

THE SCIENCE AND PRACTICE

OF

MIDWIFERY.

PART I.

ANATOMY AND PHYSIOLOGY OF THE ORGANS CONCERNED IN PARTURITION.

CHAPTER I.

ANATOMY OF THE PELVIS.

The pelvis is the bony basin situated between the trunk and the lower extremities. To the obstetrician its study is of paramount importance; for it not only contains, in the unimpregnated state, all the organs connected with the function of reproduction, but through its cavity the fetus has to pass in the process of parturition. An accurate knowledge, therefore, of its anatomical formation may be said to be the very alphabet of obstetrics, without which no one can practise midwifery, either with satisfaction to himself or safety to his patient.

In a treatise on obstetrics, however, any detailed account of the purely descriptive anatomy of the pelvis would be out of place. A knowledge of that must be taken for granted, and it is only necessary to refer to those points which have a more or less direct bearing on the study of its obstetrical relations.

The pelvis is formed of four bones. On either side are the *ossa innominata*, joined together by the *sacrum*; to the inferior extremity of the *sacrum* is attached the *coccyx*, which is, in fact, its continuation.

The *os innominatum* (Fig. 1) is an irregularly shaped bone originally formed of three distinct portions, the *ilium*, the *ischium*, and the *pubes*, which remain separated from each other up to and beyond the period of puberty. They are united at the *acetabulum* by a Y-shaped cartilaginous junction, which does not, as a rule, become

ossified until about the twentieth year. The consequence is that the pelvis, during the period of growth, is subject to the action of various mechanical influences to a far greater extent than in adult life; and these, as we shall presently see, have an important effect in determining the form of the bones. The external surface and borders of the os innominatum are chiefly of obstetric interest from giving attachment to muscles, many of which have an important accessory influence on parturition, such as the muscles forming the abdominal wall, which are attached to its crest, and those closing its outlet and forming the perineum, which are attached to the tuberosity of the ischium. On the anterior and posterior extremities of the crest of the ilium are two prominences (the anterior and posterior spinous processes) which are points from which certain measurements are sometimes taken. The internal surface of the upper fan-shaped portion of the os innominatum gives attachment to the iliacus muscle, and contributes to the

FIG. 1.



Os innominatum.

support of the abdominal contents; along with its fellow of the opposite side it forms the *false* pelvis. The false is separated from the *true* pelvis by the ilio-pectineal line, which, with the upper margin of the sacrum, forms the brim of the pelvis. This is of special obstetric importance, as it is the first part of the pelvic cavity through which the child passes, and that in which osseous deformities are most often met with. At one portion of the ilio-pectineal line, corresponding with the junction of the ilium and pubes, is situated a prominence, which is known as the ilio-pectineal eminence.

The internal smooth surface of the innominate bone below the linea ilio-pectinea forms the greater portion of the pelvis proper. In front, with the corresponding portions of the opposite bone, it forms the arch of the pubes, under which the head of the child passes in labor.

Behind this we observe the oval obturator foramen, and below that the tuberosity and spine of the ischium, the latter separating the great

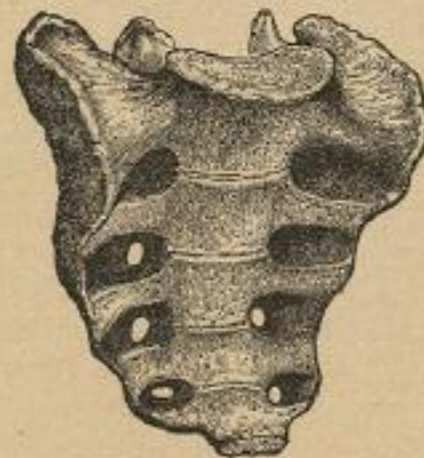
and lesser sciatic notches, and giving attachment to ligaments of importance. The rough articulating surface posteriorly, by which the junction with the sacrum is effected, may be noted, and above this the prominence to which the powerful ligaments joining the sacrum and os innominatum are attached.

The sacrum (Fig. 2) is a triangular and somewhat spongy bone forming the continuation of the spinal column, and binding together the ossa innominata. It is originally composed of five separate portions, analogous to the vertebrae, which ossify and unite about the period of puberty, leaving on its internal surface four prominent ridges at the points of junction. The upper of these is sometimes so well marked as to be mistaken, on vaginal examination, for the promontory of the sacrum itself.

The base of the sacrum is about $4\frac{1}{2}$ inches in width, and its sides rapidly approximate until they nearly meet at its apex, giving the whole bone a triangular or wedge shape. The anterior and posterior surfaces also approximate in the same way, so that the bone is much thicker at the base than at the apex. The sacrum, in the erect position of the body, is directed from above downward, and from before backward. At its upper edge it is joined, the lumbo-sacral cartilage intervening, with the fifth lumbar vertebra. The point of junction, called the promontory of the sacrum, is of great importance, as on its undue projection many deformities of the brim of the pelvis depend. The anterior surface of the bone is concave, and forms the curve of the sacrum; more marked in some cases than in others. There is also more or less concavity from side to side. On it we observe four apertures on each side, the intervertebral foramina, giving exit to nerves. The posterior surface is convex, rough, and irregular, for the attachment of ligaments and muscles, and showing a ridge of vertical prominences corresponding to the spinous processes of the vertebrae.

The sacrum is generally described as forming a keystone to the arch constituted by the pelvic bones, and transmitting the weight of the body, in consequence of its wedge-like shape, in a direction which tends to thrust it downward and backward, as if separating the ossa innominata. Dr. Duncan,¹ however, has shown, from a careful consideration of its mechanical relations, that it should rather be regarded as a strong transverse beam, curved on its anterior surface, the extremities of which are in contact with the corresponding articular surfaces of the ossa innominata. The weight of the body is thus transmitted to the innominate bones, and through them to the acetabula and the

FIG. 2.



Sacrum and coccyx.

¹ Researches in Obstetrics, p. 67.

femora (Fig. 3). There counter-pressure is applied, and the result is, as we shall subsequently see, an important modifying influence on the development and shape of the pelvis.

