in no other disease. The most

striking features are the almost universal tendency to capillary thrombosis, and the occurrence of associated areas of necrosis and hæmorrhage.

Liver.—The changes in this organ are the most constant and important of all. Ecchymoses are frequently seen on the surface, sometimes amounting to large subcapsular

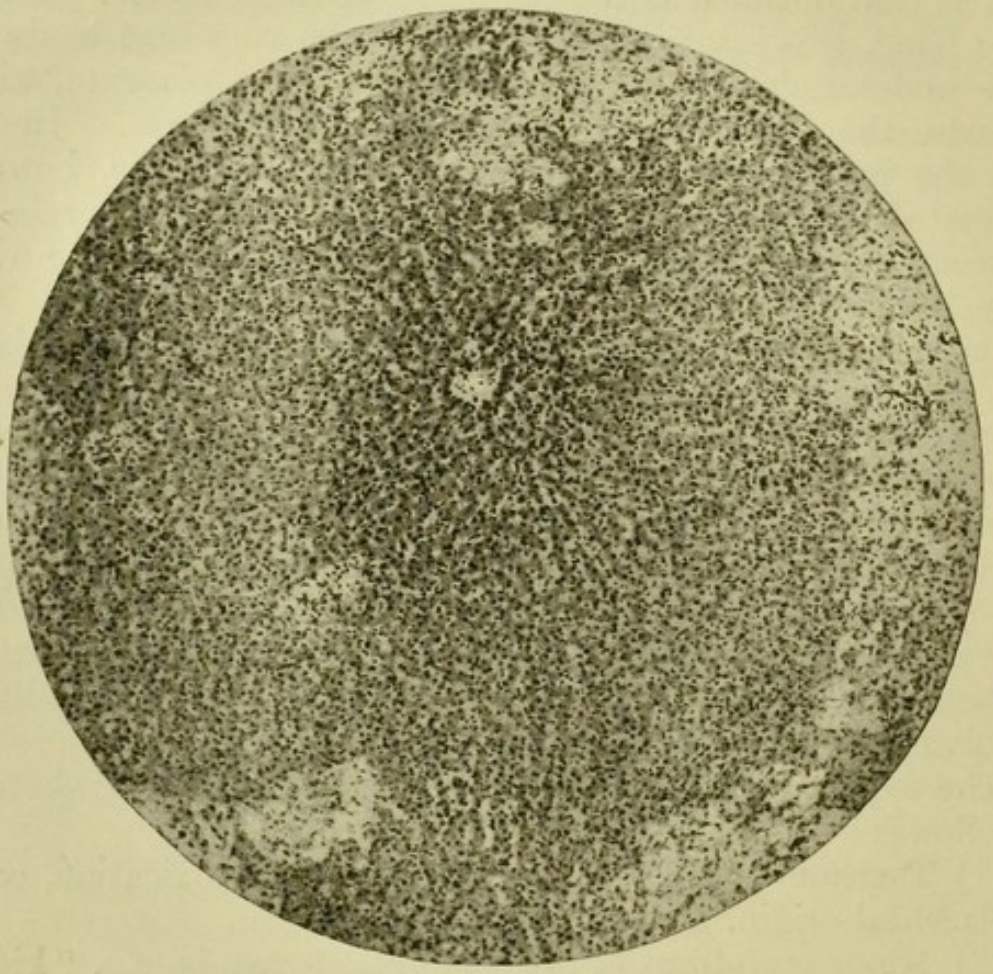


FIG. 147.—Microphotograph of liver in eclampsia.
Note the pale patches of necrosis round the periphery of the lobule.

hæmorrhages. In the substance of the organ there are found areas of degeneration at the periphery of the lobules, associated with thrombosis of the capillaries and minute hæmorrhages. This is followed by actual necrosis beginning at the periphery of the lobules, and gradually spreading over the thrombosed areas.

Kidneys.—The changes are not inflammatory but degenerative, and it is a misnomer to speak of them as "nephritis." The epithelium of the convoluted tubules is in most cases the

only part affected, and in it all degrees of degeneration are found, from cloudy swelling and fatty degeneration to actual coagulation necrosis. There are also in many cases capillary thromboses and hæmorrhages. The minor grades of kidney changes are simply those found in the so-called "kidney of pregnancy."

Brain.—The usual tendency to capillary thrombosis and hæmorrhage is seen here. Sometimes large hæmorrhages are found, but these are probably due to the high blood pressure during convulsions. Sometimes there is general œdema of the brain, with associated anæmia.

Lungs.—These are congested at the bases, and often show more general œdema, acute œdema of the lungs being a frequent terminal affection in eclampsia. Thromboses, hæmorrhages, and areas of necrosis have been seen.

Heart.—There is usually degeneration of the myocardium, associated with capillary thrombosis and hæmorrhages. Areas of necrosis are found in about 60 per cent of cases.

The spleen, pancreas, intestines, and suprarenal capsules show similar changes.

Symptoms and Course.—*Prodromal Symptoms.*—These are really the symptoms of pre-eclamptic toxæmia. The most frequent precursors of an outbreak of convulsions are disturbances of vision, flashes of light before the eyes, dizziness, headache, vomiting, epigastric pain, and a scanty secretion of urine containing much albumen and little urea. The cause of the epigastric pain is not fully understood. In all probability it is a referred pain from the liver. As a warning symptom, however, it is of the first importance. Not infrequently there are slight attacks of faintness or dizziness closely similar to *petit mal.*

Very occasionally there are no recognisable prodroma. Frequently they are present but overlooked or misinterpreted, with results that may easily prove fatal.

Actual Symptoms.—A fit is usually preceded by a few seconds restlessness, with twitching and rolling of the eyeballs. Then comes the tonic stage, which may be so brief as to escape notice. The body is rigid, the head thrown back, the eyes turned up or to the side. Respiration is stopped, and there may be actual opisthotonos. This is rapidly followed by the clonic stage, the twitching beginning in the face, and being

succeeded by more violent contractions of the limbs. The tongue may be severely bitten, and there may be foaming at the mouth. The veins stand out dark purple, and the whole face becomes livid and horribly distorted. This gradually passes off, and is followed by a period of coma with deep stertorous breathing.

A fit usually lasts for a minute or a minute and a half, rarely longer. During it the patient is quite unconscious, and the pupils do not react to light. Fæces and urine may be passed.

The length and depth of the coma depend on the number of fits. It becomes deeper and longer, as the fits increase in number and the intervals between them are shortened. In severe cases the fits may succeed each other so rapidly that there is no appreciable interval. In others the patient is comatose during the entire interval. In mild cases there are few fits at long intervals, and the patient recovers consciousness between them. The number of fits varies from one to more than one hundred. They may be excited by external stimuli. Labour pains may excite them, and on the other hand they may, and often do stimulate labour pains, and frequently particularly violent and prolonged pains. If the fits continue, the pulse rate becomes greatly accelerated, the pulse being small and of very high pressure. The temperature also rises from interference with the heat regulating centre, and very high temperatures may be registered in bad cases. If improvement sets in, the pulse rate and temperature fall again. If improvement does not occur the heart begins to fail, and this is followed by œdema of the lungs. Aspiration pneumonia and cerebral hæmorrhage may complicate the case.

In *ante partum* eclampsia the fits usually induce premature labour, the child being frequently born dead. In some rare cases the child has been born alive and has suffered from fits like the mother, characteristic eclamptic changes being found in its organs after death. In cases with only one or two fits the pregnancy may go on to term and eventuate in the birth of a living child, or else the attack may pass off and be followed days or weeks later by premature labour, the state of the child indicating that it perished during the eclamptic attack. Death or expulsion of the child is usually followed by the cessation of the fits.

Intra partum eclampsia generally causes the pains to be violent, and the labour to end quickly. But in this and in *ante partum* cases the rigidity of the cervix or other cause may call for operative delivery.

Post partum eclampsia usually occurs within a few hours of the completion of labour, and is characterised by few fits, followed by recovery. Sometimes, however, the outbreak occurs later, from the second to the fifth day. In these cases there are apt to be more numerous fits, and the prognosis is of the most grave variety.

Diagnosis.—In making a diagnosis reliance must be placed on the history, the symptoms immediately preceding the attack, and the nature of the fits if observed. The fits may, however, be atypical.

The condition of the urine is of importance if the case has not been seen before. It is always diminished in quantity, and in bad cases may be entirely suppressed. Sufficient for a rough examination can usually be obtained by catheterisation. It is loaded with albumen, and if boiled undiluted frequently turns solid. Hyaline, granular, and epithelial casts are numerous, as well as blood cells. If sufficient urine is available for a more elaborate examination, the total nitrogen output is found to be low, the urea diminished, and the undetermined or "rest" nitrogen is greatly increased. The ammonia co-efficient is variable (Fig. 146).

Epilepsy can usually be diagnosed by the history, the presence of an aura, and perhaps of a cry at the outset of a fit. The state of the urine is important. The fit is usually a single one. Uræmia cannot as a rule be diagnosed from eclampsia without a knowledge of the patient's having had previous renal disease, and often not before the autopsy. Acute yellow atrophy of the liver, and acute phosphorus or strychnine poisoning must be borne in mind, but can usually be ruled out owing to their rarity. Acute meningitis may simulate eclampsia, but can generally be distinguished by close observation of the symptoms, and, if need be, by a diagnostic lumbar puncture.

Eclampsism.—This term is applied to the rare condition of "eclampsia without fits." It is really an extreme degree of pre-eclamptic toxæmia, the patient passing into a drowsy or even comatose state. Death frequently results, and *post*

mortem the changes characteristic of eclampsia are found. The diagnosis rests on the history, the state of the urine, and possibly the retinal changes.

Prognosis. — This is grave for both mother and child. Speaking generally the maternal mortality is about 25 per cent, and the fœtal 50 per cent, but individual cases vary so much that statistics are little guide.

The general opinion is that the prognosis is worse in multiparæ than in primigravid women.

It is also generally believed that the earlier the fits come on in pregnancy, the worse is the outlook. Ante and intra partum cases are usually regarded as more severe than post partum cases, but there is a sharp division of opinion regarding the prognosis in the last named. Many authorities regard it as the most grave variety of all.

In ante partum cases the death or expulsion of the child is usually followed by the cessation of the fits, and in intra partum cases the fits tend to stop after the uterus is emptied.

Signs of good prognostic significance are—(1) few fits; (2) long intervals between fits; (3) recovery of consciousness in the intervals; (4) marked general anasarca.

Bad signs are—(1) many fits; (2) short intervals; (3) persistence of coma in the intervals; (4) a very small quantity of albumen in the urine; (5) pyrexia; (6) onset early in pregnancy or after the second day of the puerperium; (7) high arterial pressure.

Mental derangement sometimes follows eclampsia, but this is usually only temporary.

It is the exception for eclampsia to recur in a subsequent pregnancy, although it is by no means unknown. Moreover, the disease passes off in most cases without leaving any permanent damage to the liver or kidneys. The condition of the urine usually clears up completely during the puerperium, and the persistence of albuminuria after a month or two usually indicates organic kidney disease, which may have existed before the pregnancy ensued.

Prophylaxis.—This amounts to the early recognition and prompt treatment of pre-eclamptic symptoms. *Its importance cannot be over-emphasised.*

Treatment.—This naturally falls under two heads—general medical treatment (*a*) of the fits, and (*b*) during the intervals,

and, secondly, obstetrical treatment. In the description of treatment that follows it must be understood that obstetric treatment may be adopted at any stage, either before, during, or after the medical treatment, according to the nature of the case and the opinion of the physician.

Treatment of a fit consists in preventing the patient from damaging herself. A gag—the handle of a spoon wrapped in a towel does well—should be placed in the mouth to prevent the tongue from being bitten. Chloroform should be administered if possible. Ether is better owing to its having less action on the liver, but its slower action makes it useful only where the administration has to be prolonged. The patient should be placed on her side as soon as possible to prevent the secretions of the mouth from running back into the lungs.

Medical treatment is based upon two principles: Firstly, to prevent the nervous explosions by protecting the patient from anything that would stimulate a convulsion, and by administering sedatives. Secondly, to flush the toxins out of the body by every possible channel of elimination.

The sedatives mostly used are morphia and chloral. Morphia may be given in a dose of half a grain hypodermically, and followed by repeated doses of $\frac{1}{4}$ of a grain every two hours, not more than three grains being given in twenty-four hours. This satisfactorily checks the fits in most cases and lowers the blood pressure. An objection to its use is that its tendency to stop the metabolism of the body also diminishes the secretions and excretions. Chloral may also be used, thirty grains of the hydrate per rectum every two hours till the fits cease, not more than three drachms being given in the twenty-four hours. It is more depressing to the heart than morphia, and hardly so effective. Chloroform will probably need to be used along with it, whereas after the morphia has produced its effect chloroform is rarely required.

While the patient is comatose or under chloroform a stomach tube should be passed, and the stomach washed out with weak solution of bicarbonate of soda. Six ounces of magnesium sulphate in a saturated solution should then be poured down the tube and left in the stomach. Failing the use of the tube, one to two minims of croton oil should be rubbed up with a little butter and placed well to the back of the tongue. If, on

the other hand, the patient is sufficiently conscious to swallow, she should be given a potent purge, such as six grains of calomel along with a drachm of jalap. It is well, at the same time, to empty the lower bowel at once by means of large warm water enemata, repeated until all the solid matter is removed. Frequently these patients have been very constipated, and much exceedingly offensive matter, which must of necessity be highly toxic, is removed in this way. This flushing of the colon with hot fluid also tends to stimulate the kidneys. Their action may be further increased by hot fomentations or poultices applied to the flanks. The skin may be stimulated by hot packs or hot air baths, the condition of the pulse being carefully watched.

Where there is very high arterial pressure, or where the fits continue after the birth of the child, venesection should be done, and ten or fifteen ounces of blood removed. This removes a certain amount of the toxin, and the remainder may then be still more diluted by the administration of saline per rectum very slowly (one pint in half an hour, repeated every four to six hours as necessary), or into the loose cellular tissue under the breast. Diuretic salts (*e.g.* acetate of soda, 30 grains to the pint) may be added, and this is a rapid and effective method of stimulating the kidneys.

Even when venesection is not practised, the administration of salines per rectum or under the breast is very useful, having a potent diuretic influence. In view, however, of the tendency to œdema of the lungs, this form of treatment should not be persisted in unless it is accompanied by free removal of the fluid by the kidneys, bowels, and skin. If this precaution be overlooked the patient will become increasingly waterlogged and die.

In view of the possible inadequacy of the thyroid, some preparation of that gland may be given. Liquor thyroidei may be used hypodermically in ten minim doses, or the extract may be given by the mouth or rectum in doses of twenty to thirty grains, until the pulse quickens, when it should be stopped. Whether or not it acts by supplying a lack of thyroid juice, it is an efficient diuretic.

During the acute period of the disease the patient should get no food of any description, for she is totally unable to digest it. If she is conscious she should be encouraged to

drink as much water as possible. Care must always be exercised to see that she can really swallow before anything is given to drink.

The condition of the heart must be carefully watched, and stimulants given hypodermically if necessary—strophanthin, digitalin, and brandy being the most useful.

No active treatment should be done unless the patient is comatose, or under the influence of morphia or chloroform, otherwise the effect will be to stimulate and excite more fits. As soon as the active part of the treatment is finished she should be placed in a darkened room, and left under the charge of a skilled nurse, all external stimuli being as far as possible removed. The nursing is of the first importance. The patient must be kept on her side, and turned from one to the other at intervals, to let the saliva run out of the mouth.

The above is an outline of a safe and rational form of general medical treatment. There are, however, many other drugs and methods that have been vaunted from time to time. Most of these are disappointing, many are not rational, and some are dangerous. Thus veratrum viride, which is looked on as a specific in some quarters of America, has not been found more effective than the more familiar drugs. The use of pilocarpin must be held to be a danger in view of the already existing risk of œdema of the lungs. Hirudin, the active principle of leeches, has been given to overcome the tendency to thrombosis. Lumbar puncture has been tried repeatedly, but with results on the whole disappointing. Surgical treatment is referred to below.

Obstetrical Treatment.—At the outset it must be explained that there are two schools of opinion in regard to the obstetrical treatment of eclampsia. The one believes in emptying the uterus as soon as possible; the other believes in leaving the uterus severely alone, allowing labour to come on spontaneously and then expediting delivery. Both schools claim almost equally good results, but the preponderance of skilled opinion appears to be in favour of the early emptying of the uterus. There seems to be substantial evidence for the view that either one course or the other should be adopted, and not, as is so often done with disappointing results, a compromise between the two. That is to say, the uterus should either be emptied promptly as soon as possible after the first fit, or else

it should be left alone. If obstetric interference is postponed until the patient has had several fits, and it appears that she is becoming worse under purely medical treatment, the interference may be too late to save her, or it may be too exhausting to the heart weakened by repeated fits.

In a great many cases the onset of eclampsia is accompanied or speedily followed by the onset of labour pains. In such cases all that may be necessary, if it be decided to empty the uterus, is to hasten the dilatation of the os. If it be soft, this may be done manually, and, as soon as full dilatation has been secured, the child should be delivered by forceps or version. If labour has not begun spontaneously, it is more difficult to decide what is best for the patient. In hospitals where the services of a trained operator and assistants can be obtained, there is an increasing volume of opinion in favour of vaginal hysterotomy (vaginal Cæsarean section). Cæsarean section itself has been done, but since the introduction of the vaginal operation it must be relegated to those cases where the vaginal operation is contra-indicated, as for example in contracted pelvis. Other methods of *accouchement forcé* may be used, as, for example, dilatation by graduated dilators followed by branched dilators of the type of Bossi's. But where the os is closed to start with, the vaginal hysterotomy operation is, in the hands of an experienced operator at least, safer and quicker. In private practice it is probably better in these circumstances to depend solely upon medical treatment, unless sufficient dilatation to admit a Champetier de Ribes' bag can be obtained by graduated dilators. Where operative measures of any kind are adopted the strictest antiseptic precautions should be observed, as there is very considerable evidence that eclamptic women are particularly liable to septic infection.

Surgical Treatment.—*Decapsulation of the Kidneys.*—The rationale of this operation in eclampsia is to relieve the congestion of the kidney, and so permit of its being flushed with blood, and its function in this way restored. Only about fifty cases have been recorded, with very varying success.[1] It should be restricted to cases in which the fits have continued in spite of, or have originated after, the evacuation of the uterus, and in which there is at the same time complete anuria.

[1] Professor Sir Halliday Croom had one case, in the Edinburgh Royal Maternity Hospital, in which the operation was followed with complete success.

CHAPTER XXIV

DISPLACEMENTS AND ABNORMALITIES OF THE UTERUS DURING PREGNANCY

Anteversion and Anteflexion

In the early months of pregnancy there is usually an exaggeration of the normal anteversion and flexion of the uterus. This has already been referred to amongst the changes in the uterus following impregnation, and mentioned as the cause of some irritability of the bladder.

In the later months of pregnancy anteversion of the uterus gives rise to the condition known as "pendulous belly." In multiparæ this is not necessarily of significance, being due merely to the weakness of the abdominal walls induced by repeated child-bearing. In some cases where the recti muscles are much separated, the uterus hangs right forward over the pubes, covered only by the skin and fascia of the abdominal wall, the cervix and fundus lying on the same level. In primigravid women, on the other hand, the condition is much more significant, being associated with contraction of the pelvic inlet, which prevents the head sinking into the pelvis, forces the whole uterus up into the abdominal cavity, and so throws the weight of it on to the abdominal muscles. In any case a patient with pendulous belly should be examined for the possible existence of such a contraction of the pelvis.

During pregnancy the condition gives rise to no symptoms beyond increased bladder irritability, and later some discomfort and difficulty in walking. A firm abdominal binder helps these.

The obliquity is very liable to produce a malpresentation, such as breech, footling, or face. In the first and second stages of labour the uterine force is misdirected, and the cervix may be only very slowly dilated.

Treatment, apart from the malpresentation, is directed to bringing the uterus back to its proper axis. This is done by keeping the patient on her back and applying a firm abdominal binder.

Retroversion and Retroflexion

These are much more serious displacements of the uterus during pregnancy. Usually they occur together, but occasionally a simple retroversion is found. These latter cases are apt to be more severe in their symptoms.

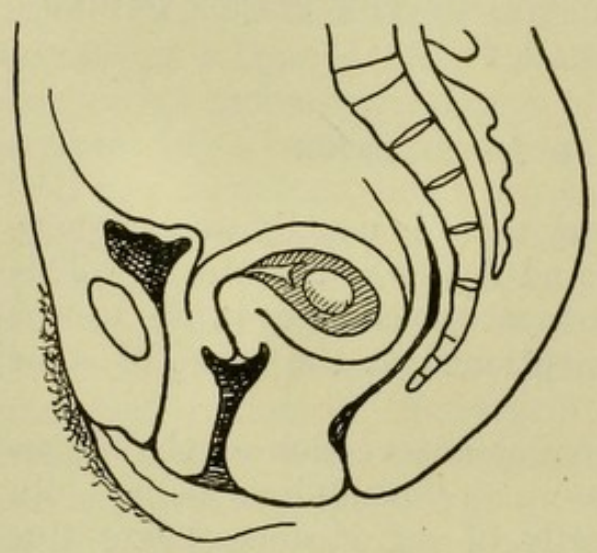


Fig. 148.—Retroflexion of the gravid uterus, causing pressure on urethra.

Cause.—In the great proportion of cases the displacement has existed before pregnancy ensued, and merely persists after the uterus begins to enlarge. It is said that very occasionally it may occur after pregnancy has begun, as the result of a fall or sudden severe muscular strain.

Course and Symptoms.—For the sake of simplicity the course followed by such a condition, when unrelieved either by nature or by artificial interference, will be considered first. It must be clearly understood from the outset, however, that such is by no means the most frequent course.

As the uterus grows it gradually fills the cavity of the pelvis, the fundus lying well down in the pouch of Douglas, and the cervix being gradually forced up above the symphysis. This displacement of the cervix causes stretching and elongation of the anterior vaginal wall and urethra, and pressure upon the bladder. The fundus may press on the rectum and sacral nerves. The resulting symptoms are increasing irritability of the bladder, and difficulty in micturition, with occasionally pain and heaviness in the pelvis, and constipation. By the end

of the third month the uterus has grown so large that it cannot get past the promontory of the sacrum, and hence the whole organ becomes *incarcerated* in the pelvis. This causes a rapid and marked increase in the symptoms. There is difficulty in micturition passing on into retention of urine, and this is followed by what is known as "paradoxical incontinence." By this is meant that the pressure inside the bladder becomes so great that ultimately it overcomes the obstruction to the outflow of urine, and a few drops are forced through the urethra. This reduces the pressure for a short time, until the intravesical pressure again overcomes the obstruction. Thus there is a frequently repeated dribble of urine escaping, which may give a misleading impression of incontinence.

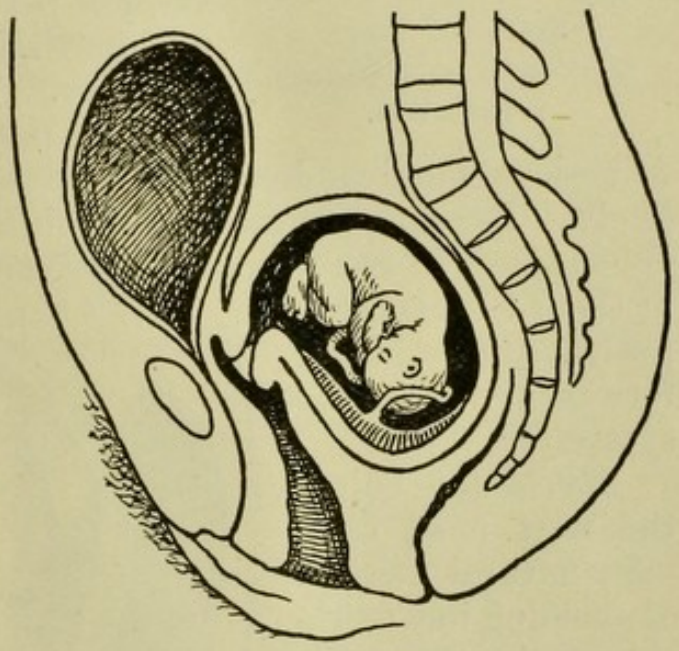


FIG. 149.—Incarceration of retroflexed gravid uterus, causing retention of urine.

When this stage is reached serious symptoms are apt to follow. The retained urine very soon decomposes, and a cystitis is set up. This cystitis is frequently very severe, large flakes of the mucous membrane and even of the muscle wall being sloughed off—so-called "exfoliative cystitis." Rupture of the bladder may occur, or the passage of infection through to the peritoneum. More frequently the infection passes up to the kidneys, causing pyelonephritis. The backward pressure of the urine may affect the kidneys and cause albuminuria and uræmia. A fatal issue may follow any of these conditions.

As has been already indicated, such a course is by no means the most usual one in this condition. Nature has three alternative ways of avoiding incarceration and its consequent train of evils, viz.: (1) *Spontaneous rectification*, (2) *Abortion*, and (3) *Sacculation of the uterus*. Either of the first two is much more common than the course just indicated.

Spontaneous Rectification.—This is probably the most frequent termination. The anterior wall of the uterus grows upwards, the whole organ expanding in the direction of least resistance. As it does so, it tends to draw the rest of the uterus after it, provided the fundus is not caught by the promontory of the sacrum, and so prevented from rising into its normal position. After the end of the third month in all cases, and earlier in cases of pelvic contraction, the fundus will inevitably be caught by the promontory. Therefore this termination is only possible before that period. Adhesions binding down the fundus make its occurrence unlikely. Moreover, in cases in which the element of retroversion (as opposed to retroflexion) is pronounced it is less likely, as in them the cervix is pushed upwards and forwards above the symphysis.

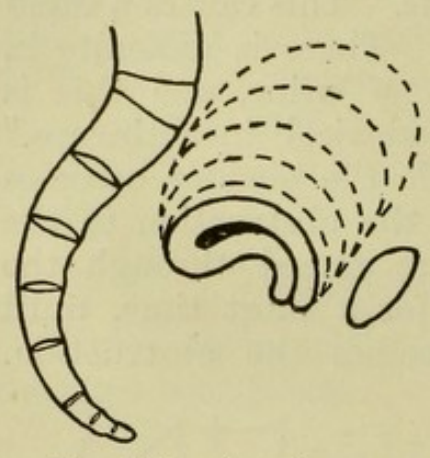


FIG. 150.—Spontaneous rectification.

Abortion.—This is the next most common natural method of avoiding incarceration and its perils. There are two ways in which it may occur. The abortion may be caused by the congestion and endometritis resulting from the displacement. In such cases it occurs early. In other cases it occurs in the third month, owing to the uterus filling up the pelvic cavity and being stimulated to action by the pressure of the surrounding organs. Abortion in all such cases is apt to be incomplete owing to the shape

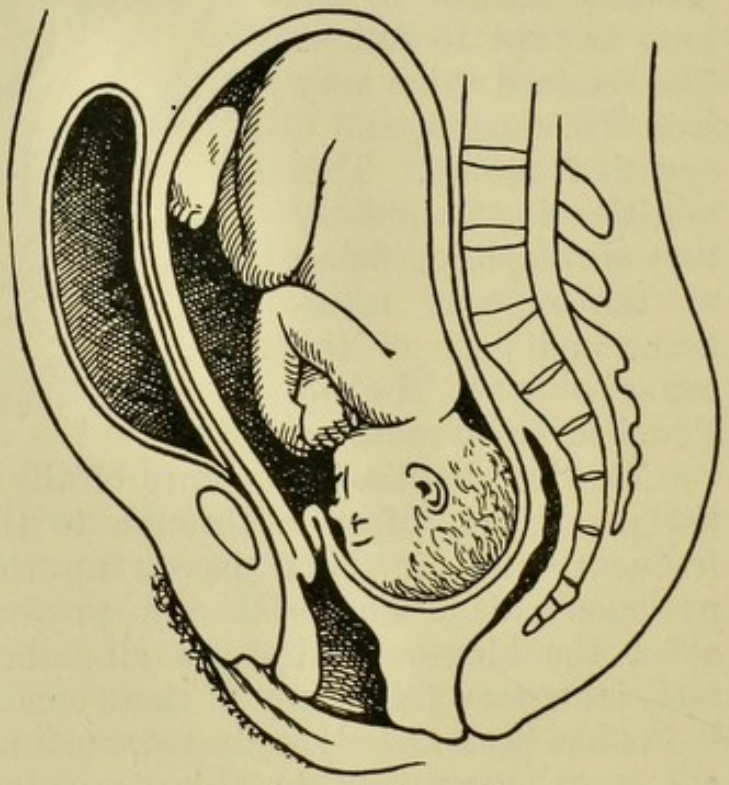


FIG. 151.—Sacculation of the uterus.

of the uterus, and artificial assistance is generally required before the uterus can be completely emptied.

Sacculation of the Uterus.—When the uterus threatens to become incarcerated at the end of the third month of pregnancy, that misfortune is sometimes averted by the free growth and expansion of the anterior wall of the uterus. This comes to form a large pouch projecting up into the abdominal cavity, and allows of the proper growth of the fœtus, the head remaining in the lower pouch of the uterus (posterior wall and fundus) occupying Douglas's pouch, and the body and limbs lying in the upper sacculation. Under these circumstances pregnancy may go on to term without interruption, and the sacculation averts the severe symptoms consequent upon incarceration. The condition may give rise to some difficulty during labour, and may necessitate operative delivery.

Diagnosis.—The symptom most usually complained of in backward displacement is increasing difficulty and pain on micturition, passing into retention if incarceration occurs. As a rule the symptoms come on gradually, and are not very noticeable until incarceration threatens. Occasionally the displacement may cause increased reflex symptoms, such as vomiting. A history of possible early pregnancy, amenorrhœa, breast signs, etc., along with difficulty in micturition, or retention, should always direct attention to the possibility of this condition, and determine a vaginal examination.

On examination the enlarged soft body of the uterus will be felt behind, and the cervix will usually be found *high up* and directed more or less forward. The body of the uterus is not felt anteriorly in its usual position, nor as high in the pelvis as the history would lead one to expect. The condition must be carefully distinguished from a tubal pregnancy or hæmatocele lying behind the uterus. In this connection the history of pain and irregular hæmorrhage and the direction of the cervix are of importance. In tubal pregnancy the cervix is more likely to be directed downwards and backwards. Small ovarian and fibroid tumours are less likely to give rise to mistakes in diagnosis, as in them the cervix is usually low, and the history will probably be different. If there is retention of urine when the patient is first seen, the distended bladder will be found occupying the abdomen, and must be slowly and

carefully emptied by the catheter before any sure diagnosis can be arrived at by vaginal examination.

Treatment.—In the early weeks of pregnancy the uterus can usually be replaced without difficulty by the fingers in the vagina. A Smith-Hodge or ring pessary is then inserted to maintain it in position, and is kept in until after the end of the fourth month. In the third month, if incarceration has occurred and there is distension of the bladder, the attention must first be paid to emptying it. Owing to the stretching of the urethra an ordinary female catheter may not be long enough to enter the bladder. A male gum-elastic catheter should therefore be used with careful aseptic precautions. If there is marked cystitis there may be difficulty with the eye of the catheter becoming blocked by blood-clot or necrotic mucous membrane. The bladder must not be emptied too rapidly. The rectum should be emptied with an enema before any attempt to replace the uterus is made. There are several methods of reposition which may be tried, viz. (1) Manual reposition, (2) Manual reposition aided by volsellum, (3) Manual reposition aided by posture, (4) Fingers in the rectum.

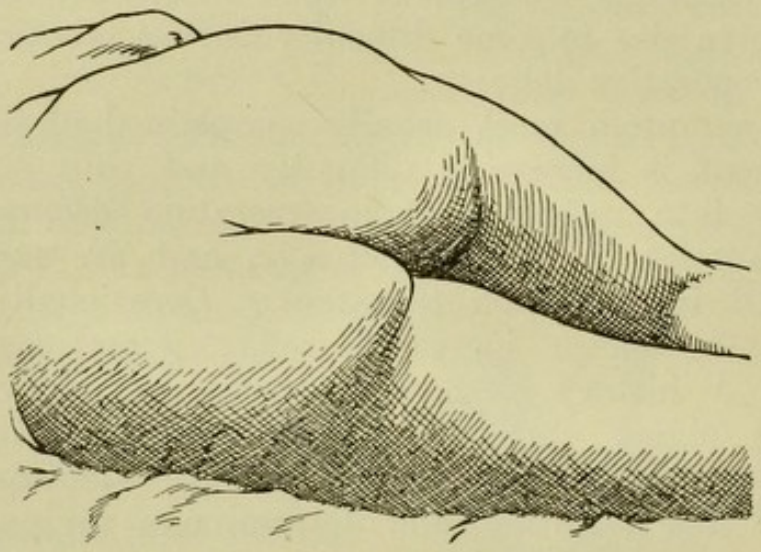


FIG. 152.—The Sims' position.

The semiprone (Sims') position, or the genupectoral position, is very useful in all efforts to secure reposition. Indeed posture alone may cure some cases if the bladder be kept empty by repeated catheterisation, and the patient lie frequently in Sims' position. Another most useful adjunct is anæsthesia, which may be combined with Sims' position.

Simple manual reposition is done in exactly the same way as in ordinary gynecological cases. Two fingers in the posterior fornix push the fundus upwards and forwards; the cervix is then caught backwards by one finger, and the other hand on

the abdomen catches the fundus and depresses it into its ordinary position. This is often rendered much easier by the aid of the volsellum drawing down the cervix. In some cases a better purchase may be obtained on the fundus by passing the fingers well up into the rectum, and pushing it forwards in that way. In all cases the semi-prone (Sims') posture is a great assistance, particularly when it is combined with anæsthesia.

If after one or two attempts the uterus still remains in its abnormal position, it is well to desist from further attempts for two or three days, in the meantime directing special attention to keeping the bladder from becoming distended. There are two very good reasons for this. One is that over-manipulation of the uterus may lead to abortion. The second is that there is quite a possibility that, if the bladder be kept empty, spontaneous rectification may still occur. Failing this, further efforts may be made to replace it.

Digital manipulations seldom fail, but if they do, a trial may be given to the method of exerting continuous elastic pressure on the fundus by introducing a hydrostatic bag into the vagina.

If this fails, the only two remaining resources are—(1) induction of abortion, and (2) abdominal section, with separation of any adhesions, reposition of the uterus, and ventro-suspension, or shortening of the round ligaments. If the bladder condition be very septic, abdominal section is contra-indicated, but otherwise it gives excellent results, and should not be too long delayed. The induction of abortion may be difficult, as the cervix may be so high up and so directed forward and upward that no instrument can be introduced into it. In such a case it has been recommended to aspirate the liquor amnii through the posterior fornix.

In the meantime treatment must be applied to the bladder, and to the general condition of the patient. Repeated washing out the bladder with weak antiseptic lotions through a double channelled catheter is indicated, as well as the exhibition of salol, urotropin, or helmitol, and bland fluids by the mouth.

Prolapse.—This form of displacement is rarely found associated with pregnancy, partly because prolapse is an obstacle to the occurrence of pregnancy, and partly because, when preg-

nancy does occur, it tends to a temporary cure of the prolapse. In almost all cases where the two conditions are associated the prolapse has existed before impregnation. Very rarely a sudden fall may cause a pregnant uterus to be displaced downwards. Many cases of so-called prolapse are really cases of hypertrophy of the cervix. As a rule the growth of the uterus draws the whole body and cervix upwards after the third or fourth month. If seen before this, it can be replaced, and maintained in position by a ring pessary. Hypertrophy of the cervix, and also the prolapse of the vaginal walls associated with descent of the uterus, may give rise to difficulty in labour.

Hernia.—Cases have been recorded in which the uterus during pregnancy formed part of the contents of a ventral hernia. In still rarer cases a uterus displaced into the sac of a femoral or inguinal hernia has become pregnant.

Developmental Abnormalities of the Uterus.—The vagina, uterus, and tubes are developed from the two Müllerian ducts, which in the early stages of development exist as separate tubes on either side running down from the kidney region to the urogenital sinus. The fusion of the two begins about the end of the second month from below upwards. The lowest thirds unite to form the vagina, the middle thirds form the uterus, while the uppermost thirds remain separate as the Fallopian tubes. This normal process of fusion may never begin, or it may be arrested at any stage. In this way arise such abnormalities as double vagina, double uterus, and the various subvarieties of the latter.

These abnormalities are for the most part rare, and the only one that need be mentioned is the double uterus. When pregnancy occurs in one-half, the other enlarges and forms a decidua. The empty half has been known to form an obstruction to delivery. This condition is of obstetric interest also, as being in many cases the probable explanation of reputed cases of superfœtation.

Occasionally the one-half of a uterus bicornis is not developed, but represented merely by a rudimentary structure joined to the developed half by a fibrous band which usually affords no

communication between the two portions. Pregnancy has been known to occur in such horns, and the only possible conclusion would appear to be that the spermatozoon passed up the tube on the opposite side, and migrated across behind the uterus and down the other tube into the rudimentary horn, where it met an ovum. Pregnancy in such a rudimentary horn is clinically the same as a tubal pregnancy, and can only be diagnosed after operation. The position of the round ligament is an important point in diagnosis of the specimen, as in most cases of tubal pregnancy the origin of the ligament is inside the sac, while in the case of a rudimentary horn the round ligament arises externally to the gestation sac.

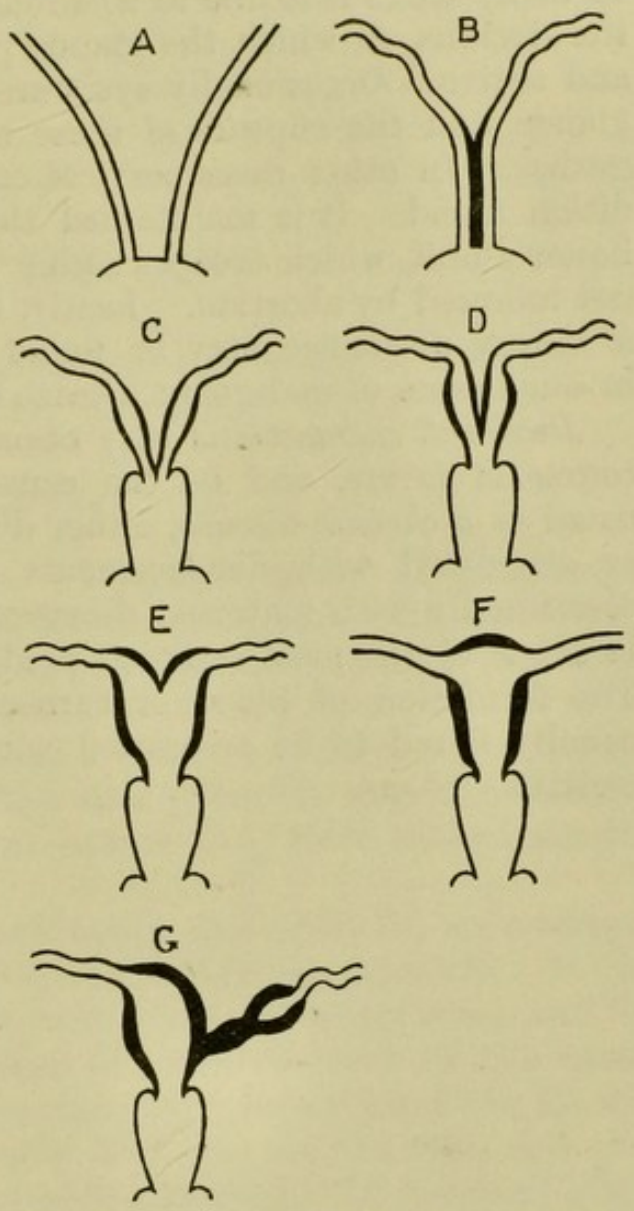


FIG. 153.—Stages in development of the vagina, uterus, and tubes.

A. Two Mullerian ducts entirely separate. B. Stage of fusion corresponding to double uterus and septate vagina. C. Stage of fusion corresponding to double uterus. D. Stage of fusion corresponding to uterus bicornis unicollis. E. Stage of fusion corresponding to uterus bicornis unicollis. F. Normal condition. G. Uterus bicornis unicollis with rudimentary horn.

Tumours of the Uterus.—Fibroid tumours of the uterus are of greater significance in regard to labour than pregnancy, and along with malignant disease of the uterus and ovarian tumours, will be taken up under the Pathology of Labour (see p. 299).

Diseases of the Decidua.—*Hydrorrhœa gravidarum* is a condition in which there is a thin watery discharge during pregnancy. It may occur either as a slight continuous dribble, or as occasional recurrent gushes, usually quite inconsiderable

in quantity. It is a symptom of various conditions, and an examination should be made to determine, if possible, the cause. In many cases it is due to a chronic catarrhal inflammation of the decidua, in which the glands persist and become enlarged and active. Occasionally cysts are formed by retention in the glands, and the rupture of these may cause the sudden small gushes. In other cases cervical catarrh may be the only condition found. It is maintained that in some cases the fluid is liquor amnii, which escapes owing to a rupture of the amnion not followed by abortion. Lastly, it must be remembered that a watery discharge may be found in hydatidiform mole, and in some cases of malignant disease of the cervix or body.

Decidual endometritis may occur as an *acute* disease in the course of fevers, and be the cause of abortion. It is more usual as a *chronic* disease, either due to previous endometritis, or associated with displacements of the gravid uterus, and occasionally with maternal diseases causing venous congestion. It is one of the most common predisposing causes of abortion. The formation of blood or carneous moles in the uterus is usually found to be associated with a chronic decidual endometritis.

CHAPTER XXV

ABNORMALITIES AND DISEASES OF THE CHORION, AMNION, PLACENTA, AND CORD

Chorion

Hydatidiform Mole. (*Syn.*— Hydatid Mole, Hydatidiform degeneration of the Chorion, Vesicular Mole.)—This condition is characterised by the villi of the chorion becoming changed into strings or clusters of cysts, that vary from the size of a tiny currant to that of a grape. Their outward resemblance to hydatid cysts explains the name, but it must be clearly understood that in their real nature they have no connection with echinococcal cysts.

The condition is rare, not being met with on an average oftener than once in 2000 to 3000 pregnancies. It is more often found in multiparæ than in primiparæ, and it has been known in a number of cases to recur in the same patient. It almost always occurs early, rarely after the fourth month. When it occurs early it affects all the villi, and the embryo dies, and in most cases is absorbed. If it occurs after the placenta has taken definite shape, only a part of the placenta may be affected, and if enough is left to suffice for the needs of the fœtus, it may even continue to live for a short time.

Pathology.—The cysts are formed of the epithelium of the villi—Langhans' layer and syncytium—and contain fluid. This fluid is a dropsical effusion in nature, and does not contain any mucin. Some of the cysts contain a little elementary connective tissue of a very gelatinous character, and this is present also in the strings or stalks connecting the cysts.

The condition is due to an enormous proliferation of the villous epithelium, with which the growth of the stroma can in

no wise keep pace. Hence the stroma becomes replaced by the elementary gelatinous tissue and the fluid just mentioned. The tremendous activity of the epithelium is shown by the fact that it has a power of eating into other tissues, which in many cases is greater than that of normal villi. In this way the mole may eat its way into the wall of the uterus, and sometimes actually perforates the entire thickness. In cases of this sort small portions of the mole are very liable to be left embedded in the wall of the uterus, and these occasionally take on later a very malignant growth, forming what is known as "chorion-epithelioma malignum."

Cause.—Of this nothing is known, but as the change has been recorded as confined to one of twins, the probability is that the cause is associated with the fœtus rather than the mother. On the other hand, instances of recurrence in one individual favour the view that it is maternal in origin, and syphilis and endometritis have both been suggested as possible factors in its production. Lutein cysts of the ovary are occasionally found in association with this condition, but their significance is meantime unknown.

Symptoms and Signs.—(1) As the condition comes on early in pregnancy, there will be a history of a short period of amenorrhœa, as well as some enlargement of the breasts.

(2) A more rapid enlargement of the uterus than in a normal pregnancy. This makes itself obvious by the third or fourth month when the uterus may be the size of a six months' pregnancy. This sign is very frequent, but is by no means invariably present.

(3) Hæmorrhage at irregular intervals, sometimes slight and repeated, in other cases profuse or continuous. Occasionally the discharge is mixed with serous fluid, and contains some of the small cysts looking like "white currants in red currant juice."

(4) The uterus is soft and boggy on palpation, no ballottement can be made out, no fœtal parts felt, and no fœtal heart heard.

(5) In some cases the reflex symptoms are excessive, such as vomiting, etc.

(6) The uterus may be tender if over-distended.

Diagnosis.—The main conditions to be distinguished from it are—

Hydramnios. Here the uterus gives fluctuation, and ballotte-

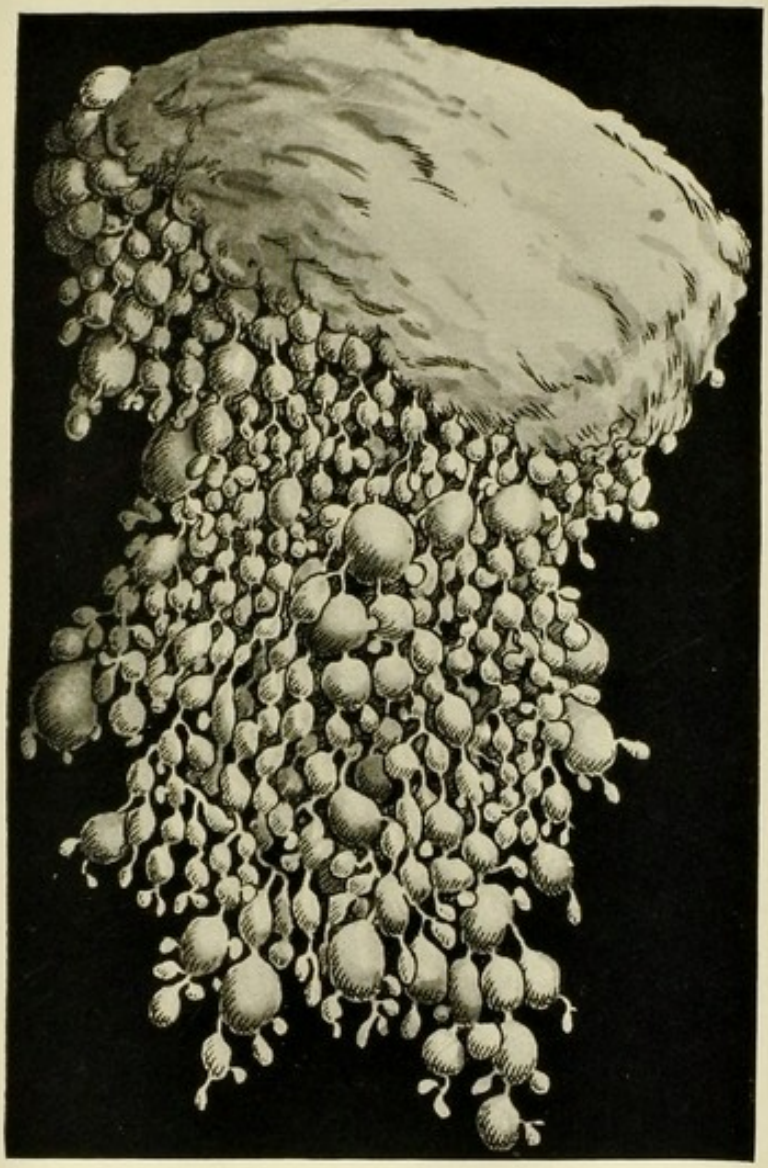


Fig. 154.—Portion of hydatidiform mole. (After Munro Kerr.)

ment is easily obtained. The uterus usually feels tense and elastic.

Twins. The fœtal parts and heart sounds can be detected.

Pregnancy with ovarian tumour. Here a careful examination under chloroform will reveal the true condition.

An absolute diagnosis of hydatidiform mole cannot be made unless the characteristic cysts have been observed in the discharge.

Prognosis.—The pregnancy almost always ends prematurely about the fourth or fifth month, if not interfered with before that. The fœtus is almost always destroyed and usually absorbed.

The principal risks are—(1) Hæmorrhage, which may be fatal at once or after prolonged bleeding. (2) Perforation of the uterus by erosion by the cyst epithelium, with consequent hæmorrhage into the peritoneal cavity and possibly peritonitis. (3) The possible subsequent development of chorionepithelioma malignum.

Early diagnosis and prompt treatment make the outlook fairly good, but the continued existence of the mole constitutes a serious danger.

Treatment consists in the evacuation of the uterus as soon as possible after a diagnosis has been made. The most scrupulous aseptic and antiseptic precautions are necessary, as a woman weakened by bleeding is particularly prone to sepsis. The cervix should be dilated with a tent or graduated dilators until two fingers can be inserted. The mole should then be loosened by the fingers, and expressed by squeezing the uterus from above, in much the same way as in expressing a retained placenta. The entire uterine cavity must then be explored and "curetted" by the finger. It is unwise to use a curette for this, as the wall of the uterus may be no thicker than a piece of tissue paper in parts, and there is great risk of perforation. Another risk associated with the operation is hæmorrhage, for the vessels and sinuses in the uterine wall are opened up, and the muscle fibres, which close them in ordinary circumstances, are often eaten away by the growth of the mole. A hypodermic injection of ergot should therefore be given as soon as the mole is expressed. It is advisable to use a hot (115° F.) sterile douche to wash out the debris from the uterus through a double channelled catheter. If bleeding still persists,

the uterus should be packed with sterile gauze for eight to twelve hours. Ergot should be given several times daily for some days after.

Subsequently the patient should be instructed to report herself monthly for a year, and at once if any unusual hæmorrhage occurs. This is on account of the risk of chorion-epithelioma malignum developing. (See p. 394.)

Amnion

Hydramnios (*Syn.*—Polyhydramnios).—This is a condition in which there is an excess of liquor amnii. In normal cases the actual quantity of fluid varies, but three pints (nearly two litres) is about the upper limit of what can be considered normal, and anything above that constitutes hydramnios. The frequency of the condition is about one in 200 cases. It is relatively more common in multiparæ, and in twin pregnancies.

In nature the fluid does not differ materially from normal liquor amnii.

Etiology.—Very little is actually known as to the causes, but it is found in association with a great many different conditions both of the fœtus and the mother. Amongst maternal conditions may be reckoned diseases of the heart, lungs, liver, or kidneys that tend to produce venous congestion, as well as conditions which tend to produce serous effusions in other serous sacs, *e.g.* nephritis, blood dyscrasias, etc. Amongst fœtal causes the more evident are those that cause obstruction to the fœtal circulation, such as abnormalities, knots, or excessive torsion of the cord, or diseases of the placenta or amniotic membrane. It is frequently associated with fœtal deformities, such as anencephalic or other monsters, hydrocephalus, spina bifida, cleft palate, hare lip, club foot, etc. It is common with twins, especially uniovular twins; and the fact that in such cases the excess is often confined to one sac only, indicates that in them the cause is presumably fœtal.

Symptoms and Signs.—The symptoms are solely due to pressure by the enlarged uterus on the abdominal and thoracic organs—dyspnœa, palpitation, indigestion, pain in the abdominal muscles, swelling of the lower limbs, and sometimes albuminuria from pressure on the renal veins.

The physical signs usually appear about half-way through pregnancy—excessive size of the uterus, free ballottement, but no fœtal heart sounds, as they are damped down by the intervening fluid.

Varieties.—The acute form in which the enlargement comes on suddenly within a day or two is rare. The symptoms are correspondingly more acute. The chronic form is much the commoner. It may occur early, about the fourth month, in which cases it is very often found to be associated with uni-ovular twins. More frequently it appears after mid-term, when it may be associated with any of the forms of fœtal deformity mentioned. In any case it is the exception for any very marked degree of hydramnios to be associated with a perfectly normal and healthy child.

Hydramnios tends, probably by over-distension of the uterus, to bring about abortion or premature labour. Not infrequently the child is born dead.

Diagnosis.—It must be differentiated from—

(1) Twins—fœtal parts and heart sounds will be detected. The two conditions are frequently present together.

(2) Parovarian or ovarian cyst, with or without pregnancy. Hydramnios causes a more rapid enlargement. The uterus is drawn up, not low in the pelvis as in cases of ovarian tumour. The uterus gives alternate contractions and relaxations.

(3) Pregnancy with ascites. This can be eliminated by percussion in different postures.

(4) Full bladder with retroversion of the gravid uterus. If in doubt, pass a large male catheter.

(5) Hydatidiform mole (*q.v.*).

Prognosis.—The risks to the mother are rupture of the uterus (rare), exhaustion both before and during labour, and post-partum hæmorrhage due to previous over-distension of the uterus; frequent malpresentations and a greater incidence of eclampsia add to the maternal risk. The fœtus is liable to be deformed. The frequency of premature labour, of malpresentations, and of prolapse of the cord, increase the risk to its life.

Treatment.—In most cases this is purely expectant, individual symptoms being treated as they arise. A firm, broad abdominal binder makes the patient more comfortable. In acute cases, or in chronic ones where the patient's health is

being menaced (*e.g.* by severe dyspnœa, lack of sleep, albuminuria) labour should be induced by the ordinary methods. If the child is not viable, or is believed to be dead, the membranes may be ruptured by the passage of a sound. The sound should be passed up between the membranes and the wall of the uterus for some distance before the puncture is made, in order to ensure the *slow* escape of the liquor. Rapid escape may produce cardiac failure, prolapse of the cord, malpresentation, premature detachment of the placenta with hæmorrhage and death of the fœtus. The labour is apt to be slow owing to the exhaustion of the uterine muscle, and post-partum hæmorrhage is a particular risk.

Oligohydramnios.—This is the opposite of polyhydramnios, namely, a deficiency of liquor amnii. It is very rare, and its pathology is obscure. It is often associated with adhesions of the amnion to the surface of the fœtus, and deformities of the fœtus. Labour is usually slow and complicated.

Umbilical Cord

Knots may be *true* or *false*. The former are caused by the fœtus slipping through loops of the cord during its movements in the uterus. They may be drawn so tight as to interfere with the circulation and lead to fœtal death. False knots are simply localised accumulations of Wharton's jelly, and have no significance.

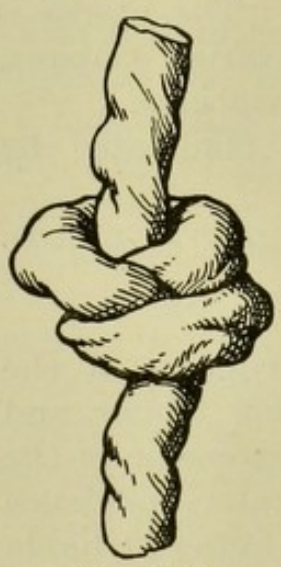


Fig. 155. True knot on umbilical cord.

The cord is very frequently found to be wound once or twice round the neck or body or limbs of the fœtus at birth.

Excessive *torsion* of the cord is an occasional cause of obstruction to the fœtal circulation.

Extremes of length of the cord may be seen —up to four or five feet (1·3 to 1·5 m.), or as short as two or three inches (5 or 7 cm.).

Abnormal insertion of the cord is not infrequent. Thus the cord may be inserted into the placenta at the very edge of that organ—the so-called *battledore* insertion. More rarely it is inserted into the membranes an inch or two away from

the edge of the placenta, the umbilical vessels running in the membranes to join the placenta. This is called a *velamentous* insertion, and if the vessels become torn across when the membranes rupture, the fœtus may bleed to death before its birth.

Œdema of the cord is often met with in cases of dead and macerated children.

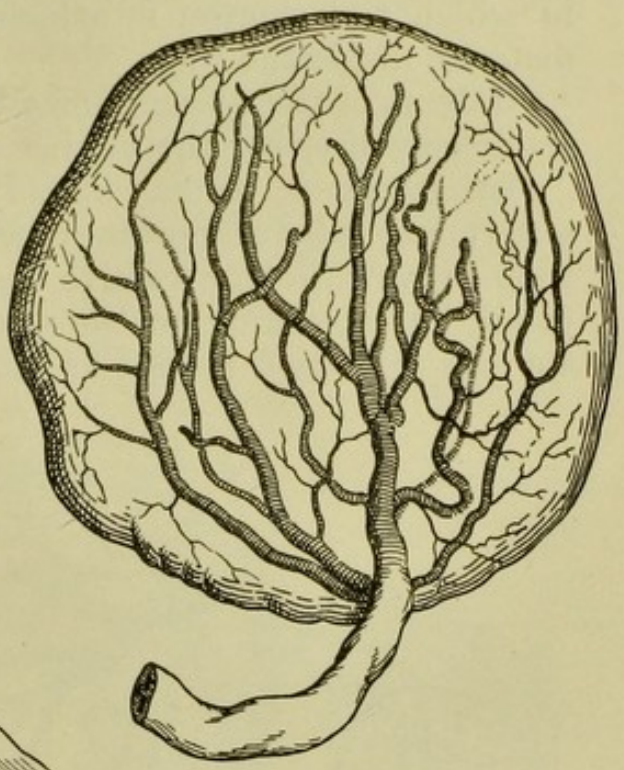


Fig. 156.—Battledore placenta. (From a specimen in Obstetrical Museum, University of Edinburgh.)

Placenta

Malformations.—The placenta may be divided into two or even three definite lobes—*bipartite* or *tripartite* placenta. A malformation of great practical importance is a *placenta succenturiata*, an accessory lobule developed apart from the normal placenta by the persistence of some chorionic villi in the chorion læve. Its circulation is derived from the main placenta, the vessels running across to it in the membranes. Such a placenta is liable to be left behind in the uterus when the main placenta comes away, and it may then either cause secondary post-partum hæmorrhage, or, if it decomposes, give rise to sapræmia.

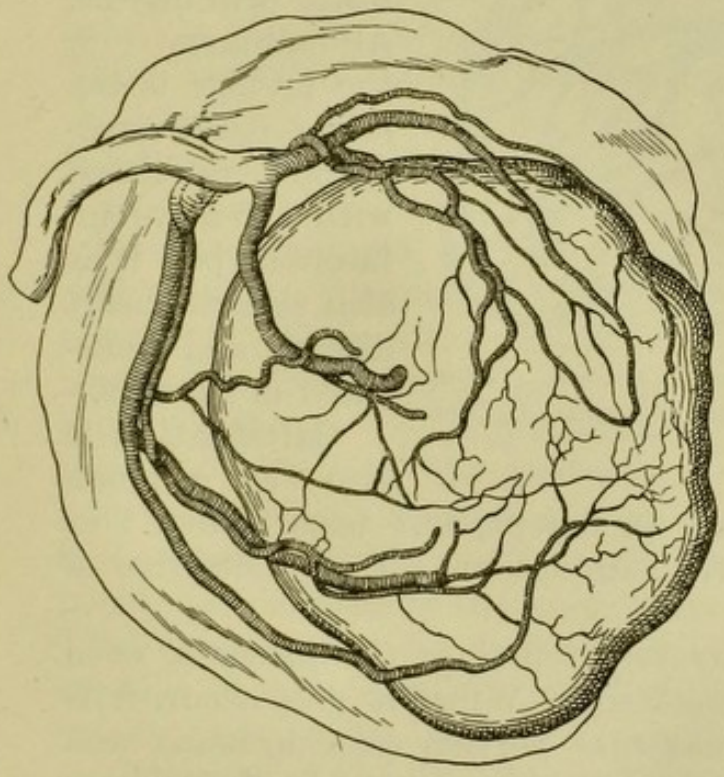


Fig. 157.—Velamentous insertion of the cord. (From a specimen in the Obstetrical Museum, University of Edinburgh.)

An excessively thin and correspondingly large placenta is called a *placenta membranacea.* A *placenta marginata* is one in which the chorion is attached all round it at some little distance inside the edge.

Œdema of the placenta may be a marked feature in dropsical conditions of either the mother or the fœtus.

Infarction is, as has already been pointed out (p. 74), to a moderate extent a normal change. In pathological conditions it is present to an excessive degree. The process is the same in all, but according to the stage at which the process is seen we may find dark masses of blood, or as the colouring matter becomes absorbed and fibrinous organisation occurs, brown and later yellowish-white firm masses. Albuminuria in the mother is the most usual condition associated with extensive infarction, but it is also seen in heart disease, and sometimes in syphilis.

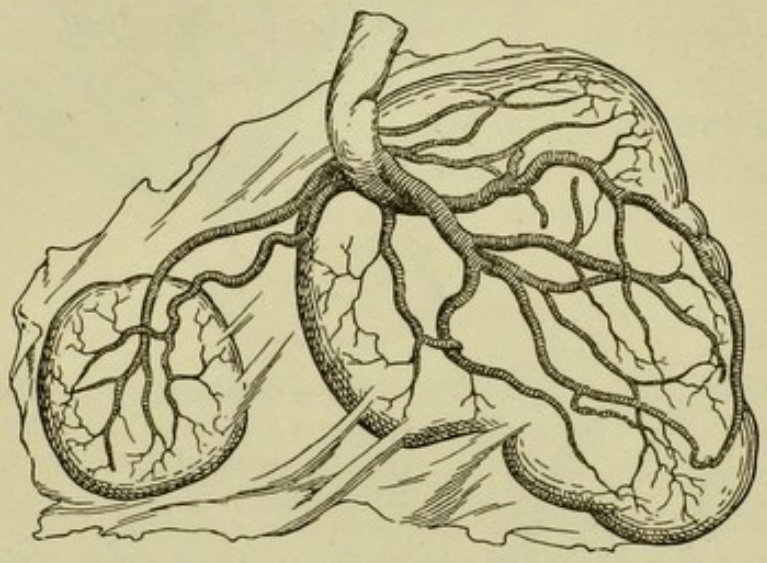


FIG. 158.—Placenta with succenturiate lobe. (From a specimen in the Obstetrical Museum, University of Edinburgh.)

Calcification is also a common appearance, varying greatly in extent, but usually found as very small nodules scattered throughout. It is indicative of senility of the placenta.

Tuberculosis.—This is rarely found in the placenta, even in women with advanced phthisis. When it does occur, it is usually confined to the maternal portion (the decidua), and only very seldom found in the villous portion. In these latter rare cases, however, tuberculosis may be a direct inheritance.

Syphilis.—It is important to be able to recognise syphilis in the placenta and in the fœtus, as a diagnosis can then be made and treatment of the parents instituted in spite of a possibly dubious history.

A syphilitic placenta is large, pale, often greasy looking,

and œdematous. Owing in great part to the malnutrition of the fœtus, the relative weights of the placenta and fœtus are greatly modified. The normal relationship of placenta to fœtus is about 1 to 6, but in syphilis it may be as much as 1 to 3.

On teasing out the villi under water, they appear thick and stumpy, and this is borne out on microscopical examination. The villi are fewer in number and thickened.

The vessels, few in number, are thickened with arteritis, and in some cases the lumen is obliterated. The stroma of the villi is densely infiltrated with round cells.

These changes explain the impairment of function in a syphilitic placenta, which is one of the ways in which the disease leads to the death of the fœtus.

It is convenient to take up here the syphilitic appearances in a dead-born fœtus, or one that dies shortly after birth. The fœtus is small, badly nourished, the skin wrinkled, and the facial expression like that of an old man. There may be a bullous eruption on the hands and feet, and large flakes of skin may be peeling off in a dead-born child. The liver and spleen are enlarged, and studded with miliary gummata. Microscopically they show marked cirrhosis. Spirochætæ may be readily found by appropriate methods. A very characteristic and easily demonstrated change is the osteochondritis at the epiphyseal lines at the ends of long bones, *e.g.* the head of the tibia or the lower end of the humerus. This line is normally smooth, white, and evenly curved. In syphilis it is thickened, irregular in outline, dirty yellow in colour, and sometimes contains small abscesses.

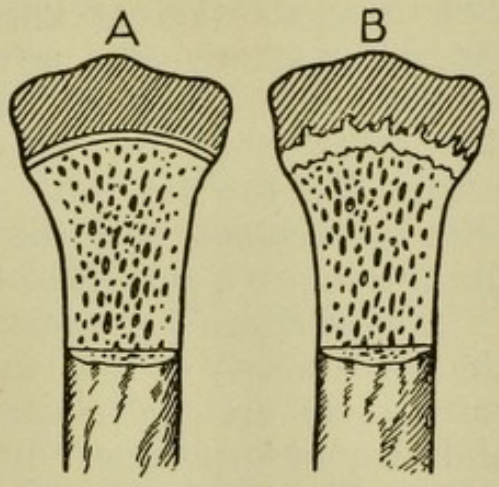


FIG. 159.
A, Normal, and B, Syphilitic epiphyseal lines.