The **coccyx** (Fig. 2) is composed of four small separate bones, which eventually unite into one, but not until late in life. The uppermost of these articulates with the apex of the sacrum. On its posterior surface are two small cornua, which unite with corresponding points at the tip of the sacrum. The bones of the coccyx taper to a point. To it are attached various muscles which have the effect of imparting considerable mobility. During labor, also, it yields to the mechanical pressure of the presenting part, so as to increase the antero-posterior diameter of the pelvic outlet to the extent of an inch or more.

If, through disease or accident, as sometimes happens, the articular cartilages of the coccyx become prematurely ossified, the enlargement of the pelvic outlet during labor may be prevented, and considerable difficulty may thus arise. This is most apt to happen in aged primiparæ, or in women who have followed sedentary occupations; and not infrequently, under such circumstances, the bone fractures under the pressure to which it is subjected by the presenting part.

Pelvic Articulations.—The pelvic bones are firmly joined together by various articulations and ligaments. The latter are arranged so as to complete the canal through which the fetus has to pass, and which is in great part formed by the bones. On its internal surface, where the absence of obstruction is of importance, they are everywhere smooth; while externally, where strength is the desideratum, they are arranged in larger masses, so as to unite the bones firmly together. The pelvic articulations have been generally described as symphyses or amphiarthrodia, a term which is properly applied to two articulating surfaces, united by fibrous tissue in such a way as to prevent any sliding motion. It is certain, however, that this is not the case with the joints of the female pelvis during pregnancy and parturition. Lenoir found that in 22 females, between the ages of eighteen and thirty-five, there was a distinct sliding motion. Therefore, the pelvic articulations are, strictly speaking, to be considered examples of the class of joints termed arthrodia.

Lumbo-sacral Joint.—The last lumbar vertebra is united to the sacrum by ligamentous union similar to that which joins the vertebræ to each other. The intervening fibro-cartilage forms a disk, which is thicker in front than behind, and this, in connection with a similar peculiarity of the fifth lumbar vertebra, tends to increase the sloped position of the sacrum, and the angle which it forms with the vertebral column. It constitutes the most prominent portion of the promontory of the sacrum, and is the part on which the finger generally impinges in vaginal examinations. The anterior common vertebral ligament passes over the surface of the joints, and we also find the ligamenta subflava and the inter-spinous ligaments, as in the other vertebræ. The articular processes are joined together by a fibrous capsule, and there is also a peculiar ligament, the lumbo-sacral, extending from the transverse process of the vertebra on each side, and attaching itself to the sides of the sacrum and the sacro-iliac synchondrosis.

Ligaments of Coccyx.—The sacrum is joined to the coccyx, and, in some cases at least, the separate bones of the coccyx to each other, by small cartilaginous disks like that connecting the sacrum with the last lumbar vertebra. They are further united by anterior and posterior common ligaments, the latter being much the thicker and more marked. In the adult female a synovial membrane is found between the sacrum and coccyx, and it is supposed that this is formed under the influence of the movements of the bones on each other.

Sacro-iliac Synchondrosis.—The opposing articular surfaces of the sacrum and ilium are each covered by cartilages, that of the sacrum being the thicker. These are firmly united, but, in the female, according to Mr. Wood,¹ they are always more or less separated by an intervening synovial membrane. Posterior to these cartilaginous convex surfaces there are strong interosseous ligaments, passing directly from bone to bone, filling up the interspace between them, and uniting them firmly. There are also accessory ligaments, such as the superior and anterior sacro-iliac, which are of secondary consequence. The posterior sacro-iliac ligaments, however, are of great obstetric importance. They are the very strong attachments which unite the rough surfaces on the posterior iliac tuberosities to the posterior and lateral surfaces of the sacrum. They pass obliquely downward from the former points, and suspend, as it were, the sacrum from them. According to Duncan, the sacrum has nothing to prevent its being depressed by the weight of the body but these ligaments, and it is mainly through them that the weight of the body is transmitted to the sacro-cotyloid beams and the heads of the femora.

The **sacro-sciatic ligaments** are instrumental in completing the canal of the pelvis. The greater sacro-sciatic ligament is attached by a broad base to the posterior inferior spine of the ilium, and to the posterior surfaces of the sacrum and coccyx. Its fibres unite into a thick cord, cross each other in an X-like manner, and again expand at their insertion into the tuberosity of the ischium. The lesser sacro-sciatic ligament is also attached with the former to the back parts of the sacrum and coccyx, its fibres passing to their much narrower insertion at the spine of the ischium, and converting the sacro-sciatic notch into a complete foramen.

The **obturator membrane** is the fibrous aponeurosis that closes the large obturator foramen. Joulin² supposes that along with the sacro-sciatic ligaments, it may, by yielding somewhat to the pressure of the fetal head, tend to prevent the contusion to which the soft parts would be subjected if they were compressed between two entirely osseous surfaces.