Tumours of the Placenta.—These are very rare. In almost every case they are angiomata of the chorionic villi. They may be single or multiple. In a number of cases they have been associated with hydramnios. Cysts under the chorion are occasionally found. They have no obvious significance.

CHAPTER XXVI

PREMATURE INTERRUPTION OF PREGNANCY

(*Syn.*—Abortion or Miscarriage, Premature Labour.)

The terms abortion and miscarriage refer to the interruption of pregnancy at any time previous to the attainment of viability by the fœtus, *i.e.* before the sixth or six and a half months. Thereafter, until full time, the term premature labour is used. To the lay mind the word "abortion" suggests a criminal element, and the term miscarriage should be used in speaking to a patient or her friends.

A miscarriage is a miniature labour, and the later it occurs the more nearly does it resemble a full time labour. In all cases there are two stages recognisable—that of dilatation and that of expulsion. In late miscarriages and premature labours the third stage of separation of the placenta is also distinguishable.

In the first two months the entire contents of the uterus are frequently cast off in one mass. In such a case the deciduæ vera and basalis may form a roughly triangular cast of the uterus, and when this is opened, the decidua reflexa will be seen surrounding the tiny ovum. In these cases the uterine surface of the decidua is rough and shaggy, while the surface next the cavity is smooth. The blood clots must be carefully washed away before these points can be made out.

In other cases the decidua reflexa is torn through, and the embryo surrounded by the unruptured amnion and chorion, or sometimes only by the amnion, is expelled, the decidua following later.

From the third month onward the expulsion of the fœtus

with its membranes intact becomes more and more rare. What usually happens is that the fœtus and liquor amnii are expelled, and the membranes, decidua, and placenta follow later. But as the young placenta develops, there is an increasing tendency for portions of it to remain behind, so that the abortions tend particularly in the third, fourth, and fifth months to be what is termed *incomplete*.

Abortion is said to occur most frequently about the third month. This is because the decidua is extremely vascular in these early months, and the attachments of the ovum are still slender and not fully formed. It is most liable to occur at times corresponding to the suppressed menstrual periods, owing to the increased congestion and greater reflex irritability of the uterus at these times. It is more common in multiparæ than in primiparæ, especially in those who have had a rapid succession of pregnancies.

Frequency.—Very early abortions rarely come under the notice of the physician, and are frequently overlooked by the patient herself. Any estimate of the frequency of abortion must therefore be more or less speculative. But it is generally agreed that 15 per cent of all pregnancies is not too high a figure—that is to say, that every sixth or seventh pregnancy ends in abortion. There are comparatively few married and fertile women who escape without at least one miscarriage.

Etiology.—The contractions of the uterus, which lead to the premature separation of the ovum and its expulsion, may be excited in three ways: (1) By hæmorrhage into the decidua; (2) by death of the embryo or fœtus; (3) by conditions acting upon the uterine centre in the spinal cord.

1. Hæmorrhage may occur into the decidua, or into the fœtal membranes, or amongst the delicate growing attachments of the young ovum. The extravasation of blood (*a*) causes a certain amount of separation of the ovum, (*b*) in many cases leads to its death, and (*c*) the clotted blood acts as a foreign body and sets up reflex contractions of the uterus.

2. Death of the fœtus or embryo may be due to hæmorrhage destroying its vital connections with the decidua, as has just been mentioned, or it may be due to disease or malformation of some portion of the fœtus or its membranes or attachments.

These two conditions, either separately or together, account for the great majority of abortions.

3. In some cases the uterine centre is stimulated, not from the uterus itself as in the preceding cases, but from some other direction. In this way may be supposed to act strong purgatives, "abortifacient" drugs, traumata, surgical operations on other parts, excessive fatigue, violent emotions and the like. In some of these cases an abrupt alteration in the blood pressure may lead to decidual hæmorrhage, but for the most part they may be regarded as exciting the uterine centre in the spinal cord. It must be borne in mind that the "irritability" or reflex excitability of the uterus varies greatly in different individuals. One woman will come through a serious railway collision without her pregnancy being interrupted, while in another a mere stumble while walking may be enough to produce abortion.

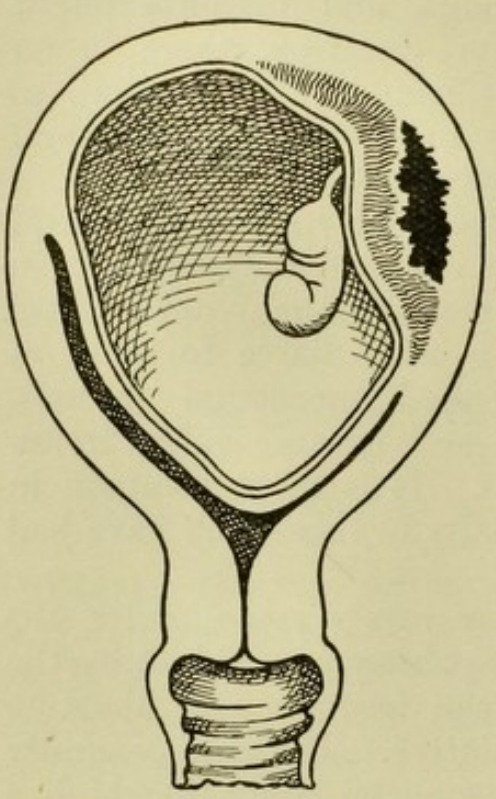


FIG. 160.—Hæmorrhage into the decidua causing abortion.

Predisposing Causes.—These are legion, and it is impossible to discuss them individually. A little consideration will show that they all lead to one or more of the three immediate causes mentioned above. Most of them tend either to the destruction of the fœtal life, or to hæmorrhage, by producing a congested decidua or affecting the health of the vessel walls. They may be classified as follows:—

Paternal.—Syphilis, and other toxic states.

Maternal.—

(*a*) *General:*

Toxic states—

Syphilis,	Fevers,
Tubercle,	Lead poisoning,
Toxæmia of pregnancy,	Malaria, etc.

Diseases affecting the circulation—

Heart disease,	Kidney disease,
Liver disease,	Lung disease.

Ecbolic drugs. Excessive fatigue, or emotion.

(*b*) *Local:*

All causes of acute and chronic pelvic congestion—
Malformations of the uterus.
Displacements, especially retro-displacement.
Metritis.
Endometritis.
Salpingitis.
Tumours.
Trauma.
Sexual excess.

Criminal induction.

Fœtal.—Anything leading to death of the fœtus, as diseases or deformities of the fœtus, placenta (especially low insertion, placenta prævia, and extensive infarction as often found in albuminuria), membranes, cord, or liquor amnii (*e.g.* hydramnios).

The relative frequency of all the predisposing causes of abortion is said to be—(1) Endometritis; (2) Retrodisplacement; (3) Syphilis; (4) Toxæmia of pregnancy; (5) Criminal induction; (6) Low insertion of the placenta.

Symptoms and Signs.—These are four in number:—

(1) *Hæmorrhage.*—This is usually the first to appear. It begins as a slight discharge in most cases, and becomes more profuse as the abortion proceeds. After the uterus has expelled its contents the bleeding ceases.

(2) *Pains.*—These are miniature labour pains in typical cases—situated in the small of the back and passing round to the front, and being intermittent in character. They begin gently and become progressively more severe until the abortion has been accomplished.

(3) *Dilatation of the os uteri* usually follows the onset of pains, but in some cases the os may be found open on examination immediately after the pain has begun. When the uterine contents have been entirely expelled the os closes again just as after labour.

(4) *Protrusion and Expulsion of the Contents of the Uterus.*—When this occurs there remains no possibility of averting the abortion. Occasionally the ovum remains for some time in the cervical canal, the uterine contractions being too feeble

to expel it completely. This is spoken of as a "cervical abortion."

Diagnosis.—The first point to determine is whether the patient is pregnant. This may be done by the history and the signs and symptoms of early pregnancy. Abortion is then diagnosed by the presence of the above symptoms—pain, bleeding, dilatation of the os, and possibly protrusion of the ovum. In regard to differential diagnosis it is of the highest importance to exclude extra-uterine pregnancy and also hydatidiform mole, uterine polypus, and malignant disease. The diagnostic points are given under these respective heads.

Having diagnosed abortion, it may be possible to distinguish the exact variety with which one is dealing.

Varieties.—Abortions have been arranged in different varieties from more than one point of view. From the etiological point of view they fall into two groups, *Spontaneous* and *Induced*, and the latter may be further subdivided into *Therapeutic* and *Criminal*. From the clinical point of view abortions are regarded as *Threatened* (where it seems possible to stop the process by appropriate treatment) and *Inevitable* (where the process cannot be stopped). When the abortion proceeds it falls either into the category of *Complete* abortions, if the uterus empties itself entirely, or of *Incomplete* abortions, if portions of the products of gestation are retained. A last variety is what is called *missed* abortion. These may be represented in a scheme as follows :—

- Abortion
  - Spontaneous
    - Inevitable
      - Complete.
      - Incomplete.
    - Threatened.
    - Missed.
  - Induced
    - Therapeutic.
    - Criminal.

Threatened Abortion may be diagnosed when the symptoms are not severe—when the bleeding is not excessive, the pains infrequent and not severe. The best rule, indeed, is to regard every abortion as threatened until it can be definitely shown to be inevitable.

Inevitable Abortion.—Free bleeding and frequent and severe pains make it unlikely that the abortion will be averted, but the only thing which can be definitely regarded

as proving it to be inevitable is either the escape of the liquor amnii, or the protrusion of the ovum through the os externum indicating a considerable separation of the ovum.

Complete Abortion.—Where the fœtus with its membranes and the decidua has been expelled entire, as often happens in the first ten weeks, the abortion is *complete*, and the signs and symptoms promptly subside, while the involution of the uterus proceeds just as after labour. Inspection of what has come away is the best means of diagnosing a complete abortion. Failing that the diagnosis must rest on the cessation of the symptoms, the closure of the os, and the subsequent disappearance of all signs of pregnancy.

Incomplete Abortion is specially common from the tenth to the twentieth week owing to the firm attachment of the placenta. In these cases the membranes rupture and the fœtus escapes, but the placenta remains with at least portions of the membranes and decidua. The pains frequently cease after the fœtus is cast off, but the bleeding tends to go on, and the os remains patent. If the remaining contents are not either expelled spontaneously or removed within a few days, they are apt to decompose, and the discharge becomes offensive. The patient develops sapræmia, and the conditions are the same as a puerperal sapræmia (*q.v.*).

After the contents are removed the discharge soon ceases, and the os closes.

Missed Abortion.—This term is applied to cases in which the symptoms of abortion come on, but subside without anything having been expelled. This may recur once or twice, and ultimately after months the contents of the uterus are expelled in a state which shows that the fœtus died at the time of the first onset of symptoms. If this first onset of symptoms occurs after the placenta is developed, the fœtus and placenta are usually in a macerated condition, but sometimes they are dried and mummified. On the other hand, when the first onset of symptoms is during the first two months or so, the ovum, when ultimately passed, may be in the condition known as a *Carneous Mole.*

The history of the formation of a carneous mole is somewhat as follows :—At the time of the first onset of symptoms of threatened abortion a hæmorrhage occurs, tears some of the delicate attachments of the ovum, and kills it. The bleeding,

however, is not sufficient to stimulate the uterus to expel its contents, and the blood, percolating round the outside of the membranes, clots, and becomes more or less organised. Sometimes the blood gets in between the chorion and amnion, and clots in small lumps under the amnion. Subsequently the little embryo may either become entirely absorbed and disappear, or it may persist. Ultimately, it may be after many months, the "mole" is passed. If it be opened, it is found to be a mass of organised blood clot with remains of chorionic villi throughout it, and with a cavity inside it lined by a glistening membrane—the amnion — containing a few drops of clear fluid. At one point on the surface of the amnion is seen the tiny embryo hanging by a short cord, or sometimes only a tiny stub of cord is visible, the rest having been absorbed. (See Fig. 168.)

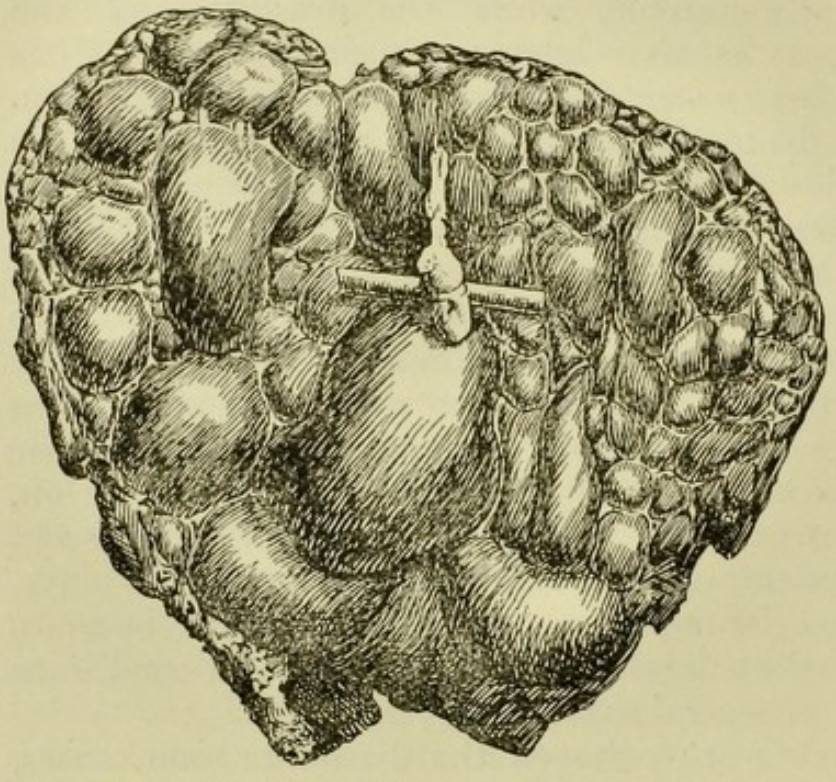


FIG. 161.—Carneous mole opened to show "tuberous" hæmatomata beneath the amnion. (Specimen in the Obstetrical Museum, University of Edinburgh.)

The embryo is seen hanging in front of the glass rod. The amnion is greatly enlarged in proportion to the embryo.

If the uterine contents are passed shortly after the death of the fœtus, before the blood has had time to be organised, the mass is called a *blood mole.*

In all cases of abortion it is most important to instruct the attendant or the patient to keep everything that is passed from the vagina. This is rarely done without specific instructions, and the diagnosis often hangs upon it.

Treatment

Prophylaxis.—This is of the greatest importance. It implies not merely the treatment of threatened abortions, but also that, when an abortion has taken place, the cause should be ascertained and treated, so that a subsequent pregnancy may not be similarly interrupted. Displacements of the uterus must be rectified, endometritis cured, syphilis treated, and so forth. During the next gestation particular care should be observed, especially at times corresponding to suppressed menstrual periods, and all causes of pelvic congestion avoided.

Treatment of Threatened Abortion resolves itself into absolute rest and the administration of sedatives—of which by far the most effective is opium in some form. The patient should be put to bed at once, and remain there with her head low, not seeing any visitors. A hypodermic injection of morphia may be given to bring the uterus rapidly under the influence of the sedative, and smaller doses of opium given by the mouth at intervals. Only the lightest and most digestible nourishment should be given, and very hot drinks should be avoided. If the bowels are loaded, they should be gently moved by an oil enema, or some mild laxative. This treatment should be maintained until the symptoms subside, and the patient should remain quietly in bed for a week after the bleeding has stopped, or preferably until the time that would correspond to the next menstrual period has passed. If the cause of the abortion is a retrodisplacement, it should be rectified, and a suitable pessary inserted. The patient should be warned not to indulge in freedom of exercise, and to avoid sexual intercourse, as hæmorrhage is apt to recur.

Treatment of Inevitable Abortion.—The active treatment of an ordinary case of inevitable abortion is—*nil*. If it be left alone, Nature will complete it without the risks always associated with interference. Interference is called for, (1) if the hæmorrhage is so severe as to endanger the patient's life; (2) if the ovum be actually protruding through the os; (3) if slight bleeding has been going on for weeks, and the patient is becoming ill; (4) if the abortion has been proved to be incomplete by inspection of what was expelled; (5) if constitutional symptoms appear, due to loss of blood or sapræmia.

The mode of interference depends upon the amount of dilatation of the os internum.

1. *If the os internum admits two fingers.*—Anæsthetise the patient and place her in the lithotomy position at the edge of the bed. Carefully cleanse the hands and the external genitals. Douche the vagina. Wearing sterile gloves, pass two fingers into the uterus, which should be fixed by the other hand placed on the abdomen and grasping it firmly. Pass the fingers above the ovum and withdraw them, peeling off the ovum as you do so.

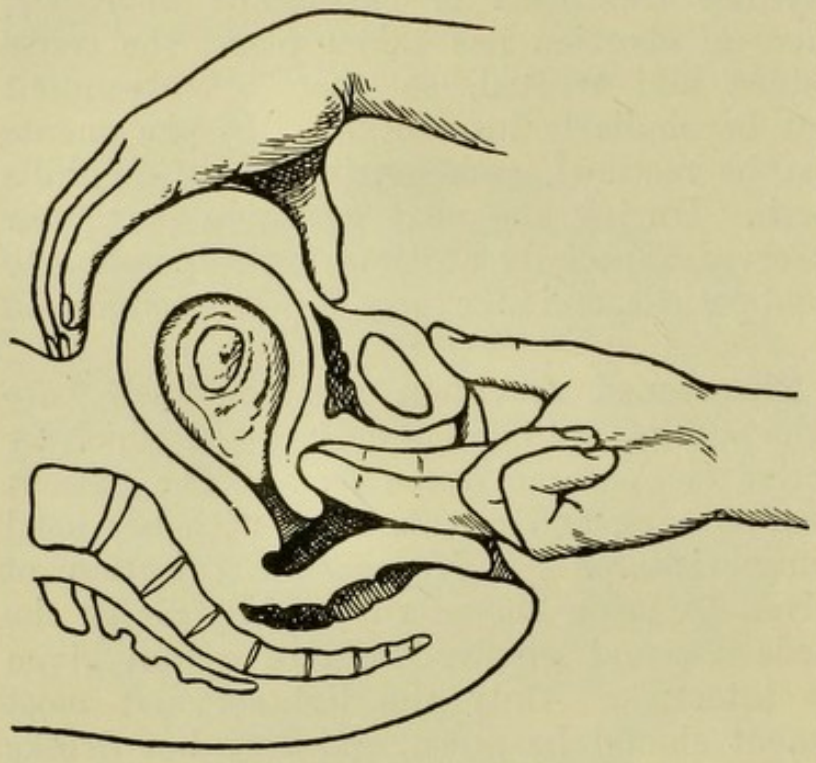


FIG. 162.—Expression of the ovum.

If you fail in this, thoroughly separate the ovum, and then, still firmly fixing the uterus against the pubes by the hand on the abdomen, pass the fingers into the anterior fornix (posterior if the uterus is retroflexed) and squeeze the uterus between the hand on the abdomen and the fingers in the vagina (Fig. 162).

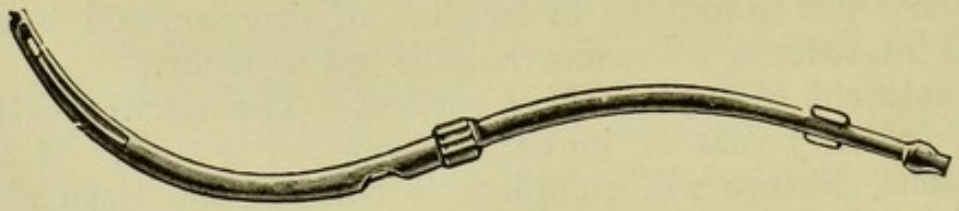


FIG. 163.—Fritsch-Bozemann double-channelled intra-uterine catheter.

This forces the contents out of the uterus. Repeat the manœuvre again and again until satisfied that the uterus is empty. Then wash out the uterus with a hot sterile solution or weak antiseptic by means of a double-channelled intra-uterine catheter. Finally, give a dose of ergot.

2. *If the os internum will not admit two fingers.*—Empty the bladder and douche out the vagina. With the patient in the lithotomy position grasp the cervix with a vulsellum or a bullet forceps, and draw it down. Pass a strip of gauze into the uterus as far as possible, and pack the cervix if possible. Plug the vagina tightly with gauze, or, better, damp sterilised cotton-wool tampons, packing the fornices tightly to begin with. Keep the plugs in by a perineal bandage fixed in front

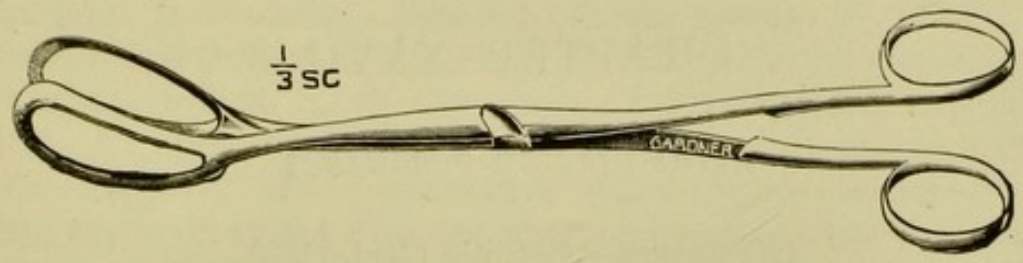


Fig. 164.—Ovum forceps.

and behind to an abdominal binder. Remove the plug after eight or ten hours. The ovum may be found lying on the top of the plug, but at any rate the os internum will be dilated enough to admit two fingers. Always douche the vagina after it has been plugged.

3. *Where the os is closed* and the bleeding is dangerously free, the os must be forcibly dilated at one sitting by Hegar's dilators, and the ovum removed by the finger and the flushing curette. The ovum forceps may also be used to grasp and extract, but the finger should be passed in afterwards to make sure that the uterus has been emptied. If there has

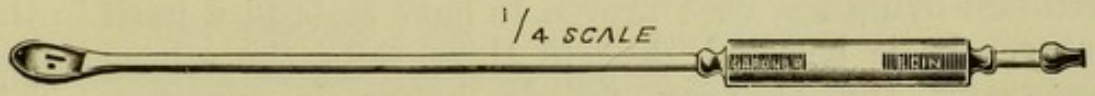


Fig. 165.—Rheinstädter's flushing curette.

been sapræmia in a case of incomplete abortion, the uterus should be washed out after its contents are scraped away by the finger, and finally swabbed out with a sound dressed with cotton wool and dipped in pure carbolic acid, tincture of iodine, or formalin.

Premature Labour.—The treatment of miscarriages in the sixth month, and of premature labour, differs in no essential from the management of an ordinary labour.

CHAPTER XXVII

EXTRA-UTERINE PREGNANCY

(*Synonym*—Ectopic Gestation).

In some exceptional cases the fertilised ovum engrafts itself on some part other than the mucous membrane of the body of the uterus. Such a pregnancy is called "extra-uterine" or "ectopic." According to the situation we may have Abdominal, Ovarian, and Tubal pregnancy.

Abdominal Pregnancy.—The primary engrafting of the fertilised ovum on the peritoneum of the abdominal cavity is a theoretical possibility. One or two cases have been claimed as examples of it, but the proof has not been such as to establish them beyond doubt. Secondary abdominal pregnancy is a well-recognised stage in tubal pregnancy.

Ovarian Pregnancy.—In quite a number of cases the fertilised ovum has been proved to have embedded itself in the ovary. It is believed that in these cases the spermatozoon penetrates the Graafian follicle before it ruptures. This condition is very rare, and, clinically, does not differ from tubal gestation.

Tubal Pregnancy.—This is much the most frequent form of extra-uterine pregnancy, and the only one that need be considered here. It is subdivided into four varieties, according to the part of the tube upon which the ovum engrafts itself — Interstitial, Isthmic, Ampullar, and Infundibular. Of these the interstitial is much the rarest, and the ampullar and isthmic the most common. It may just be mentioned in passing that the occurrence of pregnancy in the rudimentary

horn of a bicornate uterus is, clinically, very much the same as a tubal pregnancy.

Etiology.—It will be remembered that normally the ovum is believed to be fertilised near the ovarian end of the tube, and that it takes several days thereafter to reach the uterus. During that time it is developing, and, by the time it reaches the uterus, it has reached a stage of development at which the trophoblast is capable of eating into other tissues, and so embedding the ovum. Bearing these points in mind, it becomes obvious that if the ovum is delayed in its passage to the uterus, it may reach the stage of development requisite for it to be able to embed itself while it is still in the tube. If this happens, the trophoblast, which is no respecter of tissues, proceeds to eat into the mucous membrane of the tube, and so embeds the ovum in the tube wall instead of the uterine wall.

Accordingly, any condition which obstructs or delays the passage of the ovum to the uterus, but at the same time does not impede the spermatozoon in reaching the ovum, may be regarded as a potential cause of tubal gestation. Such conditions may be divided into *congenital* and *acquired*. Amongst the former are (1) excessive length, or (2) excessive tortuosity of the tube, as well as (3) the occasional presence of blind diverticula or false passages amongst the complex folds of the tubal mucosa. The acquired causes include (4) previous salpingitis which partially destroys the mucous membrane, forms blind diverticula by fusion of folds in the mucous membrane, and interferes with the muscular contractility of the tube by sclerosis; (5) pelvic peritonitis, by causing adhesions and kinking; (6) tumours of the tube itself, or of adjacent organs, which occlude the lumen by pressure. In many cases, however, no obvious cause can be found.

Tubal pregnancy is more often found in women over thirty than under it. In a number of cases there has been a period of several years' sterility immediately preceding, which indicates a probability of some inflammatory mischief. Amongst the curious possibilities recorded in connection with the condition are the recurrence of tubal pregnancy in the same patient, the coexistence of extra- and intra-uterine gestations, the presence of twins in a tubal gestation, and the coexistence of two tubal pregnancies.

Pathology.—The process of embedding is the same as in the uterus. The ovum, by virtue of its trophoblast, eats its way into the substance of the mucous membrane, and forms its implantation cavity in the ordinary way. Usually the mucous membrane is so thin that the ovum eats its way partly into the muscle. The portion of mucous membrane shutting the ovum off from the lumen of the tube is called the capsular membrane and corresponds to the decidua reflexa. While the ovum is attaching itself to the walls of its implantation cavity, the mucous membrane attempts to form a decidua. In this it rarely succeeds. Small clumps of decidual cells may be seen in the neighbourhood, but there is never anything like the change that occurs in the endometrium in a uterine pregnancy. On the other hand a decidua forms in the uterus in all cases, and instances have even been recorded of decidual cells being found in the opposite tube.

This failure to develop a decidua in the pregnant tube is of great importance, for the decidual cells are believed to have a supporting function, and to enable the tissues to resist or control the destructive action of the trophoblast. The results of their absence in the tube are (1) that the muscular structure of the tube wall becomes unduly loosened and opened out, (2) large blood-vessels may be eaten into, and (3) the placenta consists mainly of fœtal villi which have no strong hold on the maternal tissues. These three results explain three dangers to which a tubal pregnancy is peculiarly exposed, namely, rupture of the surrounding tube wall, hæmorrhage, and separation of the ovum.

As the ovum grows the tube attempts to hypertrophy, but its powers of growth are meagre, and very soon the expansion of the tube comes to be at the expense of the thinning of its wall. In most cases the fimbriated mouth of the tube becomes closed about the eighth week in much the same way as in a hydrosalpinx.

While these changes are going on in the tube, the uterus in the vast majority of cases enlarges. It does not do so, however, as rapidly as in an intra-uterine gestation, and rarely becomes larger than what would correspond to a three months' pregnancy. The endometrium shows a decidual change, and becomes thick and spongy. This decidua may be cast off at any time during the pregnancy, but most frequently it comes

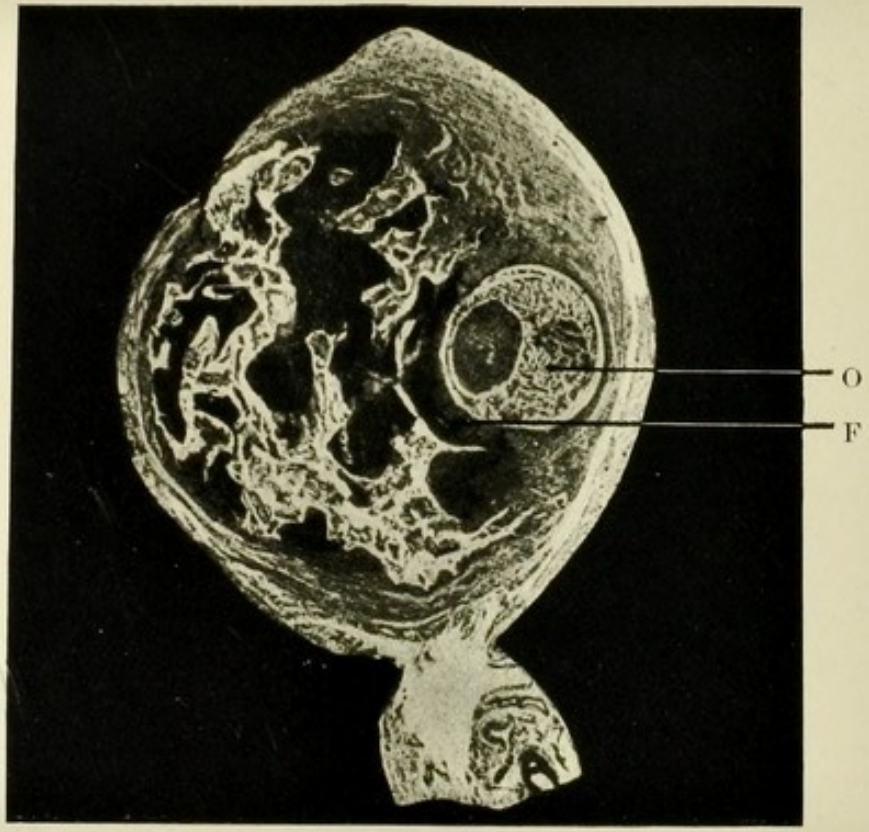


FIG. 166.—Transverse section of pregnant tube (Wade and Watson).

The lumen of the tube is intact and filled with catarrhal debris. It is separated from (O), the implantation cavity containing the ovum and chorionic villi, by (F), a "capsular membrane" consisting mainly of fibrin.

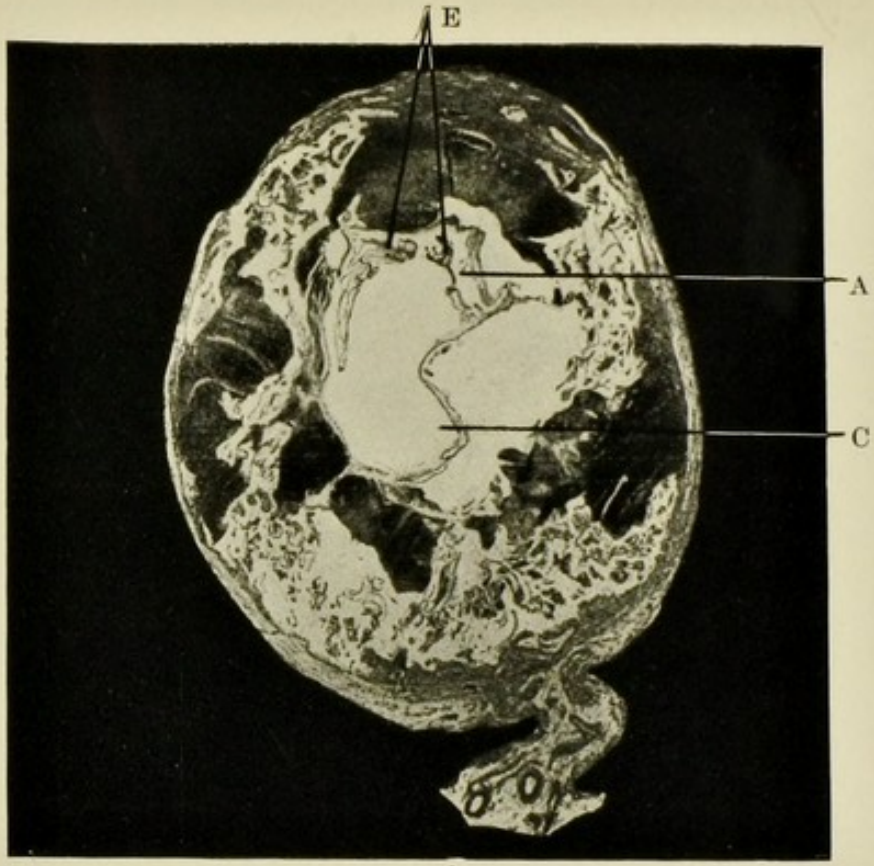


FIG. 167.—Section of same tube through the centre of the gestation sac, which has entirely obliterated the lumen (Wade and Watson).

E is the embryo, A the amniotic cavity, and C the chorionic vesicle. The rest of the tube is filled by chorionic villi and blood.

away at the time of rupture, or at term if the gestation lasts so long. In some cases it comes away in one piece, forming a perfect cast of the uterine cavity. In others it comes away in small pieces or shreds along with the hæmorrhages that are so symptomatic. Both to the naked eye and microscopically it is quite similar to the decidua vera of a normal pregnancy, the uterine surface being shaggy, while that next the cavity is smooth. The detection of portions of decidua is often of some diagnostic importance.

Subsequent Course and Possible Terminations.—In what follows the ampullar variety of tubal pregnancy will be described, and any points in which the other forms differ will be mentioned later.

There are three possible terminations that require discussion. These are (1) Tubal Abortion or Intra-tubal Rupture, (2) Extra-tubal Rupture, (3) Continuance to Term.

Tubal Abortion or Intra-tubal Rupture is the most frequent termination to the life history of a tubal pregnancy. It has already been explained that the conditions are peculiarly favourable to its occurrence. Hæmorrhage occurs, the ovum becomes separated, and the tube stimulated to contractions in exactly the same way as the uterus in a uterine abortion. The ovum breaks through the capsular membrane into the lumen of the tube, and the contractions propel it along to the fimbriated opening and eject it into the peritoneal cavity. This is a *complete* tubal abortion, and can only occur as long as the fimbriated opening is patent, *i.e.* in the first two months. Much more commonly the abortion is *incomplete*, the ovum remaining in the lumen of the tube in whole or in part.

If the original hæmorrhage be small in amount and gradual in onset, the blood may percolate round the ovum, destroying its attachments and killing the embryo, without stimulating the tube to expel it. In this way a blood mole may be formed, exactly analogous to a blood or carneous mole in the uterus. It is spoken of as a *tubal mole*. A tubal mole may also be formed in an incomplete tubal abortion where the ovum is detached but remains in the tube. If the bleeding continues the mole grows larger and larger, and may ultimately be expelled by the completion of the abortion or by rupture of the tube. On examination a tubal mole is seen to be much the same as a uterine carneous mole—blood clot, partly

organised in some cases, with a small amniotic cavity in which the embryo, if not absorbed, is seen lying.

The occurrence of tubal abortion is accompanied by pain, and hæmorrhage into the tube, and through it to the peritoneal cavity. If the abortion becomes complete, the mouth of the tube contracts, the bleeding stops, and the tube returns to an apparently normal condition. If the abortion be incomplete, or if a mole be formed, there is generally a constant drip of blood into the peritoneal cavity, forming a large clot or *hæmatocele* round the mouth of the tube.

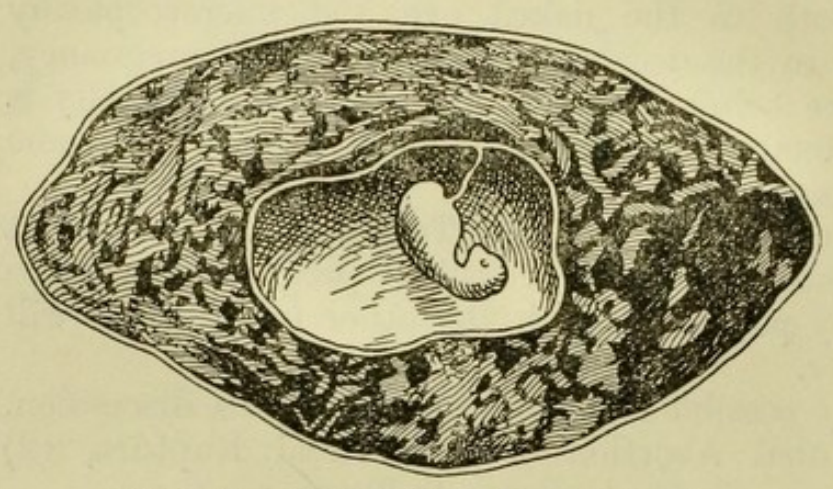


FIG. 168.—Section through a tubal mole.

Tubal Rupture.—If abortion or intra-tubal rupture does not occur, the tube will almost certainly burst. The weakening of the tube wall by the action of the trophoblast and the thinning of it have already been mentioned. It is probable that the actual bursting of the tube is due, not to the gradual thinning of the wall or the gradual growth of the ovum, but either to the action of the syncytium of the trophoblast eating right through the wall, or to the sudden occurrence of hæmorrhage. The weakened wall is not able to resist any such sudden increase in its contents as a hæmorrhage causes.

On the other hand, the rupture is sometimes caused by violence, and it is important to remember that a vigorous or careless bimanual examination may lead to this disaster.

The rupture may either be into the peritoneal cavity or between the layers of the broad ligament — *intra-peritoneal* or *intra-ligamentous.* The former is vastly the more common.

Intra-peritoneal rupture is accompanied by severe bleeding into the abdominal cavity which may easily prove fatal to the mother. In some cases the entire ovum is expelled through

the rent into the peritoneal cavity, the fœtus being killed. In others the separation is not complete, but is sufficient to destroy the fœtus. Rupture of the amnion is fatal to the fœtus, as it allows it to escape into the abdominal cavity unprotected. If the mother does not succumb, the pregnancy may in a few instances continue as a "secondary abdominal pregnancy." This can only happen when rupture has occurred at a point removed from the placental site, and enough of that organ remains attached to supply the wants of the fœtus.

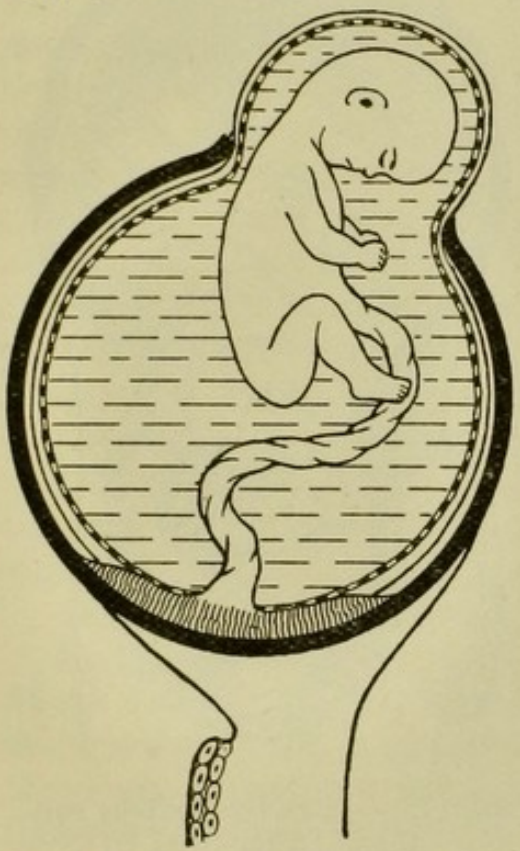


FIG. 169.—Intra-peritoneal rupture. (After Giles.)
Fœtus may live.

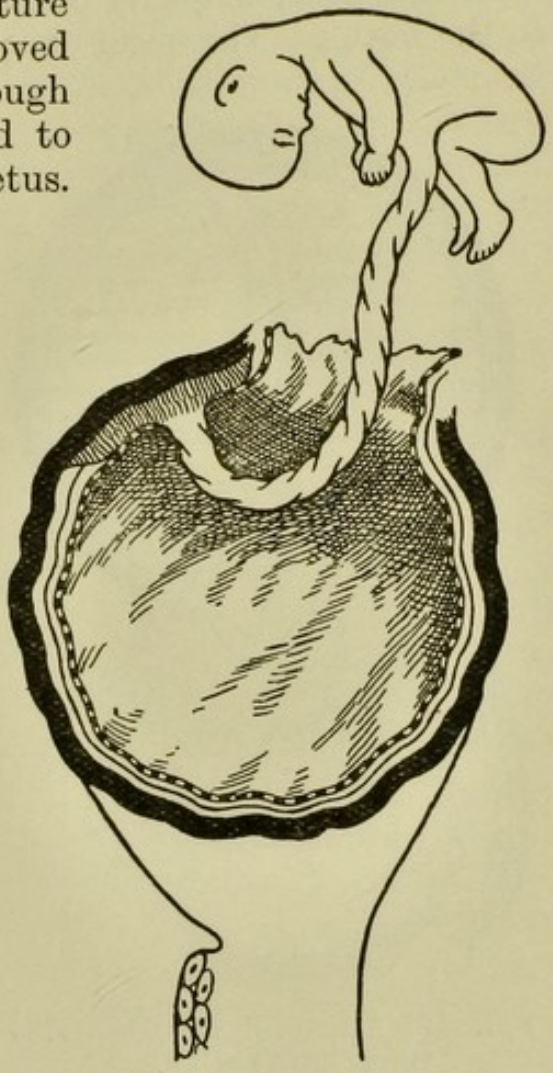


FIG. 170.—Intra-peritoneal rupture. (After Giles.)
Fœtus dies.

The fœtal membranes gain a covering by organisation of the lymph poured out, and from adhesions to the intestines and other organs. In such a case the pregnancy may go on to term.

If the rupture be intra-ligamentous, the broad ligament tends to limit the hæmorrhage, and thus the mother may have more chance of surviving. The fœtus runs the same risks as

before. If, however, both survive, the pregnancy continues between the layers of the broad ligament as a "sub-peritoneal," or "extra-peritoneal," or "ligamentous" pregnancy. As a rule continued growth leads subsequently to a second rupture into the peritoneal cavity, when again the fœtus may die, or continue as a secondary abdominal pregnancy.

In the great majority of cases the primary rupture is fatal to the fœtus. The most frequent time for the occurrence of

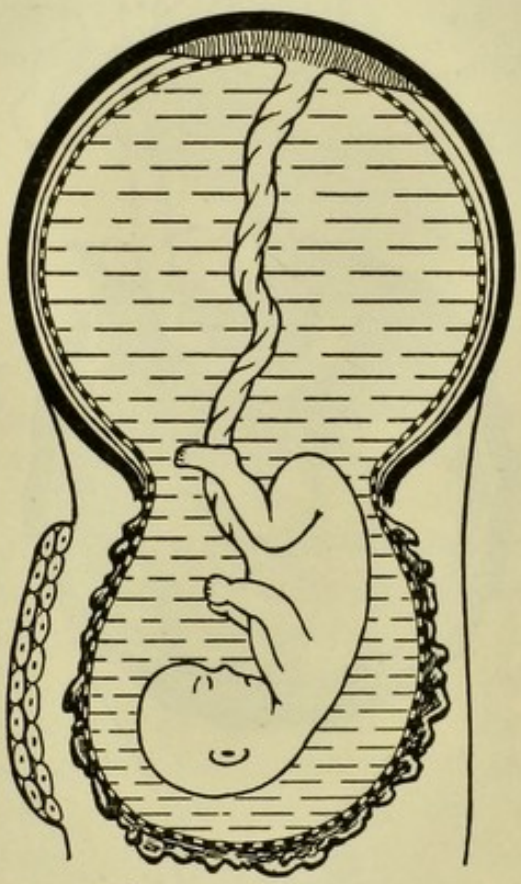


FIG. 171.—Intra-ligamentous rupture. (After Giles.)
Fœtus may live.

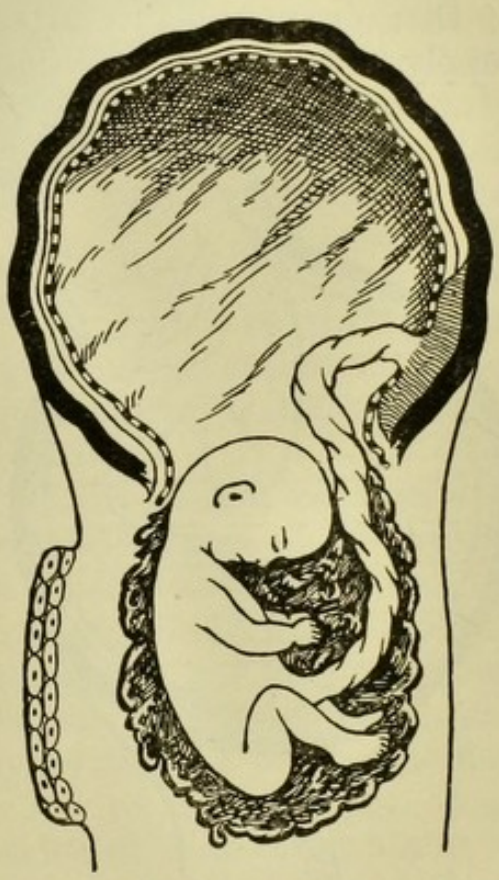


FIG. 172.—Intra-ligamentous rupture. (After Giles.)
Fœtus dies.

rupture is between the sixth and tenth weeks, but it may occur either earlier or later.

Continuance to Term.—This is the most rare termination. When it does occur it is generally a secondary abdominal pregnancy, having been preceded by a rupture which both mother and fœtus have survived. At term a "spurious labour" occurs, with severe abdominal pains, and the casting-off of the uterine decidua if that has not already occurred. The fœtus

dies during this process, but the meaning or cause of its death is not understood.

Sequels to the Death of the Fœtus.—If the death of the fœtus occurs in the early weeks, and is accompanied by tubal mole formation, the mole may be ultimately absorbed. Larger moles usually remain in the tube, and, if not removed by operation, very occasionally become infected from the bowel, and suppurate.

After the third month the fœtus is too large to be absorbed, and in such cases it may become infected, suppurate, and form an abscess, which ultimately opens into the rectum, abdominal wall, vagina, or bladder. Occasionally it becomes dried and mummified, or converted into adipocere, or infiltrated with lime salts and turned into a "lithopœdion." Instances are on record of a dead extra-uterine fœtus being retained in the abdomen for many years.

Special Varieties.—In *Interstitial* cases the ovum may abort into the uterine cavity, and continue to grow there. Otherwise the uterine wall expands and hypertrophies, and rupture occurs—frequently later than usual, although early rupture is by no means unknown. Owing to the great vascularity of the uterine cornu the rupture is very fatal.

Isthmic cases usually end in early rupture owing to the thinness of the tube at this point. Abortion is rare in this variety.

Infundibular pregnancy almost always ends in abortion.

Signs and Symptoms.—A. *Before Abortion or Rupture.*—There may be no symptoms at all. The woman may not even be aware that she is pregnant. But in the majority of cases there are symptoms which, though slight in themselves, are, like pre-eclamptic symptoms, of enormous importance as warnings of an impending disaster.

In the first place, there may be symptoms of early pregnancy. If the pregnancy has existed for a sufficient length of time, there may be a history of one or more periods missed. In a number of cases, however, there is no amenorrhœa, and in others it is masked by hæmorrhage from another cause. In some cases the bladder symptoms of early pregnancy are exaggerated. The sickness and other reflex symptoms may also be severe.

In the second place, there may be symptoms special to the

condition. These are two in number—hæmorrhage and pain. The hæmorrhage is due to contractions of the uterus squeezing the soft, unsupported decidua within it. It may occur as recurrent slight bleedings, but more usually it continues as a slight persistent brown or dark red discharge. In many cases it is looked on as menstruation or as symptomatic of a threatened or an incomplete uterine abortion, and the real cause is overlooked. Portions of the decidua may come away in this discharge, but this is not always the case. Still less is the passage of the entire decidua as a cast to be expected. Microscopic examination of decidual shreds may be of importance in the diagnosis from abortion, as the discovery of degenerated villi would indicate an intra-uterine pregnancy.

The pain is partly a referred peritoneal pain, due to congestion and stretching of the tube covering, partly a colic from contractions of the tube and uterus. It is sharp and colicky in nature, usually worst over the ovarian region on the affected side. Frequently it is accompanied by a feeling of faintness or nausea.

The physical signs on bimanual examination consist in the enlargement of the uterus, which is practically always present, and perhaps the softening of the cervix. At one side and rather behind the uterus is a swelling which is, in a typical case, round, rather elastic, pulsatile, and *usually tender*—the pregnant tube.

B. *At the Time of Abortion or Rupture.*—Clinically it is impossible to distinguish between rupture and tubal abortion. The patient is, without any warning, seized with severe cutting pain in the lower abdomen, and occasionally a feeling as of something having given way. This is immediately followed by severe collapse, fainting, deadly pallor, with a small, thready, frequent pulse. Death may ensue without any rallying, and before anything can be done. Physical examination of the pelvis immediately after the occurrence may reveal the same state of matters as before rupture. The presenee of free blood in the pouch of Douglas cannot be made out, but some hours later, when the blood has clotted, it may be felt as a doughy, semi-solid mass filling up the pelvis behind and to the sides of the uterus—a pelvic hæmatocele.

In some cases the symptoms are less sudden and less severe. In them it is usually found that there has been an incomplete

tubal abortion, and that the blood has formed a large clot encysted in a fibrinous covering around the mouth of the tube —a peritubal hæmatocele. Such cases are more favourable than those in which there is a sudden outpouring of blood into the abdominal cavity.

Diagnosis.—A very careful study of the history should be made, as well as a careful and gentle bimanual examination—under an anæsthetic if necessary. The condition may be mistaken for a small ovarian cyst with or without a co-existing pregnancy, for a fibroid tumour, or for a hydrosalpinx, or even a pyosalpinx. In all of these the history is generally different. Much more commonly, and with much graver results, the condition is confused with (1) uterine abortion, and (2) retroversion of the gravid uterus.

Uterine Abortion.—This condition and an early tubal pregnancy may have every symptom in common—signs and symptoms of early pregnancy, pain, hæmorrhage either irregular or as a continuous brown discharge, passage of shreds of decidua, enlargement and softening of the uterus. Munro Kerr states that 30 per cent of the tubal pregnancies he has seen had previously been taken for abortions. Careful examination will reveal the tubal swelling. The detection of villi in the decidual shreds proves a uterine pregnancy, but their absence proves nothing.

Retroversion of the gravid uterus is most likely to be confused with tubal pregnancy after rupture and the formation of a hæmatocele in the pouch of Douglas. In both cases there is the history of early pregnancy and the softening of the cervix. Behind the uterus there is an elastic swelling in both cases—the body of the uterus in the one, the hæmatocele in the other. Even before rupture the mistake may be made, the tubal swelling being taken for the retroflexed body. Careful bimanual examination will reveal the true condition.

Diagnosis of Rupture.—Unless the history indicates the condition, it may be impossible to make a more accurate diagnosis than that of internal hæmorrhage from the rupture of an abdominal organ. The rupture of a gastric ulcer or of the appendix may thus be mistaken for it, or *vice versa.* Torsion of the pedicle of an ovarian cyst may also be mistaken for the condition.

Happily the treatment in each case is the same—to open

the abdomen, find out the exact state of matters, and deal with it.

Prognosis.—As long as an extra-uterine gestation continues the prognosis is very grave, for at any moment a rupture may occur which may easily prove fatal. The risk of operation on an unruptured early pregnancy is slight in the hands of competent operators.

If rupture or abortion has occurred, the gravity of the prognosis varies with the severity of the symptoms and the promptitude with which skilled treatment can be obtained. Even under the best circumstances the prognosis must be very guarded.

Treatment.—A tubal pregnancy diagnosed before rupture should be removed by abdominal section at the earliest possible moment. After rupture has occurred the only treatment is still removal of the tube. The abdomen should be opened without delay, the bleeding points secured, and the tube removed. Recovery sometimes follows the operation in cases that appeared quite hopeless, and it may therefore be said that it is never too late to operate in this condition. So far as the operator is concerned, success probably depends on making the operation as brief as is consistent with efficiency, and on combating the shock and collapse.

Where an encysted hæmatocele has formed, it is not so absolutely necessary to operate, as the condition may clear up by absorption. This is a very slow process, however, and always open to the possibility of the clot becoming infected, so that the more rapid and satisfactory treatment by operation is usually preferred. In this case the operation need not be done in any immediate hurry.

Treatment of a tubal pregnancy that has gone beyond the early months—almost always a secondary abdominal pregnancy—is a very difficult matter, and very dangerous, owing to the probability that the placenta has made extensive vascular connections with the intestines or other organs. At a varying time after the death of the fœtus the placenta becomes thrombosed; it may therefore be safer to leave the case to go to term when a spurious labour will ensue and the child die. This apparent neglect of the fœtal life is justifiable owing to the serious risk to the mother of interference during the child's life, and to the fact that even full time

children in such circumstances are usually deformed and rarely survive. Some weeks after the spurious labour the abdomen may be opened, and the sac and its contents removed as far as possible. It is usually necessary to leave some of the sac, stitching it to the abdominal wound, and packing it. Convalescence in such circumstances is at the best tedious.

SECTION VI

PATHOLOGY OF LABOUR

CHAPTER XXVIII

FAULTS IN THE POWERS

Inertia of the Uterus is the somewhat misleading term applied to weakness and inefficiency of the uterine action. It may be either primary or secondary, and it is of the greatest practical importance to distinguish between the two.

Primary Inertia is present from the beginning of labour, and is due to some inherent weakness of the uterus. Amongst conditions that are said to predispose to it are—

1. Nervousness — frequently associated with primiparity, and particularly if the patient be very young or elderly.
2. Obliquity of the uterus.
3. Fulness of bladder or rectum.

These conditions appear to affect the proper innervation of the uterus.

4. Previous disease of the uterine wall, or the presence of fibroid tumours.
5. Overdistension of the uterus, as in hydramnios or twins.

The pains from the outset of labour are ineffective, the uterus not hardening to any extent, or perhaps contracting in parts only. Such pains may cause great suffering, but it must be remembered that the amount of suffering is no real criterion of the strength of a contraction. Sometimes the pains cease altogether, to return after some hours, or days, or it may be

even weeks. This last is what is known as "missed labour." On the other hand the labour may drag on for days, the pains coming very slowly. After the expulsion of the child the uterus is usually more equal to the work of the third stage.

As long as the membranes are intact, there is no danger in this delay. After rupture of the membranes the prolonged pressure may lead to death of the fœtus, and, after engagement of the presenting part, to pressure sloughing, and ultimately fistula formation in the soft passages.

Treatment.—If quite satisfied that the inertia is primary, and not secondary, reassure the patient and her friends. Have the rectum and bladder emptied if necessary, and correct any obliquity of the uterus. If the inertia persists give the patient some light nourishment, such as a cup of gruel or hot milk, and put her to sleep with morphia and scopolamine, or chloral and bromide. If the pains are still weak when she wakes up, try to stimulate them. Massage of the fundus, hot vaginal douches, or poultices to the lower abdomen may help. The newest and best remedy is the injection of a solution of pituitary extract. This is put up as a sterile solution in hermetically sealed glass capsules containing suitable doses ($\frac{1}{2}$-1 cc.) by various manufacturing chemists. Its effect is to stimulate the contractions and strengthen them without the risk of making them tetanic in nature, as may happen after large doses of ergot. Failing the above methods, dilatation of the cervix must be aided manually, and the child delivered artificially and not too rapidly by forceps. Particular care is needed in the management of the third stage, although hæmorrhage is not nearly so common as in secondary inertia.

Secondary Inertia comes after the labour has been in progress normally for some time. It is more common in the second and third stages than in the first. It may be due to the same causes as primary inertia, but is more usually an indication of exhaustion of the uterine muscle after a prolonged effort to overcome some obstruction. Such obstruction may be due to the size, position, or presentation of the child, or to some fault in the hard or soft passages. The all important point is to remember that to deliver the child with the uterus in this state is the worst possible treatment, as it is almost certain to be followed by severe post partum hæmorrhage. A flabby, exhausted uterus is not a danger

while the child remains inside it, but as soon as it is empty and the placenta begins to be separated the lack of proper retraction may readily permit a fatal bleeding.

Treatment.—The best treatment in all cases is to gain rest for the patient and her uterus by inducing sleep. Scopolamine and morphia, or chloral and bromide are most useful here. At the same time the cause of the obstruction (*e.g.* contracted pelvis, transverse presentation, etc.), if such is present, should be dealt with in the appropriate way. When the patient wakes up refreshed the pains will return with renewed energy, and the labour may then be treated in the way most appropriate to the particular circumstances. If the pains are still weak they should be stimulated by the means referred to in the preceding paragraph.

Tonic or Tetanic Contraction of the Uterus. — In an obstructed labour one of three things must happen: (1) The uterus may overcome the obstruction; (2) the uterus may fail temporarily, and, being exhausted, pass into secondary inertia; or (3) the uterus may pass into a state of tonic contraction, frequently associated with overdistension of the lower uterine segment, and ultimately rupture if not relieved. This tonic contraction may also be induced by meddlesome and unsuccessful attempts at interference, and by the premature and improper use of ergot. It may be either complete or partial.

The complete form is very serious. It occurs almost always in the second stage. The uterus, labouring against the obstruction, contracts more and more strongly; the pains become prolonged, and the intervals between them shorter and shorter until they become altogether inappreciable. The pain caused by the tonic contractions is intense, and the uterus is hard and extremely tender, so that the fœtal outlines or parts cannot be palpated. The patient looks worn and anxious, the pulse and respiration are quickened, and the temperature tends to rise. Vomiting and cramps in the limbs are common. The vagina is hot and dry and swollen, the presenting part usually firmly fixed in the pelvis with a large caput succedaneum in front of it. The soft tissues lying between the presenting part and the pelvis become bruised, and may slough, leading to fistula formation. If not relieved the patient may die of exhaustion, or else the uterus may

rupture. The *treatment* is to give chloroform at once, as well as a full dose of morphia. As soon as the spasm is relaxed, deliver with the utmost speed. If the condition has lasted any length of time, the pressure will certainly have killed the child, so that the life of the mother only need be considered, and craniotomy or any other destructive operation may be performed without hesitation.

Partial tonic contraction may occur either in the body or in the cervix. In the body the upper segment becomes retracted, causing an apparent constriction at Bandl's ring, and dividing the uterus into two parts like an hour-glass—"hour-glass contraction." This rare condition usually occurs in the third stage and causes retention of the placenta and hæmorrhage, as the uterus cannot retract completely while the placenta is inside it. Cases have been recorded where it occurred in the second stage and caused obstruction during delivery of the child.

Cervical spasm may occur in the first stage, due to too frequent examinations, or to previous disease of the cervix (spasmodic rigidity of cervix, p. 297). It may also occur in the second or third stage, usually owing to the child having been extracted by the breech through an incompletely dilated cervix. In this way the head of the child may be grasped and retained, or the placenta grasped as it is passing through. The treatment is anæsthesia prompt and deep, and if the child's life is at stake, cervical incisions if necessary.

Inefficiency of the Secondary Powers may lead to delay in the second stage. The weakness of the abdominal muscles may be due to reflex nervous inhibition from the same causes as interfere with the nervous mechanism of the uterus, or it may be due to paraplegia, or to injury of the abdominal wall.

Precipitate Labour is the term applied to a labour that is too quick. In most cases the contractions have been going on for some time, but have not been felt by the patient owing to a diminished sensibility to painful stimuli. All the patient is conscious of are one or two pains followed by the birth of the child—frequently while she is at stool, or while she is walking or standing. The child may fall to the ground and be injured, or the cord may be ruptured and it may bleed to death. In such cases the pelvic floor has usually been

injured previously, and has been incomplete; but if not, the perineum will probably be badly torn by the precipitate expulsion. Treatment should be directed to preventing the patient from bearing down if possible, and giving an anæsthetic at once to diminish the violence of the uterine action.

CHAPTER XXIX

FAULTS IN THE PASSAGES

A. Soft Passages

Rigidity of the Cervix.—This occurs in two forms — (1) functional and (2) organic. The functional form is met with characteristically in elderly primiparæ, or in very nervous women, and is really merely a spasm or tonic contraction of the cervix (p. 295). On examination the edge of the os externum is felt to be thin and smooth, sometimes no thicker than parchment. During a pain the os contracts instead of growing larger. This rare condition is often associated with primary inertia, and may, like it, be regarded as due to some reflex irritation interfering with the normal nervous mechanism and polarity. It may be found associated with a full bladder, or rectum, with excessive painfulness of the contractions, and with premature onset of labour. It is best treated by rest induced by morphia or an opium pill, or by an anæsthetic. Hot vaginal douches are also helpful.

Organic rigidity is due to disease of the cervix, such as fibroid tumours, cancer, old scars, or hypertrophic elongation of the cervix. Hot vaginal douches may be useful in this form of rigidity also. In marked cases it will be necessary to dilate the cervix artificially by means of solid or hydrostatic dilators, or by cervical incisions, all of which are discussed under *accouchement forcé.*

Malposition of the Uterus.—In extreme anteversion the force of the uterus is directed too much backwards, and dilatation of the cervix is very slowly achieved. This should be treated by placing the patient on her back, and applying

a firm wide abdominal binder to keep the uterus in its proper axis.

Impaction of the Lip of the Cervix.—The anterior lip of the cervix may be nipped between the descending head and the brim of the pelvis, and may consequently become swollen and œdematous. It may then be mistaken for the caput succedaneum or the bag of membranes. The condition causes delay, and great suffering to the patient. The treatment is to press up the lip of the cervix between pains, and hold it in position during pains if necessary, until the head has descended.

Rigidity of the Vagina or Perineum. — In an elderly primipara the tissues of the vagina and perineum are not so easily distended as in a younger woman or in one who has borne children. This may cause delay apart from any organic narrowing of the passage. Such actual narrowing, on the other hand, may be due to persistence and toughness of the hymen, or to cicatricial tissue in a perineum previously torn. In some women the perineum comes very far forward and the vulva is congenitally small. Hot douching or hot fomentations may be sufficient to overcome the difficulty. In some cases, where it is perfectly obvious that a bad tear of the perineum will occur, it is better to make postero-lateral incisions, which heal up as clean cuts (Episiotomy).

Distension of the Rectum and **Distension of the Bladder** not only interfere with the innervation of the uterus, but may obstruct the descent of the head. In regard to the bladder, this is particularly the case if there is a cystocele, when urine may collect in it in front of the presenting part, and there is a risk of the cystocele being mistaken for the bag of membranes.

Vesical Calculus is a rare cause of obstruction. It may, if small, be gently pushed back above the pubes, or expressed along the urethra by the finger. If these measures fail, it must be removed by a vaginal incision into the bladder. This is safer than to allow labour to go on, even if it were possible, with a stone between the head and the pelvis.

Enterocele, or the presence of coils of intestine in the pouch of Douglas, is another rare cause of delay. Long continued pressure on the intestine may have serious effects, therefore it should be gently pressed back with the patient in

the genupectoral position. If this fails, deliver rapidly with forceps. The condition is apt to be mistaken for an ovarian tumour.

Tumours of the Uterus and its Appendages

For the sake of convenience the subject of the effects of tumours upon pregnancy, labour, and the puerperium is taken up in one complete section at this stage, as they are more likely to give trouble during labour than at the other periods.

Fibroids.—*During Pregnancy.*—The effect of uterine fibroids in causing abortion has probably been exaggerated. They are most likely to do so when they cause either displacement of the uterus or congestion of the mucosa, practically a decidual endometritis. Their most common effect on pregnancy is to produce serious pressure symptoms, but this only occurs when the tumours are of some size. Fibroids tend to soften and alter their shape during pregnancy, and it is generally believed that they are more than usually prone to undergo "red" or other degeneration, associated with pain. Lastly, they are a fruitful cause of malpresentations.

Fibroids should be very carefully watched, but left alone during pregnancy unless circumstances definitely make their removal desirable. On the other hand, submucous polypi should always be removed, and abdominal hysterectomy may at any time become necessary owing to degeneration or severe pressure symptoms.