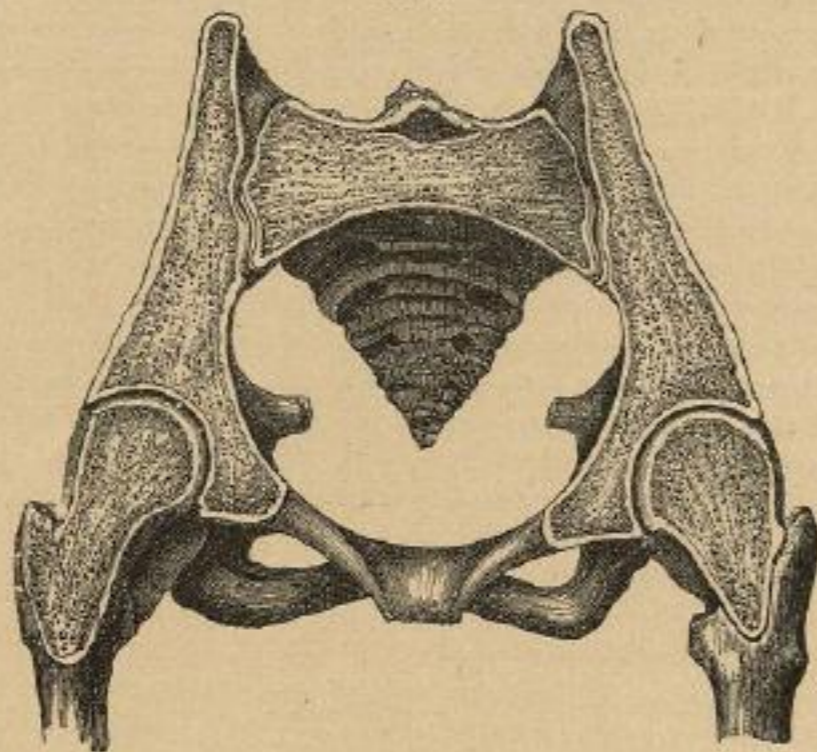
Symphysis Pubis.—The junction of the pubic bones in front is effected by means of two oval plates of fibro-cartilage, attached to each articular surface by nipple-shaped projections, which fit into corresponding depressions in the bones. There is a greater separation between the bones in front than behind, where the numerous fibres of the cartilaginous plates intersect, and unite the bones firmly together.

¹ Todd's Cyclopaedia of Anatomy and Physiology, article "Pelvis," p. 123.

² Traité d'Accouchements, p. 11.

At the upper and back part of the articulation there is an interspace between the cartilages, which is lined by a delicate membrane. In pregnancy this space often increases in size, so as to extend even to the front of the joint. The juncture is further strengthened by four ligaments, the anterior, the posterior, the superior, and the sub-pubic. Of these, the last is the largest, connecting together the pubic bones and forming the upper boundary of the pubic arch.

FIG. 3.



Section of pelvis and heads of thigh-bones, showing the suspensory action of the sacro-iliac ligaments. (After Wood.)

Movements of Pelvic Joints.—The close apposition of the bones of the pelvis might not unreasonably lead to the supposition that no movement took place between its component parts; and this is the opinion which is even yet held by many anatomists. It is tolerably certain, however, that even in the unimpregnated condition there is a certain amount of mobility. Thus Zaglas has pointed out¹ that in man there is a movement in an antero-posterior direction of the sacro-iliac joints which has the effect, in certain positions of the body, of causing the sacrum to project downward to the extent of about a line, thus narrowing the pelvic brim, tilting up the point of the bone, and thereby enlarging the outlet of the pelvis. This movement seems habitually brought into play in the act of straining during defecation.

During pregnancy in some of the lower animals there is a very marked movement of the pelvic articulations, which materially facilitates the process of parturition. This, in the case of the guinea-pig and cow, has been especially pointed out by Dr. Matthews Duncan.² In the former during labor the pelvic bones separate from each other

¹ Monthly Journal of Medical Science, Sept. 1851.
² Researches in Obstetrics, p. 19.

to the extent of an inch or more. In the latter the movements are different, for the symphysis pubis is fixed by bony ankylosis, and is immovable; but the sacro-iliac joints become swollen during pregnancy, and extensive movements in an antero-posterior direction take place in them, which materially enlarge the pelvic canal during labor.

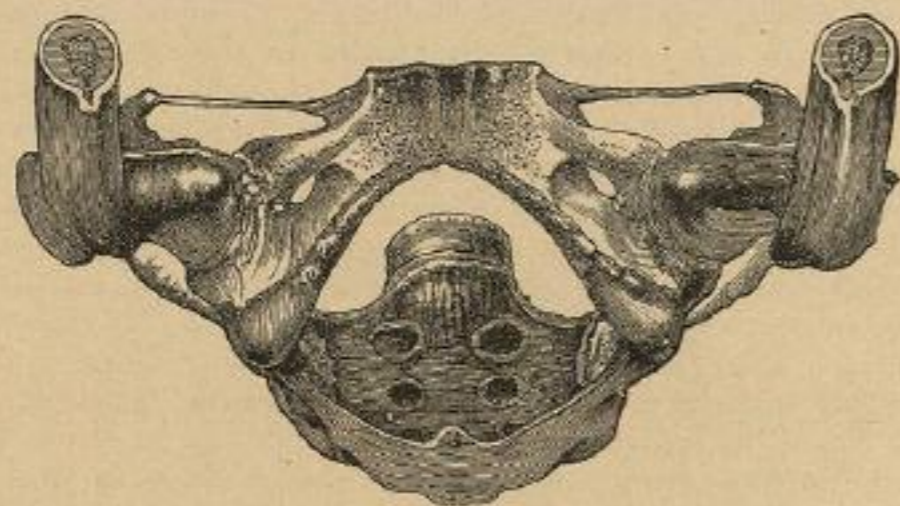
It is extremely probable that similar movements take place in women, both in the symphysis pubis and in the sacro-iliac joints, although to a less marked extent. These are particularly well described by Dr. Duncan. They seem to consist chiefly in an elevation and depression of the symphysis pubis, either by the ilia moving on the sacrum, or by the sacrum itself undergoing a forward movement on an imaginary transverse axis passing through it, thus lessening the pelvic brim to the extent of one or even two lines, and increasing, at the same time, the diameter of the outlet, by tilting up the apex of the sacrum. These movements are only an exaggeration of those which Zaglas describes as occurring normally during defecation. The positions which the parturient woman instinctively assumes find an explanation in these observations. During the first stage of labor, when the head is passing through the brim, she sits, or stands, or walks about, and in these erect positions the symphysis pubis is depressed, and the brim of the pelvis enlarged to its utmost. As the head advances through the cavity of the pelvis, she can no longer maintain her erect position, and she lies down and bends her body forward, which has the effect of causing a nutatory motion of the sacrum, with corresponding tilting up of its apex, and an enlargement of the outlet.

These movements during parturition are facilitated by the changes which are known to take place in the pelvic articulations during pregnancy. The ligaments and cartilages become swollen and softened, and the synovial membranes existing between the articulating surfaces become greatly augmented in size and distended with fluid. These changes act by forcing the bones apart, as the swelling of a sponge placed between them might do after it had imbibed moisture. The reality of these alterations receives a clinical illustration from those cases, which are far from uncommon, in which these changes are carried to so extreme an extent that the power of progression is materially interfered with for a considerable time after delivery.

On looking at the pelvis as a whole, we are at once struck with its division into the true and false pelvis. The latter portion (all that is above the brim of the pelvis) is of comparatively little obstetric importance, except in giving attachments to the accessory muscles of parturition, and need not be further considered. The brim of the pelvis is a heart-shaped opening, bounded by the sacrum behind, the linea ilio-pectinea on either side, and the symphysis of the pubes in front. All below it forms the cavity, which is bounded by the hollow of the sacrum behind, by the inner surfaces of the innominate bones at the sides and in front, and by the posterior surface of the symphysis pubis. It is in this part of the pelvis that the changes in direction which the fetal head undergoes in labor are imparted to it. The lower border of this canal, or pelvic outlet (Fig. 4), is lozenge-shaped, is bounded by the ischiatic tuberosities on either side, the tip of the

coccyx behind, and the under surface of the pubic symphysis in front. Posteriorly to the tuberosities of the ischia the boundaries of the outlet are completed by the sacro-sciatic ligaments.

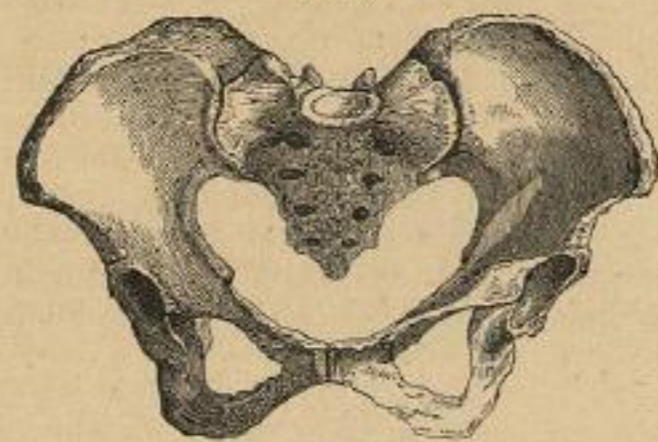
FIG. 4.



Outlet of pelvis.

There is a very marked difference between the pelvis in the male and the female, and the peculiarities of the latter all tend to facilitate the process of parturition. In the female pelvis (Fig. 5) all the bones are lighter in structure, and have the points for muscular attachments much less developed. The iliac bones are more spread out, hence the greater breadth which is observed in the female figure, and the peculiar side-to-side movement which all females have in walking. The tuberosities of the ischia are lighter in structure and farther apart, and the rami of the pubes also converge at a much less acute angle. This greater breadth of the pubic arch gives one of the most easily appreciable points of contrast between the male and the female pelvis; the

FIG. 5.

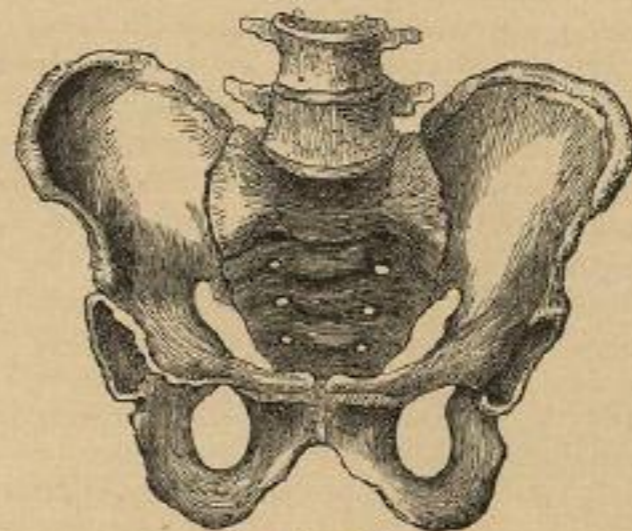


The female pelvis.

pubic arch in the female forms an angle of, from 90° to 100° , while in the male (Fig. 6) it averages from 70° to 75° . The obturator foramina are more triangular in shape.

The whole cavity of the female pelvis is wider and less funnel-shaped than in the male, the symphysis pubis is not so deep, and, as the promontory of the sacrum does not project so much, the shape of the pelvic brim is more oval than in the male. These differences between the male and female pelvis are probably due to the presence

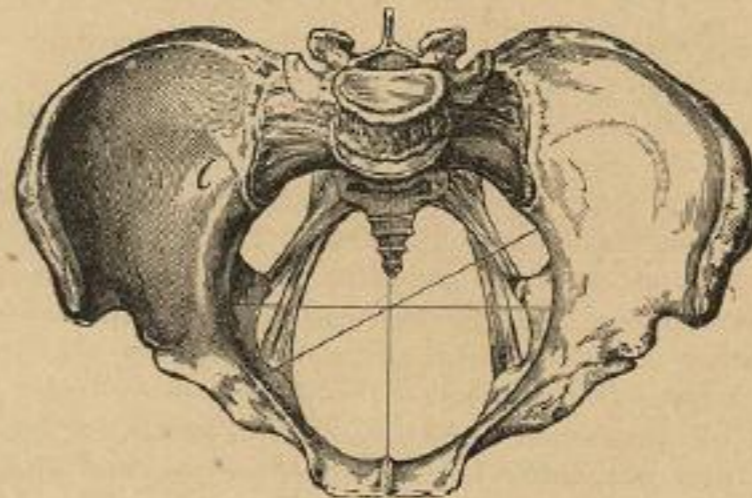
FIG. 6.



The male pelvis.

of the female genital organs in the true pelvis, the growth of which increases its development in width. In proof of this, Schroeder states that in women with congenitally defective internal organs, and in women who have had both ovaries removed early in life, the pelvis has always more or less of the masculine type.

FIG. 7.



Brim of pelvis, showing antero-posterior, c, v, oblique, D, and transverse, T, diameters.