During Labour.—Apart from producing malpresentations, fibroids may affect labour by interfering with the action of the uterine muscle and producing inertia. If this occurs during the third stage there is likely to be a serious post partum hæmorrhage. In addition to these dangers the fibroid may, from its situation, cause an obstacle to the descent of the head. This is particularly likely to happen with fibroids situated low down, but many tumours, regarded during pregnancy as likely to cause obstruction, are found to be so drawn up by the retraction of the uterus in labour as not to offer the obstruction expected. In other cases the tumour can be pushed up out of the way of the head, and where this is possible it is the proper treatment. If it cannot

be done, abdominal Cæsarean section followed by hysterectomy is the best treatment, but happily the necessity for this is very rare. Under no circumstances should the child be forcibly dragged past an obstructing tumour, such treatment being detrimental to the child, and leading to bruising and possible septic infection of the tumour.

During the Puerperium.—Septic infection of a bruised fibroid may lead to serious and even fatal hæmorrhage. Axial rotation of the myomatous uterus may occur, or of a pedunculated fibroid. Red degeneration is frequent.

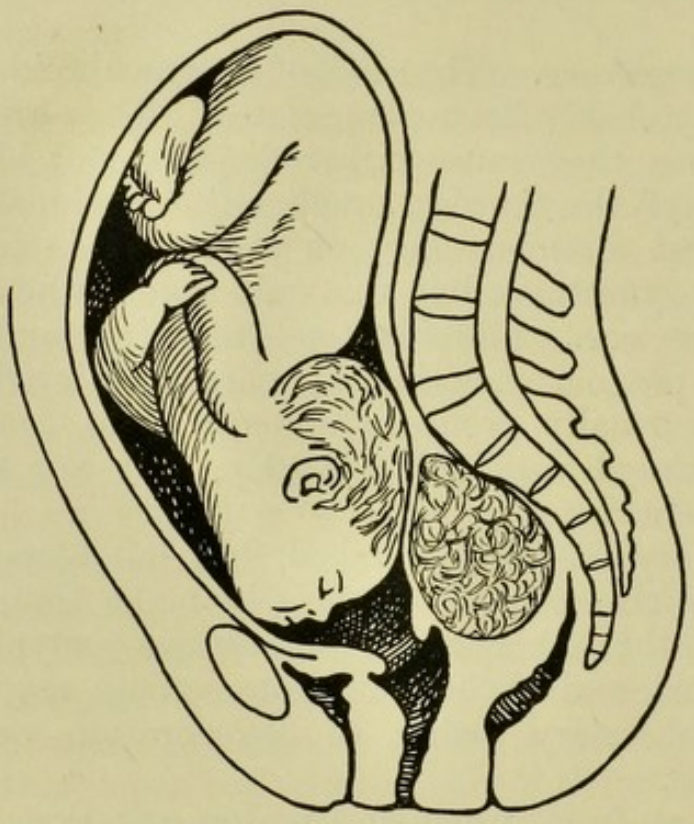


Fig. 173.—Fibroid tumour obstructing labour, and causing a malpresentation.

Ovarian and Parovarian Tumours.—*During Pregnancy.*—Ovarian tumours are rarely discovered during pregnancy unless their size is such as to cause serious pressure symptoms, or unless they suffer some complication such as torsion of the pedicle or rupture. They are said to produce abortion in 20 per cent of cases.

If diagnosed during the first half of pregnancy, the general rule as to their early removal should be followed regardless of the pregnancy. The risk of abortion following the operation is not any greater than the risk of spontaneous abortion if they are left alone. If not discovered until the latter half of pregnancy, it may be legitimate to wait until after delivery, provided the tumour is not very large, and is not complicated in any way. If it is large, or complicated by torsion of the pedicle for example, it must be removed at once, no matter what the stage of the pregnancy.

During Labour.—Tumours not obstructing the head may be left alone. If the tumour is situated in advance of the

presenting part, a very gentle effort may be made to push it up out of the way with the patient in the genupectoral position. The child should never be pulled forcibly past the tumour, as rupture of the tumour may occur, and may lead to peritonitis. Vaginal or abdominal ovariotomy may be done, followed by spontaneous delivery. Puncture of the cyst through the posterior fornix has been done, but is an undesirable operation, as it is impossible to foretell the exact nature of the tumour.

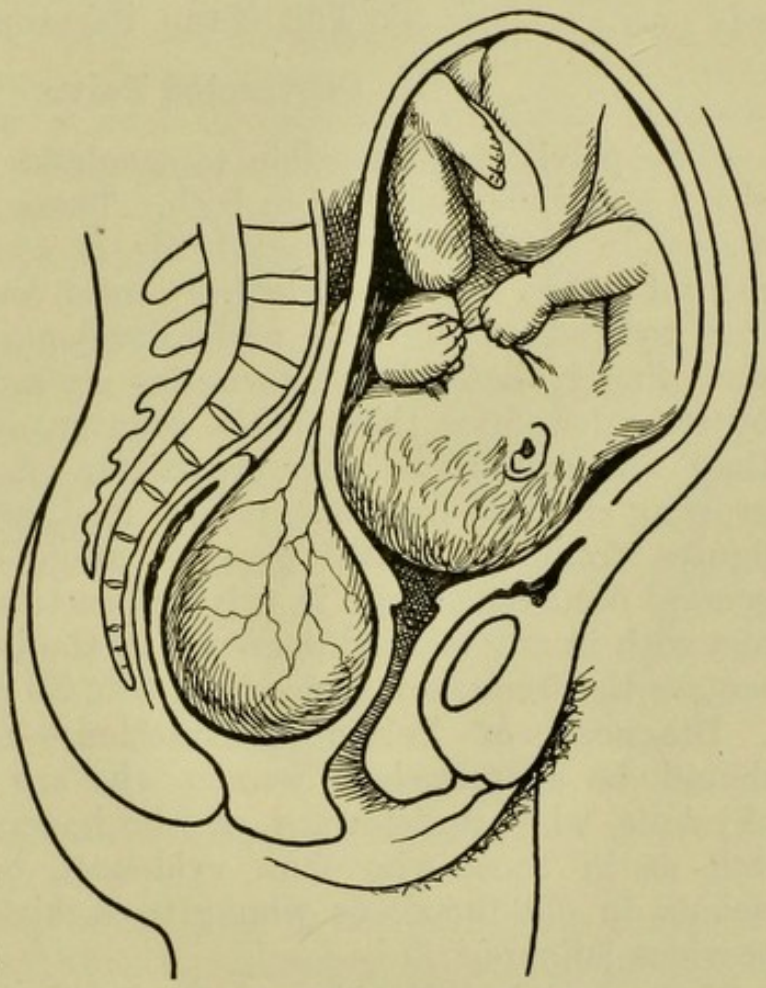


FIG. 174.—Ovarian tumour obstructing labour.

During the Puerperium. — Ovarian tumours are peculiarly liable to torsion of the pedicle and to suppuration and necrosis during the puerperium, and these complications must be carefully watched for. Unless such complications demand earlier interference, operation should be postponed to the close of the puerperium.

Cancer of the Cervix.—*During Pregnancy.*—The condition militates strongly against the occurrence of pregnancy, and is therefore a rare complication. It tends to produce abortion. If the cancer is of a size to permit complete removal, then the operation should not be delayed. If it is not operable, it may be better to wait till term in the interests of the child.

During Labour.—Delivery *per vias naturales* is apt to be accompanied with serious hæmorrhage. It is better to do Cæsarean section—followed by supravaginal hysterectomy—

in order to remove the uterus from the neighbourhood of the septic cervix.

Hæmatomata may be formed during labour either in the vagina or at the vulva, and obstruct the descent of the head; but they more usually form after delivery, and are discussed under the head of "concealed post partum hæmorrhage."

B. The Hard Passages

Contracted Pelvis

The pelvis is susceptible to manifold changes alike in its shape and dimensions, or in both. These may be the result of disease in childhood or in adult life, of accident, or of developmental errors. The abnormalities most commonly met with are due to rickets and to under-development. It is found, accordingly, that pelvic deformities are much more common in overcrowded cities than in the country, and amongst the poor than amongst those who are better off, and can give their growing children fresh air, proper food, and sunlight. Actual figures from a hospital give an exaggerated idea of their general occurrence, and in private practice they are but rarely met with in any marked degree. In the hospitals of industrial centres the frequency varies from 3 to 30 per cent.

Diagnosis of Pelvic Contraction.—Pelvic abnormalities should be suspected in women who are very diminutive in physique, who are deformed, or who have spinal curvature, as well as in those who show evidences, or give a history, of rickets in childhood, or who give a history of difficulty in previous labours.

The actual investigation of the pelvis is made by external and internal pelvimetry. Unfortunately it is not easy to measure the actual conjugate diameter of the brim, which is the important measurement in most cases, but we can make other measurements from which the length of the conjugate may be deduced with approximate accuracy.

External Pelvimetry.—The measurements are made with a pair of callipers such as are figured.

Interspinous Diameter.—The points of the callipers are held in the two hands so that the point of the forefinger rests alongside the point of the instrument. The two anterior superior

spines are located, and the points placed on them. The callipers are then screwed tight by an assistant or nurse, and the measurement read off. Normally it is $9\frac{1}{2}$ to 10 inches (24 to 25 cm.).

Intercristal Diameter.—The instrument is held as before and the points passed slowly round the iliac crests until the points of greatest separation are found, when the measurement is made. Normally it is $10\frac{1}{2}$ to 11 inches (26 to 27 cm.).

The importance of these two measurements is (1) that the intercristal is approximately double the length of the transverse of the brim; (2) the normal curvature of the iliac crests is such that the intercristal diameter is about 1 inch (2·5 cm.)

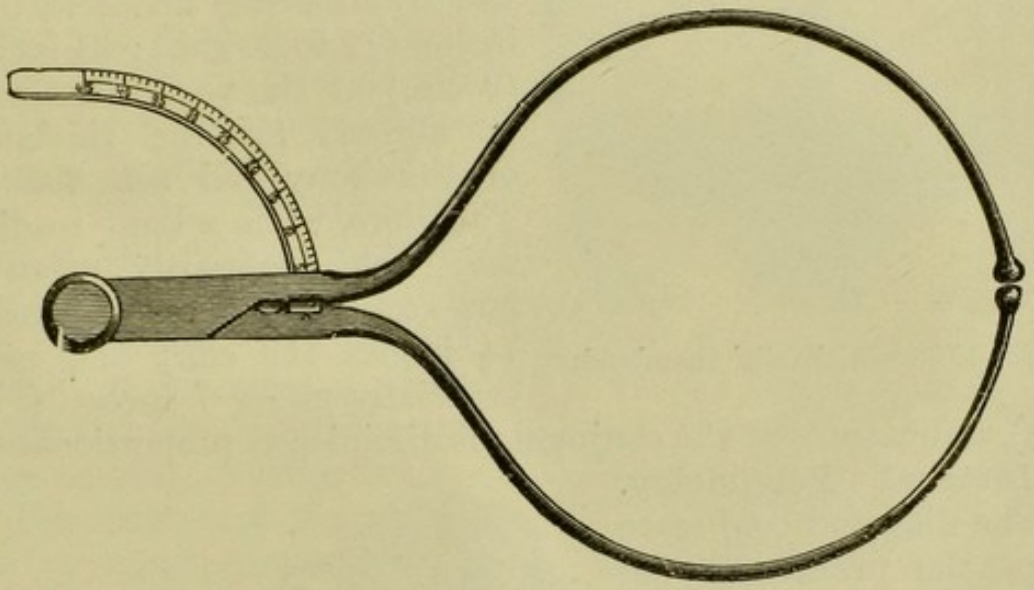


Fig. 175.—Callipers for external pelvimetry.

longer than the interspinous. But in flat pelves the curvature becomes altered, and this is indicated by a change in the relationship of these two measurements—the interspinous becoming almost equal to, and in some extreme cases actually greater than the intercristal.

The external conjugate or Baudelocque's diameter is measured by placing the one point of the callipers over the tip of the last lumbar spine, and the other over the front of the symphysis pubis. This is most easily done with the patient standing, and the tip of the last lumbar spine can be found by counting downwards from above. It is, however, usually marked by a slight dimple due to fascial attachments. In fat persons it suffices to take a point in the mid line $2\frac{1}{2}$ inches

(6 cm.) above the line joining the posterior superior iliac spines. It will be noticed that if this point and the posterior superior spines be marked, they form, with the convergence of the buttocks below, a rhomboidal figure known as Michaelis' rhomboid. The symmetry of this figure is a rough indication of the symmetry of the pelvis, and conversely.

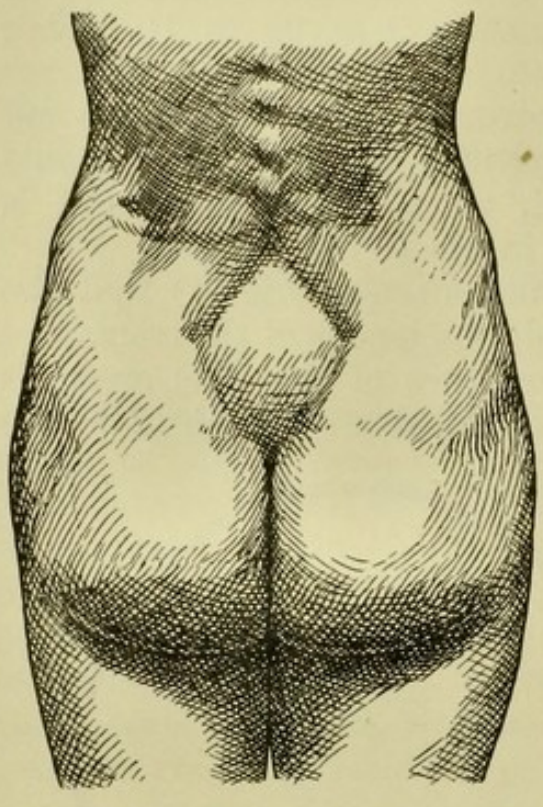


FIG. 176.—Michaelis' rhomboid.

The external conjugate usually measures about $7\frac{1}{2}$ to 8 inches (19 to 20 cm.); $3\frac{1}{2}$ inches (9 cm.) at the very least must be allowed for the thickness of the bony and soft tissues. Therefore, while a large reading may not necessarily mean a large conjugate, a reading under $7\frac{1}{2}$ inches (19 cm.), and more especially under 7 inches (17·5 cm.), indicates that the conjugate is diminished proportionately.

Internal Pelvimetry.—The diagonal conjugate from the promontory of the sacrum to the under margin of the symphysis may be measured by the fingers. The method is sufficiently indicated in the accompanying illustration. It is important to remember that when the position of the lower margin of the pubes has been marked off by the finger nail, and the hand withdrawn, the distance measured is that between the tip of the *middle* finger and the nail mark. The diagonal

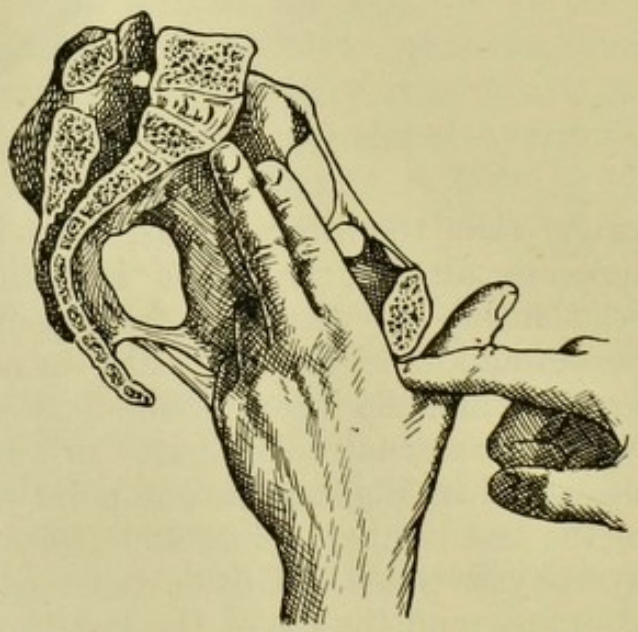


FIG. 177.—Measurement of the diagonal conjugate.

conjugate measures $4\frac{1}{2}$ to $4\frac{3}{4}$ inches (11 to 12 cm.), and $\frac{1}{2}$ to $\frac{3}{4}$ of an inch (1 to 2 cm.) must be subtracted to give the length of the conjugata vera. The actual amount to be subtracted varies with the depth of the pubic bone and its inclination towards the sacrum, so that at the best this method of estimation is but approximately correct. In practice, however, these methods are found to be quite sufficiently accurate in the vast majority of cases. It should be remembered that in a normal pelvis it is impossible to touch the promontory of the sacrum by vaginal examination without forcing the fingers so far in as to hurt the patient. Therefore if the promontory can be felt readily, it indicates a small pelvis and the desirability of more careful investigation.

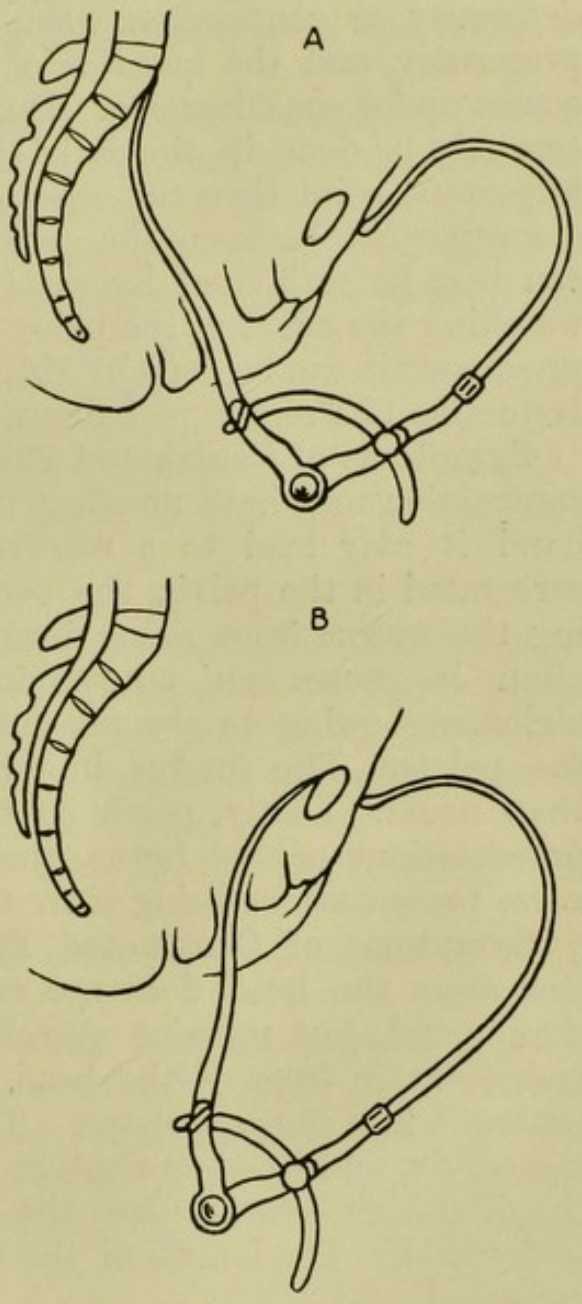


FIG. 178.—Use of the Skutsch pelvimeter.

The conjugate is estimated by subtracting the measurement in B from that in A.

The outlet of the pelvis can be directly measured in both its antero-posterior and transverse diameters by means of the fingers and a measuring tape, or more conveniently by means of a pair of callipers with the points crossed. More exact internal measurements can be made by using internal pelvimeters, the best of which is Skutsch's. The mode of using it is shown in the figure. It has no scale attached, and the distance between the points has to be measured after the instrument is withdrawn. Recently methods have been devised for calculating

the exact dimensions of the pelvis by radiography, the distance of the X-ray tube and certain fixed points from the plate being known.

Exact measurements of the pelvis are important in cases of deformity or contraction when the patients are seen during pregnancy, and the question of induction of premature labour comes up for consideration. During labour internal pelvimetry can only be done in the early stage. But in all cases a more important point than the exact size of the pelvis is the relative disproportion between the pelvis and the fœtal head. This can best be estimated by careful bimanual examination, and watching the effect of the pains on the head moulding. During pregnancy it can be done by Müller's method as described under Induction of Premature Labour.

Symptoms of Contracted Pelvis during Pregnancy.—Pelvic contraction may have no effect upon pregnancy. On the other hand it may lead to a retroverted gravid uterus being incarcerated in the pelvis, the overhanging promontory preventing the uterus from rising into the abdominal cavity. More often it causes an anteversion of the uterus—pendulous abdomen—owing to the presenting part being unable to enter the pelvis. The fundus in other cases is at a higher level than usual. Lastly, pelvic contraction tends to produce malpresentations of the fœtus, the frequency of face and transverse presentations being more especially increased.

Symptoms of Contracted Pelvis during Labour.—In the *first stage* the head does not engage in the brim until later than usual, but remains movable at the brim. The waters pass down in front of the head, and cause the membranes to protrude in a sausage shape. This leads to slow dilatation of the cervix, and to early rupture of the membranes, after which the dilatation ceases unless the head has engaged and begun to descend. The length of the first stage is thus considerably increased.

Second Stage.—The mechanism of labour is altered in directions to be specified later. Delay may be due not only to the pelvis, but also to malpresentation of the fœtus. Prolapse of the cord is liable to occur, particularly if the membranes have ruptured early The forcible contractions of the uterus may, after the escape of the liquor amnii, lead to the death of the child by compression. The caput succedaneum becomes

very large. The head moulding is exaggerated, and the cranial bones overlap one another to a marked extent. The bones may be marked by grooves or indentations from pressure on the promontory or the back of the symphysis pubis. The pressure may be so great as to cause fracture of the bones or rupture of the cranial sinuses.

The anterior lip of the cervix is liable to be nipped between the head and the brim of the pelvis, and to become swollen and œdematous, causing still further delay. Laceration or sloughing may occur at any part of the soft passages. If delivery is not effected, the lower uterine segment may become over-distended and rupture.

Third Stage.—Owing to the prolongation of labour there is an increased risk of post partum hæmorrhage. The more frequent necessity of interference increases the risk of septic mischief. The long-continued pressure may lead to sloughing and fistula formation.

Degrees of Contraction.—For convenience in discussion the degree of contraction is generally expressed in terms of the conjugate of the brim, that being in most cases the crucial measurement. The division into degrees is, of course, a purely arbitrary one.

First Degree. Conjugate from 4 to 3½ inches (10 to 8·75 cm.).

Second Degree. Conjugate from 3½ to 3 inches (8·75 to 7·5 cm.).

Third Degree. Conjugate under 3 inches (under 7·5 cm.).

Only the most common forms of contracted pelvis will be discussed fully, the others being briefly described later. The commonest are (1) pelvis æquabiliter justo-minor, or generally contracted pelvis; (2) the rhachitic flat pelvis; (3) the simple flat pelvis.

Pelvis Æquabiliter Justo-Minor (*Pelvis Symmetrically Smaller than Normal*)

Cause.—Probably developmental. It is found mostly in women of small stature, but sometimes in those of apparently good physique. It is met with in all classes of society.

Conformation.—As the full title indicates, all the diameters

are proportionately diminished, so that the normal shape of the pelvis and the normal relative proportions of the different diameters remain unaltered. It is a normal pelvis in miniature.

Diagnosis.—By external pelvimetry and vaginal examination the diameters are found to be all proportionately diminished.

Effect upon Labour.—(*a*) *Mechanism.*—The increased resistance to descent leads to an exaggeration of flexion, so that a diameter, which is if possible smaller than the suboccipito-bregmatic, engages in the pelvis. The head descends in the oblique diameter. Internal rotation, extension, and external rotation occur as usual, but there is delay throughout.

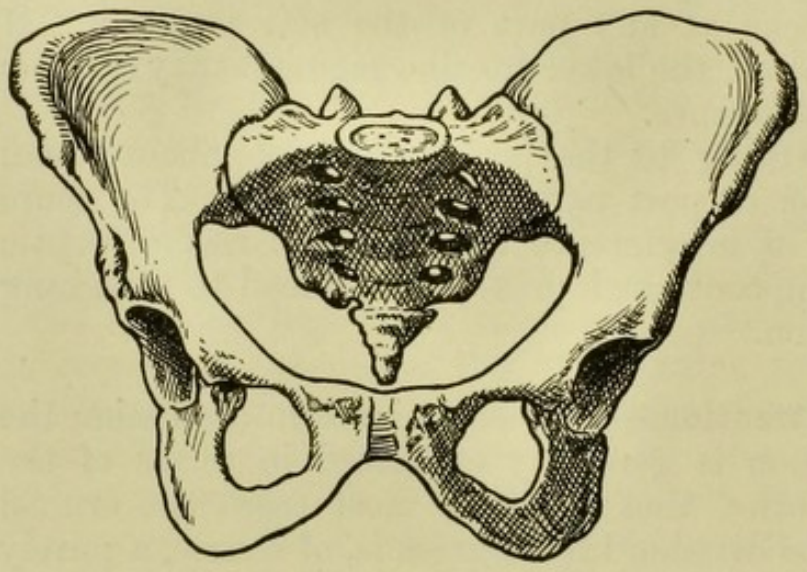


Fig. 179.—Pelvis æquabiliter justo-minor. (After Whitridge Williams.)

(*b*) *Clinically* the condition may be suspected from the extreme ease with which the posterior fontanelle can be reached owing to the increased flexion. There is delay throughout the entire labour in proportion to the degree of contraction. Not infrequently there is extreme difficulty at the outlet.

Treatment.—What applies to flat pelvis applies to a justo-minor with two qualifications: (1) The relatively smaller space in a justo-minor must be remembered in considering treatment (see p. 313). (2) Version is strongly contra-indicated in a justo-minor as the head is apt to become extended, and its larger diameters thrown across the pelvis.

Flat Pelves

Flattening of the pelvis is very frequently combined with other changes, such as general contraction due to under-development, or oblique contraction due to scoliosis. In the

following descriptions, however, these changes are disregarded, and, for the sake of simplicity, only the pure types of flat pelvis are discussed.

Rhachitic Flat Pelvis.—*Cause.*—This is due to early rickets, while the child is as yet only sitting up, and not walking. The weight of the body is transmitted through the spinal column to the sacral promontory, and thence to the iliac bones and the tuberosities of the ischia. The result, with the bones softened by disease, is to cause a rotation of the sacrum, its promontory being projected downwards and forwards towards the symphysis, and its lower end backwards. The tilting back of the lower end is usually resisted by the strong sacro-sciatic ligaments, and hence the lower end of the sacrum is often bent sharply forward. Again, the throwing forward of the promontory puts the ligaments passing between the upper part of the sacrum and the posterior superior spines on the stretch, and so pulls the spines towards the middle line. This in its turn causes the iliac bones to flare outwards, especially the crests, and explains how the interspinous diameter becomes more nearly the equal of the intercristal, or in some cases even longer than it. Lastly, this outward tendency of the iliac bones is resisted by the strong symphysis ligaments, and therefore there is a bending of the innominate bones which brings the symphysis nearer the promontory.

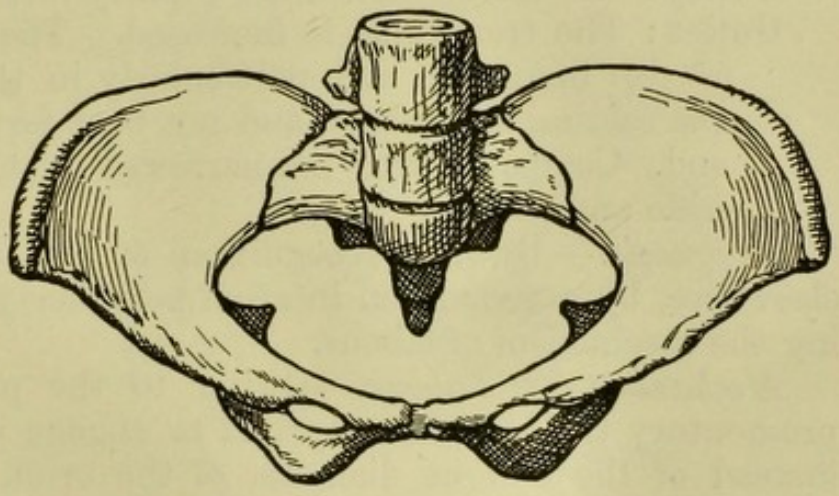


FIG. 180.—Rhachitic flat pelvis.

Conformation.—In the false pelvis the iliac crests flare outwards, and the fossæ look more forwards. The brim is elliptical in shape, sometimes kidney shaped from the extreme projection of the promontory. The sacrum is usually broad and flattened from side to side. Its lower end with the coccyx is turned sharply forward in many cases. In others the sacrum is short

and straight from above downwards. In all cases it is rotated on a transverse axis passing through the sacro-iliac joints, its promontory being thrown forward. The ischial tuberosities are set wider apart, and are everted. The pubic arch is widened.

The effect on the diameters is as follows :—

False Pelvis.—The relation between the interspinous and intercristal is altered, the former being nearly, or quite equal to the latter. The external conjugate is diminished below 7½ inches (19 cm.).

True Pelvis.—Brim : The conjugate is diminished. The obliques are unaltered. The transverse is relatively (may be absolutely) increased.

Cavity : All the diameters are slightly increased.

Outlet : The transverse is increased. The antero-posterior is also increased, and particularly in those cases where the sacrum is straight, and not bent forward at its lower end. Compared with the narrowed inlet, the outlet looks wide and gaping.

Diagnosis.—By the recognition of the signs of rickets elsewhere, by external and internal pelvimetry, and by observing the mechanism of labour.

Mechanism of Labour.—Owing to the projection of the promontory the head is compelled to engage in the transverse instead of the oblique diameter of the brim. As it attempts to descend the narrow anterior part of the head meets with less resistance than the wider posterior part, and therefore the head becomes somewhat extended, and the two fontanelles come to lie on the same level (Michaelis' obliquity). At the same time the head moves laterally to the side of the pelvis occupied by the occiput, so that the wide biparietal diameter is brought into the wider part of the pelvis at the side of the promontory, and a small diameter—the bitemporal—engages in the conjugate. The head therefore lies with its occipito-frontal diameter in the transverse, and its bitemporal diameter in the conjugate diameter of the pelvic brim.

Further, in the attempt to pass into the brim, the part of the head lying posteriorly meets more resistance from the projecting promontory than the part lying anteriorly meets from the symphysis. Therefore the anterior parietal dips down in advance of the posterior, and the sagittal suture passes towards the promontory. This position is known as

anterior asynclitism or Naegele's obliquity (Fig. 181 A). When the anterior parietal becomes relatively fixed behind the symphysis, a movement of lateral rotation takes place, by which the posterior parietal rounds the promontory, the bone being

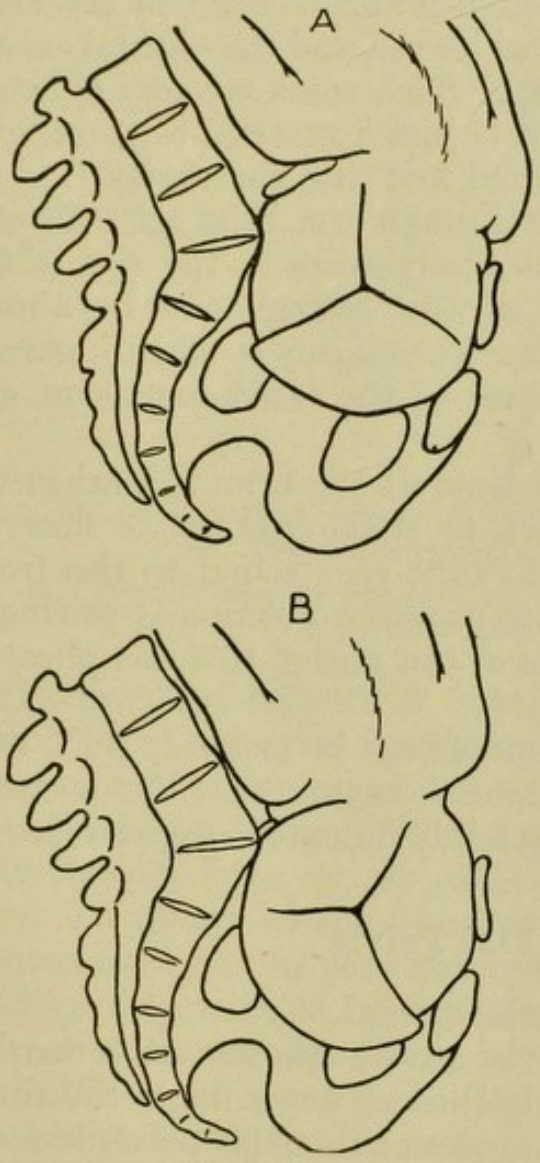


FIG. 181.

A. Naegele's obliquity or anterior asynclitism. B. Litzmann's obliquity or posterior asynclitism.

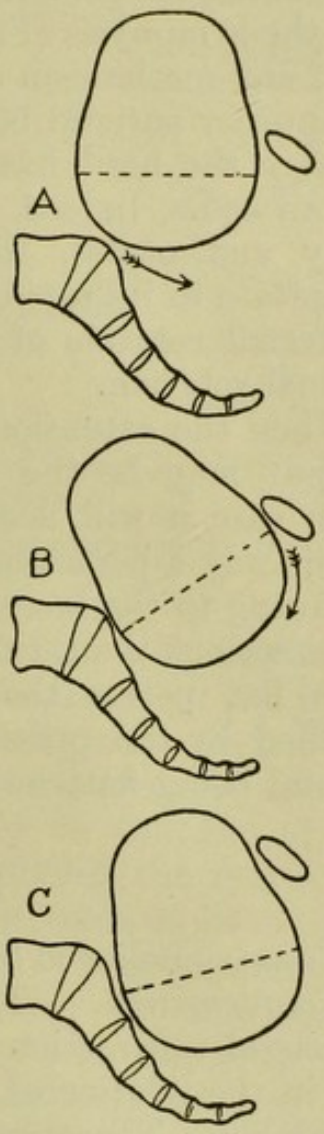


FIG. 182.—Mechanism of labour at brim of flat pelvis.

frequently indented in its passage past the projecting promontory.

This movement undoes Naegele's obliquity, the sagittal suture passing to the front again, and the posterior parietal is the first part to enter the cavity.

This movement is immediately followed by a similar one in

the opposite direction, the sagittal suture again swinging towards the back, while the anterior parietal bone is pushed down past the back of the pubes (Fig. 182). In cases of marked contraction the head may be marked by the pubes also.

In a very few cases the head lies at the brim in posterior asynclitism, the posterior parietal lowest, and the sagittal suture near the symphysis (Fig. 181 B). Such cases are very difficult, but if any mechanism occurs, it is just a reversal of the above, the anterior parietal being rotated first into the cavity.

After the head has passed through the brim all difficulty is at an end. Indeed, owing to the increase in the size of the cavity and outlet, the rest of the labour may be almost precipitate in its rapidity. The mechanism is usually normal —internal rotation of the occiput to the front, extension, and external rotation.

When the extension of the head at the brim is marked the sinciput may be the first part to strike the pelvic floor, in which case it will, according to rule, pass round to the front. In this way a persistent occipito-posterior position is produced, but owing to the increased size of the outlet this complication is less serious than usual.

In flat pelves the head moulding is marked, and it is modified by the presence of lateral asymmetry, the posterior parietal being flattened, and possibly indented or grooved.

Simple Flat Pelvis

Cause.—Believed to be developmental.

Conformation. — This pelvis rarely shows such marked degrees of contraction as the rhachitic. Accordingly the alteration in the relation of the diameters of the false pelvis is not so noticeable. The sacrum is less rotated, but is rather pushed forward *en bloc* towards the symphysis. The curvatures of the sacrum remain unaffected to a great extent, but frequently the junction between the first and second bodies projects forwards, constituting a false promontory.

The result on the measurements is briefly to make the antero-posterior measurements smaller, not alone at the brim, but also in the cavity and at the outlet.

Diagnosis.—By internal pelvimetry and the effects of the contraction upon labour.

Mechanism of Labour.—This is much the same as in a rhachitic flat, but the difficulty does not cease after the head has passed the brim, as there is antero-posterior contraction throughout. The descent through the cavity and outlet is therefore delayed all the way.

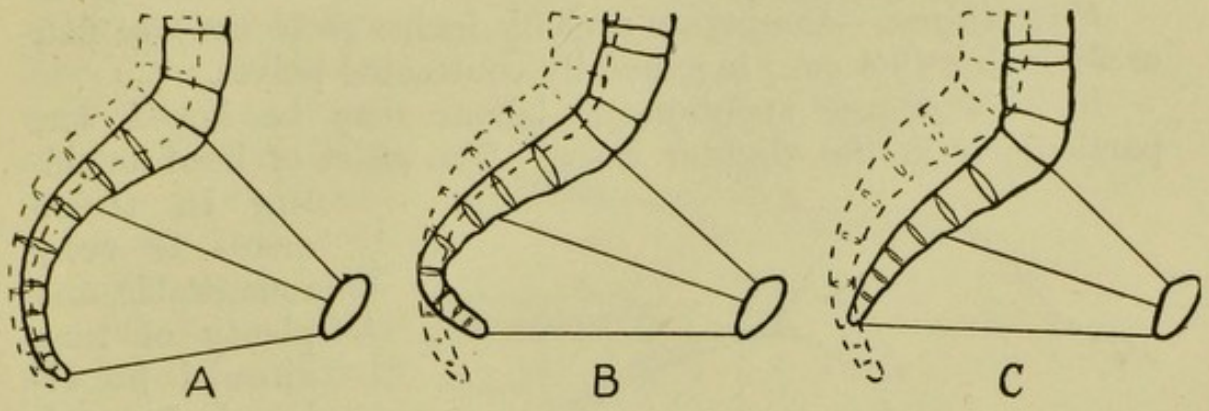


FIG. 183.—Vertical sections of A simple flat, and B and C rhachitic flat pelves contrasted with the normal.

N.B.—In A sacrum moved forward *en masse*. In B sacrum rotated on transverse axis. In C sacrum short and straight.

Treatment of Labour in Contracted Pelvis.—Emphasis has already been laid upon the desirability of examining the pelvis in the case of every primipara, or any multipara who has had difficult labours before. The choice of the particular method of treatment, however, depends not only on the size of the pelvis, but rather on the disproportion between the pelvis and the head that has to pass through it. In cases of either very slight or very marked contraction this is of less significance, as in the former spontaneous labour may be anticipated unless the head is exceptionally large, and in the latter the only alternatives are Cæsarean section and craniotomy. In the intermediate degrees, on the other hand, there is a considerable choice of methods of treatment, and it should always be borne in mind that a wise decision can only be based on a knowledge of the disproportion between the head and the pelvis in each individual case. Any rules that may be formulated for the treatment of such cases must, therefore, inevitably be general in nature, and open to modification in individual cases.

In the discussion of treatment it is to be remembered that a justo-minor pelvis is, owing to the diminution of its transverse and

oblique diameters, less roomy than a flat pelvis of the same conjugate measurement, and should be regarded rather as the equivalent of a flat pelvis with a conjugate $\frac{1}{4}$ inch (0·6 cm.) less.

[*E.g.* Justo-minor with c.v. $3\frac{1}{2}$ inches (8·75 cm.) is equivalent in regard to prognosis and treatment to a flat pelvis with c.v. $3\frac{1}{4}$ inches (8 cm.).]

First Degree.—Conjugate over $3\frac{1}{2}$ inches (8·75 cm.) in flat, or $3\frac{3}{4}$ inches (9·4 cm.) in generally contracted pelves.

In this degree spontaneous labour may be hoped for, particularly in the slighter cases. The effect of head moulding in these cases is very remarkable, and plenty of time should be allowed for this to occur. The duration of the second stage must be regulated, not by the clock, but by reference to the condition of both the mother and child. In flat pelves great assistance may be obtained by placing the patient in Walcher's position. In this the buttocks are brought to the very edge of the bed, and the limbs allowed to hang down, not touching the floor. To prevent this the edge of the bed may be raised. In this way the sacrum is fixed by the weight of the body, and the weight of the limbs causes the innominate bones to rotate at the sacro-iliac joints, thus moving the symphysis away from the promontory. In favourable cases at least half an inch can be gained in the conjugate of the brim. The position may be maintained for hours by placing two chairs to support the feet in the intervals between pains, the patient being instructed to let the legs hang down as soon as she feels a pain coming on.

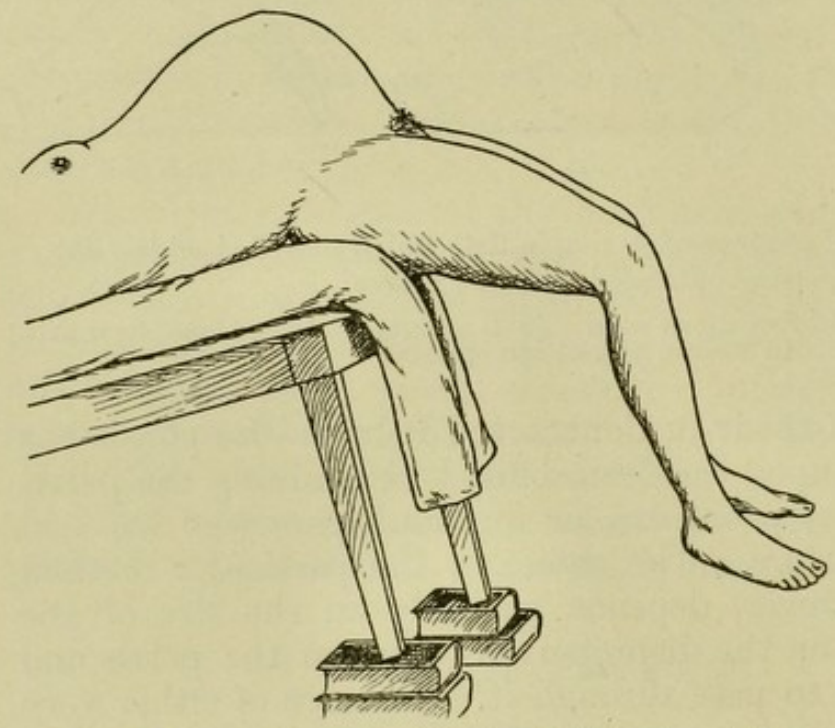


Fig. 184.—Method of obtaining Walcher's position.

If, after the head has had time to mould, advance is still slow, delivery may be aided by the application of forceps. It is very important to recognise the limitations of forceps as a method of treatment in contracted pelvis. The fœtal mortality and the maternal *morbidity* after their use in unsuitable cases are both very high. Forceps should not be used unless the head is engaged, and has had time to mould. Powerful traction is never justifiable, and not more than a moderate force should be employed. They should never be employed in a pelvis below $3\frac{1}{4}$, and rarely below $3\frac{1}{2}$ inches.

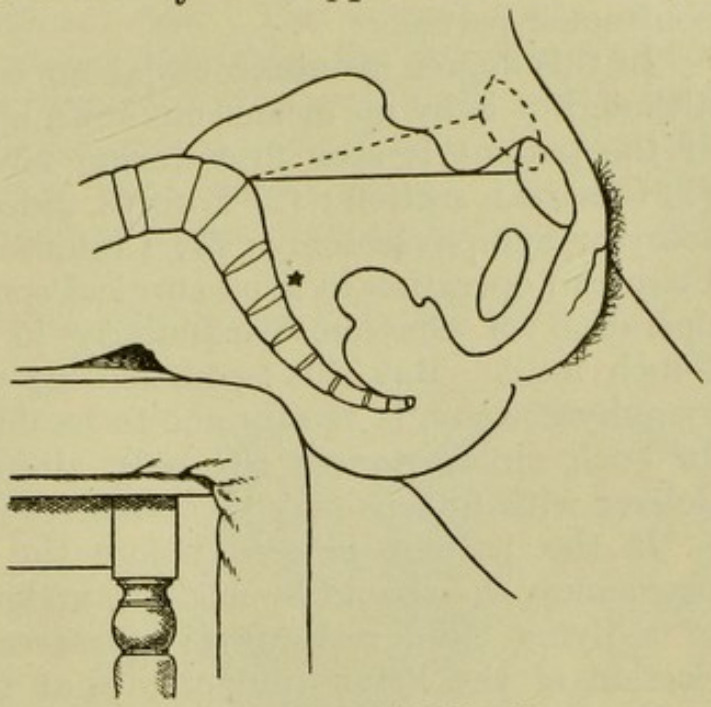


FIG. 185.—Diagram of Walcher's position.
The rotation of the pelvis on the sacrum is centred at the point *.

Version is comparatively rarely adopted nowadays in flat pelves. It must be performed early in labour, before the head has engaged. Theoretically it has the advantage that the head is brought through the pelvis with its narrow base first, and that lateral compression is thereby rendered more easy. But the increased risks to the child in a head-last delivery, and the improvement in the construction of forceps, have led to the less frequent employment of this operation.

If a patient with a pelvis of this degree of contraction is seen first before the thirty-fourth week of pregnancy, the question of induction of premature labour must be considered. In a first pregnancy the operation should not be done, as a first labour is always somewhat of an experiment, and the child should get the benefit of the doubt. If, however, previous children have been lost, the operation may hold out a means of obtaining a living child. The risk to the child increases with the degree of contraction, but in pelves with a conjugate above $3\frac{1}{2}$ the results are fairly satisfactory.

Second Degree.—Conjugate from $3\frac{1}{2}$ to 3 inches (8·75 to 7·5 cm.) in flat, and from $3\frac{3}{4}$ to $3\frac{1}{4}$ inches (9·4 to 8 cm.) in generally contracted pelves.

In this degree spontaneous labour is not to be reckoned on, although it is by no means unknown above $3\frac{1}{4}$ inches (8 cm.). If the patient is seen first during labour the options are—(1) Cæsarean section ; (2) Forceps, aided if need be by Pubiotomy or Symphyseotomy ; (3) Craniotomy. The safety of the Cæsarean operation in good surgical conditions makes this the operation of election, particularly in those cases near the 3-inch limit. But this operation, as well as pubiotomy and symphyseotomy, is hardly one to be done in general practice. In such circumstances the only alternative after failure to deliver with forceps may be craniotomy.

If the patient is seen before the thirty-second week of pregnancy, she should be made to understand that her chances of a living child rest in—(1) Cæsarean section at term, (2) Section of the Pelvis (pubiotomy) at term, and (3) Induction of Premature Labour. The chances may be estimated in that order, for induction of labour under $3\frac{1}{2}$ inches (8·75 cm.) does not hold out very much prospect of obtaining a child that will survive.

Third Degree.—Conjugate under 3 inches (7·5 cm.) in flat, and $3\frac{1}{4}$ inches (8 cm.) in justo-minor pelves.

If first seen during labour the only chance of obtaining a living child is Cæsarean section. If that is refused, or if the case is regarded as probably infected, craniotomy should be done. Below $2\frac{1}{2}$ inches (6 cm.) craniotomy becomes a serious and difficult operation, and should not be done, so that in these cases abdominal section is the only treatment.

If seen during early pregnancy the induction of abortion may require to be considered.

Obliquely contracted Pelves

This group contains three varieties :—

Naegele Pelvis.
Scoliotic Pelvis.
Pelvis with Unilateral Hip-joint Disease.

Naegele Pelvis.—In this rare but characteristic form of contraction, the ala of the sacrum is wanting on one side.

Associated with, and probably secondary to, this arrest of development there is usually ankylosis of the sacro-iliac synchondrosis on the affected side. The normal curve of the ilio-pectineal line is lost on this side, the innominate bone passing almost straight forwards to the symphysis, which, however, is displaced a little towards the sound side. The general effect is to make the pelvic brim oval in shape. The diameter most shortened is the oblique diameter measured (and named) from the *sound* side.

The contraction becomes more marked in the cavity and at the outlet, owing to the pushing in of the innominate bone on the affected side.

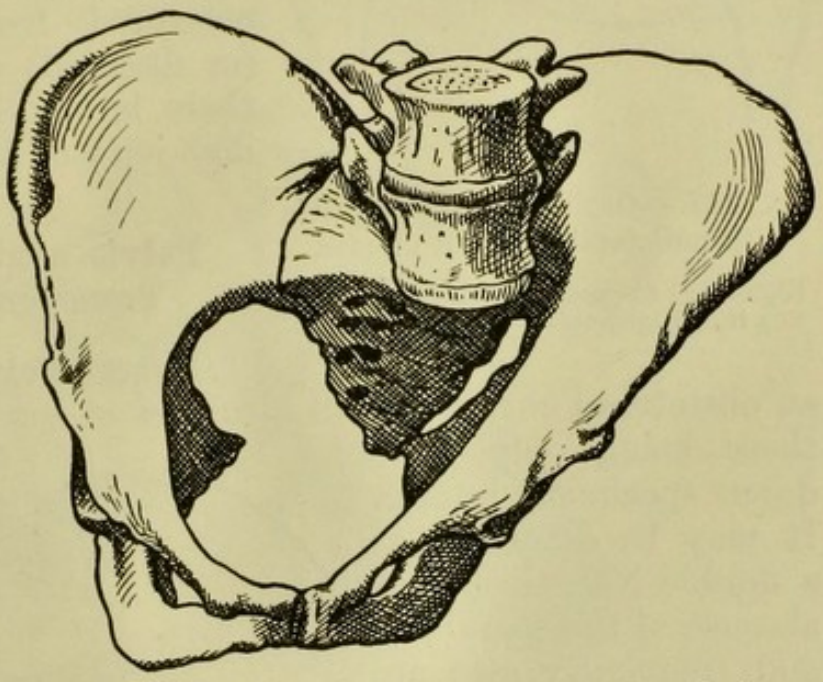


FIG. 186.—Naegele pelvis. (After Naegele.)

Where the measurements are such as to allow of the engagement of the head, the mechanism is similar to that in a justo-minor, and characterised by exaggerated flexion. As a rule, however, engagement is impossible, and Cæsarean section is then the only sound treatment. Pubiotomy or symphyseotomy is contra-indicated by the probability of the sacro-iliac joint being ankylosed, as this would prevent the separation of the cut ends of the bones.

Scoliosis.—Scoliosis only affects the pelvis when it is situated so low down that the compensatory curvature involves the sacrum. Even in these circumstances slight degrees of lateral curvature may not cause deformity sufficient to affect labour. Bad cases are usually rickety, and the pelvis shows the signs of rickets as well as of the scoliosis. The sacrum is somewhat rotated on its long axis, which is directed rather obliquely. One side of the pelvis—that corresponding to the spinal convexity—is diminished, and may be of little avail for the

passage of the head. The characters of the rickety flat pelvis are also frequently present.

Unilateral Hip-joint Disease.—Owing to the disease the affected side of the pelvis may be rather under-developed and smaller than usual. The weight of the body is thrown on the sound leg, and the result is that the healthy side of the pelvis is pushed in, causing a shortening of the oblique diameter measured from the opposite (or diseased) side. Frequently there is ankylosis of the sacro-iliac joint on the diseased side.

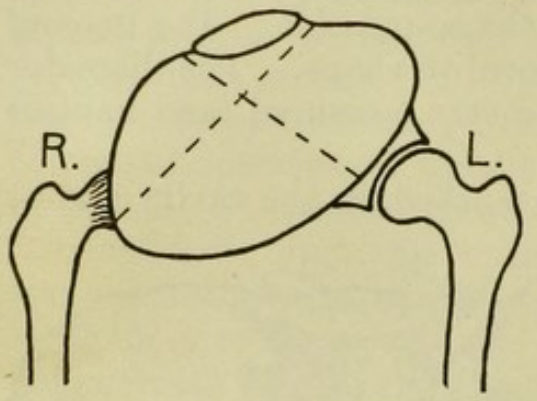


FIG. 187.—Outline of brim of pelvis with unilateral hip-joint disease.

Right side diseased. Left side pushed in. Right oblique shortened.

Pelvis contracted in the Transverse Diameter

Robert Pelvis.—This is more an obstetrical curiosity than a subject of any practical interest, there being only some dozen specimens known. It may be described as a double Naegele pelvis, absence of the sacral ala, and frequently also ankylosis of the sacro-iliac synchondrosis characterising *both* sides of the pelvis. The result is to make the whole pelvis very small, and particularly narrow from side to side. Labour at term is quite impossible, and Cæsarean section is the only possible method of dealing with such a pelvis.

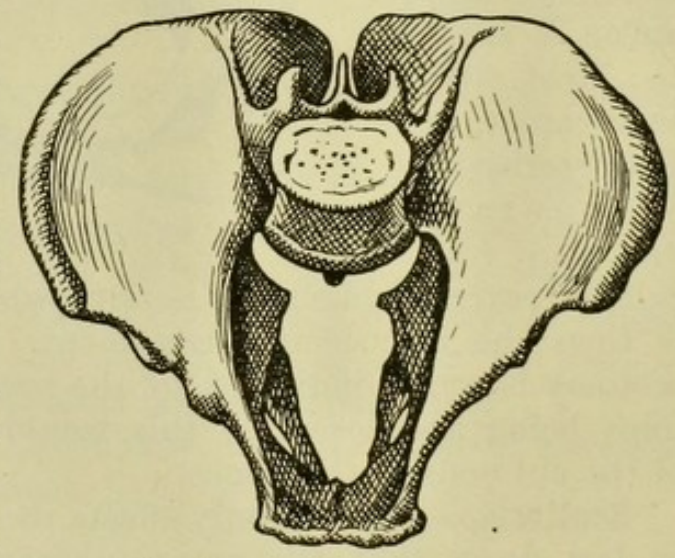


FIG. 188.—Transversely contracted pelvis. (After Robert.)

Irregularly contracted Pelves

Osteomalacic or Malacosteon Pelvis.—This deformity is the result of osteomalacia or mollities ossium. The disease is

endemic in some parts of Italy, Switzerland, and Germany, but elsewhere is very rarely seen. When it does occur in this country, it is usually found in women who are ill-nourished, live in unhealthy surroundings, and have had a rapid succession of pregnancies. Such patients usually give a history of increasing rheumatoid pains, and increasing difficulty in labour at each succeeding confinement.

The deformity is entirely the result of the softening of the bones, and as this process is not confined to the pelvis, there is deformity also in the spine and ribs, and sometimes in the limbs. The pelvis is compressed as a result of the weight of

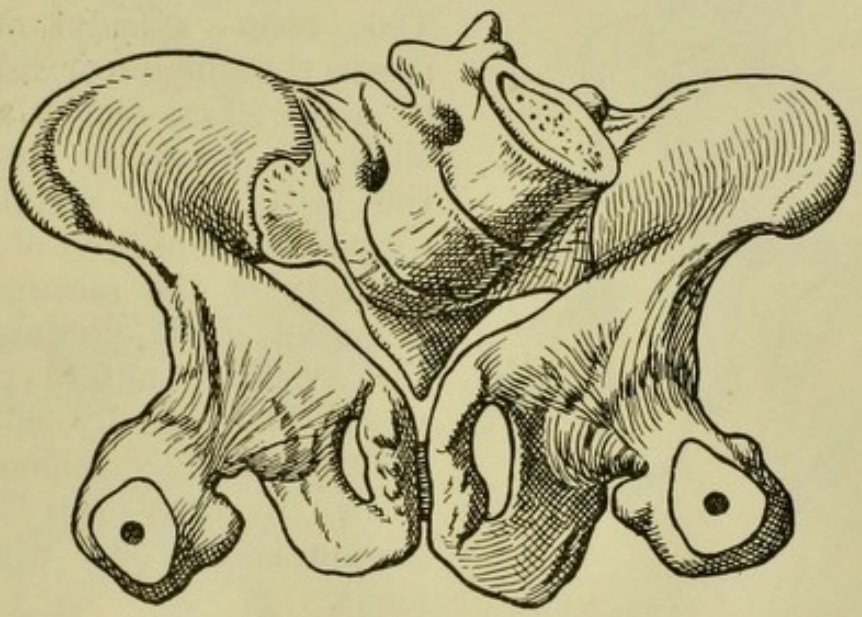


FIG. 189.—Osteomalacic or malacosteon pelvis.

the body acting on the soft bones. The acetabula, through which the weight is transmitted to the femora, are pushed inwards, while the sacral promontory is thrown forwards and downwards, and thus is produced the typical beaked or triradiate shape of the brim. At the same time the ilia become bent up into a scoop shape. The beaking of the pelvis by the approximation of the pubic rami leads to marked narrowing of the pubic angle, and consequently a great diminution of the space available at the outlet.

The best treatment is Cæsarean section followed by removal of the ovaries, or Cæsarean hysterectomy. The removal of the ovaries is believed to have an arresting influence upon the disease—presumably by the removal of an internal secretion—

although recent observations and experiments seem to show that the improvement may follow any operation, and is really due to the inhalation of chloroform.

Pseudomalacosteon or Rickety Rostrate Pelvis.—This is a rare deformity, due to rickets so severe as to cause a softening of the bones almost equal to osteomalacia, and thus leading to a similar deformity ; or to rickets coming on late in childhood after the girl is running about. In the latter case the transmission of the body weight to the heads of the femora accounts for the beaking of the pelvis.

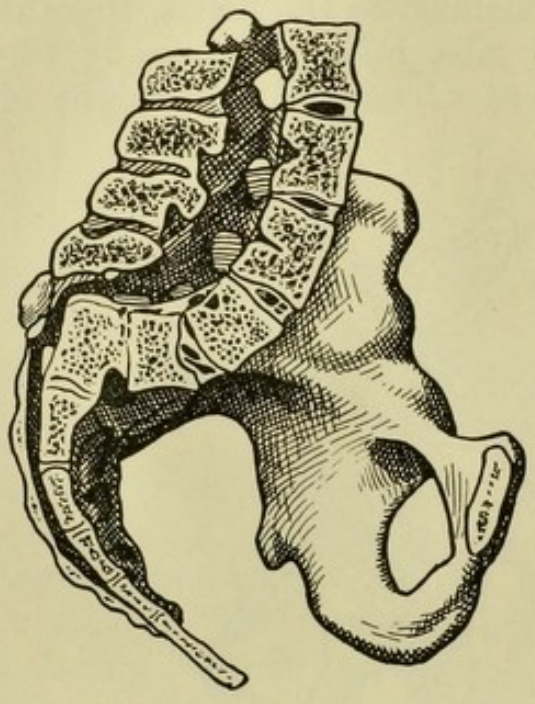


FIG. 190.—Spondylolisthetic pelvis, vertical section. (After Kilian.)

Spondylolisthetic Pelvis.—The term spondyl-olisthesis means the slipping or dislocation of a vertebra, and a spondyl-olisthetic pelvis is one where the last lumbar vertebra has slipped down in front of the promontory of the sacrum. This causes a great diminution in the available antero-posterior space, and usually effectually prevents the engagement of the head. In most cases Cæsarean section is the only wise treatment.

Other forms of irregular contraction may be caused by bony tumours of the pelvis, or by fractures. The "thorny" pelvis (pelvis spinosa) is one with exostoses on the bones. These may by pressure cause fistula formation after labour.

Pelves contracted at the Outlet

Kyphotic Pelvis.—The effects of kyphosis do not make themselves apparent in the pelvis unless the gibbus or hump is situated in the dorso-lumbar, or more particularly in the lumbar portion of the spine. Instead of being directed merely downwards, the body weight is directed downwards and backwards towards the hump, and is equivalent to a force with two components, the one acting downwards and the other

backwards. This backward acting component is the main cause of the deformity produced.

Its first effect is to pull the promontory of the sacrum backwards, rotating the whole bone and tilting the coccyx forwards. At the same time it has the effect of lengthening and narrowing the sacrum. The result of these changes upon

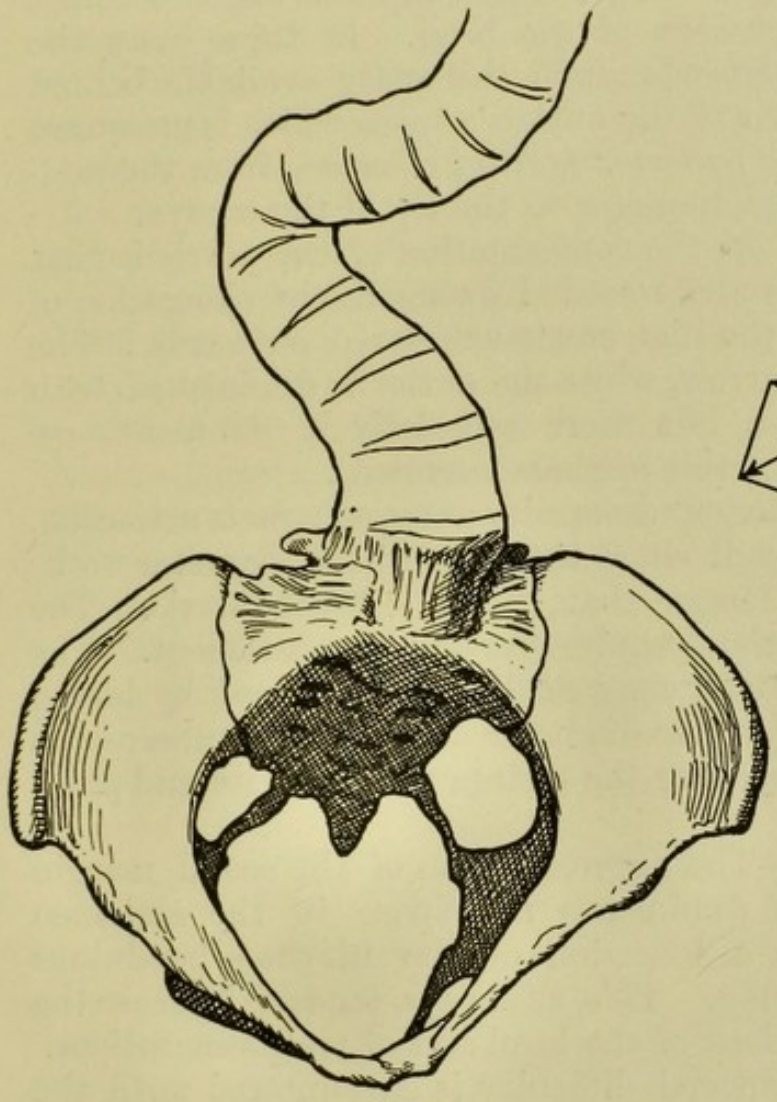


FIG. 191.—Kyphotic pelvis.

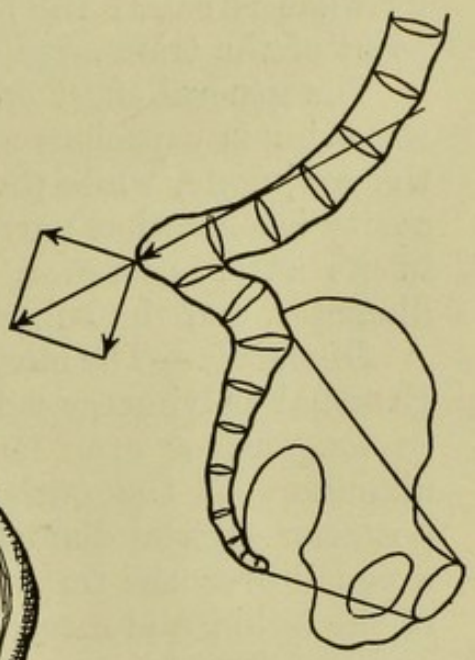


FIG. 192. — Diagram of kyphotic pelvis on vertical section.

the diameters is that the antero-posterior diameter of the brim —the conjugate—is lengthened, while the antero-posterior at the outlet is diminished.

Further, the backward displacement of the upper part of the sacrum causes a rotation outwards of the upper parts of the innominate bones, which in its turn is balanced by an inward rotation of their lower parts. In this way there is

caused a distinct narrowing of the pelvis from side to side which becomes more and more marked as we trace it through the cavity to the outlet. The distance between the ischial spines and between the ischial tuberosities becomes markedly shortened, and associated with this there is a narrowing of the subpubic angle. This last is a point of great importance, as in extreme cases the space below the subpubic angle becomes unavailable for the passage of the head. In these cases the prognosis of labour depends upon the space available behind the transverse diameter of the outlet, a space which is measured by what is called the *posterior sagittal diameter* from the mid-point of the transverse diameter to the tip of the coccyx.

The general effect on the conformation of the pelvis is that the brim is capacious and rounded owing to the elongation of the conjugate, while the iliac crests are flared outwards. The cavity is somewhat narrow, while the outlet is diminished both in its antero-posterior, but more especially in its transverse diameter, and the subpubic angle is narrowed.

Diagnosis.—The obvious deformity at once attracts attention. External pelvimetry will show the intercristal diameter to be as long as, or even longer than, the intertrochanteric. The diameters of the outlet require careful measurement. The posterior sagittal diameter may easily be ascertained by laying a pencil over the transverse diameter between the tuberosities of the ischia, and measuring the distance between its mid-point and the coccyx.

Effect on Labour.—The approximation of the costal margin and the pelvic brim diminishes the space in the abdomen proper, and leads to anteversion of the uterus—pendulous belly—during pregnancy. This, as always, tends to increase the frequency of malpositions of the head and of malpresentations.

During labour no special difficulty is encountered until the head reaches the outlet. Here its descent is obstructed first by the ischial spines, and, if it manages to pass these, secondly by the diminished transverse diameter. Here its fate largely depends on the length of the posterior sagittal diameter, as the smaller that measurement is the less chance is there of the birth of the head, and conversely. Speaking generally, delivery may be expected if the transverse diameter is not less than $3\frac{1}{2}$ inches (9 cm.).

Treatment.—In severe cases the best treatment is undoubtedly

Cæsarean section at term. In slight cases spontaneous labour may be anticipated, and if necessary aided by forceps. Pubiotomy may also be considered in cases of moderate severity. Craniotomy may be necessary if the child is dead, or other forms of operative assistance are declined.

Prognosis.—This is rather serious for both mother and child, the mortality being about 28 per cent and 40 per cent respectively.

The **Funnel-shaped** or **Masculine Pelvis** is one in which the diameters diminish towards the outlet both in the antero-posterior and transverse directions. The whole pelvis has thus the appearance of a male pelvis, or of one which has retained the characters of the fœtal stage of development.

The **High Assimilation Pelvis** is one in which the last lumbar vertebra has adopted the characters of a sacral vertebra, and become fused with the sacrum.

According to Whitridge Williams this form of pelvis is much more common than is generally supposed. The general conformation of the pelvis is much the same as the masculine pelvis, but the outlet contraction is more particularly in the antero-posterior diameter.

The effects upon labour and the treatment are much the same as in slight degrees of kyphosis.

CHAPTER XXX

FAULTS IN THE PASSENGER

Anomalies of the Membranes

Præternatural Toughness of the Membranes.—Occasionally, but not often, the membranes are either excessively tough or excessively elastic. In either case the result is that they do not rupture spontaneously when the os becomes fully dilated, as is the case in a strictly normal labour. The membranes may not rupture until they protrude at the vulva, or more rarely the child may be born with the membranes intact—placenta and membranes with the fœtus inside them being born all together. When this happens, the membranes must be ruptured instantly, otherwise the child will die, as the placental respiratory functions have, of course, ceased. This is termed being born "in a caul," the caul being the portion of membrane over the head. Such a child is credited by the superstitious with being lucky, and the dried caul has to this day a certain monetary value amongst sailors as a charm against drowning!

In these cases delay in labour is caused by the increased size of the body which the uterus has to expel, the increase being due to the unyielding liquor amnii.

Treatment is simple—to puncture the membranes after full dilatation has taken place. Rupture before the os is fully dilated does more harm than a little delay, so it is well to be certain that full dilatation has occurred. Ordinary membranes may be ruptured by the finger-nail by a sawing motion, or by nipping them between the nails of the finger and thumb. Tough membranes may require a sharp-pointed forceps, or

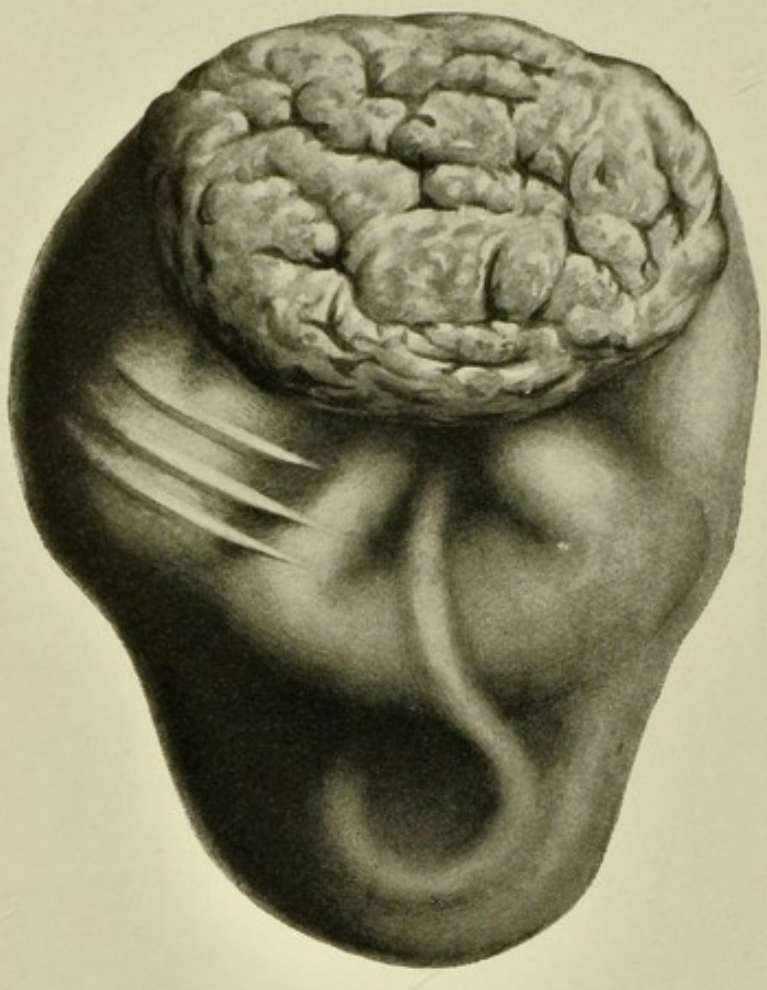


FIG. 193.—Placenta and membranes intact with contained fœtus, from a miscarriage about the 25th week. (Specimen in the Obstetrical Museum, University of Edinburgh.)

scissors. The stylet of a catheter or a straightened-out hair-pin does very well when washed and sterilised in a flame. The puncture should be made between pains, especially if the head is not deeply engaged, in order to prevent the too sudden escape of the liquor amnii, which might lead to prolapse of the cord. Precautions must be taken not to mistake the caput succedaneum or the anterior lip of the cervix for the bag of waters.

Occasionally the membranes are unduly adherent to the lower uterine segment, the result of decidual endometritis. This may be put right by sweeping the finger round inside the os.

Premature Rupture of the Membranes.—The membranes may rupture before dilatation has been completed, or even before labour has begun at all. In these latter cases there is a history of the escape of the waters, but this may be deceptive, for sometimes fluid collects between the chorion and the uterine wall, and comes away before labour (see Hydrorrhœa Gravidarum). Vaginal examination will soon settle the point.

The cause of the condition may be the excessive thinness of the membranes, but more often it is due to some underlying condition such as contraction of the pelvic inlet, or malpresentations, *e.g.* face or shoulder. In these circumstances, as has been explained, the ball valve action of the head does not come into play, the membranes protrude in a sausage shape, and early rupture occurs. If all the fluid escapes, the labour becomes a "dry" labour.

In the absence of the bag of waters the dilatation of the cervix has to be effected by the hard unprotected fœtal head. This may result in laceration of the cervix, and sometimes it sets up an almost tetanic contraction of the uterus. Much of the uterine force is spent in thinning out the lower uterine segment rather than in dilating the cervix, and rupture may follow. Not infrequently the anterior lip of the cervix becomes nipped, and increasingly swollen—in itself a cause of delay and exhaustion to the mother. The fœtus also may suffer, compression of the head leading to interference with the fœtal circulation and asphyxia, and sometimes even to intracranial hæmorrhages.

Where the condition is associated with pelvic deformity, or malpresentation, it may be distinctly serious.

Treatment.—Prophylaxis consists in early examination to ascertain the exact state of affairs, and if necessary to rectify the presentation. This is of especial importance in primiparæ, in whom the consequences of a dry labour are more serious.

In uncomplicated cases the treatment is largely that of rigidity of the cervix—to control the force of the uterine contractions and favour dilatation. These indications are met by giving chloral or opium, and hot vaginal douches. Chloroform anæsthesia is necessary if the contractions threaten to become tetanic. In more obstinate cases dilatation must be aided either by the fingers or by Champetier de Ribes' bag. After dilatation is complete the second stage should be finished with forceps in order to prevent exhaustion of the mother.

Absence of the Bag of Waters, due to the close apposition of the head to the lower uterine segment, is clinically the same as the above. If diagnosed early, it may be treated by gently pushing the head back a little, so as to allow some of the liquor amnii to flow down past the head.

Anomalies of the Liquor Amnii

Polyhydramnios and **Oligohydramnios**—too much and too little liquor amnii—have already been discussed under the pathology of pregnancy. They need only be mentioned here as causes of delay in labour.

Anomalies of the Umbilical Cord

Shortness of the Cord.—This may be either absolute or relative.

An absolutely short cord is due to some error of development. It has been noted in association with oligohydramnios. A case is related of a cord only two inches long, which ruptured during labour.

A relatively short cord is one which is rendered short by being wound round the limbs or body or neck of the child, although its actual length may not be less than normal.

What length of cord is necessary to allow of the birth of the child without pulling upon the placenta? The distance from the fundus to the vulva during labour is about 8 inches (20 cm.). Where the fœtus is descending head first we must add

to that the distance from the umbilicus to the breech—namely, 4 inches (10 cm.). In breech cases one must add the distance from the umbilicus to the vertex—namely, 7 inches (17·5 cm.). Therefore any cord which is under 15 inches (37 cm.) long may be said to be an absolutely short cord.

The risks of the condition are premature separation of the placenta with consequent death of the child, and serious maternal (accidental) hæmorrhage. Inversion of the uterus is also a risk. The condition is rarely diagnosed until the child is actually being delivered. Treatment is to clamp the cord in two places and cut between.

Presentation and Prolapse of the Cord.—When a loop of the umbilical cord lies in advance of the presenting part before the rupture of the membranes, it is spoken of as a *Funic Presentation.* This is a rare condition. Much more common is a *Prolapse of the Cord*, by which is meant that a loop of the cord is swept down past the presenting part when the membranes rupture. The frequency of the two conditions combined is about 1 in 150.

Causes.—There are two conditions essential to the prolapse of the cord, and a number of others which may in certain cases be contributory.

The first essential is that the presenting part should not accurately fit the lower uterine segment. This misfit may be due either to the shape of the presenting part, or to the shape of the lower uterine segment. Face, shoulder, and pelvic presentations do not fit into the lower segment so closely as the vertex. On the other hand, the shape of the lower segment may be modified by deformity or contraction of the pelvis, by fibroid or other tumours of the uterus, by the insertion of the placenta in the lower segment, or by hydramnios.

The second essential is the presence of enough liquor amnii to sweep down the cord when the membranes rupture. In this connection also the risk of hydramnios becomes obvious.

Lastly, there are minor contributory causes such as an abnormally long cord, and a marginal or a velamentous insertion of it.

Risks and Prognosis.—To the mother the effects are *nil*, unless she suffer as a result of interference on behalf of the child.

To the child the risks are slight before rupture of the membranes, *i.e.* from mere presentation of the cord. After rupture the risk is that the cord may be so compressed between the presenting part and the wall of the pelvis that the fœtus may die from interruption of its circulation. How very considerable this risk is may be judged from the fact that the fœtal mortality is about 50 per cent.

Diagnosis.—This can only be made by vaginal examination. The cord is felt, and particularly after the rupture of the membranes its shape, and the fact that, if the fœtus is still alive it pulsates, suffice to identify it. The condition may be suspected by the detection of a funic souffle, or the progressive slowing of the fœtal heart-beat on auscultation, but actual diagnosis can only be made by vaginal examination.

Treatment.—(*a*) *If the membranes are intact*, i.e. *funic presentation.*—The membranes must, if possible, be preserved intact, as while they remain so there is little risk of serious pressure on the cord. To this end the patient should be kept in bed, and any vaginal manipulations performed with the utmost care. At the same time an effort may be made to replace the cord by the effect of posture. There are three positions which have the effect of bringing the fundus to a lower level than the cervix—the knee-elbow, Sims', and the Trendelenburg. Of these the first is the most efficacious for the present purpose, but Sims' the most easily maintained for any length of time.

The patient, then, should be placed in the knee-elbow position with her head and breast resting on the bed as far as possible. If the presenting part is not firmly engaged, it will now slip down by gravity towards the fundus, and the loop of cord will slip back with it. The fingers passed gently into the vagina will feel whether this happens or not. If it does not occur spontaneously, the fingers may very gently push back the presenting part, so as to allow the cord to fall back. Once the cord has slipped back, an assistant should press the presenting part firmly into the brim of the pelvis so as to fix it there. The patient may then be allowed to adopt the less uncomfortable Sims' position until after the membranes have ruptured spontaneously. If there is difficulty in pressing the presenting part into the pelvic brim, the membranes may be ruptured artificially, and the patient kept in Sims' position until the

uterine contractions have forced it so far down that all risk of subsequent prolapse of the cord is past.

(*b*) *If the membranes have ruptured*, i.e. *prolapse of the cord.*—Before determining on any line of treatment, ascertain by auscultation the condition of the child. If the child is dead, no treatment is necessary. If the pulsations in the cord are very slow, intermittent, and feeble, it is not likely that the child will survive, unless it can be immediately and *easily* delivered. If, however, the child's condition is favourable,

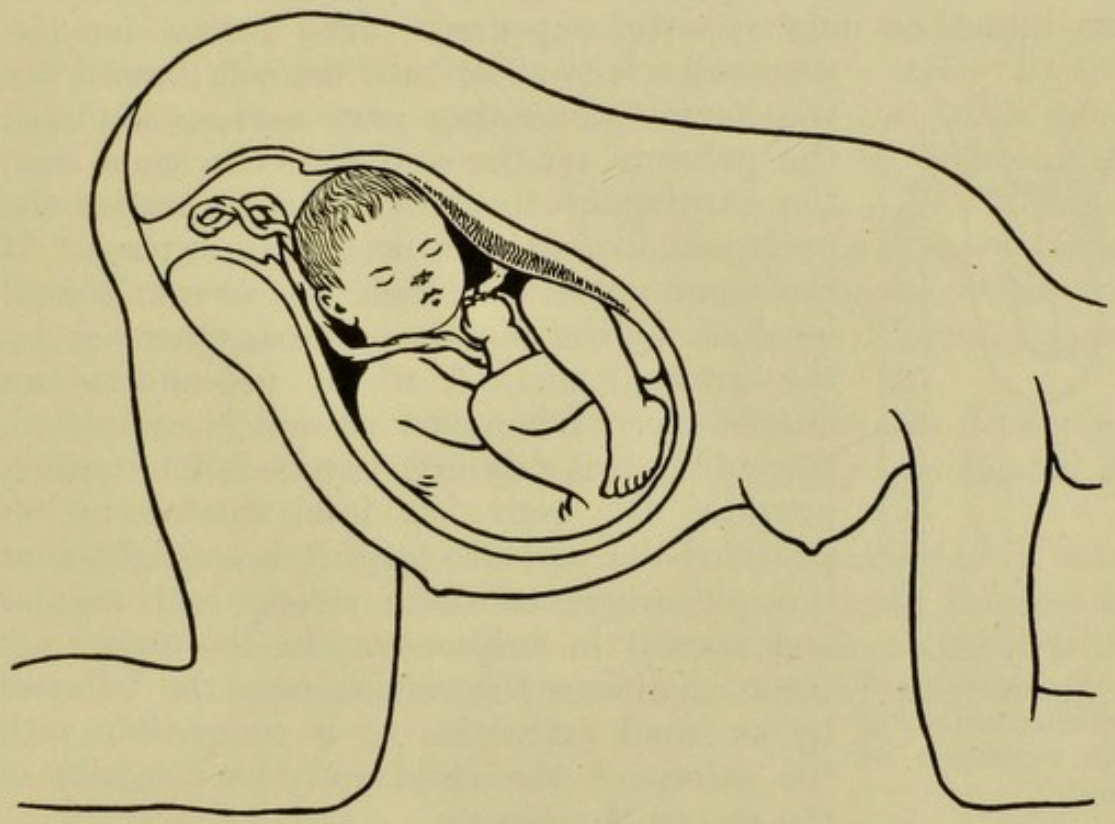


FIG. 194.—Knee-elbow position in prolapse of the cord.

there are three lines of treatment to be considered—Reposition of the Cord, Podalic Version, and Immediate Delivery.

Reposition.—This is done in exactly the same way as before the rupture of the membranes, but care must be taken to push back the presenting part only in the intervals between pains. If the part is fixed, it is wiser to anæsthetise the patient in the Sims' or Trendelenburg position before attempting to replace the cord. After reposition the presenting part must be firmly pressed into the pelvis as before.

The difficulty of this manipulation has led to the employ-

ment of various instruments for the same purpose. None of them is so good as the fingers; and if the fingers fail, success is not likely to attend instrumental efforts. Of them all the simplest and best instrument is a sterilised gum-elastic catheter with a loop of sterile string or tape attached, as shown in the illustration. With this the cord is gently pushed past the presenting part, after which the catheter is carefully withdrawn—if possible without bringing the cord back too.

Podalic Version.—This is an alternative treatment in cases in which the head or shoulder presents, and the membranes are intact or only recently ruptured. The reason for the treatment is to substitute the soft breech for the harder presenting part, and so diminish the pressure on the cord. At the same time the turning of the child usually carries the prolapsed loop of cord up into the uterus. If the membranes are intact the version should be done by the bipolar method, otherwise by the internal method which necessitates an anæsthetic. When the version is completed, the subsequent delivery may be left to nature, provided the cord has been carried up, or provided the pressure upon it is so slight that the pulsations continue strong and regular and normal in frequency. In the absence of these conditions the version must be followed by as rapid extraction as is compatible with the safety of the child and the integrity of the maternal passages.

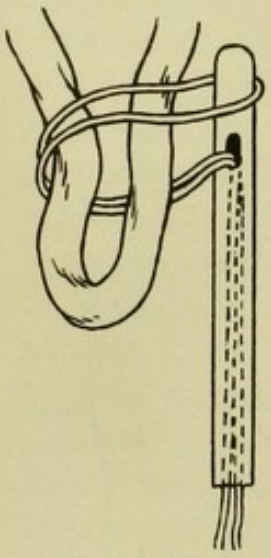


FIG. 195. Arrangement of catheter and string for reposition of cord.

Immediate Delivery.—This is indicated in cases in which reposition has failed, and the child's condition is unfavourable. If the cervix is dilated the matter is easy—the application of forceps in head-first cases, extraction by traction on the leg in breech cases. Where the cervix is not dilated, the chances of the child's survival must be carefully but rapidly balanced against the extra risk to the mother involved in any forcible dilatation. The only justifiable methods of dilating the cervix in such a case are manual dilatation and superficial incisions of the cervix.

Of the three methods of treating prolapse of the cord, manual reposition is the one favoured by most competent authorities.

Anomalies of the Fœtus

Influence of Sex upon Labour.—Difficulties and complications in labour are on the whole more often associated with male infants than with female. The maternal mortality and morbidity are therefore higher in association with male births; and both the immediate and the more remote infant mortality and morbidity are greater amongst male infants than amongst females.

Large Size of the Child.—This may cause difficulty and delay in labour. The average weight is about seven pounds, and infants of more than twelve pounds are very rare. At the same time cases are on record of infants weighing at birth more than twenty pounds. Excessive size usually depends on one of two factors—heredity and prolonged gestation. The children of large parents—particularly the sons of large fathers—tend to be larger than normal. Further, if gestation be prolonged, the fœtus goes on growing *in utero* until the deferred labour comes on.

Dystocia from this cause usually requires the use of forceps. If the child dies during parturition, craniotomy is indicated in the interests of the mother.

Excessive size of the head, or *premature ossification* of it, may be associated with normal development and size of the rest of the body. Premature ossification of the head interferes with proper head moulding, and so causes difficulty and delay in labour.

Pathological causes of enlargement :—

(1) Fœtal ascites.

(2) Overdistension of the fœtal bladder.

(3) Abdominal enlargement from the presence of congenital cystic kidneys.

(4) General dropsy of the fœtus.

(5) Putrefaction of a dead fœtus with gaseous distension of the abdomen.

(6) **Double monsters**, due to the incomplete separation of uniovular twins, are a rare source of delay in labour. Such monsters are seldom large, and cause as a rule much less difficulty in delivery than might be expected. No compunction need be felt in performing craniotomy or decapitation if a diagnosis is made before delivery.

(7) **Anencephaly.**—This is a condition of arrest of development. The whole of the vault and back part of the skull are wanting, and frequently there is associated with it some degree of spina bifida and meningo-myelocele. Anencephalous monsters do not live, but they may cause difficulty in their birth. This is partly owing to the fact that the shoulders are broad, but more especially to the fact that the deformed head is an inefficient dilator of the cervix.

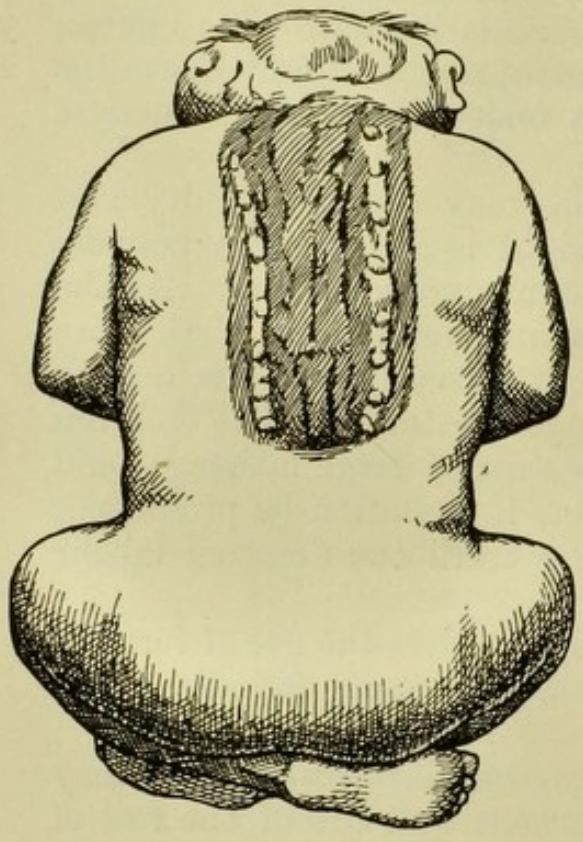


FIG. 196.—Anencephalic fœtus with spina bifida.

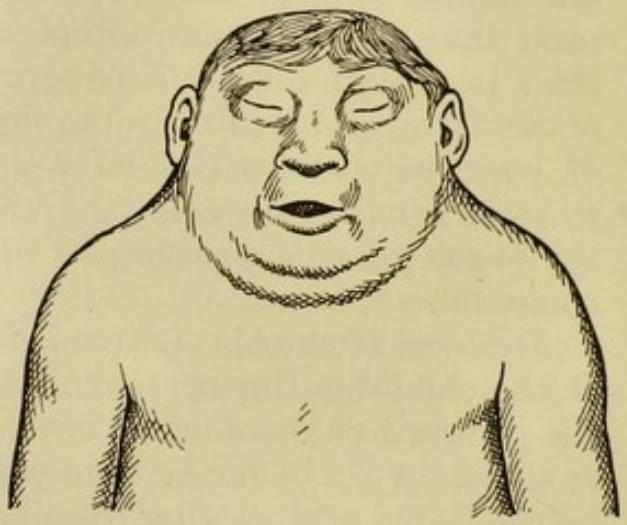


FIG. 197.—Anencephalic fœtus (front view).

(Specimen in Obstetrical Museum, University of Edinburgh.)

(8) **Congenital Hydrocephalus** is the commonest pathological enlargement of the fœtus. In this condition the cerebral ventricles, particularly the lateral ventricles, are distended with an excess of cerebro-spinal fluid. The condition may arise after birth, but frequently it begins *in utero*, and the head may attain such colossal proportions that spontaneous delivery becomes impossible. Several pints of fluid have been drawn off such heads after perforation.

Hydrocephalic children may present *in utero* by the head, but breech or footling presentations are at least equally as common.

Diagnosis.—In either head or breech presentation there is arrest of the head at the brim of the pelvis, and combined with

this there is probably no lack of efficiency in the expelling powers, nor any pelvic or other maternal cause of delay. On examination the head will, in a head presentation, be found high up, right above the pelvic brim. It is larger and more rounded than usual. The sutures are wider and the fontanelles large and bulging. "Islands of bone in a sea of membrane" is a description that has been applied to it.

When the breech presents it will generally be observed that the limbs and trunk are small and shrivelled, which makes any obstruction from the head all the more unexpected, and at once suggests the real state of matters. The diagnosis may be confirmed by palpating the large rounded head above the symphysis.

Prognosis.—The great danger is rupture of the uterus. In 74 cases this accident occurred 16 times. The child is often dead; but in any case its life is of no consideration, except where for legal reasons it is desirable to have a child born alive, because, if it survives, it is almost inevitably doomed to hopeless idiocy.

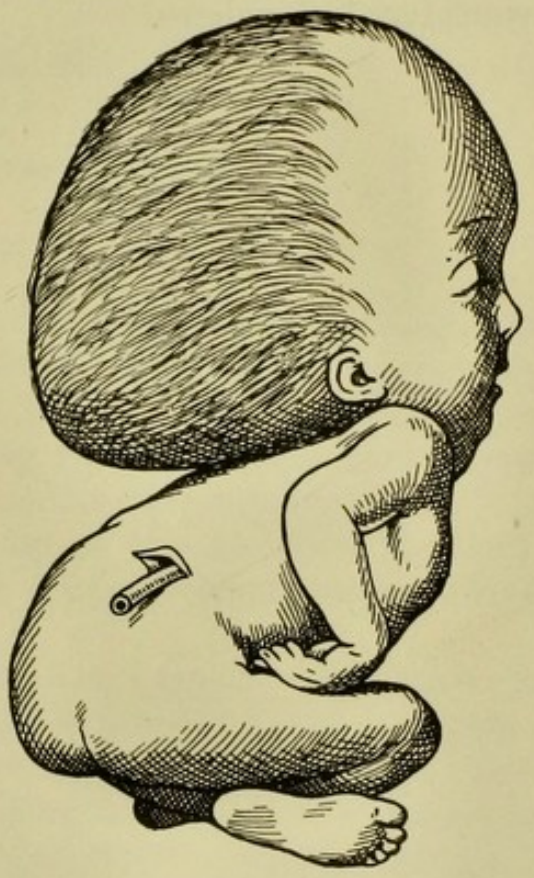


FIG. 198. — Hydrocephalic fœtus delivered by tapping the spinal canal. Head subsequently stuffed to original size. (Specimen in Obstetrical Museum, University of Edinburgh.)

Treatment.—Very few cases end spontaneously. Forceps are not only useless, but actively dangerous, and should never be used prior to perforation. Perforation by some method is the only satisfactory treatment.

In head presentations a perforator, or aspirating needle, or a pair of sharp scissors may be used. Make sure that the child is destroyed by passing the instrument to the very base of the brain. The head may then be extracted by forceps, or a cranioclast.

In head-last cases perforate through the base of the occiput or through the roof of the mouth. If the head is inaccessible,

tap the spinal canal. Cut down on the lumbar spines, and insert an aspirating needle or a stiff catheter into the vertebral canal. If possible pass the catheter right up the canal to the brain, as the foramen of Monro is not always patent, and otherwise it may not be possible to draw off the fluid.

Malpositions of the Head and **Malpresentations of the Fœtus** are frequent causes of delay, but they have been fully considered elsewhere.

CHAPTER XXXI

ANTE PARTUM HÆMORRHAGE

I. Accidental Hæmorrhage

This may be defined as bleeding during the last three months of pregnancy owing to the premature separation of a normally situated placenta (*i.e.* a placenta situated entirely within the upper uterine segment). Bleeding from the same cause may, of course, occur in the earlier months of pregnancy, but it is then regarded more as a symptom of the abortion that will probably result from it, than as a separate condition requiring special description.

Etiology.—The condition is four times commoner in multiparæ than in primiparæ, and is usually found in women who are debilitated by disease or rapid child-bearing. This probably means that the underlying cause is to be found in such conditions as decidual endometritis, which lead to a weakening of the attachments of the placenta to the uterine wall. Interstitial and submucous fibroids, and placental infarcts and disease may also cause it. Some general diseases of the mother have frequently been found associated with accidental hæmorrhage—particularly renal disease (albuminuria), heart disease, blood dyscrasias, and syphilis.

In most cases the patient attributes her symptoms to some accident such as a fall or blow, or to a fright or sudden emotion. It is probable, however, that these factors have no influence unless there is some underlying weakness in the placental attachments. On the other hand, if such weakness or disease of the uterine wall is present, they may precipitate the disaster by causing sudden alterations in the blood pressure or exciting contractions of the uterus.

Occasionally the premature separation of the placenta occurs during labour, due to the traction of an abnormally short cord, or to the sudden diminution of the contents of the uterus when the membranes rupture in hydramnios.

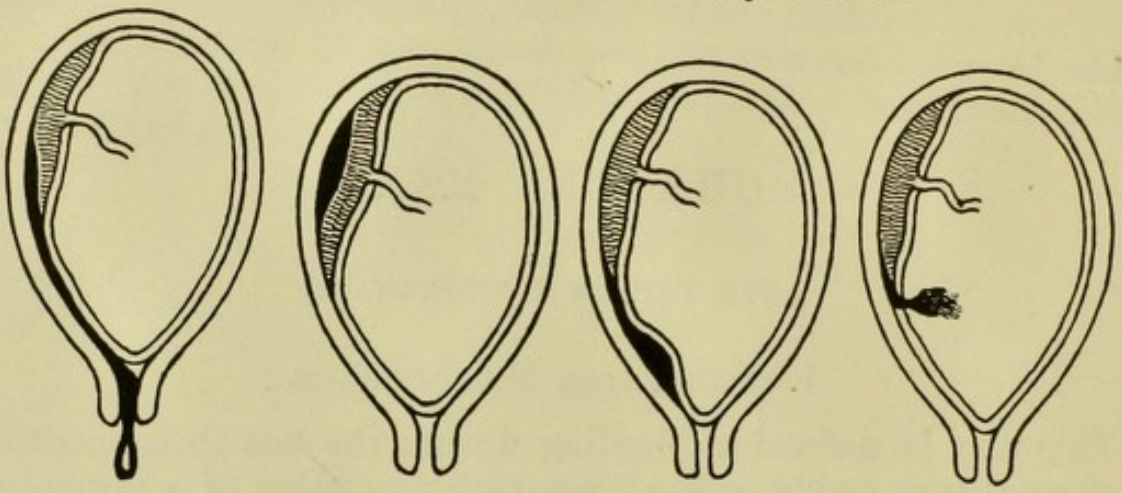


Fig. 199.
External accidental hæmorrhage.

Fig. 200. Fig. 201. Fig. 202.
Varieties of concealed accidental hæmorrhage.

Frequency.—Severe cases are happily rare; but including those cases in which the bleeding is slight, the frequency may be put at 1 in 200.

Varieties.—(1) External—where the blood escapes externally by the vagina (Fig. 199). This is much the most common variety.

(2) Concealed or Internal—where the blood remains within the uterus. There are three subdivisions of this: (*a*) the blood may collect behind the placenta as a retro-placental clot (Fig. 200); (*b*) the blood may separate the membranes from the wall of the uterus but not as far as the internal os, and so remain lying between the membranes and the wall (Fig. 201); (*c*) the blood may burst into the amniotic cavity (Fig. 202).

(1) **External Variety.**—The symptom is bleeding, which may be accompanied by some pain and tenderness over the uterus, and possibly by uterine contractions which culminate in premature labour. The bleeding may come on at any time, apart from any exertion, or may follow on some accident, strain, or emotion. The blood may escape in a steady stream, or may accumulate in the uterus and be expelled in gushes when the uterus contracts. In some cases the discharge is composed of clots and serum. If the bleeding is very extensive, there are the usual symptoms of collapse.

Diagnosis.—The condition must be distinguished from the "unavoidable" hæmorrhage due to the separation of a placenta prævia. This is to be done by excluding on examination the presence of the placenta in the lower uterine segment. Occasionally it may be done by abdominal examination alone, for if the head present and be fixed in the pelvic brim, placenta prævia is most unlikely to be the cause of the hæmorrhage. On vaginal examination the placenta cannot be felt, and the presenting part is palpable. It may be impossible by these methods to exclude the possibility of a *marginal* placenta prævia, but this is a matter of no moment, as such cases are to be treated on the same principles as accidental hæmorrhage.

Treatment.—Palliative measures may be adopted in cases where the bleeding is slight, if the period of gestation is such that the child, if born, is unlikely to survive, and if the patient is in a position to be well looked after. The treatment is the same as for a threatened abortion. If the bleeding recurs to any extent, palliative measures should be at once abandoned.

Active measures should be adopted at once in cases where the bleeding is more severe, and where it comes on shortly before labour, or is accompanied by the onset of labour pains. The two great principles of treatment are—to control the hæmorrhage, and to promote delivery.

A.—In external hæmorrhage with an undilated cervix there are two lines of treatment, both of which meet these two requirements almost equally successfully. These are—(1) rupture of the membranes, and (2) packing the vagina.

Rupture of the Membranes.—This may be done by the passage of a sterilised sound or catheter stylet through the os. The result of the escape of the liquor amnii is that the uterus contracts down upon the body of the child, and the placenta is compressed between it and the placental site. In this way the further escape of blood is mechanically prevented. At the same time labour pains are induced, if not already present. After rupture of the membranes, the fundus of the uterus should, if necessary, be massaged to excite the requisite contractions, and the labour allowed to proceed naturally, a close watch being kept on the patient to see that the bleeding is really controlled. The labour will, of course, be a dry one, and tedious.

If the bleeding is not controlled, *accouchement forcé* will be necessary. The best method in such cases, especially in private practice, is the introduction of a Champetier de Ribes' bag after manual dilatation of the cervix sufficient to admit it. Recourse should never be had to packing the vagina after rupture of the membranes has failed, unless the uterus is contracting strongly.

Packing the Vagina.—The bladder should be emptied, and the vagina well douched with an antiseptic lotion. Sterile gauze or tampons of sterile wool wrung out of weak antiseptic lotion are the best materials for packing. To be any use the packing must be firmly done; and as this is a painful process, an anæsthetic is helpful. The posterior vaginal wall should be drawn back by a Sims speculum or the handle of a spoon, or two fingers of the left hand. With the right hand the gauze or tampons are passed in, the posterior and other fornices being first tightly packed, and then the vagina filled as full as possible. A broad firm abdominal binder must then be put on and drawn tight over the fundus. Lastly, a pad of wool is placed over the vulva, and a perineal bandage attached in front and behind to the binder to keep the vaginal pack from coming out.

The effect of this treatment is firstly to stimulate uterine contractions and dilatation of the cervix, but at the same time the organ is to some extent compressed between the tight binder above and the vaginal pack below. The alleged danger of converting an external into a concealed hæmorrhage by this treatment is more theoretical than real; for, although bleeding may continue for a short time behind the pack, it will cease as soon as the pressure inside the uterus equals the pressure inside the arteries. With a uterus capable of contracting this equalisation of pressure occurs very soon, and the danger only arises where the uterus is so diseased that it just expands before the increase in its contents. Such cases are very rare, and very grave.

The vaginal pack should be left in until labour pains are strong and frequent, usually a matter of a few hours only. Failing the onset of labour, it must be removed after twelve hours, the vagina douched out, and a fresh pack introduced.

B.—In cases in which the os is partially dilated, *i.e.* where the patient is in labour, the membranes should be ruptured without delay. If this fails to stop the hæmorrhage, version

by the internal or bipolar method may be done and a foot drawn down, and the child *slowly* extracted; or the os may be completely dilated by hand and forceps applied.

Other methods of treatment comprise the various forms of *accouchement forcé*. The element of shock inevitably associated with these is a very serious objection to their employment. Of them all the use of Champetier de Ribes' bag is the least harmful. In hospital vaginal Cæsarean section has been successfully employed.

(2) **Concealed or Internal Variety.**—The symptoms of this extremely serious condition are principally shock and collapse from internal hæmorrhage—increasing pallor, faintness, restlessness, rapid feeble pulse, cold perspiration, sighing respirations, and air hunger. In addition there is increase in the size of the uterus, which becomes hard and extremely tender to the touch, while the patient suffers from the same sort of agonising pain as is met with in cases of impending rupture or tonic contraction of the uterus.

Diagnosis.—This is based on the foregoing symptoms and signs, but is more difficult than in the external cases, where the attention is at once directed to the hæmorrhage and to the uterus as the source of the trouble.

Treatment.—The fact that the hæmorrhage is concealed indicates that the uterus is inert, probably from disease of its walls, and there is consequently less hope of being able to excite uterine contractions. Rupture of the membranes is obviously a risky form of treatment in the circumstances, and it is probably best to pack the vagina and put on an abdominal binder in the hope of exciting contractions. In the meantime the serious shock from which the patient is suffering—induced by the sudden over-distension of the uterus combined with the loss of blood—must receive careful attention. Hypodermic injections of ether, brandy, adrenalin, or pituitary extract should be tried, but it is probably useless (if not worse) to give injections of large quantities of saline until the open vessels have been controlled.

In hospital such cases are sometimes best treated by abdominal Cæsarean section followed by hysterectomy, performed as soon as the patient has rallied from the primary shock. Failing this, the only line of treatment is *accouchement forcé*.

Prognosis.—The prognosis of the external variety of accidental hæmorrhage varies with the amount of blood lost. It is never so grave as that of the concealed variety where serious shock is superimposed on the dangers of internal bleeding. The maternal mortality of accidental hæmorrhage in general is from 5 to 10 per cent, the fœtal about 60 per cent. In the concealed variety alone the maternal mortality is 50 per cent and the fœtal 90 per cent.

After-treatment.—Particular care must be taken to guard against post partum hæmorrhage. If the placenta is not immediately expelled, it is better to remove it manually, and give a hot intra-uterine douche as well as a hypodermic injection of pituitary extract or ergot. If necessary the uterus must be packed with gauze. Subsequent general treatment of the shock and collapse will be required, just as after a severe post partum hæmorrhage.

CHAPTER XXXII

ANTE PARTUM HÆMORRHAGE—*continued*

II. UNAVOIDABLE HÆMORRHAGE—PLACENTA PRÆVIA

A PLACENTA PRÆVIA is one which is situated either in whole or in part upon the lower uterine segment, or more strictly, upon that part of the uterus which will, on the commencement of

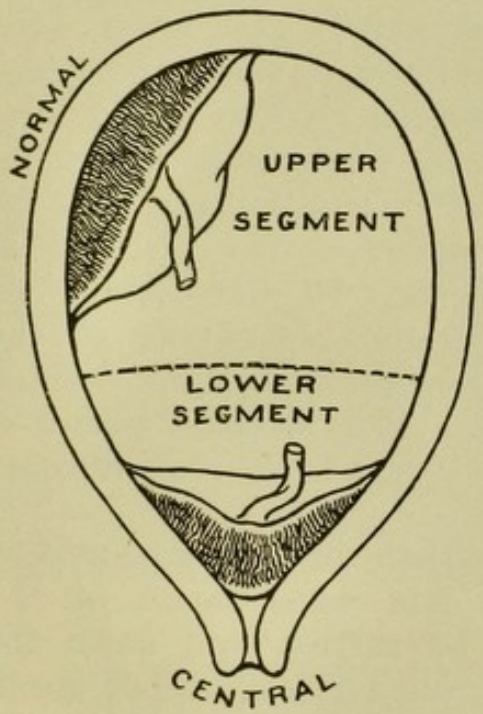


FIG. 203.—Normal and morbid situations of the placenta.

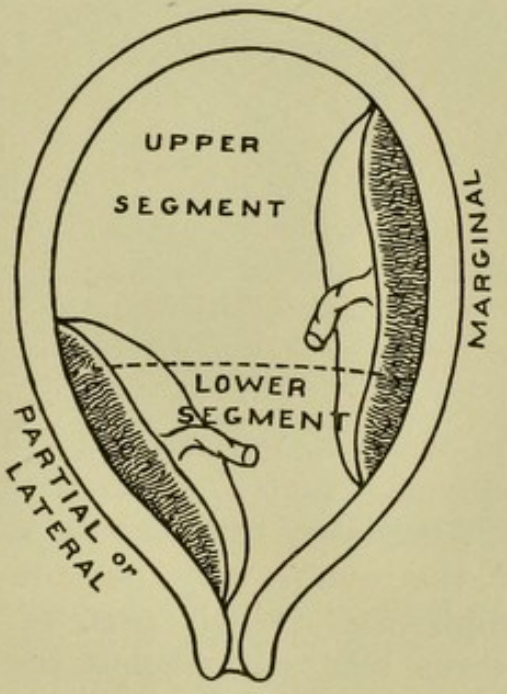


FIG. 204.—Morbid situations of the placenta.

labour, become the lower uterine segment. A placenta that completely covers the internal os is called a *central* placenta prævia; one whose edge partly overlaps the os is distinguished as a *partial* or *lateral* placenta prævia; while one that is

situated mostly on the upper uterine segment, but overlaps at its lower edge into the lower uterine segment, is called a *marginal* placenta prævia. The differentiation into these varieties is unsatisfactory, for it is obvious that a placenta which entirely covers the os when it is closed may only partially do so when the os is opened. A closed state of the os is, therefore, generally taken for granted when these terms are used.

Etiology.— Placenta prævia is most commonly found in multiparæ, and frequently there is a history of previous endometritis. How the placenta comes to be situated so low down in the uterus is not easy to explain.

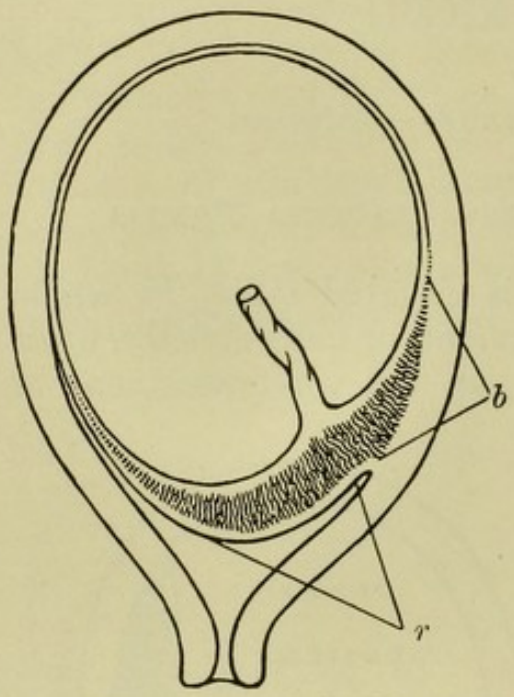


FIG. 205.—Reflexal development of placenta (after Whitridge Williams). *b*. Decidua basalis. *r*. Decidua reflexa.

The old theory that, owing to the enlargement of the uterus from endometritis, the ovum is free to slide down to the region of the os internum before becoming embedded, has never been proved by anatomical specimens. The modern view, which is supported by anatomical specimens, is that the condition is due to the development of the placenta in connection with the decidua reflexa at the lower pole of the ovum as well as with the decidua basalis. The ultimate fusion of the decidua reflexa with the vera around the os internum explains a central placenta prævia.

Associated with this is the view that the low implantation of the ovum may be due to a late development of the trophoblast, which permits it to be carried well down the uterus before it reaches the stage when it can embed itself. Further, defective vascularity of a diseased endometrium may compel the ovum to maintain its villous attachments over a larger area than usual, and so tend to the persistence of a reflexal placenta. An increased demand for nourishment on the part of twin ova and the consequent enlargement of the placental site explain the greater frequency of the condition in twin pregnancies.

A placenta prævia is but rarely normal in other respects. It is usually larger than normal, and thinner, and the cord is often inserted abnormally.

Frequency.—Happily the condition is rare. Amongst hospital patients its frequency is about 1 in 250, but in private practice it falls to 1 in 1000. The marginal variety is the commonest, the central the rarest.

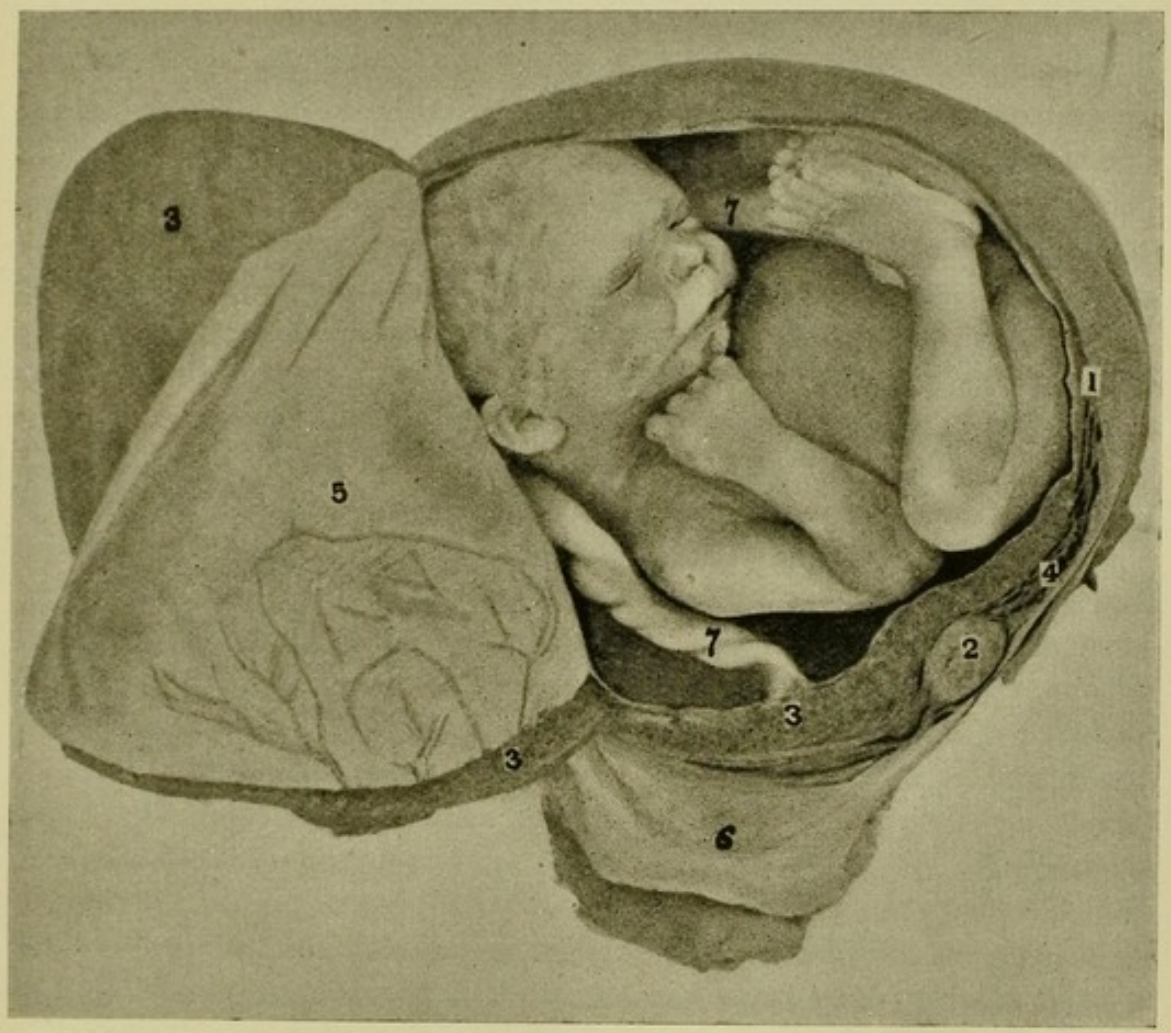


FIG. 206.—Case of partial placenta prævia at sixth month of pregnancy. Note how the placenta prævia has caused a transverse lie of the fœtus. (Specimen in Obstetrical Museum, University of Edinburgh.)

1. Wall of uterus. 2. Small fibroid tumour. 3. Placenta. 4. Blood sinuses underlying placental site. 5. Membranes partially detached from placenta. 6. Bladder with peritoneum overlying it. 7. Umbilical cord.

Symptom.—The one and only symptom is hæmorrhage, which comes on with no apparent cause. It is rare for this bleeding to occur before the seventh month of pregnancy, but

thereafter its frequency increases as the gestation proceeds. The severity of the bleeding varies greatly. In some cases the first onset may be so serious as to endanger the patient's life. More often the first hæmorrhage is slight, and ceases spontaneously, but is followed by recurrence after several hours or days. The hæmorrhage may come on at any time, during sleep for example, and is in most cases not connected with any exertion or trauma.

The presence of the placenta in the lower pole of the uterus is associated with a tendency to malpresentation. Pelvic presentations, and more particularly transverse lies of the fœtus, are considerably more frequent than usual (Fig. 206).

The occurrence of the hæmorrhage is usually followed by the onset of labour. The labour is thus in many cases premature, a fact which accounts to some extent for the high fœtal mortality.

Cause of the Hæmorrhage.—The lower uterine segment must expand before the fœtus can be expelled. If the placenta is attached to this portion of the uterus, the expansion of the placental site is inevitably associated with separation of the placenta, and consequent hæmorrhage. Hence the term "inevitable" or "unavoidable" hæmorrhage. This explanation suffices for those cases (and they are the majority) in which the bleeding comes on at the beginning of labour. For cases in which the bleeding ensues during the seventh or eighth month we must either assume that the painless contractions, that are always passing over the pregnant uterus, have resulted in some slight expansion of the lower segment; or else that the abnormally situated and abnormally developed placenta is unusually prone to degeneration, and that this degeneration leads to separation. The latter supposition really places these cases in the same category as accidental hæmorrhage, the only difference being in the situation of the placenta.

Sources of Hæmorrhage.—The main source of the blood is, of course, the exposed part of the placental site. Occasionally some of the blood may appear to come from the placenta. This happens when a cotyledon of the placenta is partly attached and partly detached, the blood going in at the attached part and escaping from the detached surface. Still more occasionally there may be bleeding from the marginal sinus of Meckel at the edge of the placenta, if this is torn. Lastly, an important source of hæmorrhage *may* be tears in the

cervix caused during attempts at delivery, the cervix in these cases being peculiarly vascular and soft. In all these cases it is the maternal blood that is lost.

Diagnosis.—Every hæmorrhage occurring in the last three months of pregnancy is to be regarded as probably due to a placenta prævia until and unless that condition can be excluded. The exact diagnosis is made by feeling the placenta. In the majority of cases the os is sufficiently open to allow one or even two fingers to be introduced, and the soft mass of the placenta can be felt. In lateral placenta prævia the edge of the organ may be felt, and the finger even passed over it so as to feel the vessels worming their way over the fœtal surface. The placenta may be distinguished from a blood-clot by the fact that a clot is easily broken up by the fingers, while the placental substance is more solid. At the same time the cervix is softer than usual, and there is an increased pulsation in the fornices, indicating greater vascularity. The presenting part is not easily felt, the boggy mass of the placenta intervening between it and the finger.

On abdominal examination the presenting part is found, as a rule, rather high, and is rarely fixed at the beginning of labour. Malpresentations are common, owing, as has been already mentioned, to the placenta occupying the lower pole of the uterus, and altering the shape of the cavity.

Treatment.—The aims of treatment are the same as in accidental hæmorrhage—to control hæmorrhage, and promote delivery.

In the first place, it must be stated that to adopt palliative measures in placenta prævia is to take a much greater responsibility than in accidental hæmorrhage, because the hæmorrhage is unavoidable, and is bound to recur before the woman is ultimately delivered. Palliation should accordingly not be attempted unless the patient is in a position to be constantly watched, and instantly treated when the bleeding recurs.

Active treatment varies according to the condition of the cervix, and may conveniently be taken up in three divisions :—

(1) When the os is closed.
(2) When the os admits two fingers.
(3) When the os is fully (or almost fully) dilated.

When the os is closed.—This, fortunately, is but rarely the case. When it does occur, the best treatment is to pack the

vagina and apply a binder and perineal bandage, exactly as was described for accidental hæmorrhage. The pressure of the packing compresses the placental site against the placenta, and so controls bleeding, while at the same time the uterus is reflexly stimulated to contractions which lead to dilatation of the os. The objection to vaginal packing is that it causes an accumulation of blood and secretions behind the pack, and these are apt to be infected unless strict asepsis is observed. The pack should therefore never be left in a moment longer than is absolutely necessary. On its removal one hopes to find the cervix sufficiently dilated to admit two or more fingers.

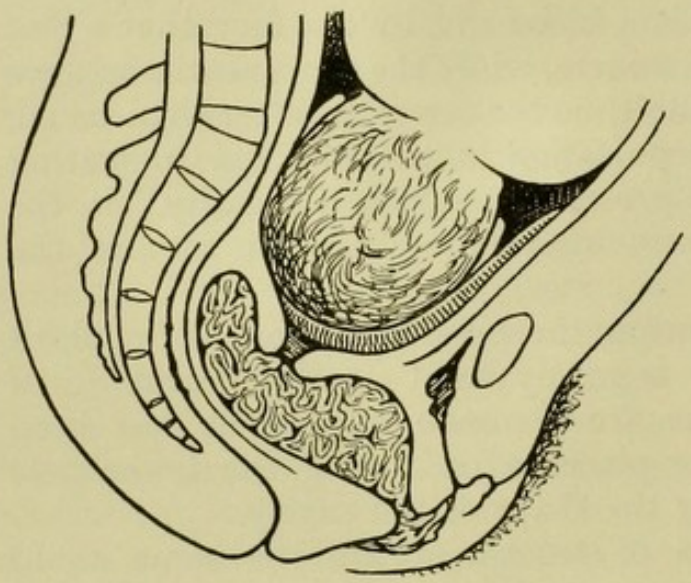


Fig. 207.—The vagina packed with gauze in placenta prævia.

When the os admits two fingers (either as the result of previous packing, or when first examined).—In the majority of cases of hæmorrhage the cervix is found so dilatable that two fingers can be passed through it. In these circumstances there are two methods of treatment open—either podalic version, or the use of Champetier de Ribes' bag.

Podalic Version.—This is the best possible form of treatment. If the membranes are intact the bipolar method should be adopted; otherwise an attempt must be made to do internal version.

The method of performing it is described under Version (p. 416). If the presentation is already a pelvic one, the version is, of course, unnecessary. When the version is completed the membranes must be ruptured and a foot brought down.

The object is to draw down one leg through the cervix, and plug the lower uterine segment with the half-breech. A glance at the illustration will show that the half-breech is an almost ideal plug for the lower pole of the uterus, compressing the placenta so firmly against the uterine wall that further

hæmorrhage is impossible. To control the bleeding in this way, the foot must be drawn right down to the vulva. The labour may then be allowed to proceed spontaneously.

The other method of packing the lower uterine segment is by the introduction of a *Champetier de Ribes' bag*. The method of using it is described under *Accouchement forcé* (p. 457). The pear-shaped bag is introduced *through* the membranes, and filled. Traction is then put upon it, and its wide end compresses the placenta against the placental site very much as the half-breech does after version.

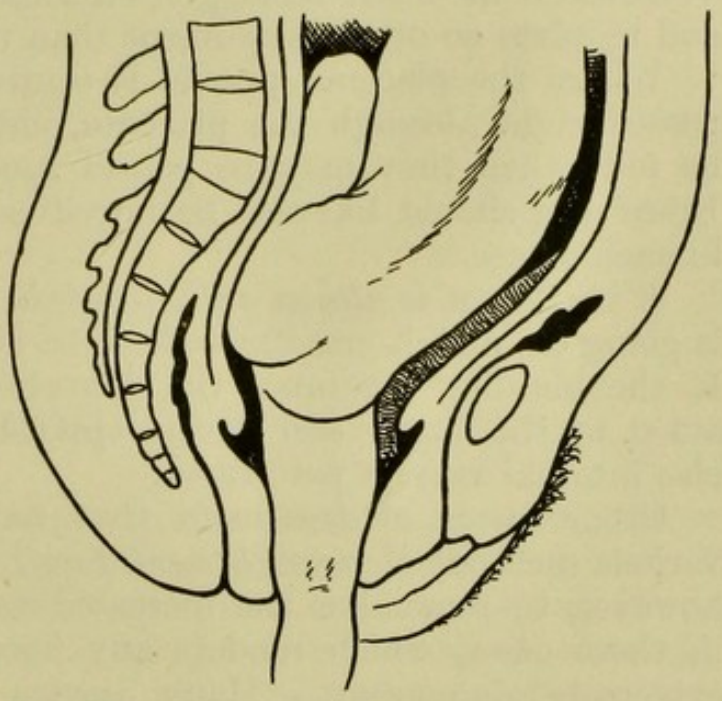


FIG. 208.—Plugging the lower uterine segment with the half-breech.

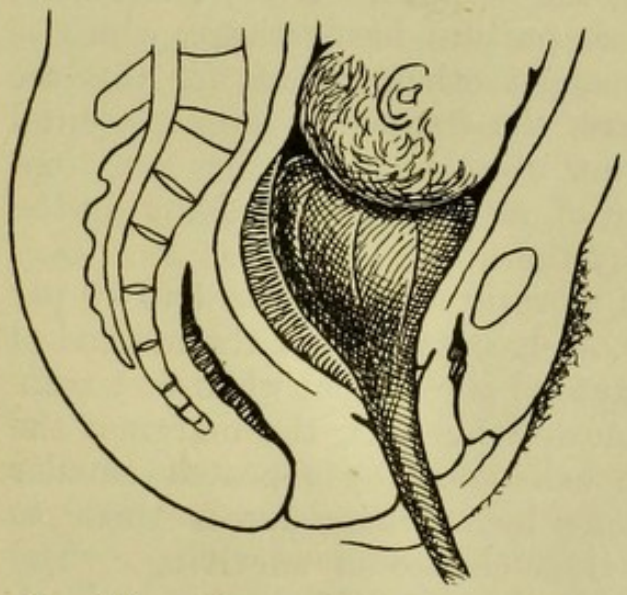


FIG. 209.—Champetier de Ribes' bag in position.

A small weight should be attached to the stalk of the bag, and hung over the end of the bed. Labour should then be allowed to go on spontaneously, until the bag is expelled, after which forceps may, if necessary, be applied.

The rationale of these two methods of treatment is identical, viz. to compress the placenta against the placental site. The objection to the use of the bag is that it necessitates a special instrument, that it leads to increased risk of sepsis, and that the bag is apt to displace the head and cause a malpresentation. At the same time statistics

show that it gives a smaller fœtal mortality than version. Version, on the other hand, gives a smaller maternal mortality, and requires no other instrument than the two hands.

Where the placenta prævia is central, the fingers must be passed right through the placenta, unless the edge of it can be felt, when they may be passed round it. Champetier de Ribes' bag should likewise be introduced *through* the placenta in such a case.

When the os is almost fully dilated.—In these cases labour is going on, and it usually suffices to rupture the membranes. If the bleeding continues the dilatation of the os should be aided by the fingers and forceps applied as soon as possible, or else internal version performed.

Other forms of treatment that have been tried are the various methods of *accouchement forcé*. It is most important, however, to remember the increased vascularity of the cervix in these cases, which renders any form of forcible dilatation extremely dangerous. Many women have died from the hæmorrhage due to tears of the cervix caused by well-intentioned efforts at delivery, who would have survived the bleeding due to the placenta prævia.

As soon as the child is born, the placenta should be removed manually unless the bleeding has stopped. Every effort must then be made to prevent post partum hæmorrhage, which is peculiarly apt to follow. Amongst other reasons for this are the frequency of cervical tears, the frequently large placental site, and the fact that the lower uterine segment has not, from its structure, the same power of retracting and sealing up the blood-vessels as is possessed by the upper segment.

Prognosis.—The maternal mortality varies from 1 to 40 per cent according to the variety of placenta prævia, the method of treatment adopted, and the state of the patient when first seen. The central variety is the most dangerous, the marginal the least so. Women who are exhausted by repeated smaller hæmorrhages, before a serious hæmorrhage forces them to seek advice, have obviously less chance of surviving. The fœtal mortality varies from about 40 to 60 per cent, death being due to premature separation of the placenta, to the methods of interference in favour of the mother, and to such complications as prolapse of the cord, malpresentation, etc.

CHAPTER XXXIII

POST PARTUM HÆMORRHAGE

Of all the serious complications of a confinement, post partum hæmorrhage is at once the most common, the most full of possibilities of immediate disaster, and the most trying to the nerve and presence of mind of the accoucheur. A thorough understanding of the causes and treatment is of the first importance, because, happily, the prognosis is good in cases where the treatment is prompt and correct.

Definition.—Under the term post partum hæmorrhage are included hæmorrhage during the third stage—before the expulsion of the placenta—and hæmorrhage in the first six hours following delivery. Strictly speaking, this is known as *primary* post partum hæmorrhage, as opposed to *secondary* hæmorrhage coming on during the puerperium and better known as *puerperal* hæmorrhage.

Varieties.—It may be divided, from an etiological point of view, into two varieties :—

(1) Atonic. (2) Traumatic.

Atonic Post Partum Hæmorrhage

is the more common variety, and it includes bleeding from several causes, all of which, however, are associated with imperfect contraction and retraction of the uterus.

The significance of the various causes will be better appreciated if consideration is first given to nature's methods of arrest of hæmorrhage after labour.

(1) *Contraction and Retraction of the Uterus.*—These are by far the most important factors in the arrest of hæmorrhage.

The same contractions which cause separation of the placenta compress the mouths of the placental sinuses, and prevent the escape of blood. Retraction—the faculty possessed by the uterine muscle of maintaining permanently some of the shortening of the muscle fibres gained by contraction—is even more important, for it keeps up the closure of the vessel mouths, and allows time for firm clots to form. Subsidiary factors are—

(2) *Contraction of the torn arteries themselves.*

(3) *Clotting of the blood* in the torn ends of the vessels.

(4) *Apposition of the anterior and posterior walls of the uterus*, which exercises a certain amount of mechanical control.

It is obvious that the contraction and retraction of the uterus may be interfered with after the birth of the child by the same factors as interfere with them during labour (cf. Uterine Inertia). Accordingly we find that a large group of cases are due to uterine inertia or exhaustion, which either continues after the birth of the child, or arises *de novo* in the third stage as a result of mismanagement in the delivery of the child and placenta. In addition there is a group of cases in which the interference with retraction is more directly mechanical, the result of imperfect separation or expulsion of the placenta.

Predisposing Causes.—

All favouring primary uterine inertia.

- *Multiparity*—especially a rapid succession of pregnancies. The actual cause in these cases is probably the chronic metritis so commonly associated with them, the muscular tissue being in part replaced by fibrous tissue.
- *Debility*, the result of chronic diseases, underfeeding, bad surroundings, etc.
- *Over-distension of the uterus*, as in hydramnios, and twins.
- *Uterine fibroids.*
- *Ante partum hæmorrhage*—placenta prævia, and accidental hæmorrhage.

Malpresentations and malpositions of the fœtus. *Pelvic contraction.* Other causes of *prolonged* or *obstructed labour.* *Primary uterine inertia.* (See above.)	Favouring secondary uterine inertia.

Prolonged administration of chloroform.
Injudicious use of Scopolamine-morphine narcosis.
Diminished coagulability of the blood—Hæmophilia.

Exciting Causes.—*Artificial Delivery during Secondary Uterine Inertia.*—The heinousness of this mistake has already been emphasised in discussing the subject of inertia. It may be said to be a direct invitation to disaster.

Mismanagement of the Third Stage.—The importance of keeping control of the uterus throughout the third stage has already been mentioned. Unnecessary massage is to be deprecated, but whenever the contour of the uterus grows vague, or its consistence threatens to become flabby, brisk massage is indicated. If the hand is kept on the fundus there is little possibility of the uterus filling with blood without the obstetrician's knowledge.

Incomplete Separation of Placenta or Membranes.—This interferes mechanically with the proper retraction of the uterus. Simple retention of the separated placenta, or portions of it, may have a similar effect, particularly where there is already a tendency to inertia.