Measurements of the Pelvis.—The measurements of the pelvis that are of most importance from an obstetric point of view are taken between various points directly opposite to each other, and are known as the *diameters* of the pelvis. Those of the true pelvis are the diameters which it is especially important to fix in our memories, and it is customary to describe three in works on obstetrics—the antero-posterior

or conjugate, the oblique, and the transverse—although, of course, the measurements may be taken at any opposing points in the circumference of the bones. The *antero-posterior* (diameter *Conjugata vera*, c. v, *sacro-pubic*), at the brim (Fig. 7), is taken from the upper part of the posterior surface of the symphysis pubis to the centre of the promontory of the sacrum; in the cavity, from the centre of the symphysis pubis to a corresponding point in the body of the third piece of the sacrum; and at the outlet (*coccy-pubic*), from the lower border of the symphysis pubis to the tip of the coccyx. The *oblique* (diameter *Diagonalis*, D), at the brim, is taken from the sacro-iliac joint on either side to a point of the brim corresponding with the ilio-pectineal eminence—that starting from the right sacro-iliac joint being called the right oblique (diameter *Diagonalis dextra*, D. D), that from the left the left oblique (diameter *Diagonalis sinistra*, D. S); in the cavity a similar measurement is made at the same level as the conjugate; while at the outlet an oblique diameter is not usually measured. The *transverse* (diameter *Transversa*, T) is taken, at the brim, from a point midway between the sacro-iliac joint and the ilio-pectineal eminence to a corresponding point at the opposite side of the brim; in the cavity, from points in the same plane as the conjugate and oblique diameters; and at the outlet, from the centre of the inner border of one ischial tuberosity to that of the other. The measurements given by various writers differ considerably and vary somewhat in different pelvis. Taking the average of a large number, the following may be given as the standard measurements of the female pelvis:

	Antero-posterior,	Oblique,	Transverse,
	C. V.	D.	T.
	Inches.	Inches.	Inches.
Brim	4.25	4.8	5.2
Cavity	4.7	5.2	4.75
Outlet	5.0	—	4.2

It will be observed that the lengths of the corresponding diameters at different places vary greatly; thus, while the transverse (T) is longest at the brim, the oblique (D) is longest in the cavity, and the antero-posterior (C. V) at the outlet. It will be subsequently seen that this fact is of great practical importance in studying the mechanism of delivery, for the head in its descent through the pelvis alters its position in such a way as to adapt itself to the longest diameter of the pelvis; thus, as it passes through the cavity it lies in the oblique (D) diameter, and then rotates so as to be expelled in the antero-posterior (C. V) diameter of the outlet.

In thinking of these measurements of the pelvis, it must not be forgotten that they are taken in the dried bones, and that they are considerably modified during life by the soft parts. This is especially the case at the brim, where the projection of the psoas and iliacus muscles lessens the transverse (T) diameter about half an inch, while the antero-posterior (C. V) diameter of the brim, and all the diameters of the cavity, are lessened by a quarter of an inch. The right oblique diameter (D. D) of the brim is, even in the dried pelvis, found to be on an average slightly longer than the left (D. S), probably on account of the increased development of the right side of the pelvis from the greater

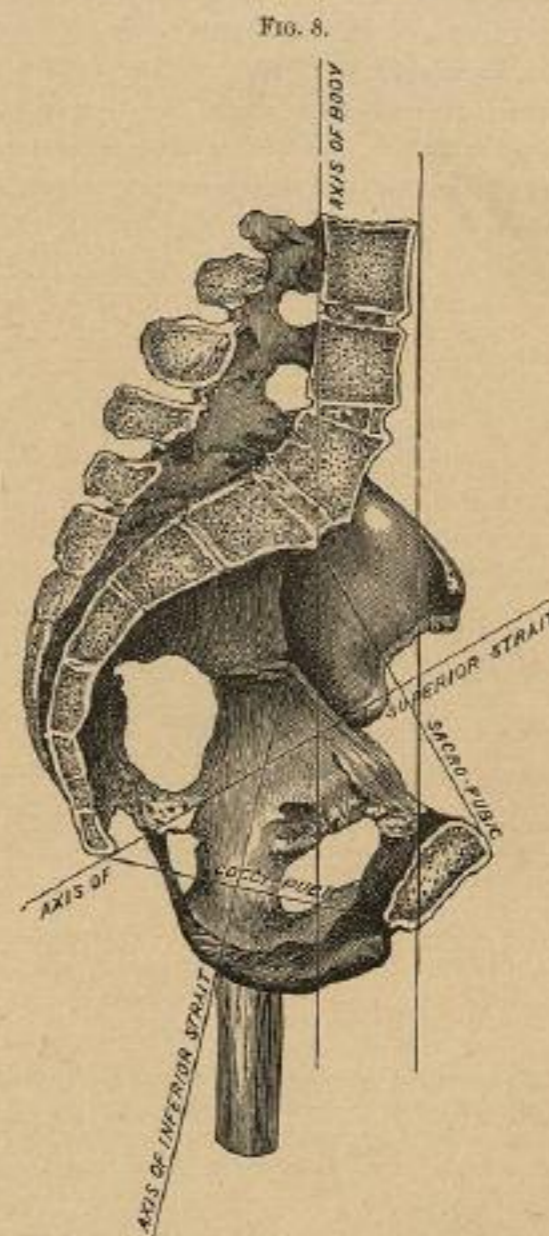
use made of the right leg; but, in addition to this, the left oblique diameter (D. S) is somewhat lessened during life by the presence of the rectum on the left side. The advantage gained by the comparatively frequent passage of the head through the pelvis in the right oblique diameter (D. D) is thus explained.

There are one or two other measurements of the true pelvis which are sometimes given, but which are of secondary importance. One of these, the sacro-cotyloid diameter, is that between the promontory of the sacrum and a point immediately above the cotyloid cavity, and averages from 3.4 to 3.5 inches. Another, called by Wood the lower or inclined conjugate diameter (diameter *Conjugata diagonalis*, C. D), is that between the centre of the lower margin of the symphysis pubis and the promontory of the sacrum, and averages half an inch more than the antero-posterior diameter of the brim [1]. These measurements are chiefly of importance in relation to certain pelvic deformities.