Diagnosis. — This is a simple matter when the blood suddenly gushes from a flabby uterus. More commonly, however, all that is visible is a continued ooze of blood from the vagina, which soaks into the bedding, and so may escape notice for some time. In these cases the soft uterus may have meantime been filling up with blood, and when the fundus is grasped and compressed, a large quantity of blood is expressed. According to the amount of blood lost, there is more or less collapse of the patient, with a small rapid pulse, and all the other symptoms of hæmorrhage—pallor, faintness, restlessness, etc.

The first type of case, where the blood suddenly gushes out like water from a hydrant, is much the more serious. If not

instantly treated, the patient may be dead within two or three minutes. Fortunately a wider knowledge of the correct conduct of the third stage has made this type of case rare.

Treatment.—In normal labour the separation and expulsion of the placenta are very often accompanied by the loss of a few ounces of blood, and it is hopeless and valueless to attempt to state in actual figures what constitutes a post partum hæmorrhage and what is still within the limits of normal. The loss of blood is to be measured, not in ounces or drachms, but by its effects on the patient, for a hæmorrhage that does little harm to one woman may easily prove fatal to another.

Every case of post partum hæmorrhage demands instant treatment. There is no time to cogitate as to what is to be done. It is necessary, therefore, to have in mind some routine of practice, and to understand the principles upon which it is based. Treatment is aimed at stimulating the inert uterus to retract properly; at removing anything inside it which may be preventing this; and thirdly, at mechanically preventing the escape of blood, until such time as the uterus may have recovered its normal powers. The following methods may be employed consecutively. Slight cases will yield to the simpler measures; severe ones may call for the more drastic measures.

(1) *Grasp the fundus* firmly between the fingers and thumb, massage it, and knead it until it becomes firm and definite in outline. If the placenta is still inside it, express it by Crede's method, along with any blood-clot that happens to be in the uterus. If in *more serious* cases the attempt to express the placenta fail, the hand must be passed into the uterus and the placenta or blood-clots removed manually. This indicates the desirability of always keeping the right hand as far as possible aseptic during a labour. Unless competent assistants are present there is no time to put on a glove, still less to re-sterilise the hand.

(2) Meantime the nurse should be preparing a hypodermic injection of *ergotin* or *pituitary extract*. Where there is reason to fear or anticipate hæmorrhage this should be prepared beforehand, and be ready for use the moment the placenta has been removed. Pituitary extract is the most active drug known for stimulating uterine contractions. Some of the ergot preparations are, however, not far behind it—

particularly "Ernutin" and "Aseptic Ergot"—and their effect is perhaps more lasting. All these drugs are supplied in small glass capsules, sterilised, and ready for instant use. The injection is best made deep into the buttock. The liquid extract of ergot may be given by the mouth in doses of one to two drachms, but it is slow in action, and rather apt to make the patient sick.

(3) *Hot water* at a temperature of 115 to 120 degrees Fahr. is a potent uterine stimulant. Ice-cold water has a similar though less pronounced effect, but its use is contra-indicated on account of the shock involved. The hot water is applied in the form of a douche—either plain sterile water, or weak lysol (1 drachm to a pint) or cyllin (1 drachm to a pint). The douche is used vaginally in the first place, but if necessary it should be carried into the uterus, right up to the fundus, care being taken to provide by means of one finger alongside the douche nozzle a channel for the return of the fluid, or to use a two-way catheter

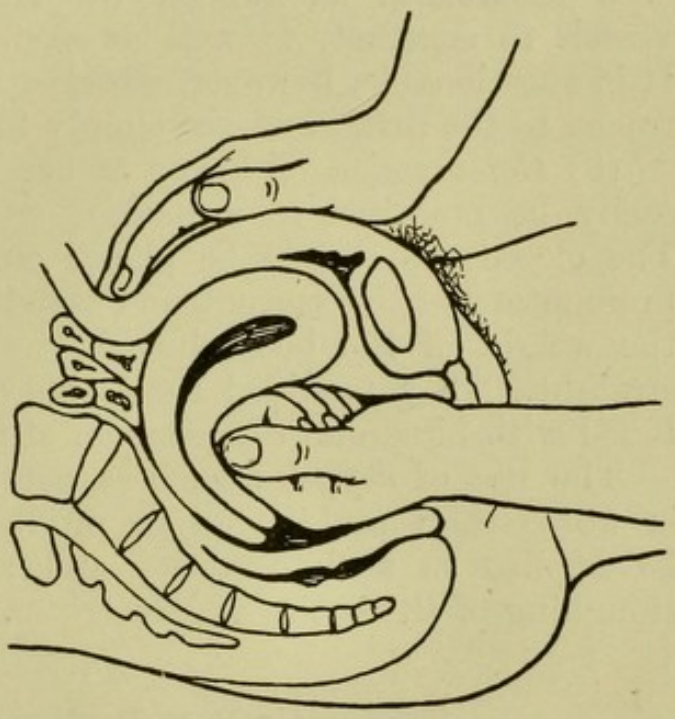


FIG. 210.—Bimanual compression.

These measures rarely fail to stimulate the uterus to contraction; but if they do fail, the case becomes more serious, and more drastic methods of treatment must be employed.

(4) *Compression of the uterus* between the two hands may control the hæmorrhage for some time. The fingers of the one hand are passed into the vagina against the anterior fornix, while the hand on the fundus squeezes the uterus downwards on to them. If the vagina is roomy the entire closed fist may be passed into it. In some cases the closed fist may even be passed right into the uterus, which is then pressed down upon it by the hand on the abdomen. This is really equivalent to the next mode of treatment, namely—

(5) *Packing the Uterus.*—If this is carefully done, it absolutely controls the hæmorrhage. Broad sterilised gauze is the best material to use, but anything else suitable may be used, provided it is sterile. The cervix should be grasped by a volsellum and drawn down to the vulva, and the gauze passed in by the hand or a pair of long forceps. After packing the uterus, pack the vagina, and apply a firm binder over the fundus.

The use of gauze impregnated with adrenalin, or wrung out of water containing several drachms of the 1 in 1000 solution, is a theoretical advantage, the adrenalin stimulating the vessels to contract, as well as exciting uterine contractions. It is questionable, however, whether the good results are to be traced to the drug, and not simply to the packing.

(6) *Compression of the aorta* has been advocated, and may easily be practised in a patient with thin abdominal walls. The closed fist should be placed on the aorta just above the promontory of the sacrum, and standing well above the patient the weight of the body should be rested on it with the arm straight. In a modified form this compression may be combined with bimanual compression of the uterus.

The use of styptics, such as perchloride of iron or vinegar, is worse than useless, as to produce any effect they must be applied in such quantity and strength that they cause sloughing of the entire endometrium.

Traumatic Post Partum Hæmorrhage

is bleeding from tears and other injuries of the genital tract caused during labour. Serious hæmorrhage may occur from tears of the cervix if they extend into the base of the broad ligament, or if the placenta has been situated on the lower uterine segment.

Tears of the vaginal wall and the anterior part of the vulva in the neighbourhood of the clitoris may cause very free bleeding. Perineal tears do not, as a rule, cause much bleeding.

Diagnosis.—This is made, generally in the course of treating the hæmorrhage as presumably due to inertia of the uterus, by noticing that the bleeding continues in spite of the fact that the uterus is quite hard and contracted. Careful

visual and manual exploration must be made to locate the site of the hæmorrhage.

Treatment.—Tears of the vulva and vaginal walls should be secured by stitches. Cervical tears may also be stitched after the cervix has been drawn down by a volsellum. A speculum and a good light are necessary. The alternative is to pack the tear with gauze, and even this is by no means easy unless a speculum and a good light are available.

Vulvar or Vaginal Hæmatoma

This is a concealed form of traumatic post partum hæmorrhage of rare occurrence. It is due to rupture of subcutaneous veins in the stretching of the tissues during labour. It may occur either above or below the attachment of the pelvic fascia to the vaginal wall. If it occur above, it may pass up into the base of the broad ligament and be very serious, the peritoneum being lifted up and a large quantity of blood lost. When it occurs below the fascial attachment, it usually passes down into the labium majus, where it may cause a tumour as large as a child's head. Very occasionally such a hæmatoma may form before the delivery of the child, and even cause obstruction to the descent of the head.

Treatment.—As a rule no treatment is required and the blood is slowly absorbed. If the hæmatoma is rapidly increasing in size, or if, after some days, it shows signs of suppurating, it should be opened, cleared out, and stuffed.

Treatment of Collapse after Hæmorrhage.—The treatment of the collapse after a serious hæmorrhage is almost as important as the arrest of the bleeding. It is essential to replace the fluid that the body has lost, and even a momentary anæmia of the vital centres in the medulla is to be avoided. The head must be kept low, the foot of the bed raised, and the blood that is in the body conserved for the use of the brain and other vital organs by firm bandaging of the limbs from below upwards.

The restoration of fluid to the system is best carried out by the injection of large quantities of warm sterile saline solution (one drachm to the pint). The most direct method is that of intravenous transfusion, but injection by a large cannula into

the submammary tissue is easier and less risky in private practice. Easier still, and almost equally effective, are repeated slow injections into the rectum—two to three pints every three hours. The fluid must not be run in more quickly than about a pint every half-hour, or else it will not be retained and absorbed. Two or three drachms of adrenalin or some pituitary extract may with advantage be added to the first rectal saline.

Cardiac stimulants may also be given, but not recklessly. Hot black coffee with two or three ounces of brandy may be given per rectum, if that channel is not being used for the administration of saline. Brandy or ether may be injected subcutaneously.

Recovery after serious hæmorrhage is always tedious, and apt to be complicated by septic manifestations. It should not be hurried, as late complications such as "white leg" may arise.

Puerperal Hæmorrhage (Secondary Post Partum Hæmorrhage)

This may come on any time in the puerperium after the first six hours. In early cases it takes the form of excessive red lochia, in later cases of a sudden return of blood in the lochia. Most cases will be found to be due to the retention of portions of placenta or membranes, which may or may not have become septic; to subinvolution; or to displacements of the uterus.

Sudden alarming hæmorrhages are due to the retention of considerable portions of placenta, such as a succenturiate lobule.

Continued hæmorrhage coming on in the third or fourth week should not be allowed to pass without thorough investigation, as it may be due to chorion-epithelioma (*q.v.*).

Treatment varies with the cause. Before exploring the uterus, the effect of large doses of ergot, hot vaginal douching, and rest should be tried. If these fail, the uterus must be explored, and any retained portions of placenta removed, or displacements remedied. Chorion-epithelioma can only be diagnosed after curettage, and calls for immediate hysterectomy.

Retained and Adherent Placenta

A *retained* placenta is one which has been separated from the wall of the uterus, but is not expelled owing to the weakness of the uterine contractions. Its presence prevents complete retraction of the uterus, which is already somewhat atonic, and there is usually a good deal of hæmorrhage.

An *adherent* placenta is one which has failed to separate after an hour in spite of active uterine contractions. Normally, the separation takes place through the spongy layer of the decidua basalis; and pathological adherence of the placenta may be due to an excess of strong connective tissue in that layer, or to a more or less complete absence of the spongy layer. The former condition is believed to be the consequence of previous interstitial endometritis; while the latter is presumably the result of atrophic processes in the endometrium—absence or extreme thinness of the decidua basalis resulting in the placental villi attaching themselves to the actual muscle wall of the uterus.

This abnormal adhesion of the placenta is rarely, if ever, complete. There is almost always some amount of separation, and therefore some amount of bleeding. If the adhesions are general all over the placental area, there is no hæmorrhage; but if a portion separates while the rest remains adherent, the complete retraction of the exposed part of the placental site is interfered with, and post partum hæmorrhage follows.

Treatment.—If the placenta fails to come away spontaneously within forty minutes or an hour after the birth of the child, an attempt should be made to express it by Crede's method (see p. 164). Failure to expel it by this method, carefully and correctly performed once or twice on an actively contracting uterus, indicates some abnormal adherence. In these cases the placenta must be removed by hand.

In all cases, if there is post partum hæmorrhage, and the placenta cannot be expelled by Crede's method, it must be removed by hand without delay.

In pre-antiseptic days this was one of the most serious operations in obstetrics, because the fingers were brought into close and intimate connection with the uterine wall without even the protective intervention of the fœtal membranes.

With strict aseptic precautions, and more especially since the adoption of sterilised rubber gloves, the risk of the procedure has been greatly diminished. The patient should be brought to the edge of the bed, and the vulva thoroughly scrubbed with an antiseptic lotion. The right hand, similarly cleansed, should be slipped into a sterilised rubber glove, and dipped in a weak solution of lysol or other sterile lubricant. The hand should then be passed gently into the uterus and the edge of the

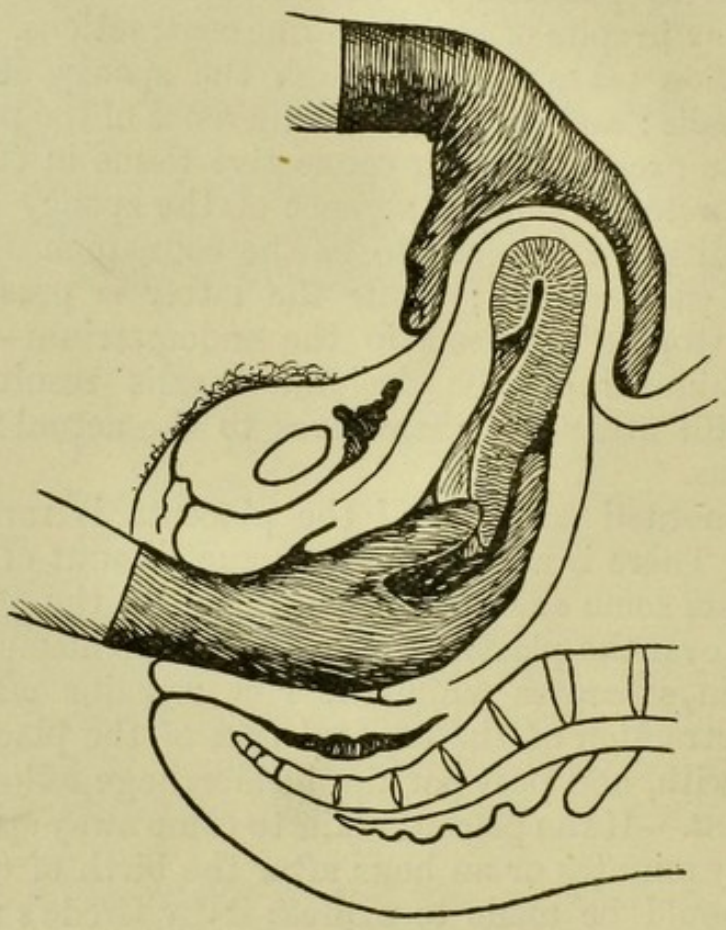


FIG. 211.—Manual removal of adherent placenta.

placenta sought for, the fundus being meantime pressed down by the other hand on the abdomen. The gloved fingers should then be insinuated by a sawing movement between the placenta and the uterine wall, and the whole placenta gradually separated and removed. After its removal the hand should be again introduced to make sure that no small bits have been left behind, and, if so, to remove them. This again should be followed by a hot antiseptic douche and a hypodermic injection of ergot.

Sometimes the retention of the placenta, or improperly executed efforts to express it, set up irregular contractions in a partially atonic uterus, which may take the form of a spasm of the retraction ring—so-called "hour-glass contraction" (see p. 295). In such a case, if there is hæmorrhage, the hand must be introduced and the placenta removed. An anæsthetic should be given to relax the spasm, and the hand in a cone shape very gently and gradually passed through the contracted ring, the other hand on the abdomen helping by pressing the fundus down. Too great rapidity or violence will defeat the object in view by exciting further spasm.

CHAPTER XXXIV

INJURIES TO THE GENITAL TRACT

Rupture of the Uterus

This very serious accident may occur during pregnancy, but in the great majority of cases it occurs during labour—particularly protracted and obstructed labours.

During pregnancy the rupture is generally associated with a diseased condition of the uterus, such as the presence of scar tissue consequent upon a previous Cæsarean section or the removal of an adherent placenta ; with faulty development and hypertrophy ; or with pregnancy in the interstitial part of the tube. The rupture is usually in the upper segment of the uterus, and the symptoms vary with the amount of hæmorrhage, being in some cases extraordinarily slight.

Rupture during Labour

Etiology.—The *actual cause* of rupture during labour is the excessive thinning of the lower uterine segment, to which in some cases must be added manipulative interference. It is well to recall here that in the later weeks of pregnancy there is situated immediately above the cervix an area—the lower uterine segment—which has the following characteristics :—

(1) Its muscle fibres are mostly longitudinal, arranged in parallel lamellæ.

(2) In front the peritoneum is loosely attached over it.

(3) *During labour* it is bounded above by the retraction ring.

(4) Below it is bounded by the cervix, which is attached to the vagina and the sides of the pelvis, and during labour is also to some extent fixed by the descent of the presenting part.

During labour this lower uterine segment is for the most part quite passive, and becomes progressively expanded and thinned out between the upper segment above, which grows shorter and thicker, and the cervix below, which is relatively fixed. (The opening up of the cervix is due more to the dilating pressure of the bag of membranes than to any traction upon it from above.)

In obstructed labours this expansion of the lower uterine segment is carried much farther than in a normal labour, and it may be estimated clinically by the prominence and gradually ascending level of the retraction ring. The more protracted the labour, the more pronounced and higher up in the uterus does the ring become. Ultimately a point is reached when the lower uterine segment gives way either spontaneously or as the result of the extra strain put upon it by attempts at interference.

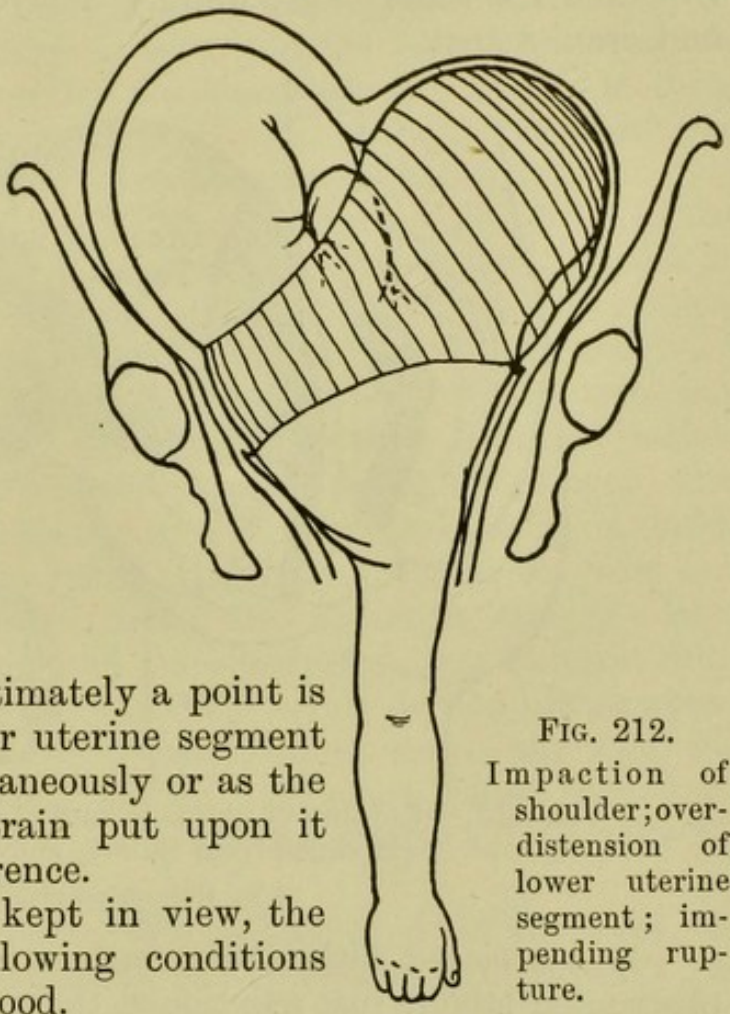


FIG. 212. Impaction of shoulder; over-distension of lower uterine segment; impending rupture.

If these facts are kept in view, the significance of the following conditions will be readily understood.

Predisposing Causes.—The following are the conditions with which rupture is most commonly associated :—

(1) *Contracted Pelvis.*—The accident is more prone to occur with moderate degrees of contraction, which have escaped detection by the attendant, than with extreme degrees, which usually compel attention before the labour has advanced very far.

(2) *Neglected Transverse Presentation.*—Here a larger part than usual of the child's body occupies the lower segment (Fig. 212).

(3) *Hydrocephalus.*—This is a source of danger from the

liability of its being overlooked, and from the consequent possibility of attempts being made to deliver by forceps *before* perforation.

(4) *Large size of the child*, or *malpresentations*.

(5) *Operative or manipulative interference* — particularly attempts to perform version after the membranes have been ruptured for some time, unduly delayed forceps application, and craniotomy.

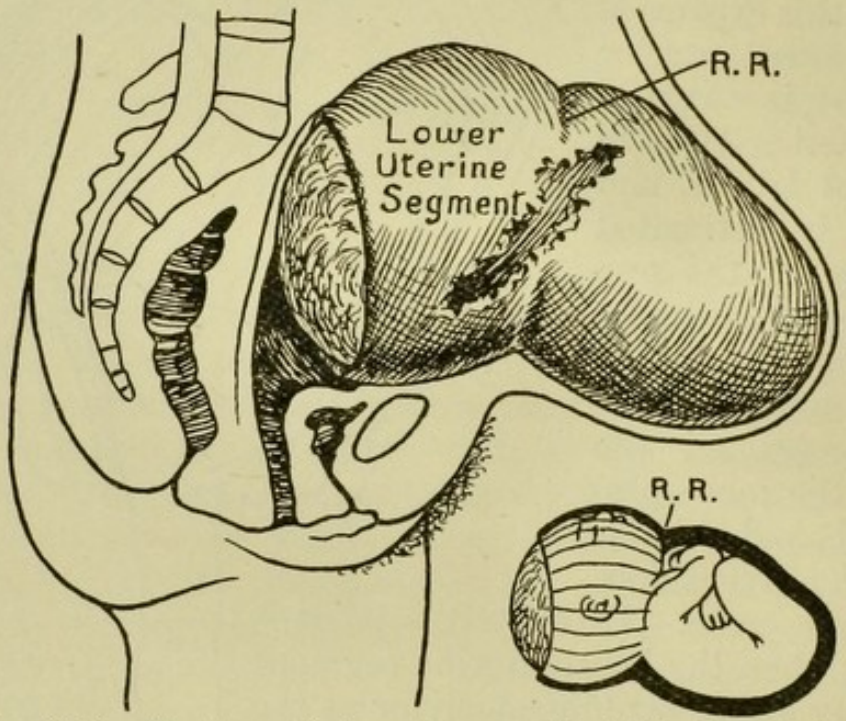


FIG. 213.—Rupture of uterus in case of fœtal hydrocephalus. (Modified from Bumm, and Jellett.)

R.R. Retraction ring.

(6) Associated with all the various forms of protracted and obstructed labour just mentioned there is an element of *bruising of the uterine tissues*, which is of considerable importance. The long-continued pressure of the head against the brim of a contracted pelvis, for example, must inevitably lead to injury and weakening of the part of the uterus nipped between them, and so predispose to rupture at that point.

Situation.—The rupture almost invariably occurs in the thinned-out lower uterine segment, but it may extend thence up into the upper segment, or down into the cervix, and even to the vaginal fornices. The direction of the tear may be transverse, oblique, or longitudinal. Tears due to violence—that is to say, to manual or instrumental interference—tend to

be longitudinal, the hand or instrument easily separating the longitudinal muscle fibres; spontaneous ruptures are more often transverse or oblique. Where bruising of the tissues has been marked, the rupture may be oval or almost circular. The tear may occur on any aspect of the lower segment; not infrequently it occurs on the lateral aspect, and extends into the space between the folds of the broad ligaments.

Varieties.—Distinction is usually made between a *complete* rupture in which the entire thickness of the uterus is torn, including the peritoneum, and *incomplete* rupture, in which one or other coat (usually the peritoneum) escapes damage.

Symptoms.—*A. Of Impending Rupture.*—These are of the greatest importance, for if they are recognised and treated in time, rupture may be averted. They are practically identical with those of tonic contraction of the uterus. In almost every case the second stage has, owing to some obstruction, been protracted in spite of strong pains. The patient becomes restless and anxious, the pulse and temperature rising somewhat. The pains become more frequent and stronger, and one pain tends to pass without interval into the next. There is pain and tenderness over the lower part of the abdomen, and, *if looked for*, the retraction ring will be observed as an oblique ridge over the lower part of the abdomen one or two inches above the symphysis. As the condition becomes worse, the ring will be observed to rise even higher. In some cases the round ligaments may be felt as taut bands, passing up towards the upper third of the uterus.

B. Of Actual Rupture.—The classical description of the symptoms of actual rupture is somewhat as follows. The symptoms of impending rupture just described become more severe, and during the acme of a particularly agonising pain the patient cries out that something has given way inside her. This is followed by a cessation of the pains, and a momentary feeling of relief. If the tear is large enough, a part or the whole of the fœtus may pass through it into the peritoneal cavity, causing a change in the shape of the abdomen, and a recession of the presenting part if it was not previously fixed. This is followed more or less rapidly by the symptoms of shock, and collapse from internal hæmorrhage. Some external hæmorrhage is also usual.

In many cases this dramatic picture is entirely wanting.

Indeed it may be said to be characteristic only of large complete tears which permit the escape of the fœtus into the peritoneal cavity. Where the rent is small, and particularly where it is incomplete, there may be no feeling of tearing, the shock is relatively slight, and the collapse comes on slowly. Diagnosis in such cases may be impossible until after the child has been born. Incomplete tears extending into the broad ligament may be accompanied by slow but extensive bleeding, a large subperitoneal hæmatoma being formed (cf. p. 355).

Diagnosis.—This is easy where there is a characteristic history. Concealed accidental hæmorrhage may be confused with rupture, especially if the patient has not been under supervision during her labour. Where the fœtus has passed into the abdominal cavity, it may be palpated with suspicious ease. Careful vaginal examination under an anæsthetic may enable one to feel the rent.

Treatment.—*Prophylaxis* is the most important treatment. The symptoms of threatened rupture should always be recognised, and, if promptly treated, rupture can usually be averted. The first thing to do is to put the patient fully under an anæsthetic, and carefully examine to find out the cause of the obstruction. If this can be removed without risk to the mother, it should at once be done. If not, the child should be delivered with the minimum amount of intra-uterine manipulation. Version is accordingly contra-indicated and forceps may be risky. The child's life is probably already seriously endangered, and therefore craniotomy or decapitation may be done without hesitation.

If rupture has occurred.—The first thing to be done is to deliver the child as quickly as possible. Provided no part, or at the most only a very small part, of the fœtus has passed through the rent, delivery should be effected by the vagina. The actual method of delivery to be adopted depends on the state of the case—forceps, traction on a leg, craniotomy or decapitation. Version should never be attempted. If, however, any considerable portion of the fœtus has passed through the rent, it is unsafe to attempt to draw it back into the uterus. Such cases can only be delivered by abdominal section.

The subsequent treatment varies very much in different circumstances :—

(1) Cases attended with slight symptoms may be treated in

a purely expectant manner, large doses of ergot being given in the hope that the bleeding will be controlled in that way.

(2) If a small complete rent can be felt, but the symptoms do not indicate any serious intra-peritoneal bleeding, a small sterile gauze wick may be passed through the tear to act as a drain, and ergot again given. Strict asepsis must be observed. The drain should be removed twenty-four hours later, and not introduced again unless there are signs of peritoneal mischief.

(3) If the hæmorrhage from the vagina is severe, the case should be treated on the lines of post partum hæmorrhage, and the whole uterus and vagina firmly packed with gauze, and a binder and perineal bandage applied.

(4) If the fœtus has passed so far through the rent that any attempt to deliver it through the vagina would only make the rent larger, or if, after delivery of the child *per vias naturales*, there are signs of serious internal hæmorrhage, the patient should be prepared for abdominal section, and the operation performed as soon as possible. In the meantime treatment must be directed to the collapse and shock.

When abdominal section is done, the child must be removed along with the placenta and membranes. The rent may then be stitched if it is small. If it is large and ragged, it may be better to remove the whole uterus by hysterectomy.

Prognosis.—It will be readily understood that rupture of the uterus is one of the most serious accidents that can occur in the whole range of obstetrics. No simple statement can be made as to the prognosis in such a case, because it depends on so many different factors—the situation and extent of the rupture, the amount of hæmorrhage, the general surroundings of the patient which govern the lines of treatment to be adopted, and the skill and promptitude with which that treatment is carried out. The gravity of the accident is reflected in the general statistics, which place the maternal mortality at 65 per cent for complete, and 58 per cent for incomplete rupture. The chances of the child's survival are negligible.

Lacerations of the Cervix and Vagina have already been discussed under the heading of Traumatic Post Partum Hæmorrhage (see p. 354).

Laceration of the Perineum. — This is probably the commonest accident in obstetrics, and, although not in itself serious, its consequences, if neglected, may be far-reaching in predisposing to displacements of the uterus, and associated chronic ill-health.

In the chapter on the "Management of Normal Labour" the cause and prevention of perineal tears have been discussed.

A perineal tear begins at the fourchette, and tends to pass backwards and to one side towards the anus. It may involve the lower portion of the posterior vaginal wall, and in the most serious cases it also involves the sphincter ani and the anterior wall of the rectum. According to their extent perineal tears are divided into three degrees :—

Tears of the *first degree* involve only the fourchette and the anterior margin of the perineum.

Tears of the *second degree* involve the perineal body, but stop short of the sphincter ani.

Tears of the *third degree* involve the rectal wall, and are called *complete* tears.

A fourth but very rare variety is the *central* tear, which involves the perineal body and sometimes the rectum, but spares the posterior commissure of the vulva.

Diagnosis.—Perineal tears should always be looked for, especially in the case of primiparous women. Care should be taken to examine with a good light, and to look for any involvement of the lower part of the vaginal wall.

Treatment.—The best rule to follow is that "every tear, even the smallest, should be sewn up." The instruments required are a large and a medium-sized full-curved needle and a needle-holder, several strands of silkworm gut, and some chromicised or iodised catgut.

The repair of the perineum may most conveniently be undertaken during the third stage of labour—at least so far as the introduction of the stitches is concerned. It is better not to tie them until the placenta has been expelled, as its passage may put a strain on the stitches and cause them to cut out through the tissues. The operation should be done with the patient in the lithotomy position at the edge of the bed.

When the patient's condition is very grave, or where the light is very bad, it may be advisable to postpone the opera-

tion for some hours. But it must be remembered that the probability of union by first intention begins to diminish after twelve to twenty-four hours. Moreover, a delayed operation involves an anæsthetic being again administered, whereas immediately after labour the parts are to some extent benumbed, and the patient in many cases is already partly under an anæsthetic.

Three points must be observed in the immediate repair of the perineum. The first is that the stitches must be so placed as to close the wound *in its entire depth*. If this is not done, lochia are apt to pass into the depths of the wound and decompose, even although the edges of the wound are coapted. The second point is that the stitches must be inserted about a quarter of an inch from the edge of the wound, as the subsequent œdema of the tissues is apt to make them "cut out." For the same reason the stitches must *not* be drawn very tight. Thirdly, accurate coaptation of the edges of the wound, especially in the vagina, aids in securing sound healing.

Tears which do not involve either the rectum or the vagina should be closed by deep sutures of silkworm gut carried well under the deepest part of the tear. These sutures may be put in at intervals of about a third of an inch. Superficial stitches of catgut may be used in addition if necessary. It is not satisfactory to use catgut for the deep stitches, as it is absorbed more rapidly than usual owing to the excessive moisture of the situation.

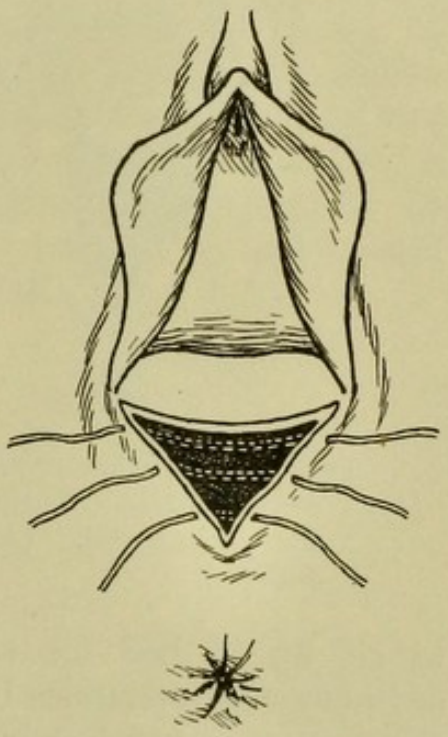


FIG. 214.—Perineal tear of first degree, with sutures in position. (After Jellett.)

If the rectum and vagina are involved, they must be repaired first. The rectum may be stitched from above downward with catgut, either continuous or interrupted. Most authorities prefer interrupted sutures with the knots in the rectum. The vagina must then be closed by deep silkworm gut sutures knotted on the vaginal aspect. Lastly, the perineum itself is closed as

before by deep silkworm gut, and, if necessary, superficial catgut sutures.

After-treatment is important and consists mainly in maintaining strict asepsis. The perineum must be bathed with a mild antiseptic every time the vulvar dressing is changed. If the lochia become fœtid, the vagina must be douched out twice daily. If the patient is very restless, it may be advisable to tie her knees together, but otherwise this is unnecessary. If the tear has been extensive the patient should not be allowed

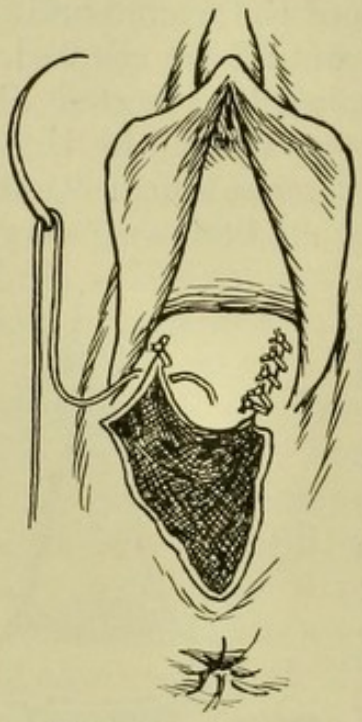


FIG. 215.—Perineal tear of second degree. Suturing the vaginal wall. (After Jellett.)

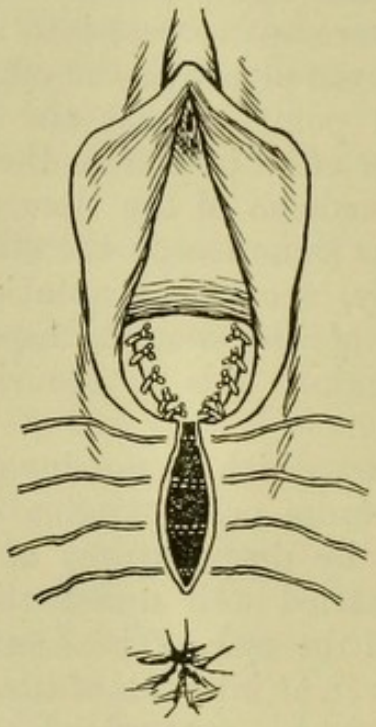


FIG. 216.—Vaginal wall sutured. Perineal sutures in position. (After Jellett.)

to sit up in bed for ten days. The deep stitches may in ordinary circumstances be removed on the tenth day. When the rectum is not involved, the bowels should be moved daily as usual. In complete tears, on the other hand, the bowels are best kept closed for a day or two, and the first few movements preceded by an injection of warm oil to soften the fæcal masses. A light diet with the minimum of residue should be given for a few days in these cases. Albumen water is in this respect ideal.

Prognosis.—Where the operation has been properly done,

and the subsequent nursing has been careful, most tears of the first and second degrees heal by first intention. Tears involving the rectum very often break down, and require a subsequent operation after the close of the puerperium.

Inversion of the Uterus.—This is a very rare accident, occurring only once in many thousands of cases, and then usually as the result of bad treatment. It is spoken of as "acute puerperal inversion" in contrast to the gynecological "chronic inversion" which may be caused by, for example, a submucous fibroid tumour. The inversion may be only partial, but in some cases the entire organ has been turned inside out, and prolapsed outside the vulva. The commonest causes are pulling on the umbilical cord, and the attempted expression of the placenta by Crede's method *between pains*. The accident is thus usually met with in the practice of ignorant midwives.

The symptoms are pain and a feeling of "something coming down." Usually there is free hæmorrhage rapidly followed by collapse and shock. Inspection and vaginal examination render the diagnosis clear. The treatment is to cleanse and replace the inverted part at once, if possible. If the placenta is attached to the exposed part, the atonic uterus should be replaced before the placenta is removed. The shock and hæmorrhage render the prognosis serious.

SECTION VII

PATHOLOGY OF THE PUERPERIUM

CHAPTER XXXV

PUERPERAL INFECTION

UNDER this heading are included all the morbid conditions arising in the puerperium as a result of the introduction of organisms into the genital tract before, during, or after labour at full term, miscarriage, or abortion. Formerly these conditions were grouped under the title of "puerperal fever," and that term is still preserved in Acts of Parliament; but for scientific purposes it is at once too vague, and too suggestive of a specific zymotic disease.

From the earliest times of which we have any record, the conditions to be described were regarded as due to the retention of the lochia. Other ancient views were that they were caused by a metastasis of the milk, that they formed a specific disease—hence the term "febris puerperarum,"—that they were due to a miasma, or simply to an "act of Providence." In 1795 the *contagious* nature of the disease was pointed out by Gordon of Aberdeen, and he was followed in 1843 by Oliver Wendell Holmes, who, in a paper read at Boston, urged that the epidemic form of the trouble was always to be traced to some lack of precautions on the part of nurse or physician. In the following decade the first great step in advance was made by Ignaz Semmelweiss, then assistant at the Obstetric Clinic at Vienna, where the mortality of labour

from this cause was annually about 10 per cent. By a process of brilliant deductive reasoning Semmelweiss came to the conclusion, which he afterwards proved by the results of prophylactic treatment and by experiments, that infection was conveyed to puerperal women through minute portions of dead and putrefying matter on the hands of the students and nurses, and that "puerperal fever" was the same as "wound fever." His work, however, received practically no recognition until Lister proved the organismal nature of wound fever. Following the demonstration by Pasteur of streptococci from the lochia in an infected case, the organismal nature and the intense infectivity of "puerperal fever" were gradually recognised, and the logical sequel—that it is a *preventible* infection—is in the present day *the* fundamental fact which governs, or ought to govern, the whole practice of Obstetrics.

Frequency.—In pre-antiseptic times the disease was very prevalent, and particularly so in hospitals where the patients were herded together. Since the application of antiseptic and aseptic principles to midwifery, the disease has practically vanished from lying-in hospitals. Unfortunately, however, there is not the same improvement in private practice, in which a perfectly aseptic technique is very difficult to carry out. The better training of midwives has done something to improve the statistics of recent years, but the death-rate from puerperal infection still runs at about two per thousand confinements. In other words, nearly 2000 women die annually in the United Kingdom from this cause alone, and it is as disastrous in its results as all the other accidents and complications of childbirth put together.

Etiology

Organisms.—The organisms found in cases of puerperal infection belong to two great classes. There are, first, the parasitic organisms, which are capable of living in and upon living tissues, and which, therefore, are capable of passing into and multiplying in the body of the patient. Secondly, there are saprophytic organisms which are only capable of living upon dead tissues. The following organisms have been found :—

Streptococcus Pyogenes.—This is the cause of the most grave

and epidemic forms of the infection. Frequently in the most virulent cases it is found in company with other organisms, especially the *B. Coli communis.*

Staphylococci Pyogenes Aureus et Albus. — These common pus-forming organisms are found everywhere—on the skin, in dust, and especially in sores or eruptions. Hence the peculiar risk of any sores on the person of either the nurse or obstetrician.

Bacillus Coli Communis.—This organism is always present on the vulva owing to the proximity of the anus. Hence the importance of cleansing the genitals of the patient before labour, and during the puerperium.

Gonococcus.—That this organism may cause puerperal infection there is no doubt, although the infection is rarely acute. But observers differ in regard to the frequency with which it is to be found, and in some cases it would appear to have been confused with another diplococcus, known as Diplococcus A.

The following pathogenic organisms have also been found:—

Bacillus Diphtheriæ (Klebs Loeffler).—In the rare but occasional presence of this organism true diphtheritic membranes may be formed on vulvar or vaginal tears.

Diplococcus Pneumoniæ.—This has been found not necessarily in association with pneumonia. The organism is frequently present in the mouth, nose, and pharynx of healthy persons.

Bacillus Tetani.—This is present in dust, especially of streets, and has caused infection to both mother and child where the surroundings have been very bad, and precautions wanting.

Saprophytic Organisms. — These are numerous, but not readily distinguished. They are mostly anaerobic.

Bacillus Aërogenes Capsulatus.—This organism has been found, but in most cases is to be regarded as a saprophyte, existing in company with other organisms, particularly the streptococcus. When it is present, there has been noted a great formation of gas in the uterus—"tympania uteri"—and in the body generally after death.

Bacteriology of the Genital Tract in Pregnancy and the Puerperium.—This subject has already been referred to in connection with the management of labour (see p. 153). It

may, however, be as well to recall here that the healthy vagina, whether the woman be pregnant or not, contains a little white curdy secretion in which are to be found epithelial cells, a number of the vaginal bacilli of Döderlein, and various saprophytic organisms. The healthy vagina never contains any of the pyogenic organisms such as streptococci and staphylococci, and their absence is believed to be due to the acid formed by the vaginal bacilli which is inimical to the growth of other organisms.

The interior of the uterus is absolutely sterile in all cases at the beginning of labour, unless it has been interfered with.

In the puerperium the uterus and vagina are bathed with the lochial discharge which is alkaline in reaction, and it reduces the acidity of the vagina to such an extent that saprophytic organisms are enabled to flourish. Accordingly after the second or third day of the puerperium multitudes of saprophytic organisms may be found in the vagina, and in some cases even in the uterus, the contamination becoming more frequent and more marked as the puerperium advances. Pyogenic organisms are, however, never under normal circumstances found in the healthy uterus or vagina after labour.

The all-important facts are, therefore, that pyogenic organisms are never under normal circumstances present in either the vagina or uterus, and that, if they are found in these situations, they have been introduced from without. The only exception to this statement is the gonococcus, which is able to live in the vagina in spite of the acid-forming bacilli, and sometimes lies latent there or in the cervix, and becomes activated again during the puerperium.

The Question of Auto-infection. — Occasionally cases, which have never been handled in any way during labour, become infected in the puerperium without any reason to account for it, and this gave rise to the idea that sometimes pyogenic organisms might be present in the uterus or vagina before labour set in, or might gain access from the bowel. From what has just been said, it will be seen that the observed facts lend no support to the view that such an auto-infection is possible. Transmission of organisms from the bowel is unknown except in cases of severe bowel disease, such as appendicitis; while if the organisms are in the vagina or

uterus before labour, they must have been introduced there from without at some earlier period, and therefore such an infection is in no sense an auto-infection.

With the passing of this idea of the possibility of auto-infection there has also passed the practice of routine douching of the vagina prior to labour. In cases of disease of the vagina or cervix, where the vagina is already infected, such a practice is, of course, most desirable. But if the vagina is healthy, douching merely destroys the protective influence of the vaginal bacilli, and probably does more harm than good. This has been borne out by the statistics of large numbers of cases.

Sources of Infection.—These have already been discussed under the management of labour. It must be remembered that even a perfectly cleansed hand or a sterile instrument may be a source of danger by conveying organisms from the vulva. Therefore the cleansing of the vulva is equally as important as the cleansing of the hands and instruments.

Specially strict precautions ought always to be taken if the physician or nurse has been recently in contact with a case of puerperal or surgical sepsis, because infection from such a source seems to be particularly virulent and dangerous.

Channels of Entrance.—The channels by which the offending organisms or their toxic products are absorbed are numerous. Perineal and vaginal tears may be the starting point. Lacerations of the cervix are a not uncommon point of entrance. The interior of the body of the uterus, and particularly the placental site, are, however, the most usual and the most dangerous channels by which infection may enter. Once the introduction of organisms has been effected, the puerperal vagina and uterus are a perfect paradise for their further growth and multiplication. The conditions of temperature and moisture are ideal, and blood-clot and necrotic decidua provide an abundant pabulum. Further, the greatly developed lymphatic system of the uterus, which in normal circumstances is occupied by the removal of the products of involution, is, unfortunately, equally available for the passage of organisms or their toxins into the general circulation.

Predisposing Causes.—Amongst conditions in which the patient is exposed to a greater risk of infection are primiparity, on account of the greater number of lacerations in a first labour, and complicated or instrumental labours. In other

conditions the patient's powers of resistance are lowered. This is the case, for example, after post partum or other hæmorrhage; after eclampsia; in cases of extreme general debility; and in underfed women.

Constipation is also generally regarded as a predisposing cause. The effect of mind over matter is often seen in the readiness with which patients who are mentally depressed—unmarried mothers, for example—become infected. Retention *in utero* of portions of placenta or membrane is with striking frequency followed by infection by saprophytic organisms—Sapræmia—as it provides abundance of the dead tissue necessary for the growth of these organisms.

Pathological Anatomy

The amount of morbid change in cases of puerperal infection varies enormously—from a slight inflammatory reddening of a perineal tear to a profound destructive inflammation involving the whole genital tract, and associated with changes in all the other organs of the body. Indeed in some cases, and these the most immediately fatal of all, there is practically no change to be observed, the organisms being so rapidly absorbed, and of such an intense virulence, that the patient succumbs without the occurrence of any reaction. These are the fulminating cases—*sepsis foudroyante*—in which a fatal issue ensues within a few hours of the first symptoms. Fortunately such cases are extremely rare.

Vulva, Perineum, and Vagina.—Tears in this region are apt to become infected, and occasionally puerperal ulcers are found, coated with a necrotic membrane, frequently described as "diphtheritic," although the Klebs Loeffler bacillus is rarely present. In other cases a more diffuse vaginitis is seen.

Uterus.—Owing to the raw condition of the endometrium, especially at the placental site, the first infection of the uterus is an endometritis. Occasionally the infection is confined to the placental site; more usually it is generalised.

Two main types of endometritis may be distinguished—(1) Putrid endometritis, in which the infecting organisms are predominantly saprophytic, a condition known clinically as Sapræmia; and (2) Septic endometritis, in which the organisms are of the pyogenic type, particularly the streptococcus.

These two types are, however, the two extremes, and the majority of cases will be found to present appearances intermediate between them, tending more towards the *putrid* or the *septic* according as the infecting organisms are preponderatingly saprophytic or pyogenic.

Putrid Endometritis.—As has already been indicated, this condition is associated with the retention of dead tissue in the uterus—usually fragments of placenta or membranes. It is therefore more commonly met with after abortion or premature labour than after labour at term.

The uterus is enlarged and flabby. Its interior is filled with quantities of soft, shaggy, stinking slough, bathed by lochial discharge which is dirty, blood-stained, purulent and frothy, and very offensive in smell. This lochial discharge is usually increased in quantity. The amount of necrotic material is sometimes very considerable, and it may recur to a great extent after the uterus has been cleared out.

Microscopically the cavity is found to be lined by a thick layer of necrotic material in which are to be seen swarms of organisms. Outside this is a thick layer densely crowded with leucocytes. In the superficial part of this protective layer a few organisms may be seen, but in the deeper parts none, showing that they have not been sufficiently virulent to pass through the ranks of the leucocytes. Below this the muscle wall of the uterus is comparatively unaltered.

Septic Endometritis.—The uterus is enlarged, but of a rather less soft consistency than in the putrid endometritis. Its interior is smooth—perfectly and abnormally so. The lochial discharge may be increased, but in many cases it is diminished in quantity, or even suppressed. It is *not fœtid in the most serious cases* of pure streptococcal infection, but in mixed infections with many saprophytic organisms or *B. Coli* there may be an offensive odour.

Microscopically the superficial necrotic layer is thin, and consists of a fibrinous exudate to which its extreme smoothness is due. Streptococci or other pyogenic organisms swarm in it. Below this is a thin and poorly developed layer showing leucocyte infiltration. Organisms, with which the leucocytes are waging a losing battle, are visible throughout the layer, and may even be seen invading the lymphatics of the muscular wall.

If the organisms succeed in thus penetrating the protective layer of leucocytes, they may give rise to metritis, parametritis, peritonitis, thrombo-phlebitis, salpingitis, and oöphoritis; and to general septicæmia or pyæmia.

Metritis in such cases is of the acute infective type, and abscesses may form in the muscular wall and below the perimetrium as the result either of a direct lymphatic spread of the organisms or of infection of the thrombi in the veins. Parametritis and pelvic peritonitis (perimetritis) are the next stages in the spread of the infection. One or the other may be the more pronounced affection, but usually they are associated.

Parametritis (Pelvic Cellulitis).—This may be caused by the infection spreading by the lymphatics from the uterine cavity, but frequently it is the result of infection of lacerations of the cervix. The first change is simply an inflammatory œdema; and if the infection is not very virulent, the process may go no farther, and the œdema be slowly absorbed. Frequently, however, it is followed by pus formation—an abscess or "broad ligament phlegmon" being formed in the connective tissue of the broad ligaments. The connective tissue around the pelvic veins may be involved and cause "phlegmasia alba dolens." Such an abscess, if unopened, may burrow in any direction along the connective tissue planes, and not uncommonly opens in the groin. Occasionally it bursts into one of the hollow viscera.

Pelvic Peritonitis (Perimetritis).—This is usually the result of direct lymphatic spread from the endometrium. In mild cases it is characterised by fibrinous exudation and the formation of adhesions, which may wall off the pelvic organs. In more severe cases there is pus formation, the pus collecting in the pouch of Douglas, and sometimes in front of the uterus. If protective adhesions have not already formed, *general peritonitis* follows, and this is one of the commonest causes of death in puerperal infections.

Thrombo-phlebitis.—If the thrombi in the veins of the placental site become infected, the inflammation may spread along the veins as a phlebitis, and pass either upwards or downwards. This is a frequent cause of "phlegmasia alba dolens."

Pyæmia.—If portions of infected thrombi become detached, they may be carried to any part of the body, and cause

metastatic abscesses. Acute endocarditis may be a sequel, or pleurisy, or a septic broncho-pneumonia.

Salpingitis and **Oöphoritis** may result from the direct spread of the infection along the tubes, or by the lymphatics.

Clinical Aspects of Puerperal Infection

Although serious symptoms may follow the infection of lacerations of the vulva, vagina, or cervix, the outlook in most cases is governed by the condition of the uterus and the nature of the infection. Accordingly most cases fall conveniently into one of two groups—Sapræmic and Septicæmic, the latter of which may be accompanied or followed by any or all the forms of local pelvic infection described above.

Sapræmia.—This may be defined as an intoxication by the products of putrefactive decomposition. The organisms causing the decomposition are saprophytic, and the dead tissue upon which they live is in the uterus or vagina. Usually it is some fragment of placenta or membranes or blood-clot, but the mere damming up of the lochia by a retroflexion of the puerperal uterus, or by a clot lying over the internal os, may suffice to cause mild sapræmic symptoms. In all cases the saprophytic organisms remain in the focus of decomposition, and do not pass into the living tissues. If pyogenic organisms are also present, they may pass into the living tissues, and cause a septicæmic infection to supervene upon the sapræmia.

Local Symptoms.—If the infection has occurred during labour the symptoms may show themselves on the second or third day; but if the infection occurs later, the symptoms appear correspondingly later. The principal local sign is that the lochial discharge becomes increased in amount, dirty brownish in colour, and very fœtid in odour. The stain on the diaper, which is usually dark in the centre and pale at the edges, tends in such cases to be dark at the edges and pale in the centre. The involution of the uterus ceases, and that organ remains unduly large, soft, and tender. Its general condition in marked cases is that of *putrid endometritis.*

General Symptoms.—These are ushered in by a rise of temperature—rarely higher than 102°—accompanied by some feeling of chilliness, but rarely by a definite rigor. The pulse-rate rises in correspondence with the temperature. There is

generally some headache and general malaise. If untreated, the general condition may become serious, and a septicæmic infection may ensue, indicated by rigors, persistently frequent pulse, and high temperatures.

Septicæmic Infection.—In the cases falling under this heading the infecting organisms are pathogenic or pyogenic in nature, the streptococcus, staphylococci, and Bacillus Coli communis being the commonest. They live and flourish in living tissues, and are thus capable of passing into and multiplying in the blood. The pathological changes are those of *septic endometritis*, and the symptoms vary in intensity according to whether the organisms are stopped by the protective layer of leucocytes in the uterine wall, or succeed in penetrating into the lymphatics, and so into the general systemic circulation. In the former case the patient usually slowly recovers; in the latter we are dealing with a general septicæmia, and the outlook is much more grave.

In *septic endometritis* the symptoms usually come on not later than the third day. Speaking generally they closely resemble those of sapræmia, but are more severe. The first symptom is usually a sharp rise of temperature, to which attention is drawn in many cases by a rigor. The temperature may rise to 103° or 104°, and fall rapidly with the profuse perspiration that generally follows. Thereafter the temperature tends to remain high with small and variable daily remittences. The pulse-rate is markedly increased, and an important point is that it does not necessarily correspond to the temperature, remaining high even when the temperature has fallen. In this respect the pulse is a better guide to the patient's condition than the temperature.

Locally the uterus is probably rather unduly large, but the process of involution is not so characteristically interfered with as in sapræmic conditions. It is usually tender on palpation. The lochia are generally, but by no means invariably, diminished in quantity, and in severe cases may be altogether suppressed. They are fairly normal in appearance, and are not characteristically fœtid as in sapræmia. If the infection is mixed, there may be fœtor, but in serious cases of streptococcal infection there is an entire absence of it. The mammary secretion is frequently suppressed.

General Septicæmia.—If the infective process passes beyond

the endometrium, the symptoms become more severe. Each fresh extension of infection is marked by a rigor, and a further rise of the temperature and pulse. Involvement of the peritoneum usually causes abdominal pain. The patient looks very ill, the eyes sunken, the nose pinched, and the skin slightly jaundiced or muddy. The mind is usually clear, even up to a very short time before death, but occasionally delirium or coma supervenes. The tongue, which is clean and moist in mild cases, becomes furred and ultimately dry, glazy, and cracked. Vomiting may occur, especially when general peritonitis has developed, and "black" vomiting is of grave prognostic significance. Diarrhœa with offensive motions is a late symptom and also of serious import. It may, however, be induced by the injudicious use of mercurial salts in the douches. Rashes are not uncommon in grave cases; sometimes merely transient miliaria due to the perspiration, but often scarlatiniform, or in the form of erysipelatous patches.

If *general peritonitis* develops, there is usually pain over the whole abdomen, but most marked over the uterus, with resistance and tenderness on palpation. The abdomen also becomes distended from paresis of the bowels. The patient lies on her back with the knees drawn up. Vomiting is common, and in the later stages diarrhœa.

Cases in which acute general septicæmia or acute general peritonitis have developed usually end fatally within a week.

Pyæmia is very liable to occur in the course of more protracted cases. It may occur as an additional complication in a case that has been more or less acute from the outset, but sometimes it arises abruptly about the end of the first week in cases in which only a slight degree of pyrexia has been observed. Its main features are exactly the same as those of pyæmia arising from other sources, the principal characteristic being a succession of rigors with high temperature and pulse-rate, with definite remittences of pulse and temperature between the rigors. The rigors indicate fresh detachments of infected thrombi. Metastatic abscesses form where the thrombi lodge, either in the superficial tissues or in the viscera. Septic endocarditis, pneumonia, empyema, and pericarditis are amongst its possible results. The seriousness of the case varies with the virulence of the infection and the situation of the metastatic abscesses.

Diagnosis

It is a safe rule to regard every case of pyrexia in the puerperium persisting for more than twelve hours as due to septic infection, until that cause can be definitely excluded either by the subsequent progress of the case or by bacteriological investigation. There are certainly other causes of puerperal pyrexia to which reference will be made, but septic infection is the commonest, as well as the most important.

Sapræmia may usually be diagnosed without difficulty from the condition of the lochia and of the uterus, combined with the temperature and pulse, and, if need be, the result of emptying and disinfecting the uterine cavity. But pure sapræmia is rare after a full-time labour, although it is not uncommon after abortions. There is usually some mixed infection, both saprophytic and septic organisms, and therefore a bacteriological examination of the uterine lochia is of the greatest importance in any doubtful case.

Septic Infection may be diagnosed clinically by the greater severity of the onset, and the condition of the lochia and of the uterus. The disproportionate frequency of the pulse compared with the temperature is also of significance. But in all such cases an accurate diagnosis can only be made, and the most hopeful lines of treatment indicated, by an exploration and bacteriological examination of the interior of the uterus.

Bacteriological Examination of the Uterus.—This is not a difficult matter, but, like all bacteriological examinations, it must be made with scrupulous care or the results become useless or worse than useless. It must be clearly understood that the lochial discharge from the vagina in a case of this sort is valueless, as after the third day saprophytic organisms are always to be found there. Great care must, therefore, be exercised to avoid contamination by vaginal lochia.

The method is as follows:—The vagina should be douched, and a sterilised Fergusson's or Sims' speculum passed so as to expose the cervix. The cervix should be grasped by bullet forceps if a Sims' speculum is used. The cervix must then be swabbed clean by swabs of sterilised wool. A sterilised glass tube, slightly bent to fit the uterus, is then introduced into the inside of the uterus, and to its outer end a rubber tube attached

to a glass syringe pump is fastened. Some lochial discharge is then sucked into the glass tube by the syringe, and the tube carefully withdrawn. Its ends are then sealed with sealing-wax, and it is sent to a pathologist for examination. In the absence of a syringe the contrivance described by Little does admirably —a tube with a strong silk thread through it attached to a folded rubber band. On withdrawal of the band by pulling on the silk, the rubber forms a piston, and suction is caused in this way. The apparatus must, of course, be boiled before use, and the hands thoroughly cleansed. The lochial tube should be passed as far into the uterus as possible. In the absence of a tube, an ordinary sterile throat swab may be passed in exactly the same way, and sent for examination in a sterile test tube.

Prognosis

The prognosis of pure sapræmia is good, but unless a bacteriological examination has shown the case to be one of uncomplicated sapræmia, the prognosis should be guarded, because a case that begins as sapræmia may pass on into a septic infection.

In septic cases the prognosis is much more serious. Even if the infection is not very virulent such cases are apt to be protracted, and open to relapse at any time, while late complications such as parametritis, phlegmasia alba dolens, or pyæmia may supervene. In acute general septicæmia or general peritonitis the outlook is almost hopeless.

Statistics are not of great value, as the severity of the infection varies so greatly in different cases. If mild cases are excluded the mortality is about 30 per cent, although individual observers have recorded much better results. It is noteworthy that cases infected from other cases of puerperal infection have a markedly higher mortality, the figure being about 70 per cent.

Treatment

Prophylaxis.—Full discussion of this all-important point would involve discussion of much of the management of pregnancy and labour. This has already been done, and it must suffice here to recapitulate the main points to which attention should be paid.

(1) The patient should be brought into as good a condition

of health as possible before labour so as to be able to resist any morbid process. This involves careful attention to the hygiene of pregnancy.

(2) Both obstetrician and nurse must endeavour to avoid contact with any infectious patient, particularly one with puerperal septicæmia, or any septic wounds. Where this is unavoidable, they must exercise the most conscientious care in disinfecting themselves, changing and disinfecting clothes, etc.

(3) Above all, strict attention to antiseptic and aseptic precautions must be observed in every contact with the patient immediately before, during, and after labour.

(4) Vaginal examinations should be as few as possible.

(5) Each stage of labour must be properly managed so as to avoid exhaustion, unnecessary lacerations, and hæmorrhage.

(6) All lacerations should be repaired at once so as to close up possible channels of entrance of infection.

(7) After the birth of the child neither finger nor instrument should be allowed to enter the vagina, unless absolute necessity demand it.

Local Treatment.—

I. *Treatment of cases in which the symptoms are mild, and the cause probably Saprœmia* (T. 101° to 102°, no actual rigor, slight malaise, lochia fœtid).—The aim in such cases is to stimulate the uterus to empty itself completely without the necessity of direct interference, and at the same time to wash out any decomposing matter in the vagina. In the first place *a brisk purge* should be given, as this both stimulates the uterus and also removes some of the toxins from the system. Secondly, give *ergot* three times daily, either half-drachm doses of the fresh liquid extract, or three grains of ergotin in a pill. Thirdly, give a *vaginal douche* night and morning to cleanse the vagina and stimulate the uterus. At least half a gallon, preferably more, of lotion should be used at a temperature of 100° to 110°. Sterile water or saline or weak antiseptic lotions may be used. The choice is indifferent, as the chemical effect of any antiseptic in a douche is probably negligible.

If this treatment fails to clear away the symptoms in the course of twenty-four to thirty-six hours, the case must be treated as one of greater severity in the way described in the next paragraph.

II. *Cases in which the symptoms are more severe, or in which*

mild symptoms persist in spite of treatment (T. 102° or more, rigor, malaise, pulse frequent, lochia fœtid or unchanged).—Here there may be doubt as to whether the case is one of (1) more severe sapræmia, (2) mixed sapræmic and septic infection, or (3) pure septic infection. In all such cases a thorough investigation is desirable for purposes of diagnosis, and also of treatment.

For such an investigation an anæsthetic is helpful as it permits of greater thoroughness, but it is not absolutely necessary. The patient should be placed across the bed on her back with the buttocks drawn to the edge. The operator should protect himself by a large sterilised overall, and sterile gloves. Seating himself facing the vulva, he should thoroughly douche the vulva and vagina. The vulva, perineum, vagina and cervix should then be examined visually—a Sims' speculum being used for the latter. Any puerperal ulcer should be swabbed clean with sterile dabs of wool, and painted with pure carbolic acid or tincture of iodine. If a perineal tear is suppurating, the stitches should be removed to allow free drainage. A bacteriological specimen of the uterine lochia should then be taken with the precautions mentioned on page 381. Following this the gloved and sterile finger should be introduced into the uterus. Up to the end of the first week the cervix generally admits at least one finger without the need of dilatation. The interior of the uterus should be carefully and fully explored, and a careful bimanual examination of the whole pelvis made at the same time.

If the interior is very rough and shaggy, and contains debris or portions of placenta or membranes, the case is primarily at least one of sapræmia—putrid endometritis.

If it is only slightly rough and shaggy, the case is probably one of mixed infection—bacteriological examination will settle the point.

If the surface of the endometrium is very smooth, the case is probably one of septic endometritis, and the bacteriological examination will show the nature of the organisms.

In the first two types of case the debris should be removed, any adherent placenta or membrane separated off, and the whole interior of the uterus gently scraped with the finger. If preferred a blunt wire loop curette or a Rheinstädter's flushing curette may be used, but there is a risk of penetrating the softened wall of the uterus with any instrument. The cavity

should then be irrigated with a hot douche. The temperature should be about 115° to stop any bleeding: the nature of the solution is immaterial provided it is sterile, as its effect is purely mechanical and hæmostatic. If mercurial salts are used in it, some plain sterile saline should be run in afterwards to prevent the risk of mercurial poisoning. A two-way catheter should be used, such as Fritsch's or Budin's.

After the douche the cavity should be plugged for twelve hours with iodoform gauze, and subsequently vaginal douches given night and morning. The administration of ergot should also be continued.

These lines of treatment should be followed in both sapræmic and mixed infections. In the former they are almost invariably followed by complete and rapid cure.

III. If on examination the interior of the uterus is felt to be quite smooth and there is no debris in it, the case is one of septic endometritis. The value of local treatment in these cases, as well as the method to be adopted, is a subject upon which the most divergent views are held. If the symptoms are severe, the organisms will almost certainly have passed beyond the uterus into the general circulation, and the issue of the illness (general septicæmia) will depend wholly on the patient's powers of resistance. Local treatment would therefore appear to be misdirected energy, which may even weaken and exhaust the patient.

Curettage is calculated to destroy the protective layer of leucocytes, and open up fresh channels for absorption, while leaving untouched the most dangerous organisms — those already in the blood.