The external measurements of the pelvis are of no real consequence in normal parturition, but they may help us, in certain cases, to estimate the existence and amount of deformities. Those which are generally given are: Between the anterior superior iliac spines, 10 inches; between the central points of the crests of the ilia, 10½ inches; between the spinous process of the last lumbar vertebra and the upper part of the symphysis pubis (external conjugate), 7 inches.

Planes of the Pelvis.—By the planes of the pelvis are meant imaginary levels at any portion of its circumference. If we were to cut out a piece of cardboard so as to fit the pelvic cavity, and place it either at the brim or elsewhere, it would represent the pelvic plane at that particular part, and it is obvious that we may conceive as many planes as we desire. Observation of the angle which the pelvic planes form with the horizon shows the great obliquity at which the pelvis is placed in regard to the spinal column. Thus the angle A B I (Fig. 9) repre-

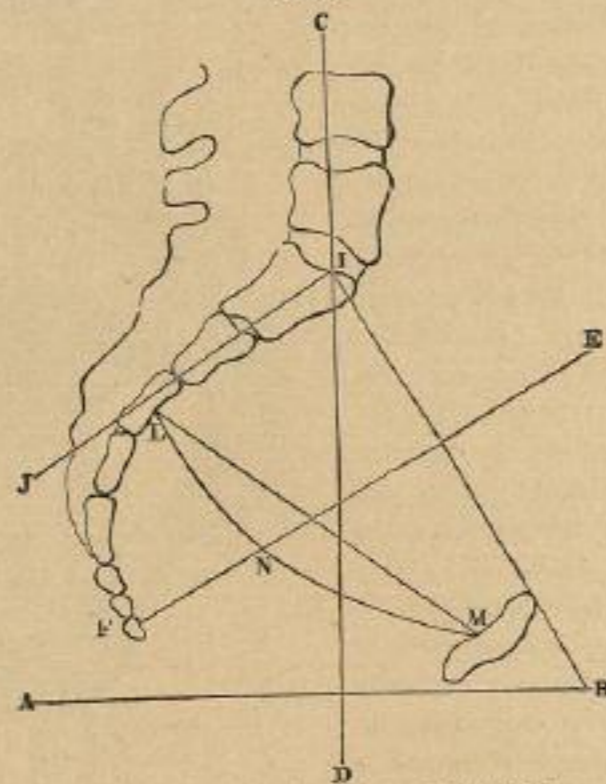
[1 The c. D is frequently used in Continental reports, instead of the c. v.—ED.]



Section of pelvis, showing the diameters.

sents the inclination to the horizon of the plane of the pelvic brim, *IB*, and is estimated to be about 60° , while the angle which the same plane forms with the vertebral column is about 150° . The plane of the outlet forms, with the coccyx in its usual position, an angle with the horizon of about 11° , but which varies greatly with the movements of the tip of the coccyx, and the degree to which it is pushed back during parturition. These figures must only be taken as giving an approximate idea of the inclination of the pelvis to the spinal column, and it

FIG. 9.

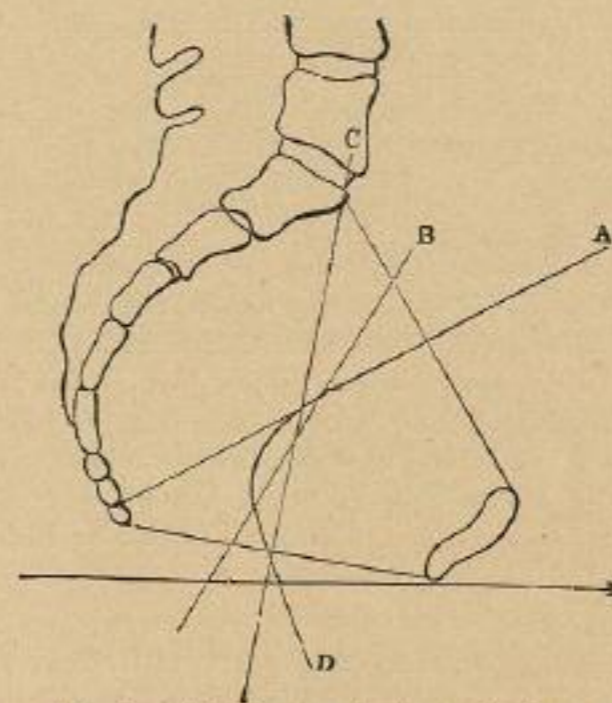


Planes of the pelvis with horizon. *AB*. Horizon. *CD*. Vertical line. *IBC*. Angle of inclination of pelvis to horizon, equal to 60° . *EIF*. Angle of inclination of pelvis to spinal column, equal to 150° . *LMN*. Angle of inclination of sacrum to spinal column, equal to 130° . *EF*. Axis of pelvic inlet. *LM*. Mid-plane in the middle line. *N*. Lowest point of mid-plane of ischium.

must be remembered that the degree of inclination varies considerably in the same female at different times, in accordance with the position of the body. During pregnancy especially, the obliquity of the brim is lessened by the patient throwing herself backward in order to support more easily the weight of the gravid uterus. The height of the promontory of the sacrum above the upper margin of the symphysis pubis is, on an average, about three and three-quarters inches, and a line passing horizontally backward from the latter point would impinge on the junction of the second and third coccygeal bones.

Axes of the Parturient Canal.—By the axis of the pelvis is meant an imaginary line which indicates the direction which the fetus takes during its expulsion. The axis of the brim (Fig. 10) is a line drawn perpendicular to its plane, which would extend from the umbilicus to about the apex of the coccyx; the axis of the outlet of the bony pelvis intersects this, and extends from the centre of the promontory of the sacrum to midway between the tuberosities of the ischia. The axis of

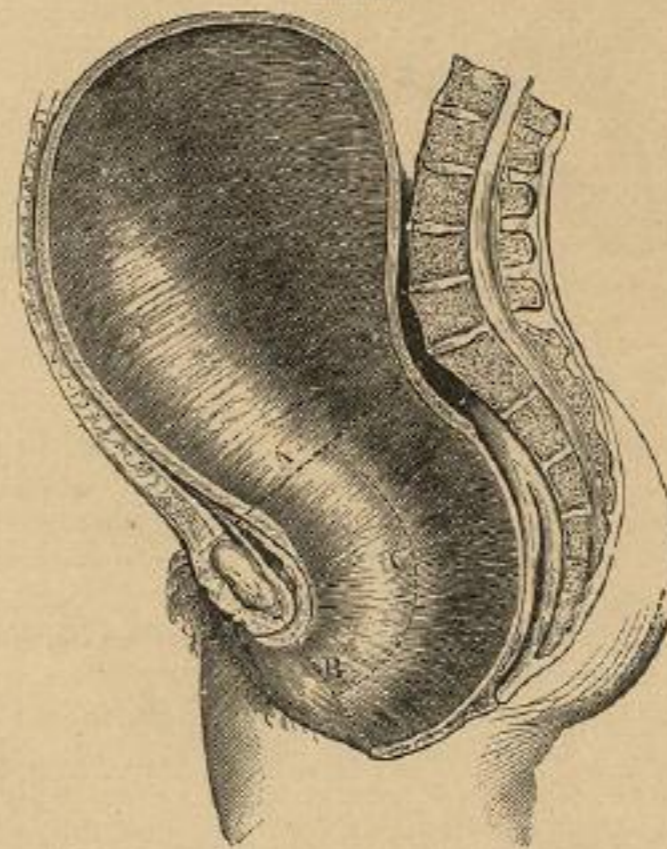
FIG. 10.



Axes of the pelvis. *A*. Axis of superior plane. *B*. Axis of mid-plane. *C*. Axis of inferior plane. *D*. Axis of canal. *E*. Horizon.

the entire pelvic canal is represented by the sum of the axes of an indefinite number of planes at different levels of the pelvic cavity, which forms an irregular parabolic line, as represented in the accompanying diagram (Fig. 10, *A D*).

FIG. 11.



Representing general axis of parturient canal, including the uterine cavity and soft parts.

It must be borne in mind, however, that it is not the axis of the bony pelvis alone that is of importance in obstetrics. We must always remember, in considering this subject, that the general axis of the parturient canal (Fig. 11) also includes that of the uterine cavity above, and of the soft parts below. These are variable in direction according to circumstances; and it is only the axis of that portion of the parturient canal extending between the plane of the pelvic brim and a plane between the lower edge of the pubic symphysis and the base of the coccyx that is fixed. The axis of the lower part of the canal will vary according to the amount of distention of the perineum during labor; but when this is stretched to its utmost, just before the expulsion of the head, the axis of the plane between the edge of the distended perineum and the lower border of the symphysis looks nearly directly forward. The axis of the uterine cavity generally corresponds with that of the pelvic brim, but it may be much altered by abnormal positions of the uterus, such as anteversion from laxity of the abdominal walls. The fetus, under such circumstances, will not enter the brim in its proper axis, and difficulties in labor arise. A knowledge of the general

FIG. 12.



Side view of pelvis.

direction of the parturient canal is of great importance in practical midwifery in guiding us to the introduction of the hand or instruments in obstetric operations, and in showing us how to obviate difficulties arising from such accidental deviations of the uterus as have just been alluded to.

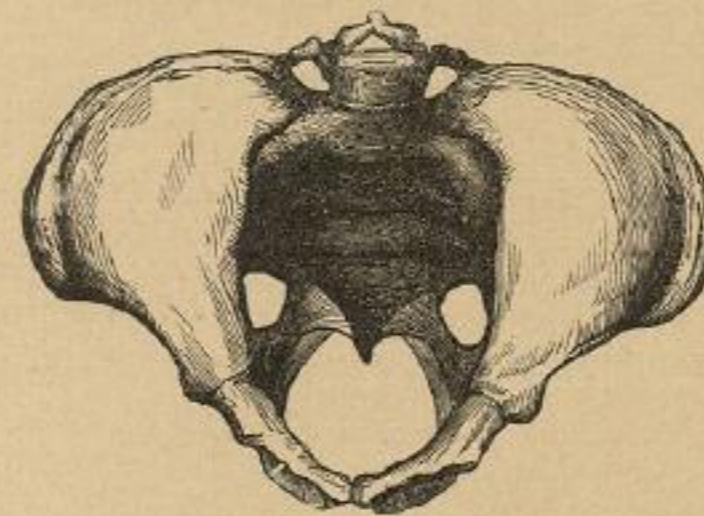
Cavity of the Pelvis.—The arrangements of the bones in the interior of the pelvic canal (Fig. 12) are important in relation to the mechanism of delivery. A line passing between the spine of the ischium and the ilio-pectineal eminence divides the inner surface of the ischial bone into two smooth plane surfaces, which have received the name of the planes of the ischium.

Two other planes are formed by the inner surfaces of the pubic bones in front and by the upper portion of the sacrum behind, both having a direction downward and backward. In studying the mechanism of delivery, it will be seen that many obstetricians attribute to these planes, in conjunction with the spines of the ischia, a very important influence in effecting rotation of the fetal head from the oblique to the antero-posterior diameter of the pelvis.