While the trend of recent opinion, then, favours the omission of local treatment in such cases, many distinguished authorities advocate it. Some recommend a thorough curettage, others the gentle use of a blunt curette, others a brushing out with a bottle brush (*écouvillonage*). Others prefer the introduction of powerful antiseptics such as formalin or alcohol.

Medical Treatment.—The further treatment of a case of septicæmia is by the use of specific sera or vaccines, and, above all, by carefully supporting the general strength.

Sera and Vaccines.—The use of antitoxic sera has been disappointing, even when the nature of the organisms has been learned by bacteriological examination of the uterus. In the

case of the streptococcus this is probably due to the many different strains of the organism that may be met with, so that even the use of polyvalent serum is like discharging a blunderbuss in the hope that one pellet may hit the mark.

More satisfaction has followed the use of *vaccines.* When the bacteriological examination of the uterus is made, a drop of the lochia should be put on a cover glass, and stained and examined. If a diagnosis can be made, a "stock" vaccine of the particular organism or organisms should at once be injected. In the meantime a vaccine from the patient's own organisms should be made with all speed, and its administration begun as soon as possible.

Drugs.—Strychnine, quinine, and ergot are the three drugs most useful. They may be given by the mouth in pill form if the patient can retain them. Failing that, they may all be given hypodermically at different times. Alcohol may be administered freely in the form of good brandy. Veronal or trional are useful for the sleeplessness; and opium in some form may be given if the pain is severe, as, for example, when general peritonitis has developed. In protracted cases iron should be given, if the stomach will retain it.

Diet.—It is of the greatest importance to support the strength. Fluid nourishment should be given in small quantities at frequent intervals. Milk should be the staple, but soups, eggs, and beef extracts should also be given in the most palatable and digestible forms.

Nursing.—Constant assiduous attention is necessary, and the ordinary aseptic precautions of the puerperium must not be neglected, as any further access of infection might be fatal. To promote drainage if necessary, the head of the bed may be raised. The temperature, when it tends to rise very high, may most conveniently and safely be lowered by an ice-cap or cold sponging of the trunk. For the pain of peritonitis hot poultices and fomentations to the abdomen may be employed.

Surgical Treatment.—The question of curettage has already been mentioned. In the last fifteen years efforts have been made to treat severe cases by operation. Some authorities claim good results from *incision of the posterior fornix*, and *drainage of the peritoneal sac* by means of a gauze pack.

Still more heroic measures have been tried in the removal of the uterus by *hysterectomy.* The difficulty in regard to this

operation is that, if it is performed soon enough to be successful, it may be performed unnecessarily in many cases, whereas, if it is performed as a last resource, little can be hoped from it, as the infection has by that time spread far beyond the uterus. In pyæmic cases considerable success has followed the *ligature of the thrombosed pelvic veins* on the cardiac side of the infected thrombi. Excision of the veins is not necessary.

Parametritis, Perimetritis, Salpingitis, and Oöphoritis.—Although these conditions often occur in the course of an acute affection, they are more often recognised clinically as the later manifestations of an infection of a lower degree of virulence. The gonococcus, for example, is a not uncommon cause of these forms of infection.

The onset of these conditions is often first detected, after several days of slight pyrexia, by the occurrence of a rigor accompanied by pelvic pain on one or both sides. The amount of pain depends on the extent of involvement of the peritoneum. In peritonitis the pain and tenderness are probably bilateral, and the patient lies with both knees drawn up. In parametritis only one side is as a rule affected, and one leg only may be drawn up.

In parametritis nothing may be felt on vaginal examination until after several days. The infiltration is then felt as a dense hard swelling, usually on one side of the uterus, and very often traceable to a cervical tear on the same side. But both sides may be affected, and the uterus even surrounded by the infiltration. In mild cases the effusion is absorbed, but it may suppurate. The latter is usually indicated by rigors and marked fluctuations of the temperature, and on examination softening may sometimes be felt in the cellulitic mass. If suppuration has been diagnosed, an incision should be made by Hilton's method over the area of softening.

In peritonitis the effusion is usually posterior to the uterus in the pouch of Douglas, and above it there may often be felt a vague mass formed by the partly adherent coils of bowel. There is generally tenderness on examination. These peritonitic effusions rarely suppurate, and are later to a great extent absorbed.

Phlegmasia Alba Dolens (White Leg—Septic Thrombophlebitis).—Two separate pathological conditions, which are sometimes combined, are included under this term.

(1) The *thrombotic* form of phlegmasia is a septic thrombophlebitis of the femoral or other veins of the lower limb. This is usually continuous with a similar process in the uterine veins, but it may be independent. The phlebitis and thrombosis tend to spread down the limb, and the venous return is obstructed, with the result that the whole lower limb from the foot up becomes markedly œdematous. The veins of the upper limbs are occasionally, but rarely, affected in the same way. The swollen limb pits on pressure, and in thin patients the affected veins may be felt as tender cords.

(2) The lymphatic or cellulitic form is really a deep cellulitis, usually but not invariably continuous with a parametritis. The glands in the groin are frequently enlarged and tender. The swelling becomes very tense and hard, and soon ceases to pit on pressure, while the skin becomes white and glossy. If the skin is pricked the fluid that exudes is coagulable lymph, not the simple serum of the thrombotic œdema.

Etiology.—The lymphatic form—the true "white leg"—is certainly septic in origin. It is rare now since the introduction of antiseptic methods. The thrombotic form is probably also septic in origin in most cases, the phlebitis being secondary to the infection of the thrombus. But the condition of the blood is an important element, for the disease is much commoner after serious hæmorrhages during labour, and in anæmic women.

Frequency.—About 1 in 400. The thrombotic form is much the commoner.

Symptoms.—The left leg is more commonly affected than the right. This is probably because cervical tears are more common on that side, but the presence of the rectum may also tend to cause thrombosis on that side more easily.

In most cases the early days of the puerperium have not been quite free of some slight feverishness. About the middle or end of the second week—often the tenth day—the temperature rises abruptly. There may be a slight rigor. Pain is felt in the affected limb, either in the thigh, calf, or ankle. The veins may be found tender to the touch.

Swelling of the limb begins in the foot and spreads upward. In the thrombotic form it always pits on pressure, never attaining the tense brawny hardness of the real "white leg."

Several days after the first onset the second leg is sometimes affected.

Under treatment the fever and pain last for a few days, and then gradually subside. Usually the veins regain their patency, and the swelling of the limbs gradually disappears in the course of several weeks. In the lymphatic form the swelling takes longer to disappear, and some swelling may persist for months, or even years.

Treatment.—This is almost entirely symptomatic. Movement of the limb must be prevented, partly to diminish the pain, but more particularly to prevent the detachment of any portion of clot with its possibilities of consequent disaster. The limb should be raised on one or two pillows, or slung in a cradle, and movement prevented by sandbags. The pain may be relieved by hot fomentations of lead and opium, or 1 in 80 carbolic lotion. When not being fomented, the limb should be wrapped in cottonwool. Even after the acute symptoms have passed off, voluntary movement should be avoided until the swelling has to a great extent disappeared. In the late stages, when all risk of embolism has ceased, gentle massage is helpful.

CHAPTER XXXVI

OTHER PUERPERAL DISEASES

Causes of Pyrexia other than Puerperal Infection

The following conditions may cause a rise of temperature :—

1. Nervous Influences.
2. Constipation.
3. Breast Troubles (Engorgement, Mastitis).
4. Intercurrent Diseases.

Nervous Influences.—Excitement, fright, or grief may cause a rise of temperature, but such feverishness is always transient. The pulse is, as a rule, not quickened in proportion to the temperature.

Constipation.—It has never been proved that constipation causes pyrexia, but it is a familiar fact that many slight pyrexias are cured by the administration of a brisk purge. Some authorities believe that the temperature is due to the absorption of toxins from the bowel, but it is more probable that it is due to some retention of the lochia caused by the rectum being loaded, and to a slight sapræmic intoxication, and that the purgation cures by stimulating free drainage of the uterus.

Breast Troubles.— *Engorgement.*—Normally the breasts should fill with milk and lactation be carried on without any disturbance of pulse or temperature. There is no such thing as "milk fever" to which one can attribute a rise of temperature about the third day. At the same time the breasts, in the early days of lactation, not infrequently become overfull and tender, with hard areas corresponding to the congested lobes. This painful condition is often accompanied by slight rise of

temperature and pulse-rate. The condition is transient as a rule, and may pass off without treatment. But it is well to give a brisk aperient, and if the pain is extreme a little opiate medicine. Very gentle massage with hot oil is soothing and helpful, the fingers of the nurse stroking the breast towards the nipple in order to empty it gradually. The withdrawal of a teaspoonful or two of milk by the breast pump also relieves the condition temporarily, but should not be resorted to unless other treatment has failed. As soon as the breast is, by either means, relieved of the immediate congestion, it should be padded over with wool and firmly bandaged to prevent recurrence.

Cracked Nipples.—Abrasion or fissure of the nipple is a fertile source of pain and inflammation. It may usually be prevented by care. The nipples should be hardened during pregnancy as directed (see p. 102). Each time the child is put to the breast the nipple should be washed over with sterilised water, and after the child is finished, with weak boracic lotion. An occasional sponge with spirit and water is also helpful in preventing the skin from becoming sodden. When the patient is up and dressed, the nipples should be protected by a clean soft dressing of linen or cotton wool.

If cracks form they must be kept scrupulously clean. A little dressing with boracic lotion may be applied, or a paint of Friar's balsam, or glycerine of tannic acid. Playfair's mixture, containing half an ounce of sulphurous acid, half an ounce of glycerine of tannic acid, and an ounce of water, is a most useful one. In all cases of fissure the nipple should at the same time be protected during suckling by a nipple shield. It is important to remember that a fissure of the nipple may bleed during suckling, and the child may swallow the blood. This it generally vomits later, to the great alarm of the mother and nurse.

Mastitis.—Actual inflammation of the breast may affect the parenchyma or the fascial investments. It is due to organismal infection, and may arise as a sequel either to engorgement of the breast or to fissure of the nipple. If not checked it may go on to abscess formation, the common sites being either in the parenchyma of the gland, or in the subcutaneous tissue (premammary abscess). Rarely it is in the fascia behind the breast (retromammary).

Mastitis rarely occurs before the end of the first week of the puerperium. It is attended by a sharp rise of temperature and pulse-rate, pain and tenderness and redness of the affected breast, and some general malaise. Suppuration may be recognised by the usual signs.

Treatment.—Nursing from the affected breast should be stopped at once, and the milk drawn off by a breast-pump at regular intervals. A brisk purge of some form of salts should be given, and the breast treated by pressure (firm bandaging) combined with cold boracic soaks or hot fomentations. If suppuration is detected, a free incision in a direction radiating from the nipple should be made at the most dependent part of the inflamed portion. The finger should be passed in and swept round so as to open up the communicating loculi which are usually found, and the cavities washed out with an antiseptic lotion such as peroxide of hydrogen. They should then either be drained freely by tubes, or, preferably, stuffed with iodoform gauze, which is renewed from day to day, and the cavities washed out.

Intercurrent Diseases.—With regard to these little need be said. Puerperal women may develop any form of disease associated with a pyrexia, such as the exanthemata, influenza, pneumonia, malaria, etc. The diagnosis of these is a matter of general medicine, and all that need be emphasised is the great care that must be exercised to exclude septic infection in every rise of temperature during the puerperium.

Sudden Death during Labour and the Puerperium.—Apart from such general causes as apoplexy, diabetic coma, uræmic coma, and the like, sudden death may occur from pulmonary embolism, or heart failure.

An embolism may reach the pulmonary artery as the result of detachment of a portion of clot in the uterine sinuses. This detachment may be due to infection and breaking down of the clot, or simply to sudden movement such as coughing, getting out of bed, or the violent movements of convulsions. There is peculiar liability to it in the extensive thrombosis associated with phlegmasia. Air embolism has also occurred, and caused death—generally the result of careless and forcible intra-uterine douching, or post partum manipulations in the Sims' position.

In extreme cases the patient expires on the instant, but usually there are a few hours of anguish—air hunger, shock, and collapse — before death ensues. In very slight cases recovery may take place. The only treatment is to secure free stimulation of the heart, plenty fresh air, and, if possible, the administration of oxygen.

Heart failure may occur in patients with diseased heart muscle or uncompensated valvular lesions, such as mitral stenosis. Death may occur during labour, but sometimes the failure comes on suddenly some hours or days afterwards. Heart failure may also be caused reflexly as a result of very sudden emptying of the uterus, or of pressure on the ovaries during improperly executed efforts to expel the placenta. The treatment is directed to cardiac stimulation. If there is extreme cyanosis an immediate venesection may be helpful.

Eclampsia.—It must not be forgotten that eclampsia may occur in the puerperium (see p. 246). It may show itself either as fits or as a progressive comatose seizure. The medical treatment is similar to that of the condition before labour.

The Insanities of Reproduction.—These include (1) the Insanity of Pregnancy or gestational insanity; (2) the Insanity of the Puerperium (up to six weeks after delivery); and (3) the Insanity of Lactation.

Taking all three forms together, the insanity of reproduction forms about 8 to 10 per cent of all cases of insanity in females in the United Kingdom. It is rather commoner amongst poorer patients and in public practice. The proportionate incidence of the three varieties is roughly as follows:—

Insanity of Pregnancy . . .	20 per cent.
Insanity of the Puerperium . .	50 „
Insanity of Lactation	30 „

From the obstetric point of view the frequency of puerperal insanity is about one case in 400 confinements.

In regard to the *causes* it is found that hereditary and personal predispositions play a large part. Exhausting and debilitating conditions are also to be taken into account (post

partum hæmorrhage, excessive lactation, etc.); while intoxications, as always, have a predisposing influence (alcoholism, toxæmia of pregnancy). The extra strain involved in a first pregnancy makes it more commonly associated with primiparity, and in particular elderly primiparity; and the mental distress and shame consequent upon pregnancy in unmarried women render it more frequent in such cases. In puerperal insanity one of the most important factors is septic infection, and the statistics quoted above show a vast improvement compared with the corresponding figures in pre-antiseptic days.

In all forms the prognosis is good. Although all cases do not recover, yet the recovery rate is higher than in any other form of insanity.

The Insanity of Pregnancy may come on about the second month, but more usually about the sixth. In the early cases it may be associated with extreme caprices of appetite, and excessive subjective symptoms. The predominant type is melancholic, with a tendency to suicide and a complete revulsion of feelings towards husband and children. Recovery is usually delayed until after delivery.

The Insanity of the Puerperium usually comes on early—about half the cases occurring in the first week. A few cases, which strictly form a separate group—the Insanity of Labour,—occur during labour. These are usually acutely maniacal, and transient. The ordinary puerperal insanity is also of an exalted type as a rule. Some are suicidal, and many infanticidal. A most significant warning symptom is persistent insomnia. Recovery follows after a few months in about 80 per cent of cases, but may occur even after years. Improvement is frequently associated with the return of menstruation.

Lactational Insanity is, like that of pregnancy, more usually of a depressed and melancholic type. It is more common after the fourth month, and generally comes on quite gradually. Under treatment about 70 per cent recover, and the duration is not often over nine months.

Treatment.—This is on general lines, attention being paid to fresh air and good feeding. The child, if born, should be removed at once, and nursing stopped. Septic infection must be treated on ordinary lines. Insomnia should be met with full doses of paraldehyde, chloral, or veronal. Free elimination by the bowels, kidneys, and skin should be secured, if there is

an obviously toxic element. When the disease resists treatment, the patient should be sent to an institution.

Chorion-epithelioma.—The more common causes of bleeding in the puerperium have already been discussed (Puerperal Hæmorrhage, p. 356). One rare but important cause remains to be noticed, namely Chorion-epithelioma. This is a new growth of extreme malignancy, composed of the same elements as chorionic epithelium, *i.e.* syncytium and Langhans' cells. Formerly it was called *Deciduoma malignum* from the erroneous impression that it was of maternal origin.

The primary growth in chorion-epithelioma is usually situated in the placental site in the uterus, but it may be in the vagina, vulva, tubes, or ovaries. In virtue of its syncytial elements it has capacities for the destruction of other tissues that are excessive even for malignant tumours. Blood-vessels, for example, are opened into freely, and in this way there is usually an early and rapid metastasis, followed by secondary growths in the lungs, liver, brain, and other organs.

The tumour may follow any pregnancy, but it is more common after abortions than after full-time labours, and it is peculiarly common after the occurrence of hydatidiform degeneration of the chorion. This is not to be wondered at when we consider the facts that the separation of the placenta is often incomplete in abortions, and that in "hydatidiform mole" the chorionic epithelium takes on excessive growth and bores its way into the depths of the uterine wall. What it is that determines the sudden and tremendous growth of these buried relics of the chorionic villi is quite unknown.

The time after delivery at which chorion-epithelioma may declare itself varies from a week or two to as much as two years, but it is usual for it to appear within six months of the end of the pregnancy.

The symptoms are hæmorrhage, and, if it is neglected, a foul discharge. The diagnosis can only be made by an expert examination of the scrapings obtained by curettage, and the great risk is that, if this is not done, the condition may be taken for retained portions of placenta (placental polypus).

The treatment is immediate and free hysterectomy, which is followed by good results if done early. In every case of hydatidiform mole the patient should be watched carefully for many months lest this condition should develop.

Subinvolution of the Uterus. — This is a condition of delayed or arrested involution. It is always due to some local condition such as retention of fragments of placenta or membranes, pelvic inflammation, or displacements of the uterus. Frequently it is associated with over-exertion during the puerperium. The symptoms are a prolongation of the lochial discharge, or a reappearance of blood in it, along with some dragging pain and weakness. On examination the uterus is found to be larger than it should be at the particular period of involution, and soft and boggy. Hot douching and the administration of ergot thrice daily may effect a cure. In marked cases, and where there is anything retained, the uterus should be curetted.

The opposite of this condition—Superinvolution—is sometimes spoken of as Lactational Atrophy. The uterus involutes too much and becomes smaller than the virgin organ. The condition is referred to in gynecological text-books.

Displacements of the Uterus.—The anatomical condition of the uterus immediately after labour is very favourable to the occurrence of anteflexion. The body of the uterus is enlarged and heavy, the lower segment is thin and collapsed, and the supporting ligaments are relaxed and softened. If the flexion is acute, it may cause a retention of the lochia, and, if the discharge decomposes, lead to sapræmia. This condition is known as *lochiometra*. The passage of a drainage tube and washing out the uterus usually suffice to cure it (see Fig. 145).

Later in the puerperium, when the fundus has sunk below the level of the sacral promontory, retroflexion and retroversion are apt to occur—from a similar lack of support, and possibly from the pressure of a tight binder or a persistently supine position. Where the displacement has existed before pregnancy, it is prone to recur. The symptoms do not appear until the patient is going about, and are very similar to those of subinvolution, with which it is generally associated. The subinvolution must be treated and the uterus replaced and held in position by a pessary. But it is of much greater importance to prevent the symptoms by examining the patient towards the close of the puerperium, and if the uterus is displaced putting it in good position and inserting a pessary. This will ensure the patient making a complete recovery, and escaping much unnecessary discomfort and chronic ill-health.

CHAPTER XXXVII

PATHOLOGY OF THE NEW-BORN INFANT

Asphyxia Neonatorum—Still Birth

In this condition the infant is born in a state of suspended animation—its heart continues to beat, but it makes no effort to breathe or to move. "Still birth" is therefore not the same thing as the child's being born dead, although death may supervene if prompt treatment is not applied. The term *asphyxia* strictly means *pulselessness*, and *apnœa* is more correct as meaning *absence of breathing*.

During intra-uterine life the fœtal blood receives the necessary oxygen from the maternal blood by means of the placenta, and anything that interferes with either the maternal or the fœtal circulation through that organ leads to the suffocation of the child. Clinically this may be observed by the progressive slowing and ultimate stoppage of the fœtal heart-sounds.

Causes interfering with the circulation of maternal blood through the placenta are (1) *Premature Separation of the Placenta* (accidental hæmorrhage or placenta prævia); and occasionally (2) *Tonic Contraction of the Uterus*, which stops all placental circulation.

Causes interfering with the circulation of the fœtal blood through the placenta are (3) *Pressure upon the Cord*, as in breech delivery, or prolapse of the cord, or due to knots or tight coiling of the cord round the trunk or limbs.

Other causes of asphyxia are (4) *Premature Efforts to Breathe*, stimulated by the cold air playing on the surface of the body in breech delivery while the head is still in the vagina. This results in the child sucking in mucus and liquor

amnii from the vagina, and it may be drowned if not speedily delivered.

(5) Severe *injuries* or *compression of the fœtal head*, due to its passage through a narrow pelvis or the use of instruments, may so damage the respiratory centre in the brain that the child makes no effort to breathe after its birth.

Indirectly, therefore, the causes of asphyxia are manifold, and it may be associated with any form of delayed or abnormal labour, and any form of fœtal disease or abnormality.

Varieties.—There are two outstanding varieties named according to the appearance of the child—the Livid or Cyanotic, and the Pallid or White. Many cases are intermediate between these two forms, and the livid form gradually passes into the pallid if not effectually and promptly treated.

(1) *Asphyxia Livida.*—This is much the more common type. The child when born is of a cyanotic blue appearance, the heart and cord beating slowly but often quite strongly, the cord full and thick, the muscles firm and tonic, the reflexes present.

(2) *Asphyxia Pallida.*—In this rarer form the child is deadly white, the heart and cord beating feebly or perhaps imperceptibly, the cord empty and flabby, the muscles (including the sphincters) limp and relaxed, and the reflexes lost.

Diagnosis.—An indication of the progressive suffocation of the child from any of the causes mentioned is to be found in the persistent and progressive slowing of the fœtal heart—persistent between the pains. This slowing is due to the stimulation of the vagus by the excess of carbonic acid in the blood. A fœtal pulse below 100 per minute means that the child is in danger, and should be delivered as rapidly as can be done with safety to the mother.

The presence of meconium in the liquor amnii in vertex presentations is an important sign, meaning relaxation of the sphincters. In breech presentations it is, of course, of no bad import.

Just before its death the child often makes respiratory efforts. Usually this hastens the end, as it simply sucks in liquor amnii, etc. But if there happens to be any air in the uterus, during, for example, the performance of version, the child may actually inspire air and utter a cry. This so-called "vagitus uterinus" is a very rare phenomenon.

Prognosis.—In asphyxia livida the prognosis is uniformly favourable, recovery being the rule if the case is properly treated. In asphyxia pallida, on the other hand, the outlook is not good, as the cause is often more serious. Even after recovery many children die of aspiration pneumonia, etc., within a few days.

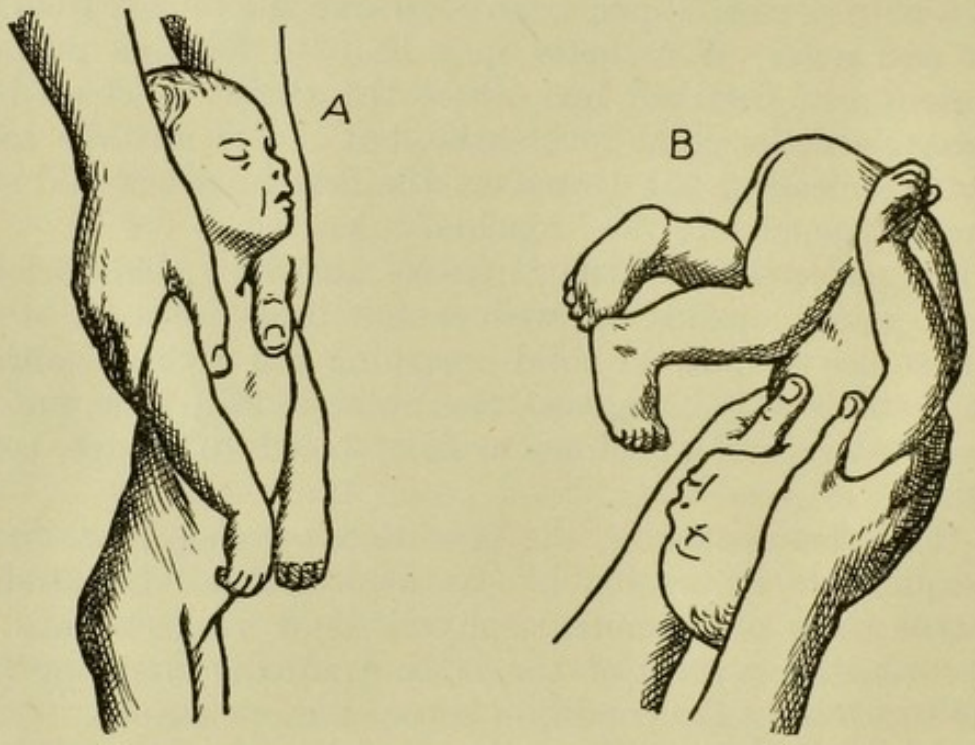
Treatment.—*Livid or Cyanotic Form.*—As long as the cord is beating strongly the child is obtaining oxygen through the placenta, therefore there is no immediate hurry to tie the cord. Hold the child up by the heels, and with the little finger covered with a small linen swab clear out the mucus from the throat and nose. A catheter may be used for this purpose, the mucus being sucked up. Once the throat is cleared we may stimulate the child to breathe, but it is a mistake to do this before clearing the throat as the first breath would suck the mucus deeper into the bronchial tubes.

A few gentle slaps on the buttocks and back, light friction over the chest, sprinkling with a few drops of cold water, usually suffice to start the child breathing and crying healthily. If, when the cord is being tied, the child is still blue, cut the cord and allow half an ounce or so of blood to escape before ligaturing.

If this treatment fails, the condition becomes more grave, and requires to be treated like an asphyxia pallida. Indeed, persistent cases of cyanotic asphyxia tend to pass into the pallid form, the surface of the body gradually changing from purple to white as the condition becomes more serious.

Asphyxia Pallida.—When the cord is pulsating feebly or not at all, the placenta is out of action, and therefore the cord should be cut at once to facilitate the manipulation of the child. To save time only one ligature need be applied. Hold the child up by the heels and clear out the throat as before. Then immerse the trunk and limbs in a bath of water that is comfortably hot to the hand. Apply light friction over the heart, splash the chest front and back with cold water, and every few seconds gently compress the chest with the hand. Clear out the throat from time to time if necessary. If these measures fail, and the heart is still beating no matter how slowly, persevere in the resuscitation. Dry the child with a warm towel, and apply one of the methods of artificial respiration. Of these the best, provided it is carefully done, is Schultze's,

but it should be remembered that the method is liable to abuse. Do not swing the child more than half a dozen times by this method. Then replace it in the hot bath, for it is essential to keep up the body heat. Again apply friction to the chest, clear out the throat, and feel whether the heart is beating. If it is beating, repeat one or other process of artificial respiration and hot bathing alternately as long as the heart continues to beat. When the child revives, keep it warm and have it carefully watched for some time lest it should relapse.



FIGS. 217, 218.—Schultze's method of artificial respiration.
A. Inspiration. B. Expiration.

Methods of Artificial Respiration.—*Schultze's.*—Dry the child and wrap it in a small warm towel to prevent it slipping out of the fingers. Hold the child, head up, grasping it by placing the fingers over the back and sides of the chest, the thumbs and forefingers encircling the axillæ. Steady the child's head between the wrists. Stand with the feet apart, and hold the child hanging down between the legs. See that you have a firm grasp of it. Then swing the child gently up to the level of your face. At the end of this swing draw the arms in towards you a little, at the same time dropping them slightly. This causes the lower limbs of the child to fall over

in front of the chest. At the same time compress the chest gently with the fingers. Then reverse the movement and swing the child down between your legs once more. Pause for a moment and then repeat. The double movement should be carried out at the rate of about twelve to eighteen times in the minute, but, as mentioned before, not more than six to eight swings should be done at a time.

When the child is hanging down, it is in the position of inspiration. When its limbs fall over in front of the abdomen at the top of the swing, their weight compresses the chest and causes a mechanical expiration.

The risks of the method are—

(1) Violent and careless swinging may cause rupture of the liver, or hæmorrhage into the other abdominal organs.

(2) The child may slip out of the hands and be flung on the floor. This is due to not making sure that you have a firm grasp before you start to swing. The intervention of a small warm towel between the hands and the child's body is a help in preventing this accident.

(3) Fractures of various bones have followed careless swinging.

(4) The child's body becomes rapidly cooled. The warm towel helps to prevent this, and the frequent plunging into a hot bath after every six swings or so.

Sylvester's and *Marshall Hall's* methods may be used, just as applied to the adult in cases of drowning, but they are not so satisfactory in the infant.

Byrd's method is better. It is carried out by holding the child face up on the two hands, the one hand under the buttocks, the other under the shoulders. Alternate extension and flexion of the entire trunk cause inspiration and expiration.

Rhythmic Traction on the Tongue is sometimes effective. The child is laid on its back and the tongue grasped with the fingers covered by a piece of linen, and pulled outwards twenty to thirty times per minute.

Direct Insufflation.—Blowing air directly into the lungs is not infrequently the most effective of all methods, as it forcibly opens up the air vesicles of the lungs. It may be done through a fine gum-elastic catheter passed into the trachea. Care must be taken, by depressing the tongue and guiding the catheter by the finger, not to pass it into the œsophagus.

The method may be carried out without any apparatus as follows :—Lay the child on its back on a table, and place a clean, fine linen handkerchief over its mouth. Place the one hand over its epigastrium and with the other close its nostrils. Then, taking two or three long breaths so as to empty the lungs of carbonic acid, place the mouth over the child's mouth and breathe into it. The hand over the epigastrium prevents the air passing into the stomach and perhaps rupturing it, while the other hand prevents the air passing out through the nose. The hand on the epigastrium also feels when the chest is full, and when this is so, the chest is gently compressed and emptied. This manœuvre is repeated a dozen to eighteen times a minute. The blowing must be gently done, otherwise the air vesicles may be ruptured.

Birth Injuries

Cephalhæmatoma.—This is an effusion of blood between the pericranium and one of the bones of the head. It may follow any form of difficult labour, but particularly bad forceps cases.

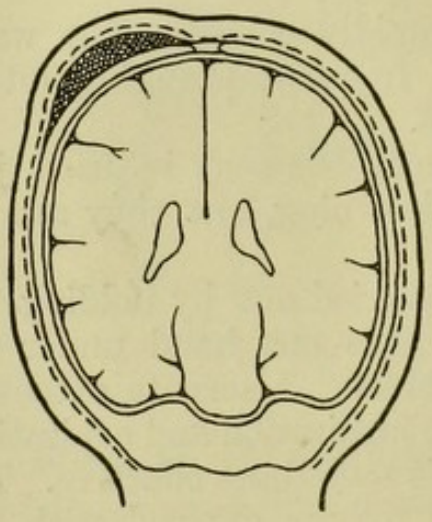


Fig. 219.—Section showing position of a cephalhæmatoma under the pericranium.

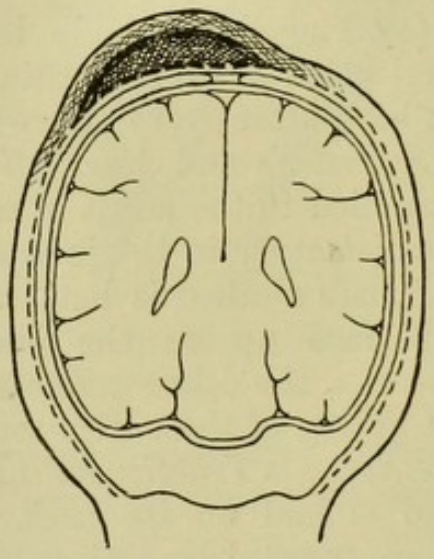


Fig. 220.—Section showing structure of caput succedaneum.

The swelling does not make its appearance until some time after labour, and is rarely recognised before the second day. It may gradually enlarge for a day or two, and then very slowly diminishes, so that it may still be recognised after eight weeks.

The swelling may appear over any bone, but is most commonly situated over the parietal. The right parietal is the most frequently affected, but both bones may present a swelling. The pericranium is bound down at the edges of the bones, therefore the tumour is always strictly limited in area to the one bone, and even when both parietals are affected, there is a definite groove between the two swellings.

The swelling must be diagnosed from a caput succedaneum and a meningocele. A cephalhæmatoma appears late, is limited by the sutures, and the skin over it is not discoloured.

A caput succedaneum is present at birth, is not limited by the sutures, is dark and discoloured, and disappears in the course of a day or two.

A meningocele is present at birth, is situated over a gap in the bone which may usually be felt and is usually in the middle line of the head, grows tense when the child cries, and when pressure is applied to it the breathing may stop or convulsions be induced.

The treatment of a cephalhæmatoma is to leave it alone unless it becomes infected. This rarely happens, but if it does, the tumour must be opened like an abscess.

Hæmatoma of the Sterno-mastoid Muscle may follow traction on the head during the birth of the shoulders, or the extraction of the aftercoming head.

Fractures and Dislocations may occur in difficult breech cases, or where the child has to be extracted. They should be treated on ordinary surgical lines, and the affected limb bound to the body by bandages for a few days, after which massage should be employed.

Depressed Fractures of the Skull may result from forceps pressure, or extraction through a narrow pelvis during which the parietal is indented by the promontory of the sacrum. In some cases these may be elevated by firm pressure in a direction opposite to the line of the fracture, in much the same way as the dents on a tin may sometimes be forced out. In others the depressed bone may be hooked up by passing in the sharp point of one blade of a vulsellum, and turning it at right angles under the bone. Still another method is to make a small incision, and pass a blunt director under the bone from the nearest suture or fontanelle, and so force out the depressed bone.

Cerebral Hæmorrhage may occur in any difficult labour, leading to asphyxia, various paralyses, and even death either before or after birth.

Facial Paralysis.—This may be due to intracranial hæmorrhage when it may be permanent, but more often it is caused by the pressure of the blade of the forceps on the nerve at its exit from the skull. As a rule it is unilateral, and passes off in the course of a few days. If it persists for more than a month it should be treated by electricity.

Brachial Paralysis (Erb's). — The upper roots of the brachial plexus are liable to be stretched either by pulling on the head in effecting the delivery of the shoulders, or in extracting the aftercoming head by the Prague grip. As a result there may be paralysis of the arm. Expert advice should be sought in these rather serious cases, as they may require either surgical or skilled electrical treatment.

Injuries to the Eye may be met with after difficult forceps delivery. They vary in severity from slight bruising of the eyelid to complete evulsion of the eyeball.

Ophthalmia Neonatorum.—Seventy-five per cent of cases are due to the gonococcus, and the infection is acquired at birth by the vaginal discharge getting into the eye when the child opens its eyes. The important point is to prevent this by wiping the eyes immediately the head is born; and, when there is any suspicion of gonorrhœa, or any vaginal discharge, to drop into the eyes two drops of 2 per cent silver nitrate solution, or 1 in 2000 perchloride of mercury. The enormous importance of this may be realised when it is considered that about 15 to 20 per cent of all cases in blind asylums are due to this disease.

If infection occurs at birth the disease shows itself in the first six days. It begins as a conjunctivitis, and the discharge soon becomes purulent. The affected eye is tightly shut by the spasm of the orbicularis palpebrarum.

Attention should first be paid to the sound eye, which should be wiped clean, and two drops of 2 per cent silver nitrate solution again dropped in, taking care that it gets well in between the lids on to the conjunctiva. The eye should then be covered with pledgets of wool kept in place by sticking plaster. The affected eye must then be opened and washed out with 1 in 4000 perchloride of mercury solution, particular

care being taken to see that the fluid does not pass to the sound eye. To obviate this the child should be inclined to the affected side. Silver nitrate solution should then be dropped in as before. The bathing and application of the silver solution should be repeated every two hours, the sound eye being looked at daily to see that it is not infected. Scrupulous care must be taken in every way to prevent the spread of the infection, the hands and instruments being sterilised after each dressing, and the swabs and dressings burned after use.

Mastitis.—In both boys and girls the breasts sometimes enlarge about the third day after birth, and a few drops of what is practically milk may be squeezed out. This should be treated on the same lines as engorgement of the breast in the mother. In girl babies a slight discharge of blood-stained mucus from the vagina is sometimes noticed.

Tongue Tie.—This is the term popularly applied to a congenital shortness of the frenum linguæ. When present it prevents the protrusion of the tongue and interferes with suckling. It is to be treated by slightly snipping the mucous edge of the frenum with a clean pair of scissors, taking care not to cut so deeply as to injure the artery.

Congenital Deformities, such as imperforate anus, undescended testicles, phimosis, talipes, and cleft palate, should be examined for after birth in all cases. The first-named requires immediate operation. In talipes much good may be done by careful massage and manipulation from the outset. Phimosis may call for circumcision, but this should be delayed for ten days or more if possible.

Jaundice.—A few days after birth there is commonly a distinct yellow discoloration of the skin, unaccompanied by symptoms. This is due to the breaking down of some blood pigment, and is in no way connected with the biliary secretion. It passes off in a few days.

True hepatogenous jaundice is a rare but almost uniformly fatal affection in infants. In some cases it is associated with congenital narrowing of the bile ducts in the liver, and the child dies of a hepatic toxæmia. In other cases it is associated with septic infection of the umbilicus and hæmorrhage from the infected scar.

Umbilical Infection.—This may occur at any time before

or after the separation of the cord. It is almost always traceable to want of care in keeping the cord clean and dry. The condition is liable to be serious, as the infection frequently spreads internally, and causes a general septicæmia associated with jaundice. Antiseptic treatment should be pursued, but is usually of little avail.

Hæmorrhage from the Cord or Umbilical Scar (Omphalorrhagia Neonatorum) is a common accompaniment of umbilical infection. It must be treated promptly—by ligatures if the cord has not separated, or by acupressure if the cord has sloughed—passing two needles at right angles to each other under the cicatrix, and tying a mass ligature round the umbilicus below them.

Melæna Neonatorum may be due to blood swallowed from a cracked nipple, to duodenal ulcer, intussusception, or to a hæmophilic condition. The latter are very serious. If no definite cause can be found, treat by giving one or two minims of adrenalin chloride solution every four hours, and feed the child as far as possible on water only until the bleeding stops.

CHAPTER XXXVIII

INFANT FEEDING

In all cases an infant should be suckled by its mother unless definite contra-indications exist. If the advantages to the child and to herself are laid before the mother, few women will refuse the privilege. For the infant it is the natural and ideal food, alike in its composition and in its freedom from contamination. For the mother it is an advantage in that it stimulates the processes of involution of the uterus. Even a few weeks of breast-feeding give the child's digestion a good start, and fit it for subsequent artificial feeding if the lactation becomes a strain to the mother.

The simple rules for breast-feeding have already been given (see p. 217). It is only necessary to insist again on the paramount importance of regularity in the times of the feeds.

Contra-indications to Breast-feeding. — The following maternal conditions make suckling undesirable :—

1. Tuberculosis, either active or latent.
2. Chorea.
3. Serious complications during or after labour, *e.g.* hæmorrhage, septic infection, eclampsia.
4. Absence of milk.
5. The occurrence of pregnancy during lactation.
6. Acute illness occurring during lactation.

On the part of the infant, contra-indications to the continuance of breast-feeding are—

1. Continuous loss of weight.
2. Persistent and intractable indigestion.

In such cases the infant must either be fed by a wet nurse or else be placed wholly or in part upon artificial feeding.

Wet Nursing.—This is the best substitute for the milk of the child's own mother. It is, however, a very expensive method, and with the improvements in our knowledge and methods of bottle-feeding it has gone greatly out of fashion. If it is decided to wet nurse the child, it is the physician's duty to choose the nurse. This is a matter of great importance, as tubercle and syphilis may be transmitted to a child by the milk. The foster mother should be a woman between twenty and thirty, and her own child should be very little older than the infant to be nursed. She must be carefully examined for evidences of disease, the throat, tongue, teeth, skin, and hair being inspected. The breasts and nipples must also be examined. Her own infant should be seen and examined for signs of syphilis or other disease. The greatest care must be exercised in every way, and in cases of dubiety the Wasserman test for syphilis should unhesitatingly be applied.

Mixed Feeding.—Where the supply of mother's milk is insufficient, artificial feeding may be substituted several times in the twenty-four hours, without putting the child wholly on the bottle. This mixed breast and artificial feeding is superior to entire artificial feeding, and infants thrive on it. The bottles may be substituted at whatever times are most convenient, but the process of substitution should be gradual, one bottle being given to start with, and afterwards the number gradually increased if desired.

Artificial Feeding.—In this country cow's milk is the most convenient substitute for breast milk. The comparative composition of the two milks is as follows :—

Composition.	Breast Milk.	Cow's Milk.
Proteid—	Per cent.	Per cent.
Casein and Lactalbumen .	1·5	3·5
Fat	4	4
Carbohydrate (sugar) . .	7	5
Mineral salts	0·2	0·7
Water	87	87

From a study of this table it will be seen that cow's milk differs from breast milk in having too much proteid and too

little carbohydrate. There is, however, an even more important difference in the nature of the proteid. In both it consists principally of casein and lactalbumen, the former of which is converted by the rennet of the stomach into a solid curd, while the latter remains practically fluid, and is therefore much more easily digested. In breast milk more than half the proteid is in the form of lactalbumen, while the casein forms a fine curd with the rennet. In cow's milk, on the other hand, the greater part of the proteid is in the form of a casein which forms a dense curd with rennet, and only about one-fifth part consists of lactalbumen.

Cow's milk must, therefore, be diluted before it becomes suitable for the infant. But here again we are met with a difficulty, for mere dilution not only does not affect the nature or the relative proportion of the two forms of the proteid, but it brings the proportion of fat and carbohydrate below what it ought to be. To make a suitable mixture with cow's milk, we must not only dilute it, but add to it fat and carbohydrate —usually in the forms of cream and sugar of milk.

Rules for Artificial Feeding during the first Two Months. —During the first two days a child that is to be artificially fed should get but little nourishment, for nature does not provide any milk during these days, and it is well to follow the natural plan as closely as possible. A little warm sterilised water with a small pinch of sugar of milk may be given occasionally on the second day, and on the third day it may be given one or two teaspoonfuls of a mixture of milk and water in the proportion of one to ten, with a little sugar of milk. On the third day a regular and definite plan of feeding should be adopted. The important points are the times, quantity, and composition of the feeds.

Times.—These should be the same as for breast-feeding, and should be adhered to strictly (see p. 217).

Quantity.—Some variation must be made for the size of the child, but for an infant of average size a feed should not be more than one ounce during the first ten days. It may then be gradually increased, so that at the end of the first month it is two ounces, and at the end of the second month three ounces. If a healthy infant is given too large a feed, it generally indicates the fact by vomiting some of it shortly afterwards.

Composition.[1]—Details of the various methods of artificial feeding are to be found in books on the subject, and all that is necessary here is a sketch of a simple and thoroughly serviceable plan of feeding for the first eight weeks.

(*a*) *Mixture to be given from the Third to the Tenth Day.*

Milk	½ tablespoonful.
Sugar of milk . . .	¼ teaspoonful.
Water	1½ tablespoonfuls.

Dissolve the sugar of milk in the water before adding the milk. Scald the mixture before use. Give every two hours during the day and twice at night.

Gradually increase the quantities of the ingredients every third day, so that at the tenth day the mixture is as below :—

(*b*) *Mixture to be given from the Tenth Day.*

Milk	½ to ¾ tablespoonful.
Sugar of milk . . .	½ teaspoonful.
Cream	½ teaspoonful.
Water	1½ tablespoonfuls.

Again gradually increase the ingredients until at the beginning of the second month the mixture is as follows :—

(*c*) *Mixture to be given from the Beginning of the Second Month.*

Milk	1½ tablespoonfuls.
Sugar of milk . . .	¾ teaspoonful.
Cream	1 teaspoonful.
Water	2½ tablespoonfuls.

Gradually increase the intervals between the feeds, so that at the end of the second month the infant is being fed every two and a half hours during the day, and only once at night if possible.

Gradually increase the ingredients so that at the end of the second month the mixture is as follows :—

(*d*) *Mixture to be given from the Beginning of the Third Month.*

Milk	2½ to 3 tablespoonfuls.
Sugar of milk . . .	1 teaspoonful.
Cream	2 teaspoonfuls.
Water	3 tablespoonfuls.

[1] See *Guide to Feeding of Infant*, by J. W. Simpson, M.D. Edinburgh : Oliver and Boyd.

Temperature.—In all cases the temperature of the mixture should be 100° F.

Use of Lime Water, Barley Water, etc. — Nurses and mothers are fond of adding barley water to the mixtures because it makes them look more nutritious. An infant cannot, however, digest starchy matter, so that the barley passes through unaffected, and is apt to set up irritation. The same applies to oatmeal water. Lime water has the effect of making the curd finer and lighter, and so making the mixture more digestible. It has also a constipating effect. While, therefore, there are not the same objections to its use as to the use of barley water, it should not be given unless the child seems unable to digest the plain mixture, or there is some diarrhœa. It should be given in the proportion of a tablespoonful to three ounces of the mixture. Citrate of soda added to the mixture has the effect of preventing the formation of curd, the milk remaining fluid. This is of value where the infant is unable to digest the curd. The citrate is conveniently added in the form of a solution in distilled water, two grains of citrate being required for each ounce of milk.

The Bottle.—The old-fashioned bottle with a long rubber tube is a perfect abomination, as it is impossible to keep it clean. There is also a tendency amongst busy working women to place such a bottle in the cot beside the child, and let it take its meals when it feels inclined. This always leads to indigestion and bad health sooner or later. Practically all modern bottles have simply a teat, which can be easily and quickly cleansed and sterilised. The hole in the teat should be of a size to allow the milk to drop out rapidly on inverting the bottle, but not actually to run out. Both teat and bottle must be kept absolutely clean. The former should be turned inside out and washed, and the latter brushed out immediately after use, and both kept in a basin of boiled water till again needed. At frequent intervals they should be sterilised by scalding. Under no circumstances should the milk be allowed to remain in the bottle for the next feed.

The Question of Sterilisation.—One of the greatest advantages of breast milk is that the infant receives it direct from the nipple, and it is therefore sterile. Cow's milk obtained even under the best circumstances is far from sterile, and under

ordinary town conditions the number and variety of organisms found in it are truly appalling. The rarity with which breast-fed children are attacked with serious diarrhœa is very significant, when we consider that amongst bottle-fed children epidemic diarrhœa is a scourge. It is believed also that tuberculosis is frequently conveyed to the infant by infected milk; and outbreaks of scarlet fever and diphtheria are often to be traced to the same source.

The advantages of sterilising the milk would therefore seem to be overwhelming. But it is only right to state that there are disadvantages also. Boiling the milk spoils its taste, and, while that is a detail to an infant that is brought up on it from its birth, it has a more serious influence in destroying some valuable ferments in the milk. The continued absence of these ferments sometimes leads to infantile scurvy.

This disadvantage of sterilisation can be circumvented without the sacrifice of the advantages by the process of "scalding." The milk is brought to the boiling point and kept at that temperature for two minutes and then cooled rapidly. This is simple and effective in that it destroys all organisms, although the spores of organisms may survive. "Pasteurisation" is also satisfactory, but more complicated. In this process the milk is brought to a temperature of 158° F. and kept there for twenty minutes. A drawback is that the tubercle bacillus may survive the process.

Patent Foods.—Speaking generally, patent foods are never so good as a simple milk and cream and water mixture, and if the rules as to the times, quantity, and method of preparation are carefully attended to, few infants will fail to thrive on it. The advantage of foods is that the rules are all printed on the bottle or tin, and command attention, whereas the physician as often as not does not even write down the rules, but contents himself with a few verbal instructions, which are soon forgotten.

Most patent foods contain starchy material which the infant is unable to digest, along with an excess of sugar which makes it fat but flabby, and too little real fat. At the same time cases do occur in which the digestion is better suited with a carefully chosen patent food, and after the child is a few months old they are often useful as an addition to the diet. Amongst the best preparations for use, either alone or as a means of modifying a milk and cream mixture, are Allenbury foods,

Savory and Moore's, Benger's, Glaxo, Mellin's, Horlick's, Fairchild's Peptogenic Milk Powder, and Albulactin.

Digestive Disturbances are naturally more common in bottle-fed infants. Vomiting may be due to too large feeds, or to the child being rocked or handled after a meal. In these cases the vomiting occurs soon after the feed. It may also be due to indigestion of the curd, in which case it comes on from a half to one hour after the meal. The treatment in the first two circumstances is to avoid the cause. In real indigestion the first step is to further dilute the mixture by the addition of more water or less milk. If that fails the curd must be rendered finer by the addition of lime water, or bicarbonate of soda (1½ grains to every ounce of milk), or citrate of soda as previously directed. In obstinate cases the milk must be peptonised by, *e.g.*, Fairchild's peptonising powders, or peptogenic milk powder.

Where the vomiting is intractable, violent, and *projectile*, the possibility of a congenital stenosis of the pylorus should be remembered.

Constipation.—If the child is on the breast, much may be done by increasing the fats and meat in the mother's diet; if bottle fed, the fat in the mixture should be increased. A few drops of castor oil or salad oil once or twice in the day may be given, or a few grains of manna added to the mixture. The use of pure Demerara (brown) sugar instead of sugar of milk for a few days is often very successful. In chronic constipation benefit may result from abdominal massage and the use of small enemata given by a special small syringe.

Diarrhœa.—In breast-fed children severe diarrhœa may be treated by stopping the breast feeding for twelve hours and substituting two or three teaspoonfuls of albumin water every two hours. If the condition improves, the breast feeding may be gradually returned to in the course of twenty-four to forty-eight hours. In the intervals the breast milk must be drawn off by a pump. Albumin water is made by slicing the white of an egg, and shaking it up with six ounces of sterilised water to which a pinch of salt has been added. It is then strained through a piece of clean muslin, and sweetened.

In less severe cases a dose of castor oil or grey powder may cure the diarrhœa.

In bottle-fed children diarrhœa should be treated on the

same lines, milk being withheld for twenty-four hours, and albumin water given at frequent intervals. Castor oil may be given to clear out the intestine, followed by a mild sedative such as ½ grain of Dover's powder three times daily. The return to the ordinary diet should be made cautiously.

Management of Premature Infants.—A premature infant has difficulty in maintaining its body heat. It is therefore imperative to keep it warm, without at the same time overheating it. This is best done by keeping the child in an incubator in which the temperature can be kept at about 78° F. with more or less exactitude.[1] Failing such conveniences much may be done by wrapping the child in cotton wool, and keeping its cot near the fire, and free from draughts in a room with a temperature of 72° F. The infant should not be bathed, but merely smeared with warm olive or neat's-foot oil, care being taken to keep it warm during the process. The feeding requires the greatest care and patience. The stomach is very small and the child may be too weak to suck. If so, it must be fed with a small teaspoon or a glass pipette very slowly. It is of the first importance that it should be fed on breast milk, with, perhaps, the addition of a little peptonised whey. The feeds should be given every hour or so, and should be started very soon after birth. If at this time there is not even colostrum in the mother's breast, some peptonised whey must be given until the breast is available. At the same time fluid should be supplied by one or two enemata of half an ounce of normal saline solution daily. As soon as the child can suck it should be put to the breast, or else the milk drawn off and fed through a rubber teat. The enemata may be discontinued after feeding is thoroughly well established.

[1] See pages 450, 451.

SECTION VIII

OPERATIVE OBSTETRICS

CHAPTER XXXIX

VERSION

Version or turning is the artificial alteration of the fœtal presentation from one pole to another, or from a transverse to a longitudinal lie.

According as the head or the breech is made the presenting part we speak of *Cephalic* or *Podalic* version. The former is rarely done, and if the term version is not qualified, it may be taken to mean podalic version.

According to the method of performance there are three varieties—*External*, *Bipolar* or *Combined*, and *Internal*.

Indications.—The operation is less frequently indicated than formerly, owing to the improvement in the design of forceps.

1. Transverse presentation is the commonest indication. If the case is seen in time, this is the only line of treatment.
2. Brow presentations, and occasionally Face presentations.
3. Placenta Prævia.
4. Accidental Hæmorrhage.
5. Flat Pelvis.
6. Prolapse of the Cord.
7. As a step in *Accouchement forcé*.

} In some cases.

External Version. — This form of version is usually cephalic, the head being made the presenting part. It is practically restricted to cases where a malpresentation is discovered in the later weeks of pregnancy or at the very outset of labour. It is possible only when the membranes are intact, and there is plenty of liquor amnii, and when the abdominal and uterine walls are lax. It is thus an extremely unsatisfactory operation to attempt in a primigravid woman, and in all cases is facilitated by an anæsthetic.

The patient should lie on her back with the shoulders slightly raised. Carefully map out the position of the child by abdominal palpation. Place a hand on each pole of the fœtus, and with a series of gentle pushing or stroking movements patiently rotate the child into the desired position in a direction such that the flexed attitude is not undone. When the head lies over the brim, press it into the pelvis, and try to fix it there by a tight abdominal binder. If the patient is in labour, fix the head by rupturing the membranes.

Bipolar Version—Combined Version.—This form of version was perfected by, and is usually associated with the name of Braxton Hicks, the English obstetrician. It may be done in cases where external version is impossible, and is indicated where it is desired to bring down a foot through the partially opened cervix. It is always a *podalic* version. The most important indication for it is Placenta Prævia.

The necessary conditions are—

(1) Intact membranes.
(2) Plenty of liquor amnii.
(3) Relaxed abdominal and uterine walls.
(4) Cervix sufficiently open to admit one or two fingers.
(5) The position of the fœtus must have been exactly mapped out beforehand by palpation.

Operation.—The patient is placed in the cross-bed position on her back, and the shoulders slightly raised. An anæsthetic is necessary as the whole hand may have to be passed into the vagina. When the vulva has been thoroughly cleansed, the hand corresponding in position (not in name) to the side on which the fœtal limbs lie, is carefully sterilised and passed into the vagina up to the cervix (*e.g.* the left hand if the limbs lie to the mother's right side). The other hand is placed on the abdomen over the breech. By a series of gentle pushes or

strokings the external hand moves the breech downwards and to the side on which the feet lie, while at the same time the hand in the vagina, with one or two fingers passed into the cervix, presses the head upwards and towards the side on which the back lies. When the head is pressed out of the pelvis the shoulder will come within reach of the fingers in the cervix, and it in turn must be pushed up in the same direction as the head. When the shoulder has been pushed clear of the pelvis the external hand will have manœuvred the breech over the pelvis. When the knee is felt a finger should be passed through the membranes and the knee hooked down, and thereafter a foot brought through the cervix. The head should then be pressed into the fundus by the external hand.

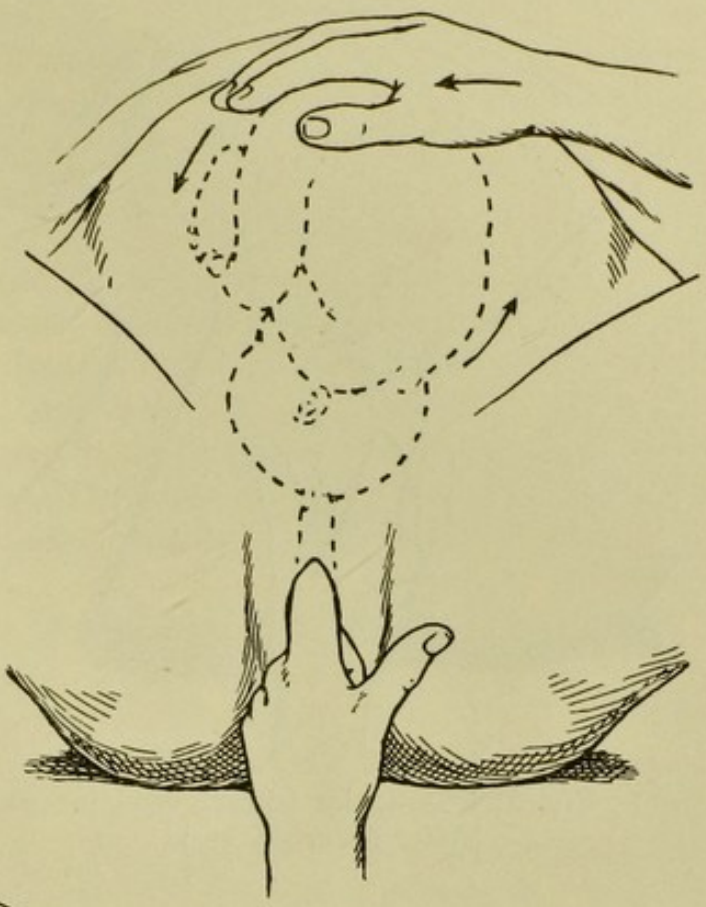


FIG. 221.—Bipolar podalic version. (After Munro Kerr.)

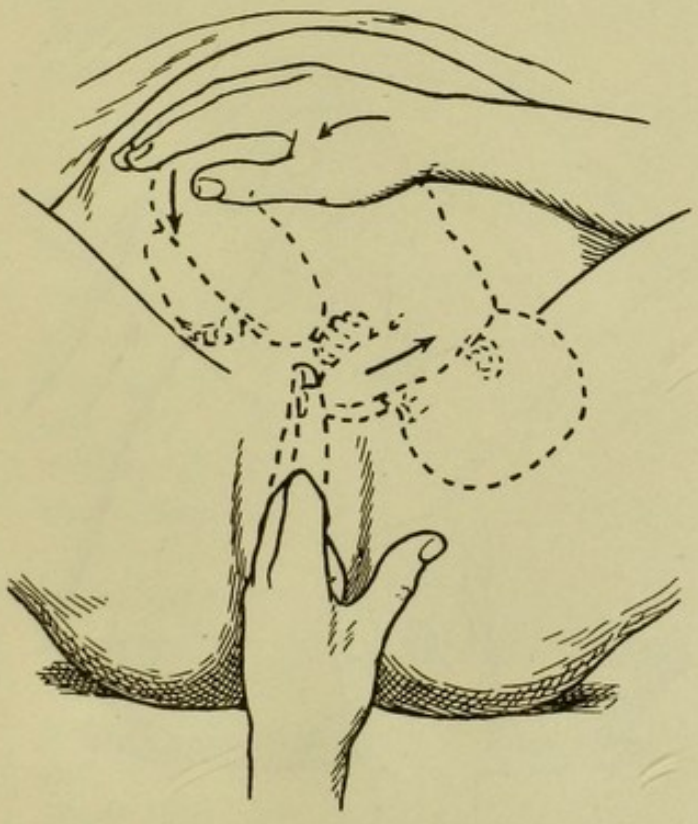


FIG. 222.—Bipolar podalic version. (After Munro Kerr.)

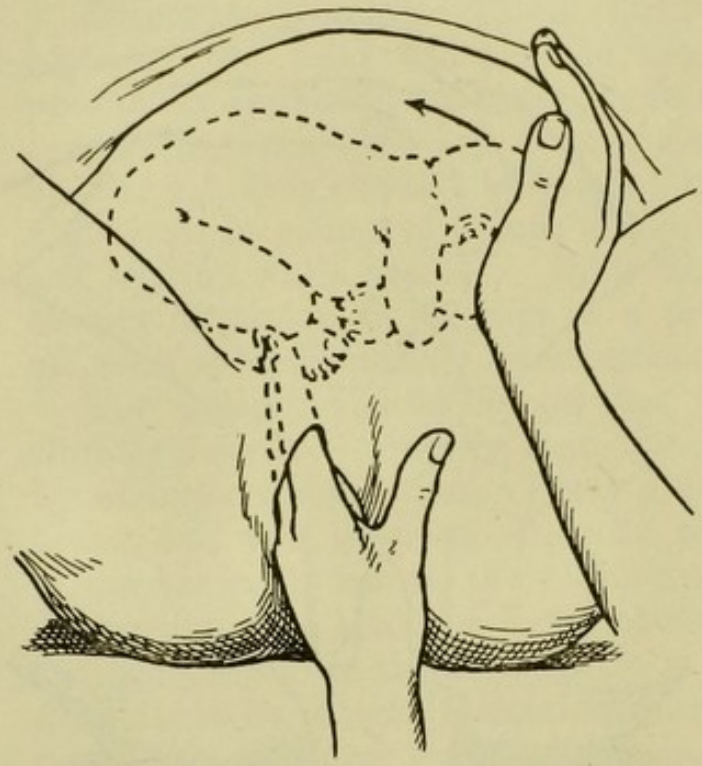


FIG. 223.—Bipolar podalic version. (After Munro Kerr.)

In almost all cases it suffices to bring down one foot only, and in placenta prævia it is important to remember that the half-breech is a much more efficient plug to the lower uterine segment than when both legs are brought down.

Internal Version.—This operation differs from bipolar version only in the fact that the internal hand is introduced inside the uterus. It is indicated in cases where turning is desirable and the other methods are impossible. Transverse presentations are the most frequent indication.

The conditions necessary for its performance are—

(1) Membranes intact or recently ruptured. In regard to this point it should be remembered that where the membranes have been ruptured for some time and the uterus has contracted down upon the child, much harm may be done by attempts to turn. This

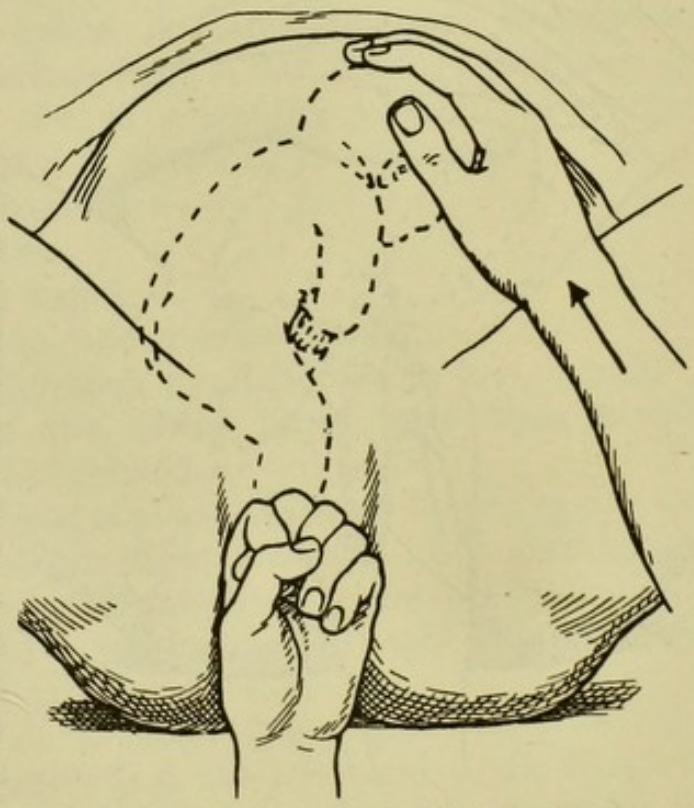


FIG. 224.—Bipolar podalic version. (After Munro Kerr.)

is one of the commonest ways in which rupture of the uterus is produced, and it often takes much judgment to determine whether or not to make the attempt. If the retraction ring can be definitely felt or seen, it is wiser to refrain and perform a decapitation. In every case the condition of the child should be ascertained first, as it is not justifiable to subject the mother to the risk unless the child is likely to be born alive.

(2) The abdominal and uterine walls must be relaxed. This is of paramount importance. An anæsthetic should always be given and full surgical anæsthesia produced. Failure in this respect may lead to reflex contractions of the uterus as soon as the hand is passed into the vagina, which not only hinder the operation, but may precipitate rupture of the uterus.

(3) The cervix must be dilated sufficiently to admit the entire hand.

(4) The position of the fœtus must have been exactly mapped out by palpation before the hand is introduced.

Operation.—The patient should be in the cross-bed position either on her back or on her left side. The vulva must be thoroughly cleansed, and the operator's hands prepared. Sterile rubber gloves should be worn.

The position of the child being exactly known, the first step is to pass the hand into the uterus and seize a foot. Many confusing rules have been given as to which hand to introduce and which foot to seize. In regard to the first point it is all a matter of convenience. A hand inside the uterus is apt to become very cramped during its manipulations, and it is important to use the hand that can be most easily passed in the required direction. That direction is over the ventral surface of the child, so as to seize a foot. Before starting the operation, therefore, it is well to form a mental picture of the position of the child as ascertained by careful palpation, and to determine (1) which hand will most easily pass over its ventral surface, and (2) which position of the mother will be most convenient for this purpose. The patient should be placed on her side or her back accordingly, and the chosen hand passed into the uterus in a cone shape. If the membranes are intact, it should be passed through them into the amniotic sac, the forearm preventing any great escape of the waters.