Development of the Pelvis.—The peculiarities of the pelvis during infancy and childhood are of interest as leading to a knowledge of the manner in which the form observed during adult life is impressed upon it. The sacrum in the pelvis of the child (Fig. 13) is less developed transversely, and is much less deeply curved than in the adult. The pubes is also much shorter from side to side, and the pubic arch is an acute angle. The result of this narrowness of both the pubes and

sacrum is that the transverse (T) diameter of the pelvic brim is shorter instead of longer than the antero-posterior (C. V.). The sides of the pelvis have a tendency to parallelism, as well as the antero-posterior walls; and this is stated by Wood to be a peculiar characteristic of the infantile pelvis. The iliac bones are not spread out as in adult life, so that the centres of the crests of the ilia are not more distant from each other than the anterior superior spines. The cavity of the true pelvis is small, and the tuberosities of the ischia are proportionately nearer to each other than they afterward become; the pelvic viscera are consequently crowded up into the abdominal cavity, which is, for this reason, much more prominent in children than in adults. The bones are soft and semi-cartilaginous until after the period of puberty, and yield readily to the mechanical influences to which they are subjected; and the three divisions of the innominate bone remain separate until about the twentieth year.

FIG. 13.



Pelvis of a child.

As the child grows older the transverse development of the sacrum increases, and the pelvis begins to assume more and more of the adult shape. The mere growth of the bones, however, is not sufficient to account for the change in the shape of the pelvis, and it has been well shown by Duncan that this is chiefly produced by the pressure to which the bones are subjected during early life. The iliac bones are acted upon by two principal and opposing forces. One is the weight of the body above, which acts vertically upon the sacral extremity of the iliac beam through the strong posterior sacro-iliac ligaments, and tends to throw the lower or acetabular ends of the sacro-cotyloid beams outward. This outward displacement, however, is resisted, partly by the junction between the two acetabular ends at the front of the pelvis, but chiefly by the opposing force, which is the upward pressure of the lower extremities through the femurs. The result of these counteracting forces is that the still soft bones bend near their junction with the sacrum, and thus the greater transverse development of the pelvic brim characteristic of adult life is established. In treating of pelvic

deformities it will be seen that the same forces applied to diseased and softened bones explain the peculiarities of form that they assume.

Pelvis in Different Races.—The researches that have been made on the differences of the pelvis in different races prove that these are not so great as might have been expected. Joulin pointed out that in all human pelvis the transverse (T) diameter was larger than the antero-posterior (C. V), while the reverse was the case in all the lower animals, even in the highest simiæ. This observation has been more recently confirmed by Von Franque,¹ who has made careful measurements of the pelvis in various races. In the pelvis of the gorilla the oval form of the brim, resulting from the increased length of the conjugate (C. V) diameter, is very marked. In certain races there is so far a tendency to animality of type that the difference between the transverse (T) and conjugate (C. V) diameters is much less than in European women, but it is not sufficiently marked to enable us to refer any given pelvis to a particular race. Von Franque makes the general observation that the size of the pelvis increases from south to north, but that the conjugate (C. V) diameter increases in proportion to the transverse (T) in southern races.

Soft Parts in Connection with Pelvis.—In closing the description of the pelvis, the attention of the student must be directed to the muscular and other structures which cover it. It has already been pointed out that the measurements of the pelvic diameters are considerably lessened by the soft parts, which also influence parturition in other ways. Thus, attached to the crests of the ilia are strong muscles which not only support the enlarged uterus during pregnancy, but are powerful accessory muscles in labor: in the pelvic cavity are the obturator and pyriformis muscles lining it on either side; the pelvic cellular tissue and fasciæ; the rectum and bladder; the vessels and nerves, pressure on which often gives rise to cramps and pains during pregnancy and labor; while below, the outlet of the pelvis is closed, and its axis directed forward by the numerous muscles forming the floor of the pelvis and perineum. The structures closing the pelvis have been accurately described by Dr. Berry Hart,² who points out that they form a complete diaphragm stretching from the pubis to the sacrum, in which are three "faults" or "slits" formed by the orifices of the urethra, vagina, and rectum. The first of these is a mere capillary slit, the last is closed by a strong muscular sphincter, while the vagina, in a healthy condition, is also a mere slit, with its walls in accurate apposition. Hence it follows that none of these apertures impairs the structural efficiency of the pelvic floor, or the support it gives to the structures above it.

¹Scanzoni's Beiträge, 1867.
²The Structural Anatomy of the Female Pelvic Floor.

CHAPTER II.

THE FEMALE GENERATIVE ORGANS.

THE reproductive organs in the female are conveniently divided, according to their function, into: 1. The external or copulative organs, which are chiefly concerned in the act of insemination, and are only of secondary importance in parturition: they include all the organs situate externally which form the vulva; and the vagina, which is placed internally and forms the canal of communication between the uterus and the vulva. 2. The internal or formative organs: they include the ovaries, which are the most important of all, as being those in which the ovule is formed; the Fallopian tubes, through which the ovule is carried to the uterus; and the uterus, in which the impregnated ovule is lodged and developed.

1. The external organs consist of:

The *mons Veneris* (Fig. 14, F), a cushion of adipose and fibrous tissue which forms a rounded projection at the upper part of the vulva. It is in relation above with the lower part of the hypogastric region, from which it is often separated by a furrow, and below it is continuous with the labia majora on either side. It lies over the symphysis and horizontal rami of the pubes. After puberty it is covered with hair. On its integument are found the openings of numerous sweat and sebaceous glands.

The labia majora (Fig. 14, a) form two symmetrical sides to the longitudinal aperture of the vulva. They have two surfaces, one external, of ordinary integument, covered with hair, and another internal, of smooth mucous membrane, in apposition with the corresponding portion of the opposite labium, and separated from the external surface by a free convex border. They are thicker in front, where they run into the *mons Veneris*, and thinner behind, where they are united, in front of the perineum, by a thin fold of integument called the *fourchette*, which is almost invariably ruptured in the first labor. In the virgin the labia are closely in apposition, and conceal the rest of the generative organs. After childbearing they become more or less separated from each other, and in the aged they waste, and the internal nymphæ protrude through them. Both their cutaneous and mucous surfaces contain a large number of sebaceous glands, opening either directly on the surface or into the hair follicles. In structure the labia are composed of connective tissue, containing a varying amount of fat, and parallel with their external surface are placed tolerably close plexuses of elastic tissue, interspersed with regularly arranged smooth muscular fibres. These fibres are described by Broca as forming a membranous sac, resembling the *dartos* of the scrotum, to which the labia majora are analogous. Toward its upper