In practice that foot should be brought down which is most

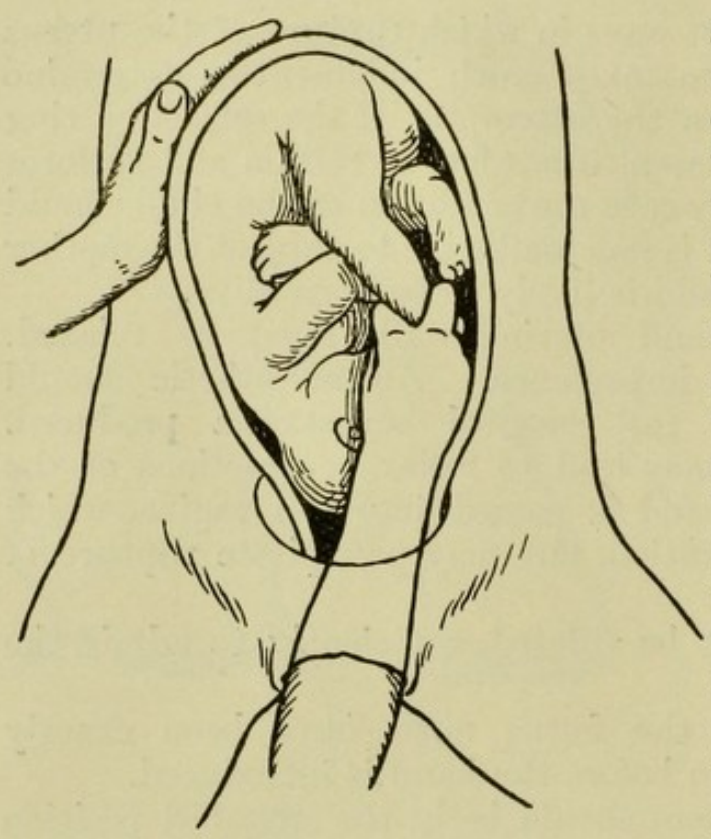


FIG. 225.—Internal version in vertex presentation.

accessible and most easily grasped. The only possible exception to this simple rule is that in dorso-posterior transverse cases it is better to try to get hold of the upper foot. The reason for this is that whichever leg is brought down rotates to the front. Thus, if the upper foot is brought down it rotates the child with its back to the mother's front, and so promotes the subsequent delivery; whereas, if the lower foot is brought down, the child descends as a face to pubes case.

If the knee is felt, it is generally easier to hook it down than to grasp and draw down a foot. Care must be taken to distinguish between a foot and a hand, or between a knee and an elbow. In the former case the heel should be definitely made out, or if in doubt, the hand passed up over the thigh to the pelvis. In the case of the knee recognition depends on the absence of the sharp olecranon, on its greater breadth compared with the elbow,

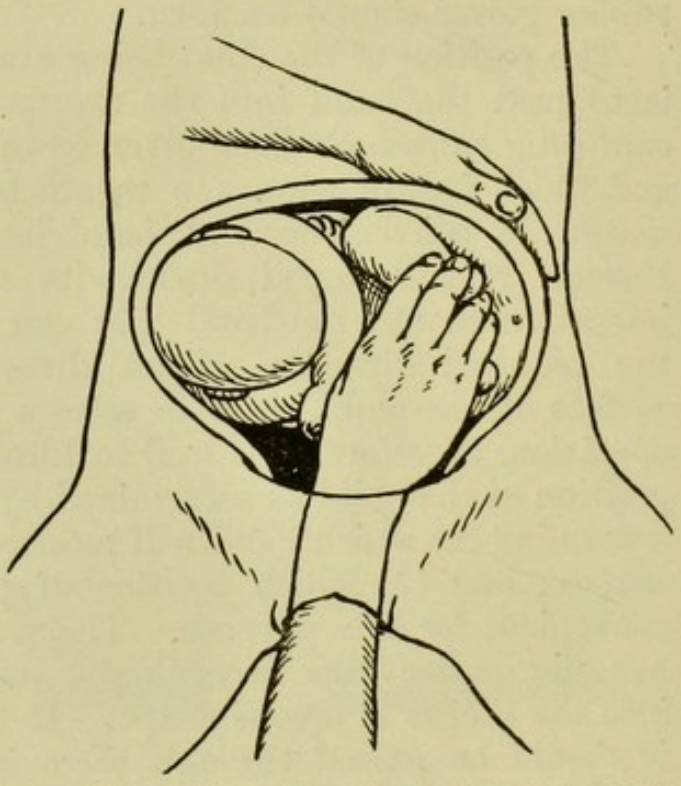


FIG. 226.—Internal version in dorso-posterior transverse case. Seizure of the upper foot.

and on the fact that it points towards the head, whereas the elbow points away from it.

The foot or knee should be brought down through the cervix, and, unless the canal is fully dilated and there is need for haste, it is better only to bring down the one foot. The half-breech dilates the passages for the aftercoming head better than when both legs are brought down. Before the operation is regarded as completed, the head must be pushed up into the fundus of the uterus. This can usually be done by the external hand, which all the time has been working in concert with the internal one, and steadying the uterus and the child.

Throughout the operation the greatest gentleness must be observed, otherwise the uterus may easily be ruptured. If a contraction comes on, the manipulations must be stopped instantly, and the hand laid flat over the body of the child until the uterus relaxes again.

If in a neglected transverse case the arm be prolapsed, a piece of sterile gauze should be tied round the wrist, and it should be allowed to pass back into the uterus as the body is turned and the head pushed up. The gauze merely enables one to prevent it from passing up alongside the head in the subsequent breech delivery—an accident which is particularly liable to happen since the fœtal attitude has already been interfered with artificially.

After the delivery is completed an antiseptic intra-uterine douche should be given.

CHAPTER XL

FORCEPS

Extraction of the head of the child by forceps is *the* obstetrical operation *par excellence*, and the evolution of the instrument and the operation forms a fascinating chapter in the history of obstetrics. Sharp-toothed forceps, for extraction of the head after death of the child, were in use before the twelfth century, but it was not until the end of the sixteenth or the very beginning of the seventeenth century that Peter Chamberlen, a London physician of Huguenot descent, invented a forceps for extracting the head of the living child. Owing to the invention being kept as a secret by the Chamberlen family it was not till a century later that the instrument became at all widely known, and entered on its career of modification, improvement, and increased usefulness.

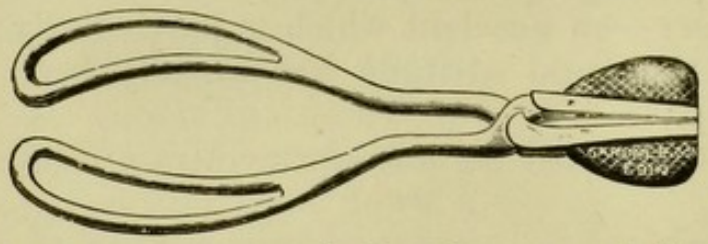


Fig. 227.—Simpson's short forceps—cephalic curve only.

Chamberlen's forceps consists of a pair of ovoid blades with shanks and handles crossing at what is called the "lock." The blades are fenestrated to prevent undue compression of the head, and they are so curved as to embrace the head between them. This curve is called the *cephalic curve.* Forceps possessing only the cephalic curve are known as *straight* forceps. They are also spoken of as *short* forceps, being applicable to the head only when it is low in the pelvis. This limitation is due to the fact that if applied to the head when it is high in the pelvis, they are either too short to grasp it, or if

they do grasp it, they do so too far back in the pelvis, with the result in an occipito-anterior case that traction tends to undo the flexion of the head, and so interfere with its normal mechanism (Fig. 228).

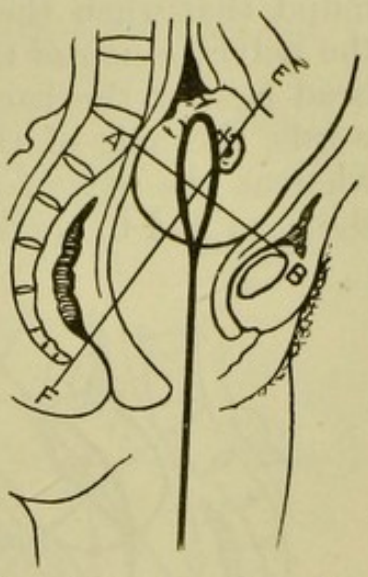


Fig. 228.—To show that straight forceps grasp a head at the brim too far back.

EF is the axis of the brim, X the centre of the head.

The first great step in the evolution of the forceps was made to overcome this difficulty, and it consisted in the application of a *pelvic curve* to the blades. This enabled the blades to grasp the head at its centre, even when the head was at the brim of the pelvis, and prevented subsequent traction from interfering with the natural mechanism. This step was made independently by the French obstetrician Levret, and by Smellie, the great Scottish obstetrician in London, about the middle of the eighteenth century. Smellie also lengthened the instrument by introducing the shanks between the blades and the handles, and to him is due the credit of inventing the "English" double slot lock. Forceps with both cephalic and pelvic curves are known as *long* or curved forceps. In regard to forceps, therefore, the terms *short* and *long* do not refer to the actual length of the instrument so much as to their possession of one or two curves respectively.

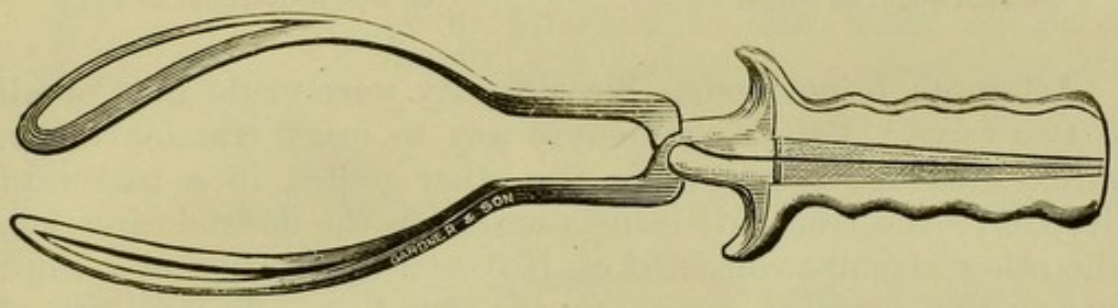


Fig. 229.—Simpson's long forceps—cephalic and pelvic curves.

The long forceps as improved by Sir James Simpson, Barnes, and others is still an admirable instrument, but as all its advantages, and many more, are possessed by the axis traction instrument, most obstetricians prefer to use the latter almost exclusively, and so become thoroughly familiar with the one instrument.

The application of axis traction to the long forceps formed the second great step in the evolution of the forceps. It was found that when the long forceps was used on a head high in the pelvis, much of the force exerted was wasted in pulling the head against the back of the symphysis (Fig. 230). In other words, the axis of the traction force was directly downwards, whereas the axis of the upper part of the pelvis, along which the head had to travel, was directed downwards and backwards.

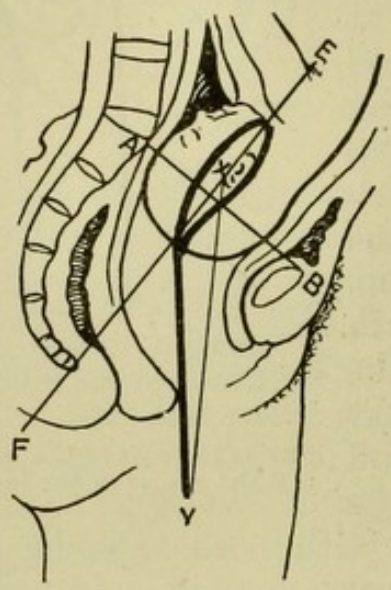


FIG. 230.—Advantage of pelvic curve.

XY is the direction of traction, EF the direction in which the head ought to travel.

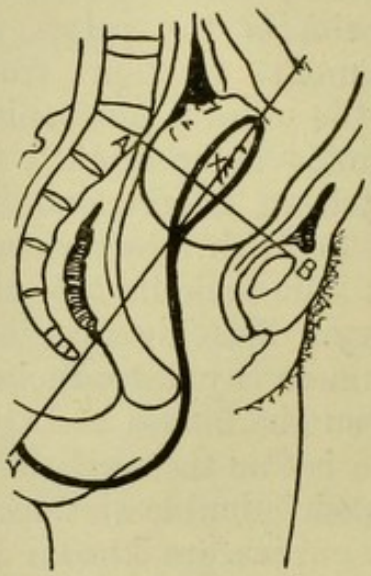


FIG. 231.—Advantage of perineal curve—axis traction.

XY now corresponds to EF.

Attempts to overcome this difficulty were made first of all in two ways. Pajot's manœuvre was to exert traction downwards with one hand, while the other pulled in a backward direction—the resultant being roughly in the desired direction. The other attempt consisted of Hubert's application of a third curve—the *perineal curve*—to the handles. The failure of these methods was due to the facts that there was nothing to indicate the proper direction in which to pull, and the operator had to make a guess at it; and, secondly, that the "axis traction" was applied too far away from the head, and did not act to the greatest mechanical advantage. Some obstetricians, however, still prefer to use a modified Pajot's manœuvre with hooks or tapes applied to the handles of a long forceps.

The problem of axis traction was solved by Tarnier, the great French obstetrician, who attached separate traction rods to the base of the blades, these rods having a perineal curve, and being freely movable. This principle was applied to Sir James Simpson's type of long forceps by Sir Alexander Simpson, and it is a still further improved model of that forceps by Milne Murray which will be described as being the best type of axis traction forceps.

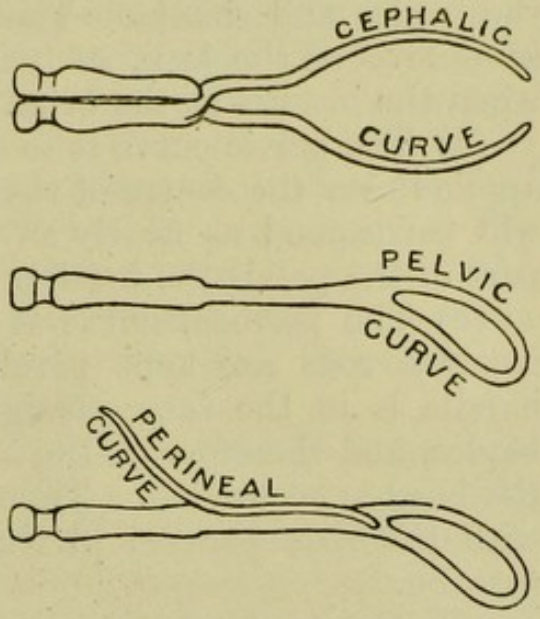


FIG. 232.—The curves of the forceps.

Milne Murray's Axis Traction Forceps.—Each half consists of a fenestrated blade with a movable traction rod attached at its base as near the fenestra as possible; a shank; a smooth application handle, dividing at the top into two and so forming the lock. The traction handle is separate and moves freely by a ball and socket joint. It fits on to studs on the ends of the traction rods by means of a flat traction plate with two slots in it. The application handles are retained in position by means of a fixation screw—the screw being attached to the lower or right handle, and fitting into a bracket on the upper or left handle by a butterfly nut. Lastly, there is a small fixation catch between the traction rods to give them strength and rigidity.

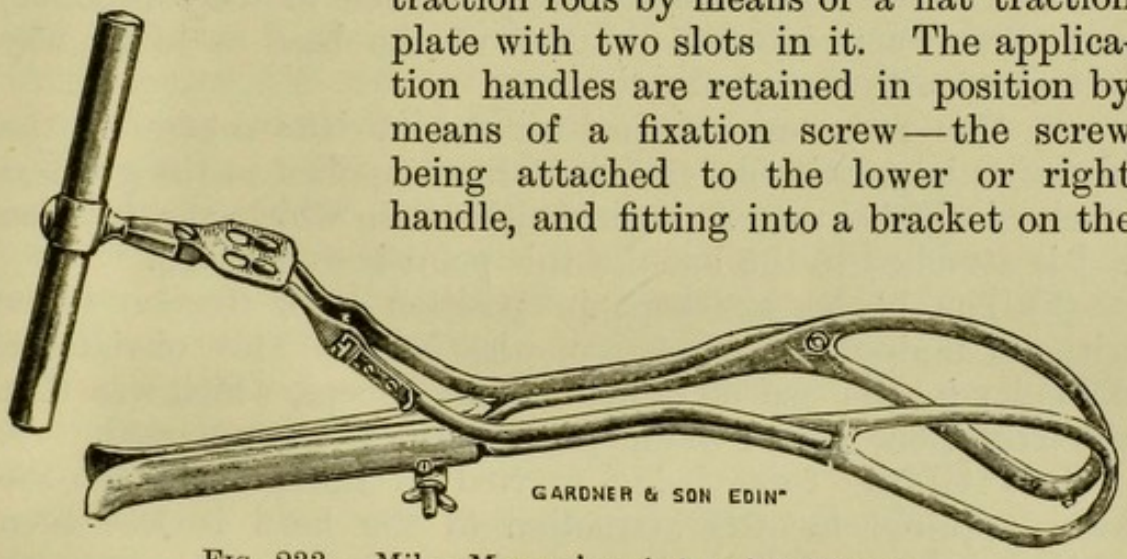


FIG. 233.—Milne Murray's axis traction forceps.

The advantages of the instrument are—

(1) It is made entirely of plated steel and can be sterilised by boiling.

(2) It is light, but rigid.

(3) The traction rods are curved so that they lie parallel to the blades and shanks. The perineal curve is placed at the same level as the lock, so that it lies outside the vulva even when the head is at the brim.

(4) The pelvic curve is so devised that, when the blades are applied over the centre of the head, the long axis of the blades will correspond as nearly as possible to the axis of whatever part of the pelvis the head is lying in.

(5) The perineal curve is so devised that, as long as the traction rods are kept parallel to the shanks, the traction handle is in the same straight line as the long axis of the blades, and therefore in the axis of whatever part of the pelvis the head is occupying. Traction applied to the traction handle with the rods parallel to the shanks will accordingly be *axis traction.*

(6) The traction rods are freely movable and able to follow the successive changes of direction of the pelvic axis as the head descends. The application handles always indicate the proper direction.

(7) The traction handle is freely movable in every direction, and the normal internal rotation of the head is in no way interfered with during traction.

(8) The rods are attached as close to the centre of the blades as is practicable, and the force is applied to the greatest mechanical advantage. In instruments in which the traction rod is attached to the handles this point is overlooked.

(9) The blades are kept in position by a fixation screw without undue compression of the head. This obviates a difficulty in the use of ordinary long forceps, which was that the harder one pulled the more the head was compressed.

(10) All the force being exerted in the proper axis, the force required for the extraction of the head is less than without axis traction.

Modes of Action of the Forceps.—The forceps is capable of acting in the following ways :—

(1) Traction.
(2) Compression of the head.
(3) Rotation of the head.

(4) Lever action.
(5) Dilatation of the passages.
(6) Stimulation of uterine contractions.

Traction is by far the most important of these, as well as the most legitimate method of using the instrument.

Compression of the head should not be carried farther than just enough to give a good grip of the head. Even this amount of compression will only be intermittent, because in the proper use of forceps the application screw is loosened at frequent intervals. The compression is more apt to be dangerous to the child when an antero-posterior grasp of the head is obtained. The risk of compression, and its serious consequences to the child—asphyxia, cerebral hæmorrhage, death—should always be borne in mind.

Rotation of the head by means of forceps is sometimes practised in occipito-posterior positions. It is not advisable, being liable to damage both the head and the maternal soft parts.

Lever action.—A very gentle lateral to-and-fro motion may sometimes be given to the instrument, and may prove useful where the head seems to have become jammed. Any backward and forward "pendulum" motion is to be avoided.

Dilatation of the passages is no doubt effected to a certain extent by the curve of the shanks and blades in advance of the head, but this is not a point to be aimed at. In almost all circumstances the forceps should not be applied until the cervix at any rate is fully dilated.

Stimulation.—It is a very frequent experience, when forceps are being applied in a case where the uterine contractions are few and feeble, that the mere introduction of the instrument reflexly stimulates the uterus to renewed activity. This is sometimes called the "dynamic action" of the forceps.

The Operation.—*Varieties.*—Application of forceps to the head after its greatest transverse diameter has passed through the plane of the brim is spoken of as the *low* operation. The farther down the head has passed the easier becomes the operation.

On the other hand, the application of forceps to a head with its greatest diameter above the brim is spoken of as the *high* operation, and is a much more serious undertaking both for the child and the mother. The difficulties and dangers are, of course, directly increased by any diminution in the size of the

pelvis. As indicated in the discussion of treatment of contracted pelves, a high forceps operation in these circumstances should be regarded as a serious undertaking involving great risk to the child, and not a little to the mother also.

Indications.—Broadly speaking, forceps are indicated when there is undue delay in the second stage, or where there is reason to shorten it for the sake of the mother or the child. The individual indications may be arranged in five groups, as follows :—

(1) Faults in the powers.
(2) Faults in the passages.
(3) Faults in the child.
(4) Dangers threatening the mother.
(5) Dangers threatening the child.

Faults in the Powers.—When there is a certain amount of uterine inertia and an absence of any other cause of delay, the second stage should not be allowed to go on more than about four hours in a primipara, two hours in a multipara. Forceps may then be applied and the child extracted *slowly*. Theoretically this is not a good indication for forceps, but more harm may be done by delaying until actual signs of exhaustion of the mother or interference with the fœtal circulation show themselves than by the proper and judicious use of forceps. The forceps in such cases is used to aid the uterus by supplying a *vis a fronte*, and not in any sense to take the place of the uterine *vis a tergo*. In the absence of uterine contractions—complete secondary inertia—delivery by forceps is strongly contra-indicated on account of the risk of serious hæmorrhage.

Faults in the Passages.—*Cervix.*—Under no circumstances should forceps be applied until the cervix is fully dilated. If the necessity of rapidly terminating the labour occurs before this, the cervix should be rapidly dilated to the full extent by the fingers. Extraction by forceps through a cervix that is incompletely dilated is very apt to lead to serious lacerations of the cervix.

Perineum.—Rigidity of the perineum, such as may be found in elderly primiparæ or in very muscular women, can usually be overcome by the administration of an anæsthetic. If this fails to cause relaxation, forceps may be used. Great care should be taken, as extensive tearing is frequent in these cases.

Contracted Pelvis.—This is at the best only a very qualified

indication for forceps. The slight degrees of contraction do not call for such interference, and the extreme degrees are definite contra-indications to any attempt at extraction. In the moderate degrees there is a field for the use of forceps, but it is a field whose limitations require to be very thoroughly understood if much unnecessary suffering and disappointment are to be avoided.

A conjugate of $3\frac{1}{4}$ inches is about the lowest absolute limit in which forceps can be justified. But since the all-important point is not the actual measurement of the conjugate, but the relative sizes of the head and the pelvis, it is obvious that the exact limit of what is justifiable will vary in each case. Indeed with a full-sized head the limit of successful forceps delivery may be nearer $3\frac{1}{2}$ inches.

In all cases the head should be given the maximum time to mould, the patient being in the Walcher position; that is to say, interference should not be begun until there are some early indications of exhaustion of the mother or circulatory troubles in the fœtus. If after such a time of probation the greatest transverse diameter of the head is still above the brim, forceps is not likely to be successful. Further, if two or three tentative pulls with moderate force fail to advance the head, attempts to deliver in that way should be desisted from. The sequel in hospitals or nursing homes may be pubiotomy, but in private practice the only alternative is, unfortunately, only too often, craniotomy. On the other hand to persist with forceps in such circumstances will probably result in the extraction of a dead child, and in grave damage to the maternal passages.

Faults in the Child.—Forceps may be indicated where the head is unduly large or ossified—except in hydrocephalus. Malpositions such as occipito-posteriors, and malpresentations such as face cases, may require forceps. The aftercoming head may also be delivered by this means in cases of difficulty.

Dangers to the Mother.—This group includes all cases where rapid delivery is necessary for the sake of the mother—accidental hæmorrhage, placenta prævia, eclampsia, serious heart disease, advanced phthisis, and where there are signs of impending tonic contraction or rupture of the uterus in obstructed labours.

Dangers to the Child.—Prolapse of the cord may call for

forceps delivery. So also may the signs of embarrassment of the fœtal circulation, namely, heart beat below 120 or above 160, tumultuous movements, and the presence of much meconium in the liquor amnii in head presentations.

The formation of a large caput succedaneum indicates that the head is being subjected to prolonged and serious pressure, and may therefore be an indication.

Essential Conditions for the Safe Application of Forceps.

(1) The cervix must be fully dilated.
(2) The head should at least be engaged with its largest circumference in the brim.
(3) The head must be in a suitable position. Marked Naegele's obliquity or Litzmann's obliquity, or a mento-posterior position of the face, are not good cases for forceps.
(4) The membranes must be ruptured.
(5) The bladder should be emptied.

Application of Forceps.—In this country the forceps is almost invariably applied laterally in relation to the pelvis, the one blade in the one side of the pelvis, and the other in the other, irrespective of the grasp obtained on the head. The best grasp of the head is obtained when the blades are situated laterally to it, but the safety of the mother is best considered by applying them strictly in the sides of the pelvis.

In hospital the dorsal position of the patient is the most convenient, but in private practice, where there is not much assistance to be had, the left lateral position is the one usually adopted. An anæsthetic is very desirable, although not an absolute necessity in the low operation. The most careful asepsis and antisepsis are necessary in all cases. The forceps should be boiled, and then placed in a ewer full of warm water with 1 per cent lysol. The hands should be prepared for operation, and it is advisable to wear gloves if possible. The vulva must be most thoroughly cleaned after the patient is anæsthetised.

Where there is only a nurse to give assistance, it is best to prepare the forceps and the patient's genitals as far as possible, then anæsthetise her fully, and place her in charge of the nurse. Sterilised gloves should then be put on, the cleansing of the genitals completed, and the forceps applied. If more chloroform is required during the extraction, the nurse may

give it under the supervision of the accoucheur. When the patient's means permit, a medical colleague should be called in to give the anæsthetic.

The patient should lie on her left side with the buttocks over the edge of the bed and the thighs flexed. The most useful place for the nurse is on the bed in front of the patient, where she can both attend to the anæsthetic and at the same time hold up the right thigh. The nurse may also, if preferred, stand at the patient's back, but this leaves little room for the operator.

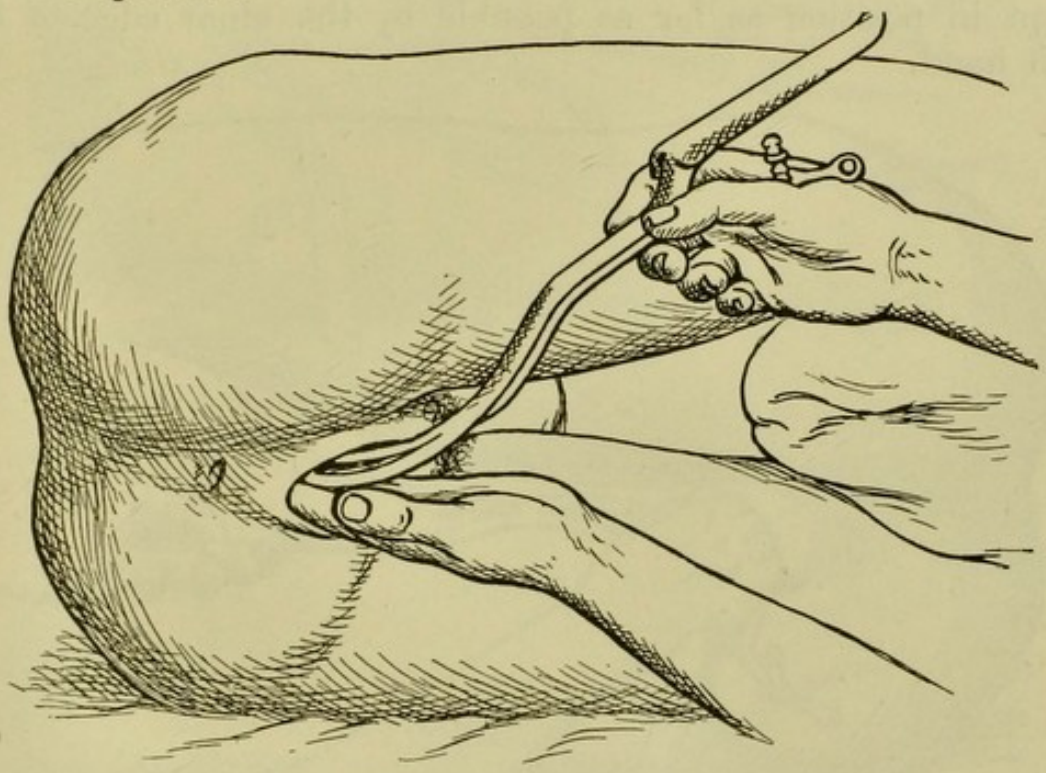


FIG. 234.—Introduction of left (lower) blade.

Introduction of the Left Blade.—To determine which is the left blade, lock the forceps and hold them in the position which they would occupy if they were in the pelvis of the patient as she lies on her left side. The left blade is then the lower, but its handle is, of course, the uppermost. The left or lower blade is introduced first because in it the shank lies behind the lock, so that the other blade can be passed in front of it, and the two then locked.

The left blade is held lightly between the fingers and thumb of the right hand, the traction rod being kept close to the shank. The left hand is then passed into the vagina, and,

the exact position of the head having been determined, is placed, palm upward, in contact with the head. The blade is then introduced along the palmar surface of the fingers, the point being kept all the time in contact with the head. The fingers of the left hand guide it carefully inside the rim of the os externum, if the head is not too low for it to be felt. The handle is then depressed, and swept gently back to the perineum, the blade in this way being carried over the side of the child's head. If the handle can be held in this position by an assistant, so much the better; but if not, it must be kept in position as far as possible by the ulnar edge of the left hand.

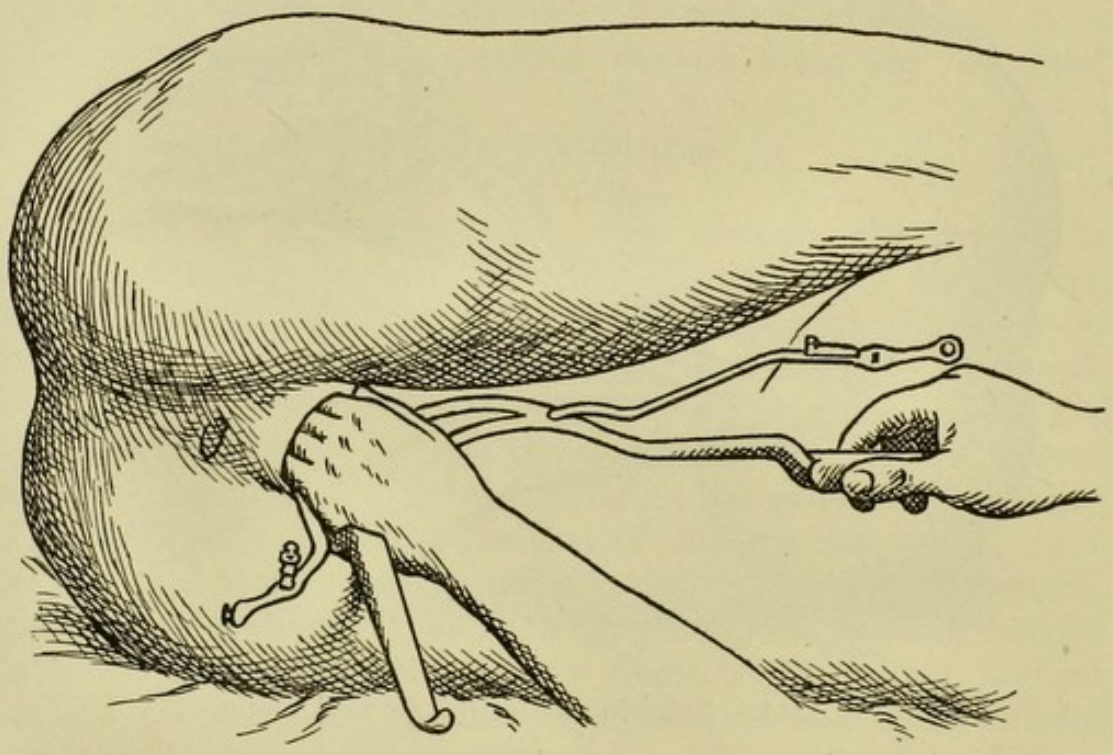


FIG. 235.—Introduction of right blade.

Introduction of the Right Blade.—The fingers of the left hand (or the whole hand if there is an assistant to hold the left blade) are now passed over the right vaginal wall and lie in contact with the head as before. The right blade is held in the right hand just as before, except that the traction rod is swung forward so that it lies on the back of the hand. This is a small but important point, and its omission leads to much confusion. The blade is then passed along the palmar surface of the fingers as before. It is, however, directed in

the first place into the hollow of the sacrum, which brings the

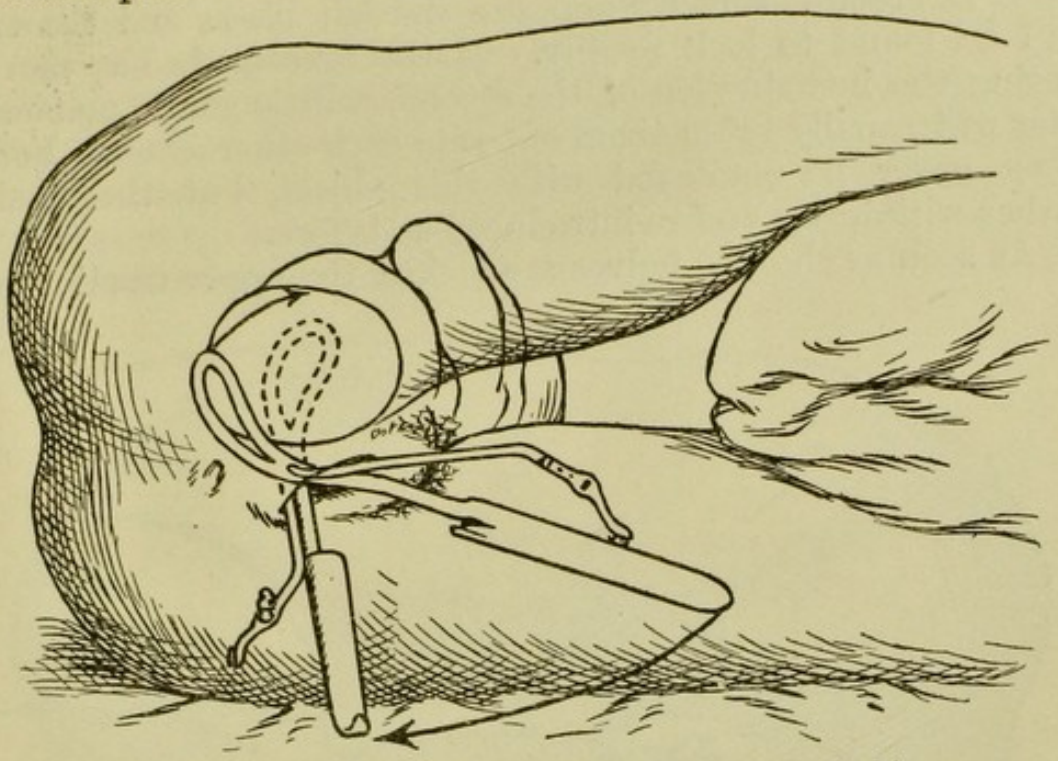


FIG. 236.—Right blade swung into position for locking.

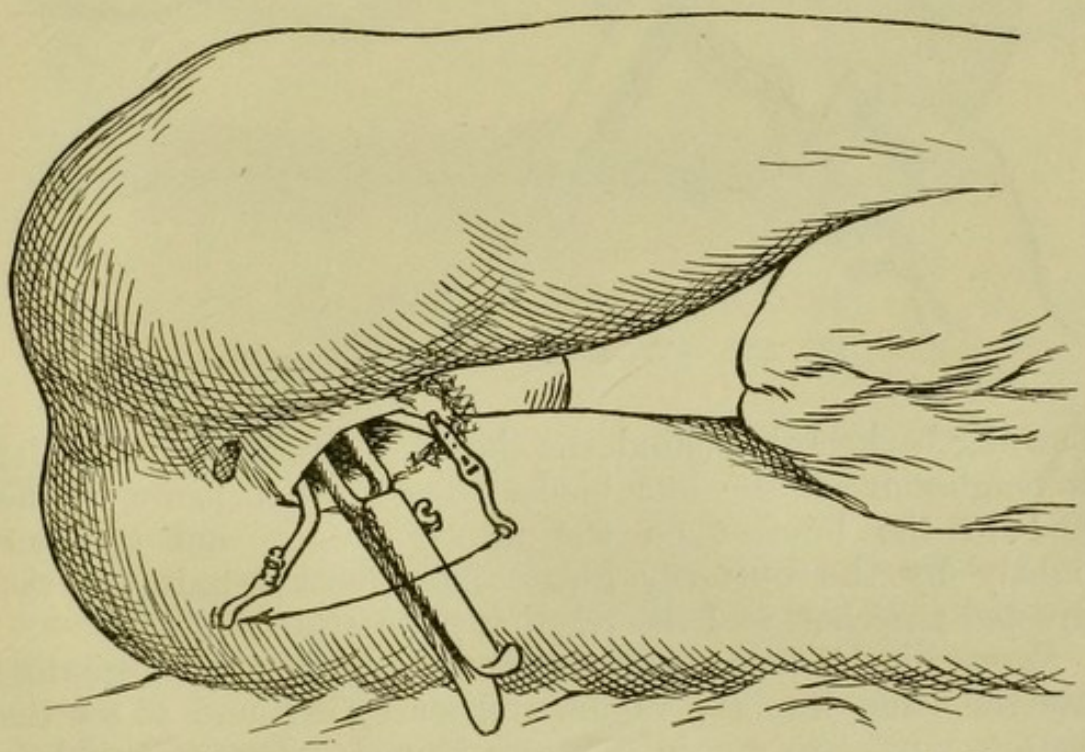


FIG. 237.—Handles locked. Upper traction rod swung back.

blade over the child's face. Then the handle is swept downwards and backwards while the fingers in the vagina guide the

blade over the side of the head. In this way the second blade is brought directly opposite the left blade, and the two will be found to lock readily. If the first blade has moved during the introduction of the second, a little gentle manœuvring will usually bring them opposite each other again. Force must never be employed with this object, but the blades rather withdrawn and re-introduced as before.

As soon as the two halves are locked the upper traction rod

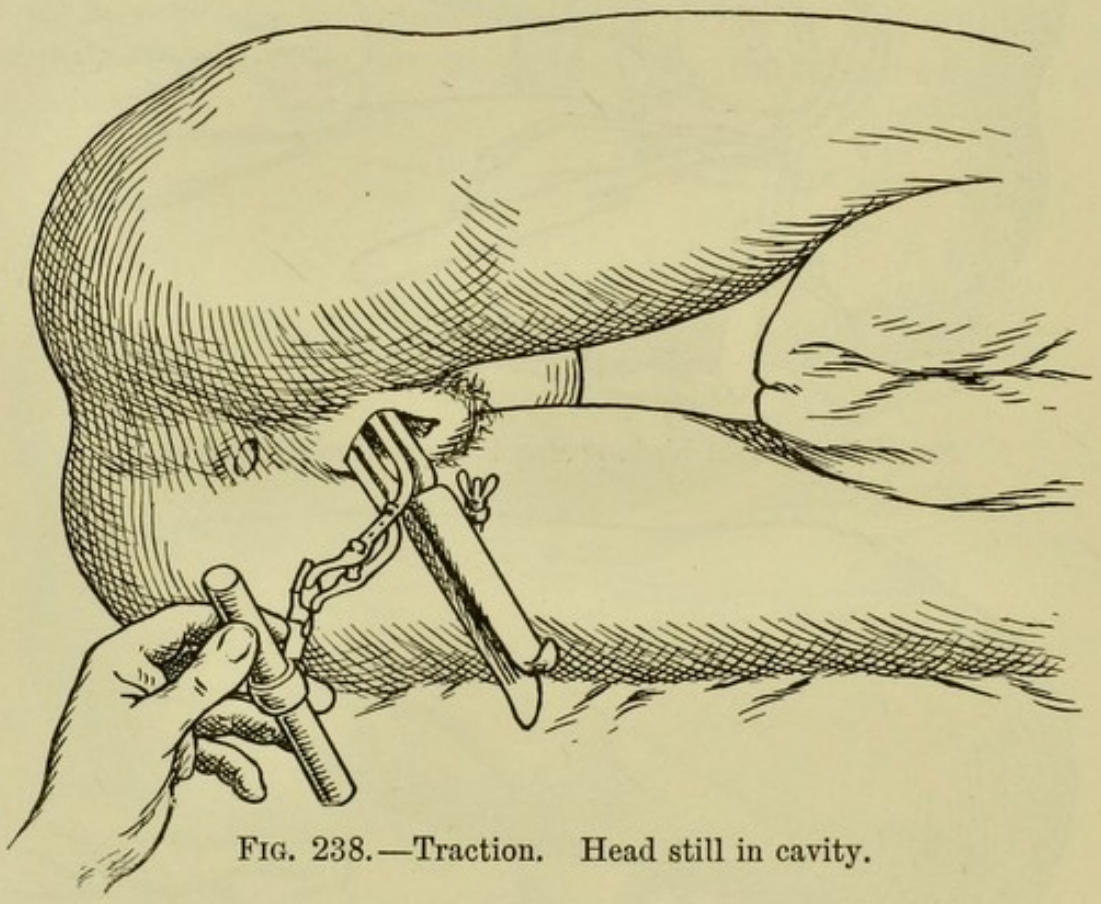


FIG. 238.—Traction. Head still in cavity.

is swung backwards behind the shank, where it lies parallel to its neighbour on the left blade. The fixation screw is then fixed in the bracket on the upper handle, and tightened slightly by the butterfly nut. The traction rods are then adjusted together, and the traction plate attached.

Everything is now ready for traction, but, before beginning, pass the hand into the vagina and sweep it round to see that the soft parts are not in any way nipped between the blades and the traction rods. A tentative pull may now be given to see that the head is firmly grasped, and the fixation screw adjusted if necessary.

Traction.—Four points must be attended to in regard to traction.

(1) The amount of force used should be as little as possible, and never more than can be exerted by the forearm alone. The weight of the body, or even the force of two arms, should not be used, as it may seriously damage the soft parts. If it is necessary, the obstruction must be so great that probably forceps is not the correct treatment.

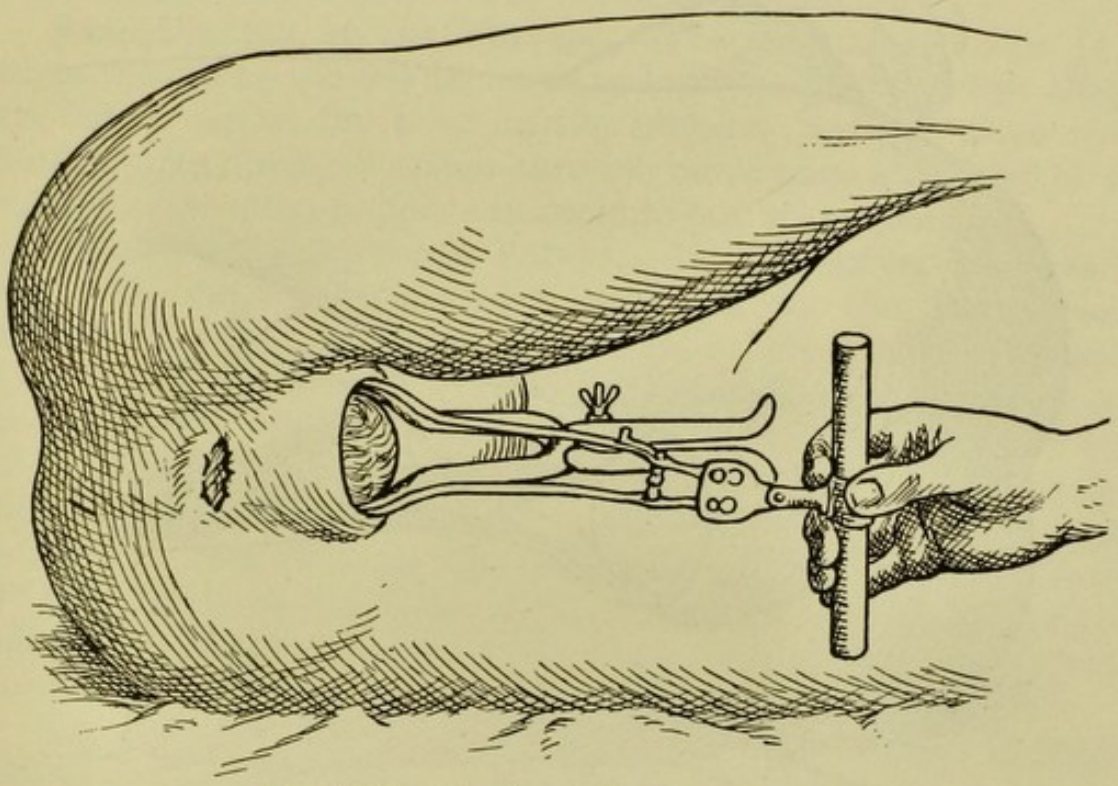


FIG. 239.—Traction. Head at outlet.
Note direction of traction.

(2) The direction of traction must be carefully watched. The traction rods should be kept all the time close to and parallel to the shanks; but they should not actually touch them, for if they do, they may press the application handles too far forward and so spoil the whole principle of axis traction, besides interfering with the mechanism of the head.

As the head descends the direction of the application handles passes more and more forwards, and this movement must be carefully followed by the traction rods. Towards the end the application handles are directed forwards and even upwards over the mother's abdomen. In these cases traction

may often be carried out most readily by passing the left hand over the patient's right thigh and grasping the traction handle from in front.

(3) Traction must only be exerted during the pains, or, if the pains are few and far between, at intervals and during periods that would correspond to natural pains.

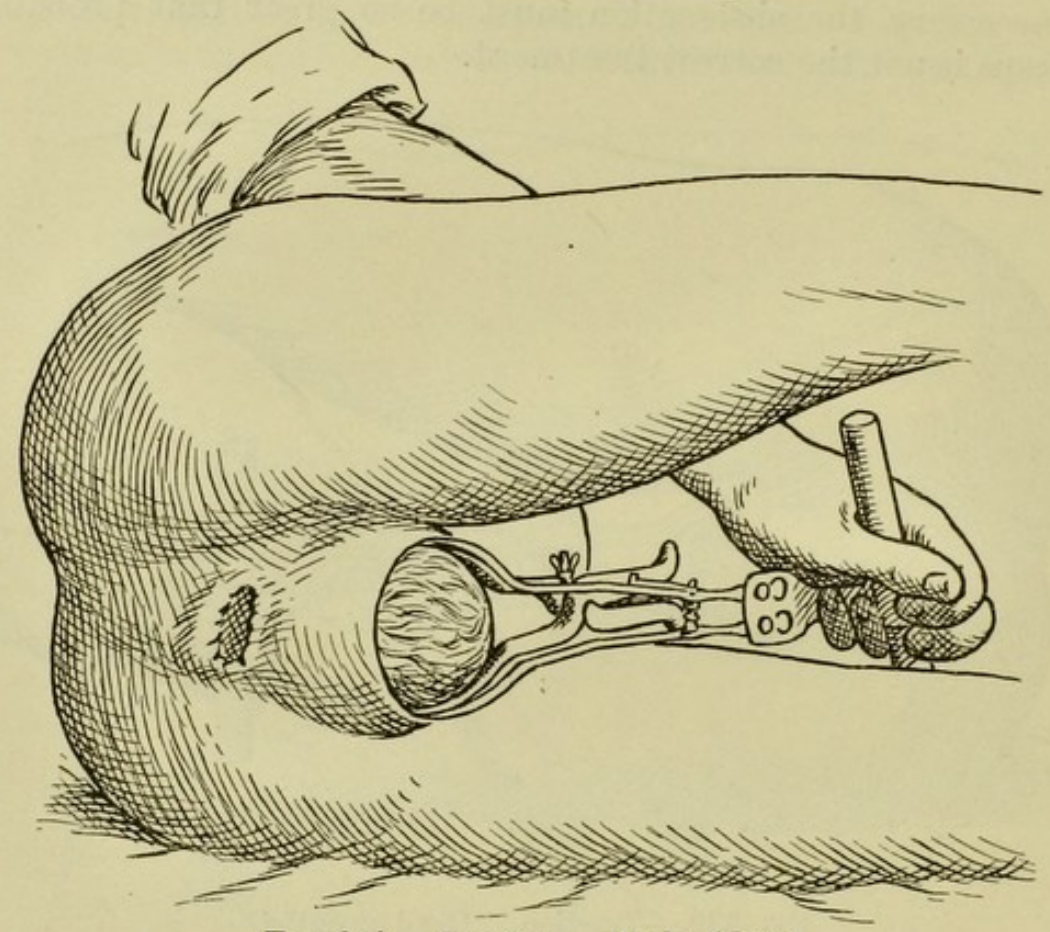


FIG. 240.—Traction. Birth of head.
Note direction of traction.

(4) During the intervals of traction the fixation screw should be loosened, so that the compression of the head may be relieved.

Extraction.—As the head passes over the perineum there is always a temptation to seize the application handles and deliver with them. It is better, however, to continue to guide the head by the traction handle only, as the seizure of the application handles almost inevitably extends the head, and so causes greater liability to tear of the perineum. Extension of the right thigh at this stage may relax the perineum somewhat.

As soon as the head is born remove the instrument. To do

this detach the traction handle and loosen the catch of the traction rods. Then unscrew the fixation screw, and unlock the blades, when they may be withdrawn.

Application of Forceps in the Dorsal Position.—This is exactly the same in principle, but the right hand will be found more convenient to pass into the vagina for the introduction of the left blade which is held by the left hand. The left hand is then used to guide the right blade which is held by the right hand and passed in front of the left blade.

Reapplication of the Forceps.—This should be done (1) when the blades cannot be made to lock easily; (2) when they are felt to slip on the head during traction; and (3) when the head rotates during traction through more than a quarter of a circle. This often happens in occipito-posterior cases.

Forceps in Contracted Pelves.—In *flat* pelves the head lies with its antero-posterior diameters in the transverse, and the forceps accordingly takes an antero-posterior grasp. The handles remain considerably separated after application, and there is much greater risk of dangerous compression of the head being exerted. Traction should be made with the patient in Walcher's position, the operator sitting, if need be, on the floor between the patient's feet. In a *justo-minor* pelvis Walcher's position is of no great advantage as its effects are confined to the brim while the pelvis is contracted throughout.

The Relative Advantages of Forceps and Version in Flat Pelvis.—The advantages of **version** in such cases are:—

(1) The head is brought down with its narrow base first, and it is supposed that compression causes elongation in its vertical diameters. But supra-pubic pressure, which will certainly have to be exerted, tends to prevent expansion in this direction.

(2) The head is brought down with its narrow bitemporal diameter in the conjugate. This, however, also occurs when the head is extracted with forceps if engagement has occurred before the instrument is applied.

The disadvantages are:—

(1) The whole hand must be introduced into the uterus.

(2) Version can only be done before or shortly after the rupture of the membranes.

(3) The child is exposed to the risks of head-last delivery.

(4) The head has to be extracted with a certain amount of rapidity, and does not get time to mould to any extent.

The advantages of **forceps** are :—

(1) The instrument can be applied at any stage after dilatation of the cervix.
(2) The whole hand need not be introduced into the uterus.
(3) The advantages of accurate axis traction may be obtained.
(4) Vertical elongation of the head occurs during compression at least as well as after version.
(5) The advantages of full moulding of the head can be obtained.

Forceps in Occipito-posterior Positions. — As the head rotates the forceps must be taken off and reapplied, pressure being meantime exerted on the fundus to prevent the head slipping back. This reapplication may have to be repeated once or twice during the long rotation.

In this country attempts to rotate the head with the forceps are not regarded with favour.

Forceps in Face Cases.—The blades must be applied strictly at the sides of the head. Care must be taken not to injure the eyes.

Risks of Forceps.—Injuries to the soft passages may be caused by carelessness in the application of the blades, or by too rapid extraction.

Hæmorrhage of a very serious nature may be caused by too rapid extraction in cases of inertia. The extraction should be gradual so that the uterus may have time to retract behind the descending child.

Injuries to the child—fractures of the skull, injuries to the eye, facial paralysis, asphyxia from compression of the head too long maintained, may all occur through want of care, or in specially severe cases.

There should be no serious risk to the mother in the aseptic use of forceps in a suitable case. But in this connection it should be remembered that when forceps extraction is practised in contracted pelves the maternal morbidity and the fœtal mortality rates both rapidly rise as the conjugate diminishes. This is true of hospitals where asepsis can be carried out rigidly, and therefore it is probably much more true of private practice.

CHAPTER XLI

CÆSAREAN SECTION

By this is meant delivery by section of the abdomen and uterus. The term is believed to originate in an almost certainly inaccurate tradition that Julius Cæsar was born in this way. The operation would seem to have been performed upon newly dead undelivered women from very early times, and from about the sixteenth century it was occasionally done upon the living woman. It was not, however, until Porro in 1876 introduced his method of amputating the uterus, that the results justified recourse to the operation in any but the most desperate circumstances. Porro's technique has since been almost entirely superseded by the conservative operation, in which the uterus is preserved; and the improvement in aseptic technique in recent years has rendered the operation remarkably safe when performed under good conditions.

Indications. — *Absolute* indications for Cæsarean section exist when delivery *per vias naturales* is impossible. Such conditions are extreme contraction of the pelvis—*e.g.* a conjugate of $2\frac{1}{2}$ inches (6·25 cm.) or less—and cases where the birth canal is blocked by large tumours.

Relative indications are more frequent and more important, and at the same time more difficult to describe briefly. Speaking generally, they are conditions in which the operation is calculated to be safer for the mother or the child, or both, than delivery *per vias naturales*, or where very rapid delivery is necessary and the cervix is still undilated. Such conditions include the following :—

1. Moderate contractions of the pelvis. The place of the operation has already been discussed in connection with the treatment of contracted pelvis.
2. Malacosteon pelvis. Here the operation is accompanied by the removal of the ovaries, partly to sterilise the patient, partly in the hope of arresting the disease.
3. Fibroid tumours of the uterus.
4. Cancer of the cervix.
5. Eclampsia.
6. Ante-partum hæmorrhage.
7. Rupture of the uterus.
8. In a moribund woman at term with a living fœtus, but the cervix undilated.

In any of the above circumstances the indication is never more than relative because other methods of delivery are at least possible.

Contra-indications.

1. Where the child is dead or in such danger that it is unlikely to survive.
2. When the maternal passages are believed to be infected, usually as a result of much handling.
3. The operation is not one to be attempted in bad surroundings or without proper assistance.

Operation.—*Time to choose for operating.*—When the patient is known during pregnancy to have some condition which makes the operation imperative or desirable, it should be arranged, if possible, to perform it on the day on which labour is due. At the same time preparations should be made some time in advance in case the patient should go into labour a few days before this. When the patient is in a hospital and under close observation, it is probably still better to wait until the very outset of labour. This policy ensures a patent cervix.

The preparations should be in every particular the same as for any abdominal section, with the addition of an antiseptic vaginal douche the night before operation.

An anæsthetist and two assistants are required, as well as a competent nurse to take entire charge of the infant from the moment of its birth. One assistant assists the operator, while the other attends to the instruments and swabs or sponges.

Instruments required are :—Scalpel, a dozen or more long

artery forceps, two pairs of dissecting forceps, one pair of long blunt-pointed scissors, half a dozen large and several smaller curved needles, a needle holder, strong chromicised catgut calculated to last for three weeks, silkworm gut, and some horse hair or fine catgut.

The abdominal incision is made in the middle line, beginning 3 to 4 inches (7·5-10 cm.) above the umbilicus and extending downwards for about 7 inches (17·5 cm.). The incision is placed high to avoid the bladder, which may be higher than usual. The uterus at once presents in the wound. If there is any possibility of the uterus being infected, it should be turned out of the abdomen, and the abdominal walls brought together below it by forceps. If there is no such fear, it is preferable not to turn the uterus out of the abdomen until after the delivery of the child. In such circumstances the abdominal cavity should be well packed off with large swabs to prevent the liquor amnii from getting into the peritoneal cavity.

The uterus is opened by a longitudinal incision in the middle line of the anterior wall, about 6 inches (15 cm.) long, which should be completed in its full length before the membranes are opened. If the placenta is attached to the anterior wall, the incision may be carried through it, or else it must be detached and moved aside by the hand. The membranes are opened by a touch of the knife, and the hand plunged in. The fœtus should be grasped by a foot or leg, and extracted as quickly as possible, for the uterus at once contracts after the membranes are ruptured, and may render the extraction difficult. As soon as the child is extracted, the cord is at once clamped in two places and cut between them, and the infant handed over to the nurse or assistant waiting for it.

If the bleeding meanwhile is very free, the assistant should grasp the broad ligament on each side of the cervix, and so control the uterine vessels.

The hand is now passed into the uterus again, and the placenta and membranes peeled off. The forefinger should then be passed through the cervix to see that it is patent and will permit free drainage of the lochia. At this stage or a little earlier it is desirable to have a dose of ergotin or pituitary extract injected hypodermically into the shoulder or buttock by a nurse.

If the uterus has not already been brought out of the abdominal cavity, it should now be brought out and the wound sutured. Strong catgut is used for this purpose, and deep interrupted sutures put in about half an inch (1 cm.) apart. These sutures should pass through the whole thickness of the uterus except the decidua. Superficial sutures are then inserted at suitable intervals to secure accurate coaptation of the peritoneum. Some operators finally cover over these stitches by a continuous suture which picks up the peritoneum on both sides of the incision—like a Lembert suture.

The swabs are now removed from the abdomen, the peritoneum dried, and the abdominal wall closed layer by layer, additional supporting sutures of silkworm gut being passed through the skin, fascia, and muscle.

Question of Sterilising the Patient.—When the patient desires it, she may be prevented from having any more children by resection of portions of the Fallopian tubes. This may be done after the uterus has been sutured. Mere ligature of the tubes is not sufficient, but a portion—usually at the cornu of the uterus—should be removed on each side by a small wedge-shaped incision. The incision is then stitched up, and the distal end of the cut tube securely ligatured.

After-treatment.—The dressing of the wound and the after-treatment do not differ from those of any abdominal section, except for the addition of the ordinary puerperal conditions.

Suprasymphysary, or Extra-peritoneal Cæsarean Section.—Among the risks of the operation just described are (1) septic infection of the peritoneum, (2) hæmorrhage owing to the extreme vascularity of the uterus, and (3) subsequent weakening of the uterus. This weakening is due to the fact that the uterus after the operation is constantly the seat of waves of contraction which deprive the wound of the immobility which is so favourable to sound healing. It was recognised that if the lower segment of the uterus were opened, it would not be subject to this disadvantage, because it is quite passive after labour. It is also in ordinary circumstances less vascular. Recently, therefore, the extra-peritoneal route was devised by Frank in order to reach the lower uterine segment.

The operation is one suited for cases which have been some time in labour and in which the lower segment is well

developed. It is also claimed that it may be performed with greater impunity in cases which are suspected of infection, owing to the peritoneal cavity not being opened. Whether or not these claims are justified remains to be seen.

A curved incision is made from one anterior superior spine to the other, passing about 1 inch (2·5 cm.) above the pubes. The recti are separated and the peritoneum exposed. In the true *extra-peritoneal* operation, the peritoneum is then separated off from the back of the pubes and the side of the bladder until the lower uterine segment is reached. Many operators, however, prefer the *trans-peritoneal* method. In this the peritoneum is opened by a transverse incision. The visceral peritoneum between the bladder and the uterus is then picked up and a similar transverse incision made in it. The upper edges of the two peritoneal incisions are then stitched together, forming a diaphragm that shuts off the abdominal cavity. The lower uterine segment is then exposed and incised longitudinally. The child is extracted by grasping the head by one hand and the blade of a pair of forceps below it, or by the leg if the breech presents. The placenta is then removed manually and the uterus packed with gauze, the end of which is passed through the cervix. The uterus is then stitched up by interrupted catgut sutures, the peritoneum replaced and sutured, and the abdomen closed.

Prognosis.—The results of ordinary conservative Cæsarean section, when done for correct indications and in good surroundings, are very good. The maternal mortality taken all over varies from 2 to about 8 per cent, according to the suitability of the case and the skill of the operator. There is no doubt that the longer the patient has been in labour before the operation is done the less favourable the outlook becomes, and the mortality in cases done after the rupture of the membranes is much higher than in those done during the first stage.

CHAPTER XLII

OPERATIONS FOR ENLARGING THE PELVIS

Symphyseotomy—Pubiotomy

The object of these operations is to enlarge the pelvic capacity during labour by dividing the cartilage or the bone of the pelvic girdle. This division is followed by a separation of the cut ends because the weight of the limbs rotates the innominate bones outwards and downwards.

The result of the movement is to give an immediate increase in all the dimensions of the pelvis. The movement is limited by the ligaments in front of the sacro-iliac joints, and in order to avoid damaging them the cut ends should not be allowed to separate more than 6 cm. ($2\frac{2}{5}$ in.). It has been reckoned that this gives an increase of 1 cm. ($\frac{2}{5}$ in.) in the conjugate of the brim, 1·5 cm. ($\frac{3}{5}$ in.) in the obliques, and 2 cm. ($\frac{4}{5}$ in.) in the transverse diameter. The actual area of the plane of the brim is increased by about one half. The gap between the cut ends of the pubes is also to be considered, as the parietal boss may bulge into it in its descent.

Indications.—Moderate contractions of the pelvis either at the inlet or the outlet. Persistent mento-posterior cases.

Conditions necessary for the Operations.—1. The child must be alive. A premature, a moribund, or a dead child is a direct contra-indication to the operation.

2. The disproportion between the head and the pelvis must not be too great. The operations should only be performed in cases where tentative traction by means of forceps with the patient in the Walcher position just fails, and where, therefore, only a small amount of additional space is required. Such

cases will be found amongst flat pelves with a C.V. of $3\frac{1}{2}$ to 3 inches (8·75 to 7·5 cm.) and in pelves with moderate contraction of the outlet. The operation is contra-indicated in a Naegele pelvis owing to the ankylosis of the sacro-iliac joint.

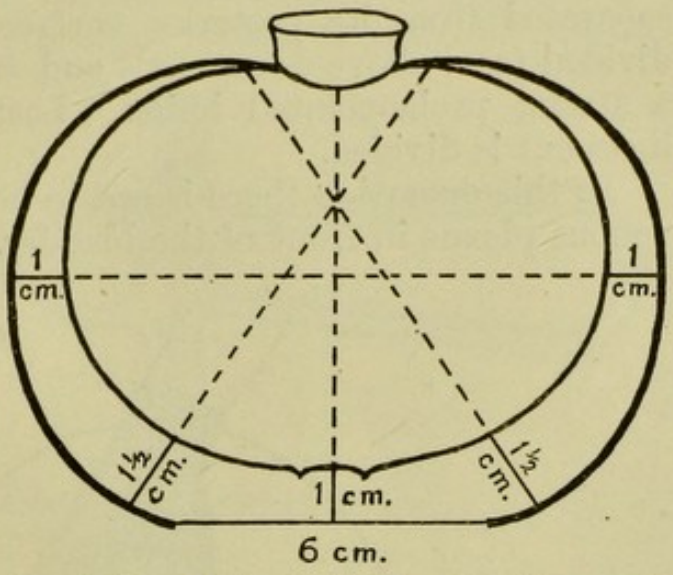


FIG. 241.—To illustrate the gain of space at the brim by division of the pubes.

3. The soft passages must be well dilated or readily dilatable. The operation is followed by the extraction of the child, and therefore it should not be performed unless the cervix is fully open, and unless the vaginal canal and vulva are large enough to allow rapid extraction. Accordingly, most operators avoid the operation in primiparæ, as in them it is apt to result in extensive tearing of the vagina, bladder, and urethra during the extraction. If the operation is done in a primipara, the vagina and vulva should be dilated manually beforehand, or enlarged by a postero-lateral incision.

4. The canal must not be infected. These operations are performed solely in the interests of the child, and all risks to the mother must be considered fully in the light of this fact.

Preliminaries.—The operations must be carried out with strict aseptic and antiseptic precautions. The pubes and labia must be shaved and painted with iodine. The vagina should be thoroughly well douched, as the patient has probably been examined several times.

The operation is done with the patient in the Walcher position. An anæsthetist and two assistants are required. The latter stand, one at each side of the patient, to support the thighs and control the separation of the cut ends of the bone or symphysis.

Symphyseotomy.—*Open Method.*—A vertical incision is made over the symphysis, deviating a little to one side at its lower end to avoid the clitoris. The suspensory ligament of the clitoris is then divided, and that organ drawn to the side by

means of a sound passed along the urethra. An incision, preferably longitudinal, is then made in the linea alba, the finger passed down behind the symphysis, and the bladder separated from its posterior surface. The cartilage is then divided from above downwards and from behind forwards with a strong probe-pointed knife. Lastly, the strong subpubic ligament is divided.

In this operation there is apt to be severe bleeding from the venous plexus in front of the bladder.

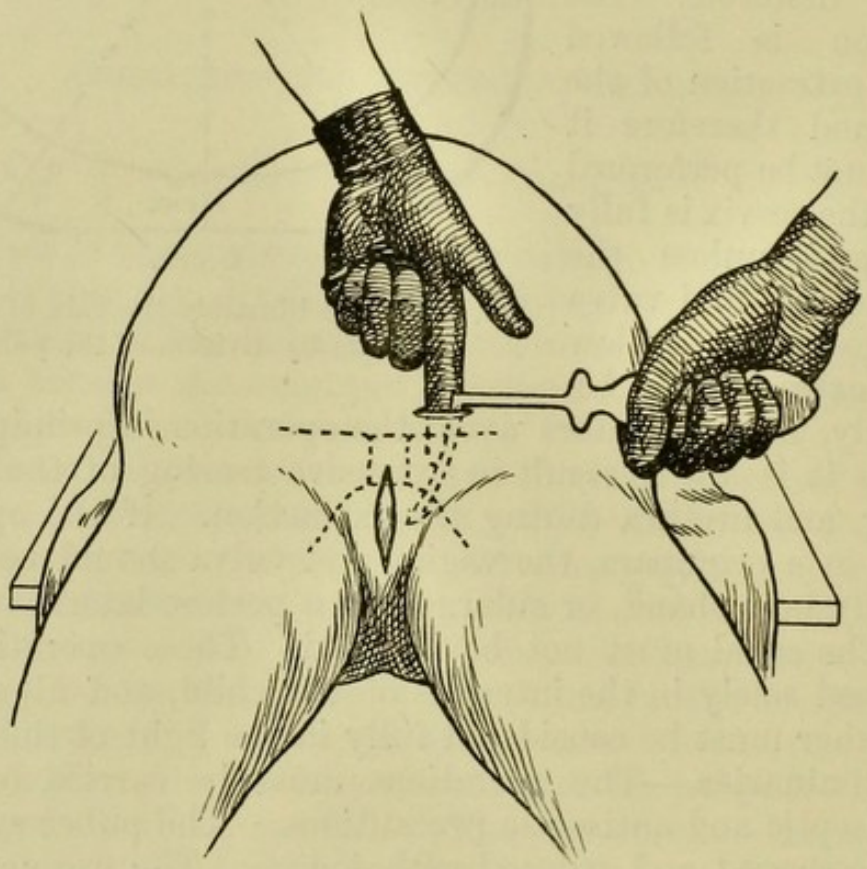


FIG. 242.—Pubiotomy, Döderlein's method.

Subcutaneous Method.—This is exactly the same as Döderlein's operation of pubiotomy, except that the needle is passed under the symphysis instead of the pubic ramus.

Pubiotomy (Hebotomy, Hebosteotomy).—*Open Method.*—This method has been quite given up, but in principle it was strictly comparable to open symphyseotomy.

Döderlein's Method. — In this so-called "subcutaneous" operation a small (1 in.) transverse incision is made right down to the bone inwards from the spine of the pubes

on the left side. The finger is then passed under the periosteum behind the bone and the adjacent structures separated off. A special curved needle is now passed down, the point being kept in contact with the bone all the way.

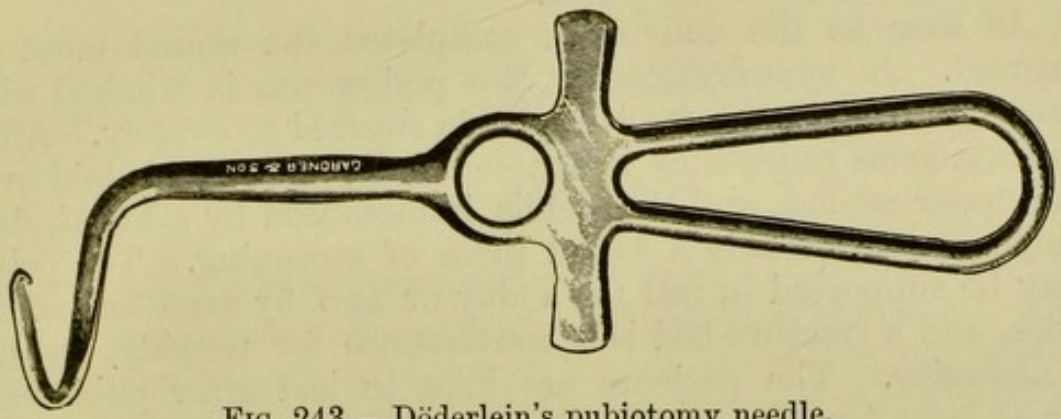


Fig. 243.—Döderlein's pubiotomy needle.

At the lower margin of the pubes the point of the needle is brought forward so that it projects under the skin of the labium majus. A small incision is made over this and the point pushed through. A Gigli's wire saw is attached and the needle withdrawn. The handles are then attached to the saw and the bone cut through.

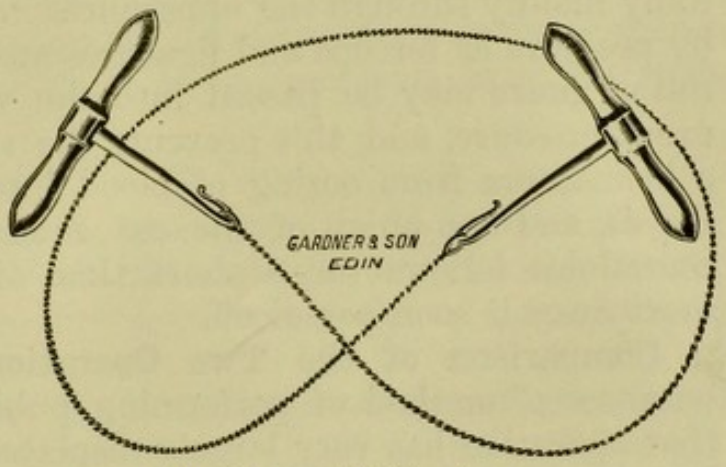


Fig. 244.—Gigli's wire saw.

After division of the pelvis by either method the cut ends spring apart, and the pelvis must be supported to prevent this separation going beyond 6 or 7 cm. If all the ligamentous structures have not been divided the separation may not occur until traction upon the child is begun.

If there is much hæmorrhage it must be checked by pressure with sponges or swabs, and as soon as possible the extraction of the child completed. Almost all English-speaking authorities prefer to apply forceps and so extract, but some continental operators put the patient to bed with a temporary

dressing and leave the labour to nature. Still others extract by version. It is during the extraction that the bladder, urethra, and vagina are most exposed to damage, because they are separated off from the support usually given to them by their attachment to the pubes.

As soon as the delivery is completed the wound must be sutured. In symphyseotomy the periosteum is stitched with chromic gut, and the fascia and skin sutured separately. After subcutaneous pubiotomy a simple sterile dressing is laid over the upper wound, and the pelvis immobilised by a broad, firm binder, or preferably a broad piece of strapping. The pelvis may be supported in bed for a day or two by sandbags at the sides, and a fracture bed is a convenience for nursing, but not a necessity. The patients are kept in bed after pubiotomy for at least fourteen days, and after symphyseotomy for three weeks. Catheterisation is necessary for some days after the latter operation.

Risks.—Injury to the vagina, bladder, and urethra has already been mentioned. The sacro-iliac joints may be injured by too sudden or too extreme separation of the bones. Hæmorrhage may be alarming in either operation—in pubiotomy mainly through the upper incision. It must be controlled by pressure as forceps and ligatures are inapplicable. A tight roll of gauze may be passed into the vagina after delivery to exert pressure, and this prevents the subsequent formation of a hæmatoma from oozing of blood into the space of Retzius. Sepsis, and non-union of the cut ends may occur. Lameness sometimes follows for a short time after getting up, but in most cases it soon passes off.

Comparison of the Two Operations. — Since the "subcutaneous" method of performing pubiotomy was introduced, that operation has very largely displaced symphyseotomy. At the same time the rival merits of the two operations are still a subject of discussion. For both operations it is claimed that a slight permanent enlargement of the pelvis may follow, allowing a subsequent labour to occur without recourse to operation.

It is generally agreed that the operations are not suitable for private practice, unless in the hands of an expert operator.

Prognosis.—The mortality after subcutaneous pubiotomy varies from 1 to 5 per cent, according to the experience of the operator. The fœtal mortality is about 5 per cent.

CHAPTER XLIII

INDUCTION OF PREMATURE LABOUR

The object of this operation is to bring on labour after the fœtus has attained an age of viability, but before full term. The operative measures are intended to induce contractions of the uterus which will lead to the spontaneous expulsion of the fœtus, and are, strictly speaking, in no way connected with artificial dilatation of the cervix or delivery of the child. These latter objects fall under the head of *accouchement forcé*, and while the two operations are sometimes combined, yet they are separate in their aim and scope.

Indications.—Broadly speaking, the operation is indicated by any condition of the mother or the fœtus which renders the continuation of pregnancy or delivery at full term dangerous to one or other or both. Such conditions may be either obstetrical or medical.

Obstetrical.

Contracted pelvis (conjugate down to $3\frac{1}{4}$ in. or 8 cm.).
Habitual excessive size of the fœtus in previous labours.
Habitual death of fœtus in last weeks of previous pregnancies.
Undue protraction of previous gestations with consequent death of the fœtus.

Medical.

Maternal diseases which are becoming progressively worse; *e.g.*

Albuminuria (pre-eclamptic toxæmia, nephritic toxæmia).
Hyperemesis gravidarum.
Chorea.
Heart disease.
Leukæmia.
Phthisis.
Insanity.
Pernicious anæmia, etc.

Time to Operate.—Theoretically the fœtus attains viability at the twenty-eighth week, but it is found practically impossible to rear an infant born before the thirty-second week. Indeed the chances of survival are so slight before the thirty-sixth week that most operators prefer, where the choice is open, to do some other operation at term rather than induce labour before this date.

Where the operation is being done on account of pelvic contraction the time for operation depends on the size of the head, not upon the supposed age of the fœtus according to the calendar. The relative sizes of the head and the pelvis are best measured by Munro Kerr's modification of Müller's method. The estimation should be repeated every ten or fourteen days after the thirty-fifth week. The patient is placed on her back and, preferably, an anæsthetic is given. The right hand then grasps the head and presses it into the pelvis, while with the fingers of the left hand a vaginal examination is made, and the consistency of the head and the extent to which it enters the pelvis made out. The thumb of the left hand at the same time estimates the amount of overlapping of the head, if any, at the brim of the pelvis. If difficulty is met with in making the head enter the brim, that is the indication for the immediate induction of labour.

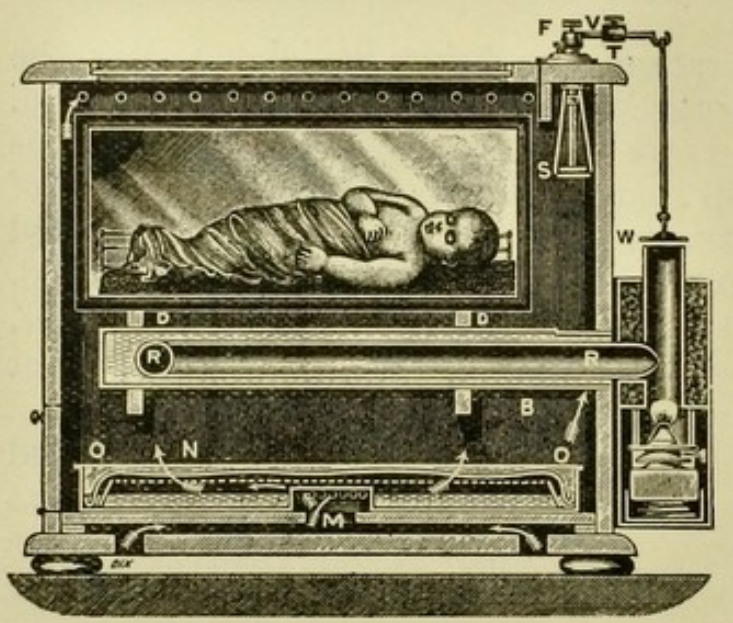


FIG. 245.—Section of baby incubator (Hearson & Co., London).

RR. Hot air flue in water-tank. SVW. Automatic heat regulator.

Preliminaries.—Before the operation is undertaken attention must be paid to the probable requirements of the premature infant, if it survives. A nurse who understands the management of such cases should be engaged, and if possible an incubator or *couveuse* obtained. A serviceable incubator can

be made by any carpenter, as it merely consists of a suitable box with a glass lid and a shelf, not running the entire length of the box, on which the infant's bedding is laid. The lower compartment has air holes, and contains hot water-bottles to warm the air, which then passes up to the upper compartment containing the infant, and out by a hole in the glass lid. The air must be kept moist by a dish of water in the bottom of the box. A thermometer must also be kept in it. The ideal temperature is about 78° F., and it must not be allowed to vary much.

Methods of Operation.—These are very numerous, and include :—

1. Ecbolic drugs.
2. Rupture of the membranes.
3. Separation of membranes from lower segment.
4. Massage of breasts.
5. Massage of uterus.
6. Injection of fluid between membranes and uterine wall.
7. Injection of glycerine between membranes and uterine wall.
8. Electricity.
9. Introduction of bougies.
10. Introduction of hydrostatic bags.
11. Hot vaginal douches.
12. Cervical tampon.

Most of these are either ineffective, or have obvious objections. Rupture of the membranes, for example, means a dry labour, which is likely to be fatal to a specially delicate child. The introduction of glycerine, again, while effective, has been followed by fatal poisonous symptoms. The only three methods which are now employed are (1) The introduction of bougies ; (2) The cervical tampon ; and (3) The use of hydrostatic bags. The last is not very suitable for use in private general practice, and need not be described here.

Krause's Method by Introduction of Bougies into the Uterus.—*Instruments.*—Two or three large-sized (No. 12) gum-elastic bougies, a few Hegar's dilators, two vulsella, Sims' speculum.

The vagina should be douched with antiseptic lotion once or twice on the day preceding the operation. The metal instruments must be boiled, and the bougies should be soaked

for at least twelve hours in 1 in 1000 corrosive, or 1 in 20 carbolic lotion.

An anæsthetic is not essential, but is an advantage, as it enables the cleansing of the external genitals to be carried out more thoroughly. The patient may either lie in the lithotomy position with a nurse to hold the legs, or in the Sims' position. In either case a good light is necessary. After the external parts have been scrubbed, the operator puts on boiled gloves and washes out the vagina. The cervix is then exposed by the speculum and drawn down by the vulsella. If necessary

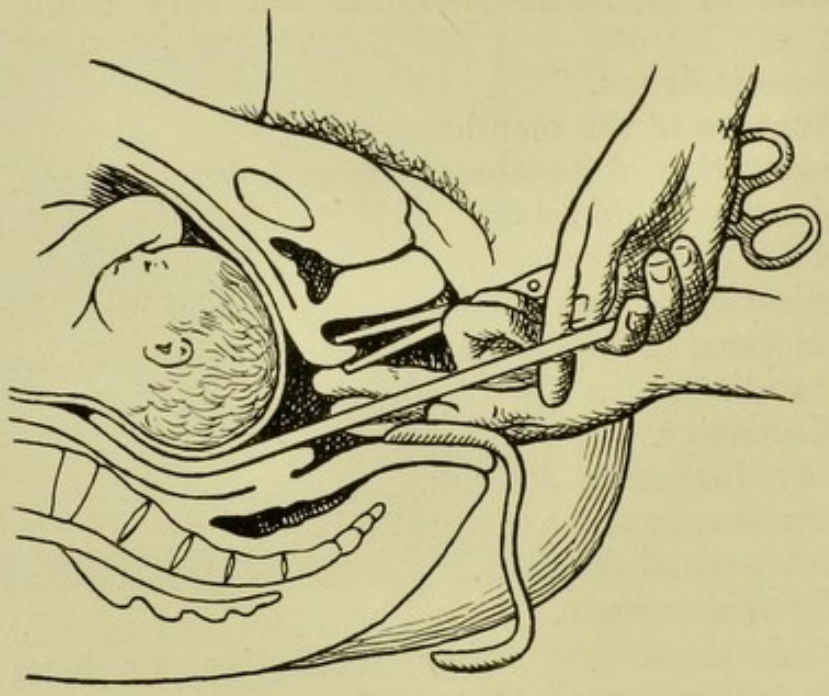


FIG. 246.—Krause's method.

the os may be dilated by one or two Hegar's dilators sufficiently to admit the finger, which is then swept round the lower uterine segment and the membranes separated. One bougie is then gently introduced between the membranes and the uterine wall, great care being taken not to rupture the membranes. If difficulty is met with in passing the bougie, force must not be used, as the obstruction is probably due to the edge of the placenta. The bougie must be withdrawn and inserted in another direction. If no obstruction is encountered, the bougie should be passed in as far as it will go, which usually leaves about an inch or so projecting outside the cervix. A second and even a third bougie may be introduced in like manner. The ends of the bougies are then wrapped in

sterile gauze and left in the vagina, which is lightly packed. The patient is kept in bed afterwards.

Labour may be expected in about twelve hours, although it may start within half an hour, or be postponed for thirty-six hours, or even a day or two. Hot vaginal douches may be given every few hours in the meantime. If labour has not ensued after forty-eight hours, the bougies should be withdrawn, the vagina well douched, and either a fresh set of bougies introduced or the cervix tamponed with sterile gauze soaked in glycerine.

If labour ensues after the introduction of the bougies they should be left *in situ* until expelled by the uterus. If removed too soon the labour may stop and the pains pass off again.

Prognosis.—When performed on account of pelvic contraction the operation is apt to give disappointing results, unless restricted to suitable cases. Below $3\frac{1}{2}$ inches the combined immediate and late fœtal mortality is very great. But even where the obstetric results are good, the subsequent rearing of a premature infant is a matter of very great difficulty among the poor.

CHAPTER XLIV

ACCOUCHEMENT FORCÉ

By this term is meant the rapid artificial dilatation of the cervix followed by the immediate delivery of the child.

Indications.—The most frequent indication is eclampsia; but in hyperemesis gravidarum, heart failure, and occasionally *ante partum* hæmorrhage (either accidental hæmorrhage or placenta prævia), the operation may be called for. Intractable rigidity of the cervix is a rare indication, except in combination with one of the above conditions.

Methods.—These are numerous, but may all be grouped under the two heads of (I.) Dilatation and (II.) Incision.

Dilatation may be performed by—

(1) Fingers—(*a*) Manual method, (*b*) Bimanual method.
(2) Tents . . . } followed by (1), (4), or (5).
(3) Graduated dilators }
(4) Hydrostatic dilators . } preceded if necessary by
(5) Branched metal dilators } (1), (2) or (3).

Incision includes the operations of—

(1) Cervical incisions.
(2) Vaginal Hysterotomy (Vaginal Cæsarean section).

Manual Dilatation.—The patient should be fully anæsthetised and placed in the dorsal cross-bed position. As the anæsthesia is likely to be prolonged it may be better to use ether, provided there are no open lights. Carefully wash and shave the external genitals. The hands must then receive very scrupulous cleansing, and sterile rubber gloves be worn. One hand is now introduced into the vagina, and the forefinger passed into the cervix. If necessary, one or two Hegar's dilators may be passed first until the cervix will admit the finger. The finger is passed right up the cervix, then with-

drawn and reintroduced along with the tip of the second finger or the thumb. The fingers are gradually worked into the canal, and then separated and turned about until the tip of the third finger can be introduced, and so on. If the thumb is used the movement is like the slow "snapping" of the fingers. Ultimately the entire hand can be introduced, and thereafter the extraction of the child proceeded with by version or the application of forceps.

The bimanual method differs from the above only in the fact that the forefingers of the two hands are introduced in the first place, then two fingers of each hand, and so on, the cervix being expanded in different directions.

Manual dilatation is the safest method, as the operator can feel exactly what he is doing, and the risk of tearing the cervix is thereby diminished. It is, however, an extremely fatiguing operation for the hands, and in a primipara not in labour may be expected to occupy about an hour and a half. In a multipara it is less tedious unless the cervix be rigid. The risk is mainly sepsis, owing to the frequent introduction and reintroduction of the hand.

Dilatation by Tents.—This is such a slow method that it cannot be used where there is any urgency. It requires to be supplemented by manual or instrumental dilatation afterwards, as the largest tents do not dilate sufficiently to admit of extraction. Laminaria (sea-tangle) tents are the only kind now used, and they may be sterilised by dry heat or by soaking for forty-eight hours in a solution of corrosive sublimate in ether. The most rigid antiseptic precautions must be observed in their use. The tent should be introduced by sight, the cervix being drawn down by a vulsellum. The largest tent that will pass into the cervix should be used, and care must be taken to see that its tip passes beyond the internal os, but not so far that its lower end can slip inside the external os. Failure in the first point leads to the internal os remaining undilated, while want of care in the second may lead to great difficulty in extracting the tent. After the tent is in position the vagina must be lightly packed with gauze.

The tent should be left *in situ* for twelve hours or more, during which time it expands by absorbing moisture. It may be withdrawn by traction on the silk cord attached to its base.

Dilatation by Graduated Dilators.—Hegar's dilators are the

type of instrument used. The method is exactly the same as in dilating the cervix previous to a curettage. The patient is placed on her back in the lithotomy position, the buttocks at the edge of the bed. Sims' speculum is passed, and the cervix grasped and drawn down by one or two pairs of vulsella. The graduated dilators are then passed in beyond the internal os, one after the other, slowly. The uterus should to some extent be pushed down upon the dilators, rather than any traction put upon the vulsella, for the soft cervix is liable to be torn.

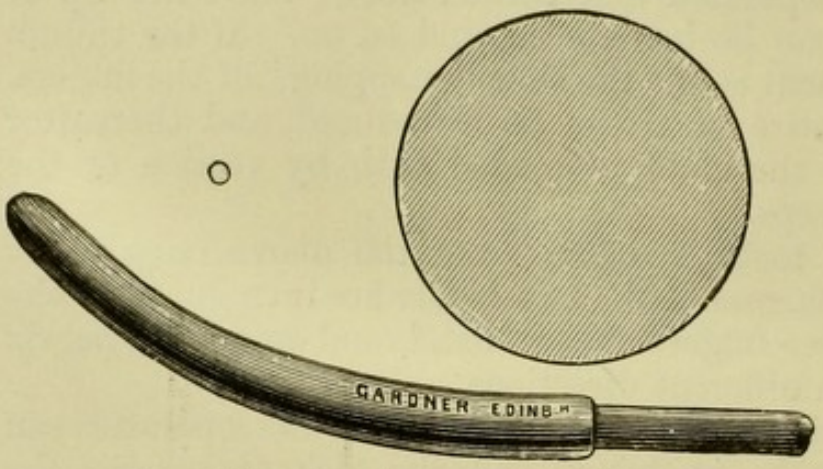


FIG. 247.—Hegar's graduated dilators. Sections of smallest and largest sizes.

Dilatation by Hydrostatic Dilators.—This also is a slow method, and a certain amount of dilatation is required before the dilator can be introduced. It is therefore not suitable for cases of great urgency, or where the cervix is closed.

Barnes was the first to introduce hydrostatic bags to the notice of the profession, but of late years his type of bag has been almost entirely displaced in favour of Champetier de Ribes' instrument. This last is a curved, pear-shaped bag made of strong waterproofed silk. The stalk is continuous with a rubber tube by which it is filled. It is

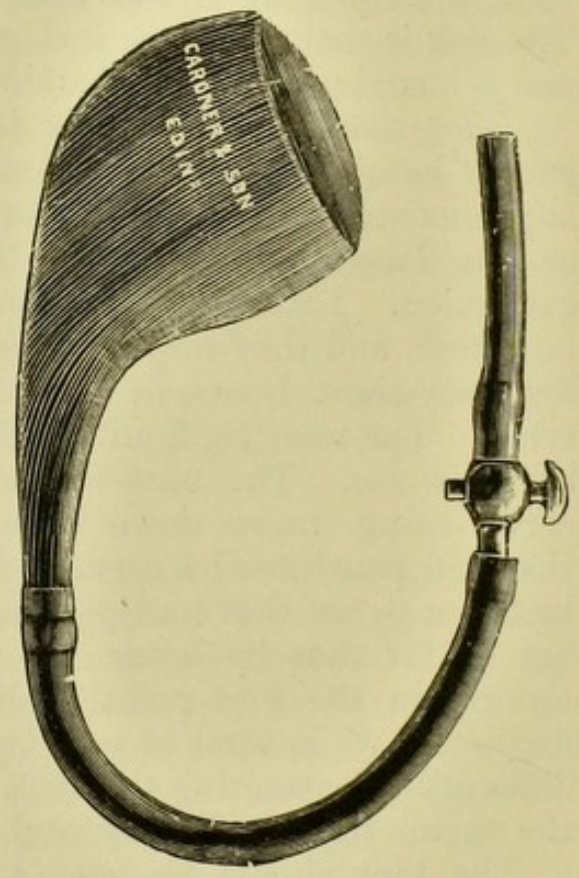


FIG. 248.—Champetier de Ribes' bag.

introduced rolled up in cylinder shape, and grasped by a pair of strong forceps, or simply by the fingers. The forceps designed for use with the bag has slightly curved fenestrated blades.

The bag should be comparatively new, otherwise it is apt to be brittle and may burst. It must be sterilised by boiling, and it is well to measure the quantity of fluid that it holds before introducing it, lest it be ruptured by an attempt to pump too much into it. During its introduction it will be found helpful to steady the cervix by grasping it with a vulsellum. After it is introduced, it must be held in position while it is slowly filled with fluid—preferably some antiseptic lotion such as boracic—by a Higginson's syringe.

As a rule it is unnecessary to rupture the membranes before introducing the bag, but in cases of placenta prævia it is

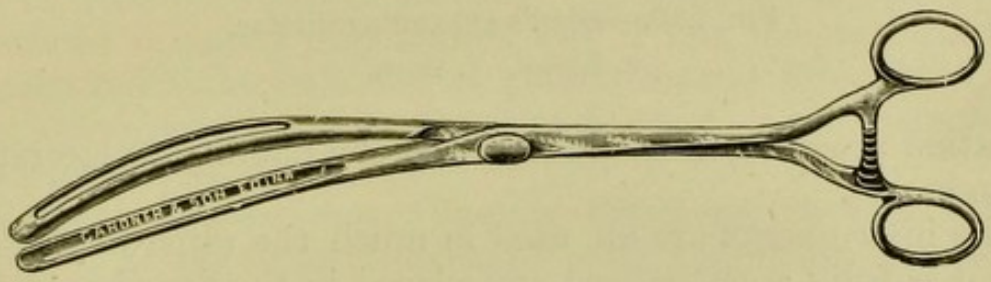


FIG. 249.—Forceps for introducing Champetier de Ribes' bag.

essential to do so. If this is not done, the bag merely causes further separation of the placenta prævia, and, while it may dilate the cervix, it certainly does nothing to control the hæmorrhage, unless the wide upper end is passed within the amniotic sac and then brought down upon the edge of the placenta.

In ordinary circumstances a hydrostatic bag takes from seven to twelve hours to dilate the cervix. If there is need for haste, a small weight of two or three pounds may be attached to the stalk by a string and hung over the foot of the bed. This may expedite matters by one or two hours.

Dilatation by Branched Metal Dilators.—Bossi's dilator is a four-pronged instrument, whose points can be very forcibly separated by a screw at the end of the handle. Frommer's dilator is similar in principle, but has eight blades. It is not generally regarded as an improvement. De Seigneux's modification has the advantage that the blades are set at an angle

which enables the cervix to be dilated without interfering in any way with its position or direction. Further, it has a series of blades of increasing breadth which can be applied as

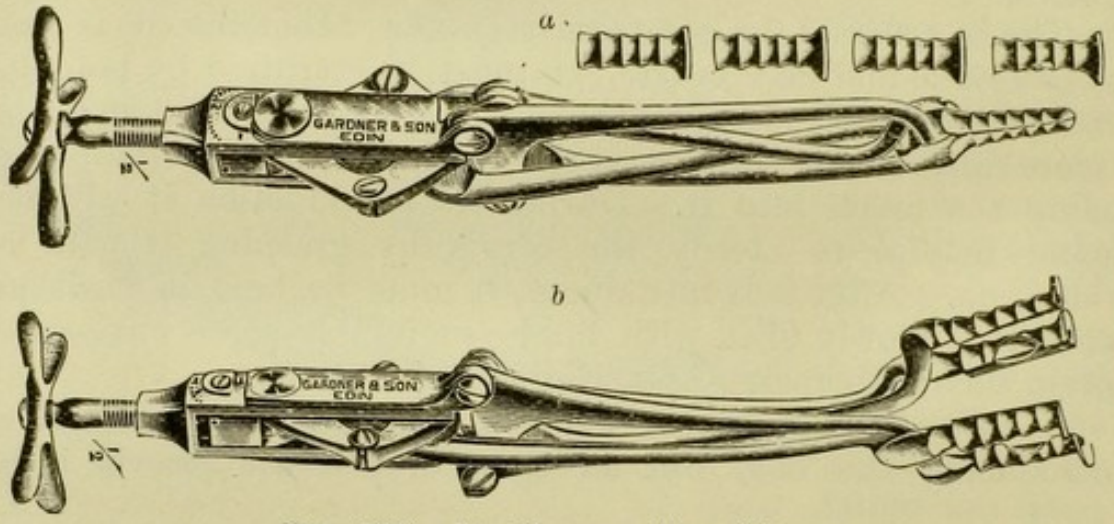


FIG. 250.—Bossi's expanding dilator.
a. Closed. *b*. Open.

dilatation proceeds, thus diminishing the liability to laceration of the cervix.

The instruments are all used in much the same way. The patient is fully anæsthetised and placed in the dorsal cross-bed position. The vulva and vagina are then carefully cleansed, and the point of the closed instrument passed into the cervix beyond the internal os. Dilatation is then begun. A pause of a minute or two should be made after every quarter turn, and later after every eighth of a turn. Full dilatation is usually obtained in this way after half an hour or forty minutes, but may take double that time. During a uterine contraction the instrument should be slightly unscrewed.

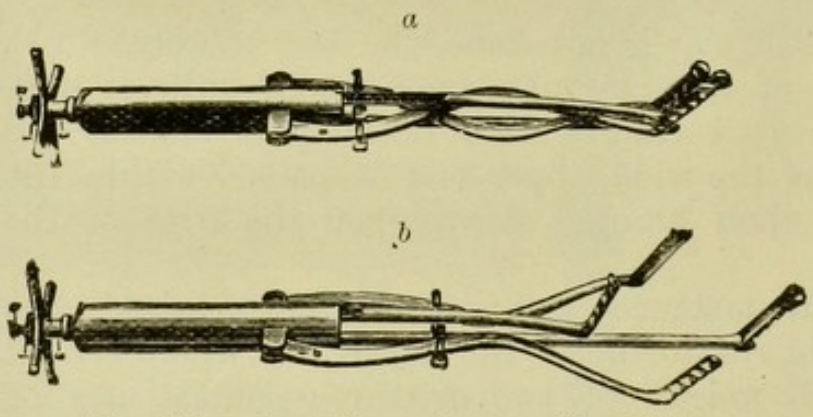


FIG. 251.—De Seigneux's expanding dilator.
a. Closed. *b*. Open.

After sufficient dilatation has been obtained, the instrument should be unscrewed and removed, and extraction performed.

The great risk of this method is laceration of the cervix. This is mainly caused by undue hurry, or the application of the instruments in unsuitable cases. It is generally regarded as unwise to apply an expanding dilator if the upper part of the cervix is still undilated. The method is also unsuitable if the cervix be very rigid, and for both these reasons is therefore inadvisable in the early months of pregnancy.

Superficial and Deep Cervical Incisions.—In some primiparous patients the external os and the lowest portion of the cervix remain undilated long after the upper part of the cervix has been "taken up." If this cervical rigidity does not yield to the influence of opium or chloral combined with hot douching, the cervix may with advantage be incised. This may be done by a pair of scissors. In some cases one or two superficial incisions may suffice, but if not, deeper cuts may be made in an antero-lateral or postero-lateral direction. The deep cuts require to be sutured after delivery, but the superficial ones may be left alone.

Vaginal Hysterotomy (Vaginal Cæsarean Section).—This operation is the most important recent advance in obstetric surgery. When performed by an operator accustomed to the technique of vaginal operations—and it should be attempted by no others—it admits of the delivery of the child within a few minutes of the beginning of the operation. It is particularly indicated in cases where, owing to rigidity of the cervix, the other methods of artificial dilatation are unsuitable, and in cases of extreme urgency.

Assistants.—An anæsthetist and at least two trained assistants are required.

Instruments.—Long-bladed anterior and posterior vaginal specula, one or two vulsellum forceps, scalpel, strong blunt-pointed scissors, several clamp forceps, long toothed dissecting forceps, several full-curved needles, needle holder, catgut or silk suture material.

Operation.—The patient is placed in the ordinary position for vaginal operations, the external genitals shaved and thoroughly cleansed, and the vagina douched.

The cervix is then drawn down by a vulsellum, and a stout silk ligature passed through it on each side. These are

grasped by the assistants, and used to keep the cervix steady at the vulva.

A longitudinal incision is then made in the middle line of the anterior vaginal wall, beginning a little above the urethral opening, and passing up to the vaginal portion of the cervix. Here a small transverse incision is made over the junction of the anterior vaginal wall and the cervix.

The bladder is then separated off from the anterior vaginal wall, cervix, and uterus, as far up as the utero-vesical fold of

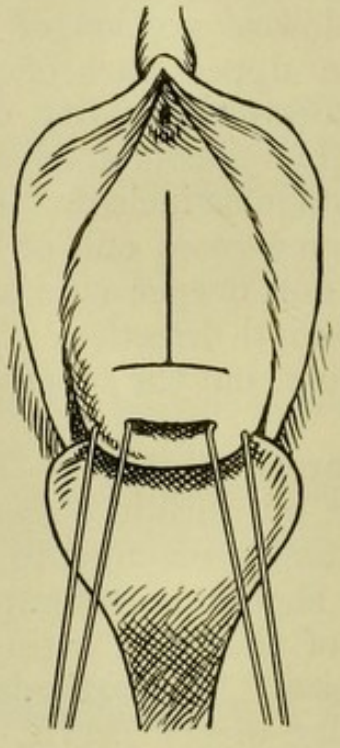


FIG. 252.—Cervix drawn forcibly down. Longitudinal and transverse incisions in anterior vaginal wall.

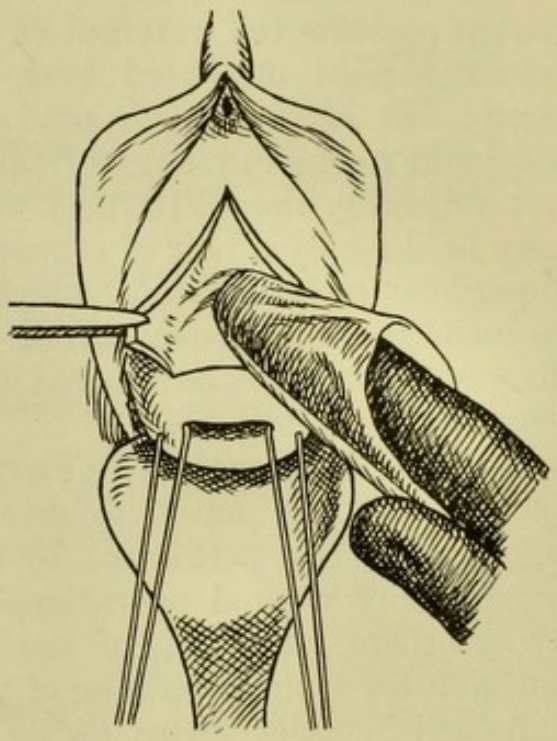


FIG. 253.—Dissecting off bladder from uterus and vaginal wall.

peritoneum. In this way the anterior wall of the uterus is exposed — during labour to a point a little above the retraction ring.

With the scissors the anterior wall of the cervix and the lower uterine segment is split in the middle line for a distance of about 4 inches (10 cm.) from the external os.

If still more room is required, a transverse incision is made over the posterior cervico-vaginal junction, and the peritoneum pushed up with the finger or sponge from the posterior aspect

of the cervix and lower uterine segment. A longitudinal incision is then made in the middle line of the posterior lip of the cervix and lower uterine segment, corresponding to the anterior one.

The membranes are now ruptured and forceps applied, or the child turned and extracted by traction on a foot. The placenta is at once expressed, and the body of the uterus packed with gauze, as there is a tendency to relaxation.

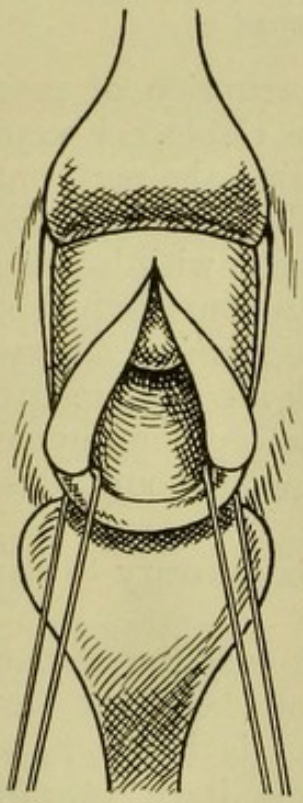


FIG. 254. — Cervix split anteriorly. Membranes bulging down.

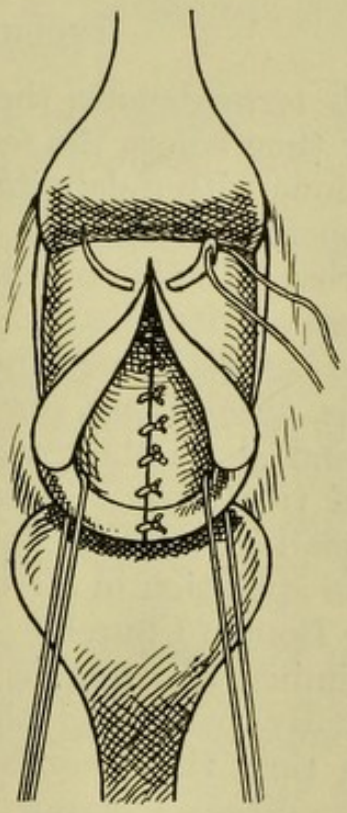


FIG. 255.—Posterior incision sutured. Suturing anterior incision.

The posterior and then the anterior incisions are now stitched up by interrupted sutures of catgut. The vaginal mucous membrane is replaced and stitched with continuous catgut sutures. A gauze drain may be left in the space between the bladder and uterus anteriorly.

Before the eighth month of pregnancy the posterior incision is rarely necessary, but if there is any dubiety as to the amount of space required it is better to make it rather than risk the anterior incision tearing upwards and involving the peritoneum. If the incisions are kept strictly in the middle

line, and the cervix kept drawn well down, the hæmorrhage is not alarming.

In a primipara it may be necessary to precede the operation by making a deep incision into the perineum and posterior vaginal wall, in order that the subsequent delivery of the child may not be interfered with in any way.

Prognosis.—In a series of about 450 cases recorded by experienced operators the mortality is only just above 1 per cent.

Induction of Abortion

This term denotes the artificial interruption of pregnancy at any time before the fœtus has become viable. Except when it is done with a definite therapeutic aim, the performance of any operation for this purpose is illegal in all Christian countries. In this country it is punishable with imprisonment or penal servitude, and any medical man convicted of such an offence has his name expunged from the *Medical Register*.

It is, accordingly, always wise to ask a colleague to see the case, and share the responsibility of determining upon such a line of treatment. This effectually prevents any attempt at blackmail by unscrupulous persons.

The operation in all circumstances is contrary to the tenets of the Roman Church.

Criminal abortion is, unfortunately, only too common. It is usually performed about the end of the third month, by which time the diagnosis of pregnancy is fairly certain, but the condition has not begun to show itself in any great alteration of the figure. Antiseptic precautions are frequently either entirely neglected, or are of the most perfunctory nature, with the consequence that the operation is often the start of serious, sometimes even fatal, pelvic inflammation.

Indications.—These may be arranged in two groups as follows:—

I. Where the continuance of pregnancy is likely to be followed by danger to the life of the mother; *e.g.*

General Conditions—

(*a*) Toxic form of hyperemesis gravidarum.
(*b*) Intractable chorea gravidarum.
(*c*) Intractable albuminuria, especially with history of eclampsia in previous pregnancy.

(*d*) Intractable pyelitis of pregnancy.
(*e*) Heart disease with distinct failure of compensation.
(*f*) Rapidly advancing phthisis.
(*g*) Insanity.

Local Conditions—
(*h*) Incarcerated retroversion of the gravid uterus.
(*i*) "Acute" hydramnios.
(*j*) Hydatidiform mole.
(*k*) Intractable hæmorrhage due to "threatened abortion."
(*l*) "Missed abortion" (sometimes).

II. Where labour at term would be fraught with grave danger, and Cæsarean section at term is declined, as in—
(*a*) Extreme degrees of contraction of the pelvis.
(*b*) Insuperable obstruction of the passages by fibroids.
(*c*) Cancer of the cervix.
(*d*) Atresia of the passages.

Methods.—*In the first Four Months.*—Rupture of the membranes by the passage of a sound is followed by abortion sooner or later, but the method, although largely employed amongst abortion-mongers, is not sufficiently certain in its results to make its adoption desirable where there is any urgency.

The administration of ecbolic drugs is generally useless. No drug will cause a *healthy* uterus to expel its contents, unless it be given in doses that are dangerously poisonous.

(1) As a rule the operation can be carried out at one sitting by the method of *dilatation by graduated bougies.* This is carried out exactly as for a curettage. The genitals are cleansed and shaved, the vagina washed out, and the cervix fixed and drawn down by vulsella. The dilators are then passed in one after the other until the cervix admits one or even two fingers. The ovum is then separated, and extracted by the fingers or an ovum forceps exactly as described on page 278.

(2) If there is no immediate urgency, the dilatation may be performed slowly by the introduction of a tent, or (3) by packing the cervix and vagina.

The risk of dilatation at one sitting is that the cervix may be torn if it is rigid. In order to avoid this, and at the same time to empty the uterus rapidly, many operators are adopt-

ing (4) the method of vaginal hysterotomy if the cervix is at all rigid. This operation, which is not suitable for private practice except in the hands of one experienced in the technique of vaginal operations, is practically the same as the vaginal hysterotomy at term. As a rule it is unnecessary to make more than the transverse incision over the anterior fornix, separate off the bladder, and divide the anterior lip of the cervix in the middle line. A posterior incision is never needed in the early months.

After the fourth month the methods are the same as those described for the *induction of premature labour*, or, if immediate emptying of the uterus is necessary, the operation becomes one of *accouchement forcé*.

CHAPTER XLV

EMBRYULCIA

EMBRYULCIA (or EMBRYOTOMY) is the term used to include all operations involving the destruction of the child with the view of diminishing its bulk and so facilitating delivery. It includes the operations of Craniotomy, Decapitation, Evisceration, and Cleidotomy. These operations will be considered separately.

CRANIOTOMY

Combines in itself three distinct steps—(1) Perforation; (2) Comminution of the head by cranioclasm, or cephalotripsy, or basilysis; and (3) Extraction.

Indications.—*Great disproportion between the head and the pelvis* either at the inlet or the outlet, *provided*—

(1) The child is already dead or is in serious danger; or
(2) That forceps have failed, and, owing to unsuitable conditions, pubiotomy is inadvisable; or
(3) That version has been done, but the aftercoming head cannot be extracted; or
(4) That the birth canal is believed to be infected; or
(5) That the child is hydrocephalic.

Contra-indication.—If the conjugate diameter is less than $2\frac{1}{2}$ inches (6·25 cm.) the operation is so difficult that Cæsarean section is generally to be preferred, and certainly if it be below 2 inches (5 cm.).

Perforation.—The best form of perforator is Simpson's. The blades are opened by pressing the handles together, and the hinged crossbar not only enables them to be fixed in the shut position, but gives rigidity to the whole instrument during the introduction.

In practically all cases the patient has been long in labour and repeatedly examined before craniotomy is decided upon.

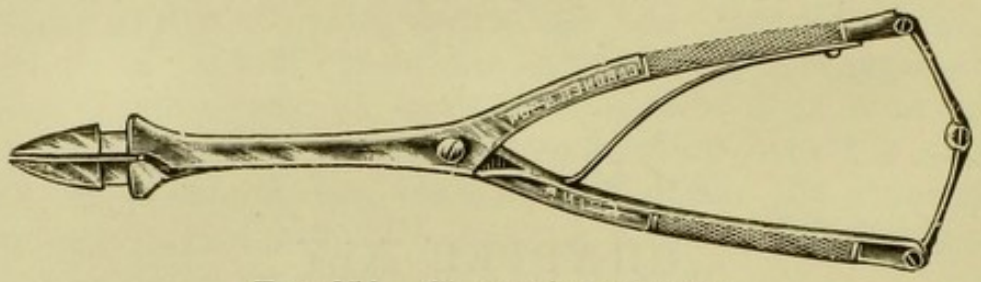


Fig. 256.—Simpson's perforator.

The risk of infection is correspondingly great, and a most thorough disinfection of the vulva and vagina must form the preliminary to the operation. The operator should then don sterilised gloves. The perforator is, of course, boiled.

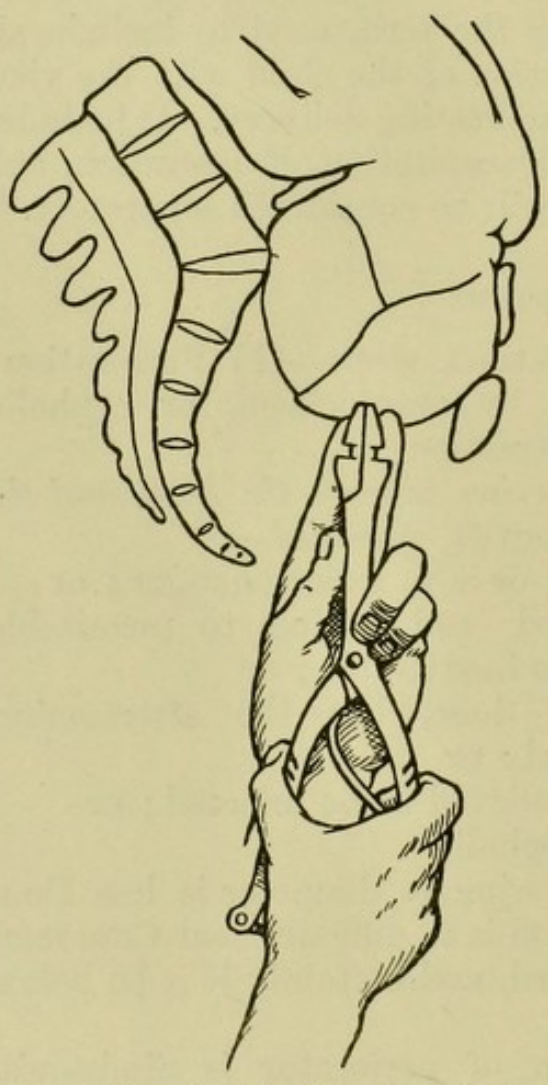


Fig. 257.—Application of perforator.

The first point in this operation is to make sure of the right spot to perforate. In vertex cases the presenting parietal bone is chosen, as near the anterior fontanelle as possible. In brow cases the frontal bone is chosen, and in face cases the roof of the mouth or the orbit. The aftercoming head is perforated through the base of the occiput, or preferably through the roof of the mouth. Secondly, care must be taken to locate the promontory of the sacrum, which has, in several cases, been perforated instead of the head. Thirdly, one must locate the cervix. The head has been perforated through the cervix in cases where the anterior lip has been thinned out over the head, the os lying high up posteriorly.

When the head has been fixed either by supra-pubic pressure or by retaining the forceps in position, the closed perforator is guided to the selected point by the fingers of the hand in the vagina, and the point pressed steadily and firmly through the bone as far as the shoulders of the instrument. The hinge of the crossbar is then flexed and the handles pressed together. This separates the points and makes a cut in the bone. The instrument is then closed and rotated through a quarter of a circle, and again opened. In this way a cruciform perforation is made. The perforator is then passed right down to the medulla to destroy the vital centres, as otherwise the child may be born alive but mangled. It is then stirred round the inside of the head several times to mince up the brain matter and render it easy of removal.

The perforator is then withdrawn and a large-sized double-channelled catheter passed in, and as much as possible of the brain matter washed out. Supra-pubic pressure or slight traction on the forceps, if they are still in position, helps to squeeze out the brains.

The principal risk of perforation is that the perforator may slip and damage the soft parts, or even perforate the uterine wall. The fingers in the vagina should be used to steady the instrument all the time it is being used.

When the disproportion between the head and pelvis is not great, the evacuation of the contents of the head may be sufficient to allow of delivery. This is particularly the case with the aftercoming head. Where it is anticipated with a forecoming head, the forceps should be left on during perforation as it forms a most admirable means of holding the head steady during the operation. The blades are, however, apt to slip off a perforated head. Failing delivery by such means the head must be crushed before extraction.

Comminution of the Head.—This may be carried out by cranioclasm, or cephalotripsy, or basilysis.

(*a*) *Cranioclasm.*—The instrument used is Braun's cranioclast, which consists of one solid and one fenestrated blade. The solid blade is introduced into the inside of the skull through the perforation, and the fenestrated one is passed round the outside of the head exactly like the blade of a forceps. The two blades are then tightened up by the screw

at the end of the handles. This partially compresses the head, and in many cases it may be extracted by traction on the cranioclast without further difficulty.

If delivery is still obstructed, the occiput and the two

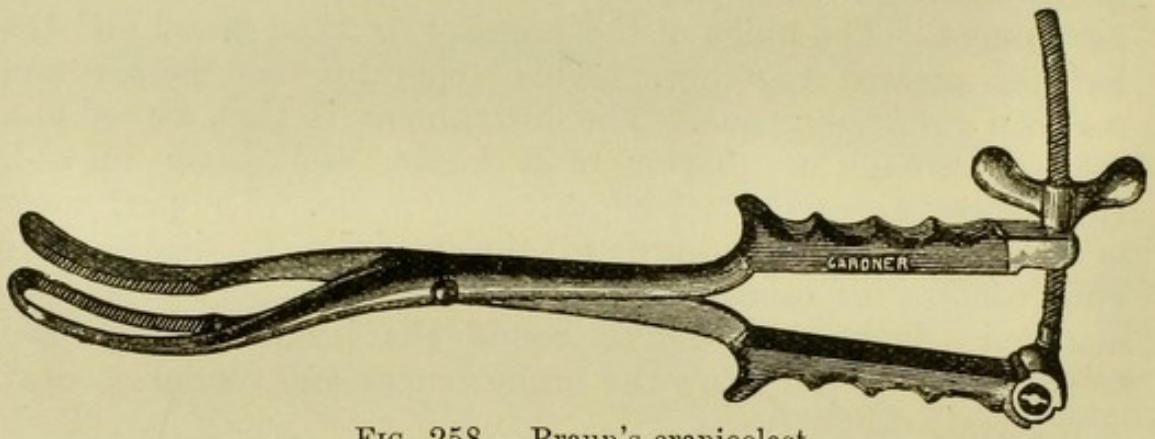


FIG. 258.—Braun's cranioclast.

sides of the head must be grasped in turn in the cranioclast and with a twisting movement forcibly detached from the base of the skull. This causes the collapse of the head. The instrument is then applied with the outer blade over the face and extraction proceeded with, care being taken to see that the edges of the bones of the vault are all covered in by the scalp, as otherwise lacerations may be caused.

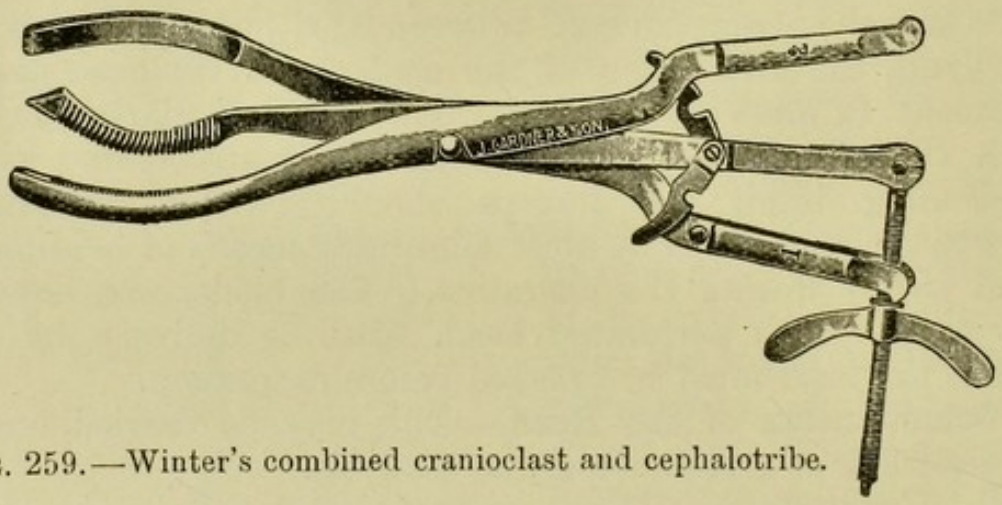


FIG. 259.—Winter's combined cranioclast and cephalotribe.

(*b*) *Cephalotripsy.* — The instrument used is Braxton Hicks' cephalotribe, which consists of two long heavy solid blades, with serrated inner surfaces. They are applied like the blades of forceps, one on either side of the head, and screwed together by a powerful screw at the end of the handles.

The entire head is crushed by this instrument, but the gain in the one diameter is compensated by an increase in the opposite diameter. After the head is crushed the instrument may be used as an extractor.

The combined cranioclast and cephalotribe of Winter is the most modern and the best instrument for the purpose.

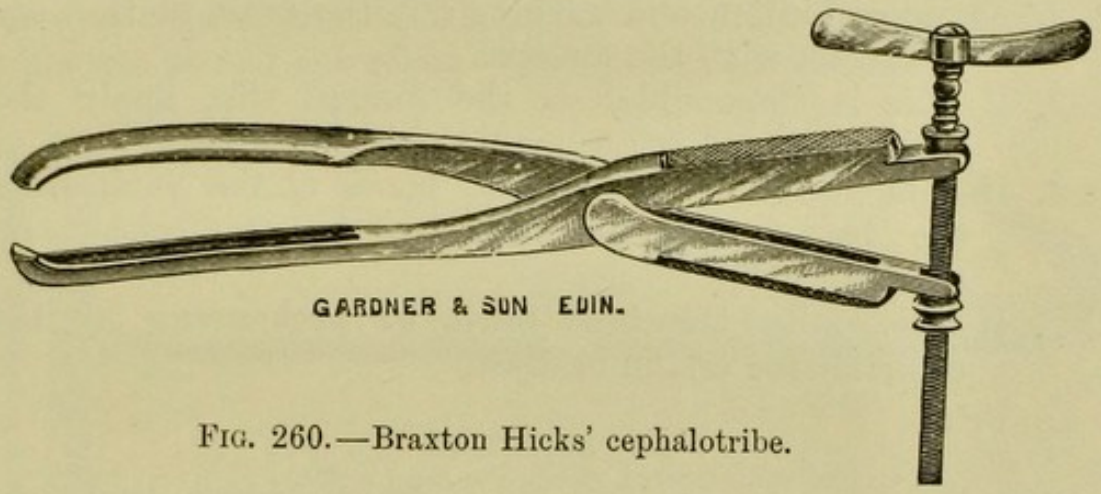


FIG. 260.—Braxton Hicks' cephalotribe.

(*c*) *Basilysis* is the operation of breaking up the base of the skull, after which extraction is usually easy. The best

FIG. 261.—Simpson's basilyst.

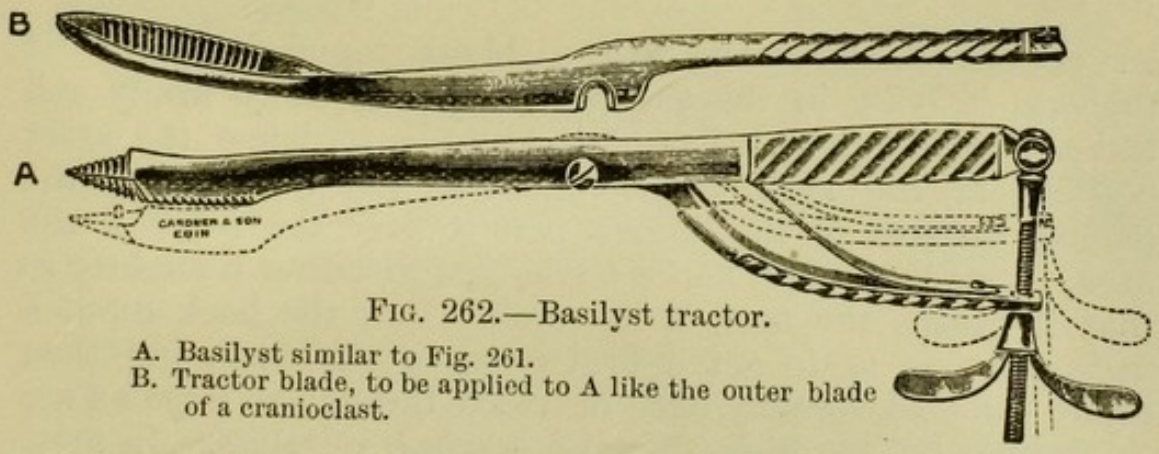


FIG. 262.—Basilyst tractor.

A. Basilyst similar to Fig. 261.
B. Tractor blade, to be applied to A like the outer blade of a cranioclast.

instrument for the purpose is Sir A. R. Simpson's basilyst. It is used first as a perforator, and subsequently passed down to the base of the skull and forcibly opened. The base is fractured in all directions by this means. A tractor blade is

then applied on the outside of the head, like the female blade of a cranioclast, and the head extracted.

Summary of practical points :—

1. If craniotomy is decided on after forceps has failed, keep the forceps on to steady the head during perforation.
2. After perforation and washing out the brain matter, try to extract with the forceps.
3. If this is impossible, or the forceps slip, apply the cranioclast and try to extract with it.
4. If this also fails, detach the bones of the vault from the base, grasp the face by the cranioclast, and extract.
5. If this fails, the base must be broken up by the cephalotribe or the basilyst.

Decapitation

The instruments required are a Braun's blunt hook and a pair of long blunt-pointed scissors. Braun's hook has

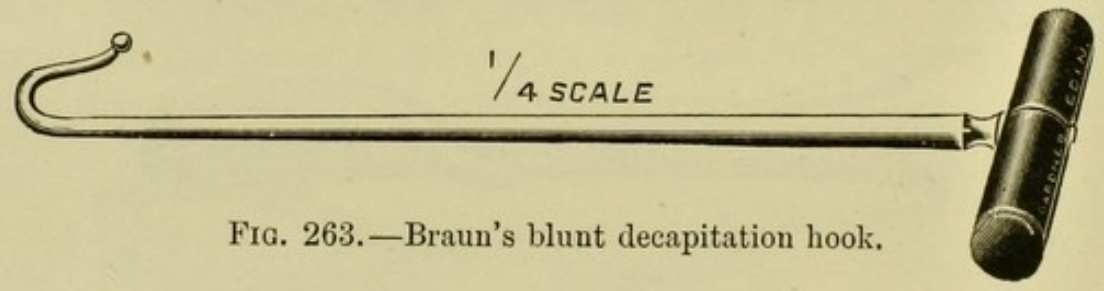


Fig. 263.—Braun's blunt decapitation hook.

an acutely bent crook with a blunt rounded point. If the arm is lying in the vagina, it is pulled down firmly and the neck thus fixed. Examine carefully to define the exact position of the neck. Then guiding the hook along the palmar surfaces of the fingers pass it over the front of the neck, rotate it through half a circle, and withdraw it slightly so that it grasps the neck in its crook. Pull the hook down a little more so as to get a firm grasp of the neck, and then rotate the hook forcibly once or twice through as large an arc as possible. This dislocates the cervical vertebræ. In most cases continued backward and forward rotation of the hook causes it to force its way right through the soft tissues of the neck as well, and so complete the decapitation. Sometimes, however, it is necessary to introduce the blunt-pointed

scissors with the same care as was used with the hook. The neck, held in position by the arm and hook, is then cut through. The body is then extracted by pulling it out shoulders first, or by bringing down the feet. The loose head should then be fixed at the brim by supra-pubic pressure, and extracted by hooking it out with a crotchet, or by applying forceps. In a contracted pelvis it can be crushed by a cephalotribe and extracted.

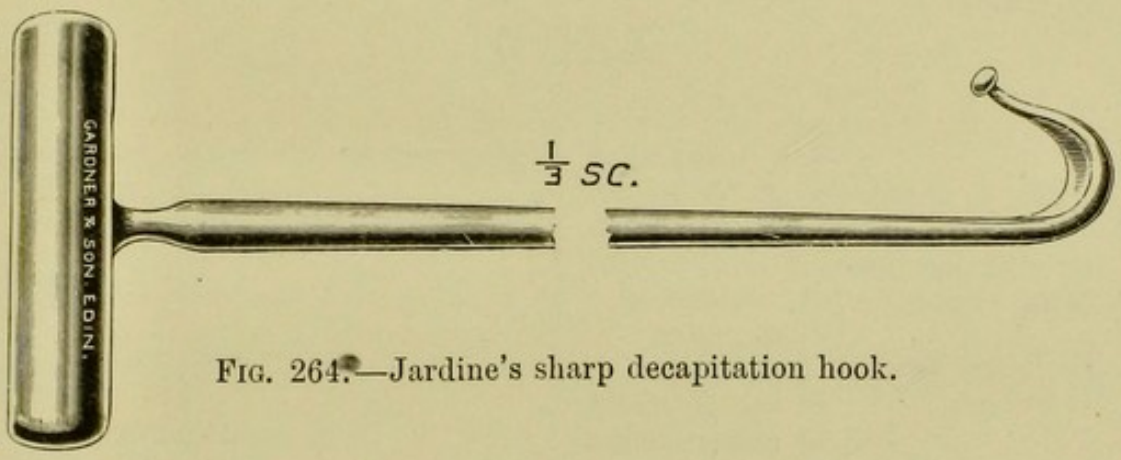


FIG. 264.—Jardine's sharp decapitation hook.

Another method of decapitation is to use a hook with a sharp cutting edge on the inner surface. These hooks are used for cutting right through all the tissues of the fœtal neck. The objections to them are their greater size, and the danger of cutting the maternal soft parts. They are applied in the same way as the other, and decapitation performed by a sawing movement.

SPONDYLOTOMY

This means division of the spinal column, and is done where the back presents and the neck is out of reach. It may be done with a stout pair of scissors.

EVISCERATION

This operation is rarely done. It means the evacuation of the contents of the thorax and abdomen. Its sole advantage is that it requires only a pair of scissors. After the two latter operations the body is doubled up and extracted after the mechanism of spontaneous evolution.

Cleidotomy

This means the division of the clavicles. It is useful in cases where, owing to excessive breadth of the shoulders, there is difficulty in delivering a dead fœtus. It is done by guiding the points of a pair of strong scissors over the clavicle and opening them sufficiently to admit a grasp of the bone. The bone is then divided, and the bisacromial diameter diminished. If need be, both clavicles can be divided.

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