PELVIS.—(Latin, derived from the Greek πέλις, a basin, the same word as Eng., pail; Fr., *bassin*; Ger., *Becken*; It., *bacino*. The appropriateness of the appellation will be evident on placing a human pelvis on a table in a horizontal position, when it will be seen to resemble a somewhat deep wash basin, with the rim broken away in front and behind.) In a restricted sense, the bony and ligamentous skeleton of that portion of the trunk to which are attached the abdominal limbs. Topographically the term is used to designate the whole region for which the bony pelvis serves as a framework, comprising, in this sense, the whole of the pudendal, perineal, sacral, subinguinal, coxal, trochanteric, and gluteal regions, and a part of the pubic and inguinal regions.

The importance of the skeletal framework is great and twofold. First, because it is through it that the weight of the body is supported, and from it that arise the powerful muscles that move the posterior limbs; second, because it forms a bony canal which contains an important portion of the genito-urinary apparatus, and through which the matured fœtus must pass to reach the outer world. The first of these considerations is architectural, the second obstetrical, while both have important surgical bearings.

Boundaries.—This portion of the trunk is defined on the surface of the body by certain landmarks and furrows. Above, there may be noted, in well-nourished individuals, crossing the median line in front, a shallow depression, concave upward, separating the pubic eminence (mons pubis, mons veneris) from the general surfaces of the abdomen. This may be called the pubic furrow and extends from groin to groin. From either end of this the shallow but well-marked inguinal furrow (sulcus or plica inguinalis) may be followed upward and outward to the anterior superior iliac spine. The crest of the ilium may then be easily traced along the flank backward as far as the depression which marks the posterior superior iliac spine. From this a line should be drawn to the spinous process of the fifth lumbar vertebra, which for topographical purposes is usually included in the pelvic region, and is characterized by a well-marked depression. This boundary, drawn on each side, will mark the limits of the pelvis above.

Below, it is best defined behind by the well-marked gluteal fold (sulcus gluteus) that indicates the lower border of the nates or rump. An arbitrary line drawn horizontally outward from the outer end of this fold, around the thigh to the inguinal furrow, will roughly include somewhat more than may properly belong to the pelvis, as it takes in the upper part of the femur with the great trochanter, usually regarded as belonging to the crural region.

Surface Markings.—Within the area thus delimited there is in front the pubic eminence, covered with hair in the adult and resting upon the pubic bone. It is more prominent in the female. On either side of this the inguinal furrow follows the course of Poupart's ligament from the anterior superior spine of the ilium to the spine of the pubis. It is maintained by fibres passing from this ligament to the skin, resembling in this respect the axillary fossa. Shallow and broad when the subject is standing erect, it is deep when the thigh is flexed. Above, it is continuous with the iliac furrow; below, it ends in the genito-femoral furrow. In females and well-nourished persons a second furrow is usually seen, corresponding more nearly to the flexion of the thigh. This terminates before reaching the anterior superior iliac spine at a depression corresponding to the separation between the sartorius and the tensor of the fascia lata. Below, it runs into the inguinal furrow.

In muscular persons, not too fat, the outer edge of the rectus abdominis, well defined upon the abdomen, may be traced down to the inguinal furrow, which it cuts at an acute angle. It is at this point (the inguinal trigone of Henke), immediately above and external to the spine of the pubis, that is found the external or superficial abdominal ring from which the spermatic cord in the male

and the round ligament in the female may be easily traced to the scrotum and the labium majus respectively. The internal or deep abdominal ring is a little more than half an inch (15 mm.) above Poupart's ligament, and midway between the anterior superior iliac spine and the symphysis pubis.

The spine of the pubis (tuberculum pubicum) lying, as it does, between the course of an inguinal and that of a femoral hernia, becomes an important point to determine. In fat persons it cannot be felt with ease except by pushing up the skin of the scrotum or labium, but may always be found by tracing up the tendon of the adductor longus muscle, made tense by adducting the thigh. The spine is nearly on a level with the top of the great trochanter, and this enables us to determine its position when it is desired to avoid external manipulation. Between the spine and the symphysis pubis the pubic crest may be made out.

Another important point is the anterior superior iliac spine, always easily felt. It is used as a point of reference in judging of deformities and injuries to the pelvis, and in measuring the relative length of the two limbs. Although situated much farther from the median line than is the spine of the pubis, it will be seen, when the pelvis is viewed laterally in its normal position, to be in the same frontal plane. A line connecting the anterior superior spines of opposite sides passes just above the level of the promontory of the sacrum. In females it is, when the pelvis is normally placed, at the same height as the middle of the third sacral vertebra, and very nearly on a level with the upper edge of the great sciatic notch. In males it is 1 or 2 cm. higher.

Below the pubic eminence appear the external organs of generation, separated from the thigh by a deep groove, the genito-femoral furrow, more fully seen on the perineal aspect. The angle of the pubis, where the two pubic bones unite at the median line, may be obscurely felt from without. In the female it is much more obtuse than in the male, and is easily accessible by vaginal examination. In the normal position of the pelvis its vertex is on a level with the lower bony edge of the obturator foramen and with the middle of the posterior surface of the tuberosity of the ischium.

If the pelvis be looked at from the side, it is seen to be limited above by the crest of the ilium, whose general situation is indicated by a slight superficial depression, the iliac furrow (sulcus coxæ). This does not, however, exactly correspond with the underlying crest, the difference depending on the varying length of the aponeurotic fibres of the external oblique muscle of the abdomen, which is inserted on the outer lip of the crest. The midaxillary line produced passes through the highest point of the crest (punctum coxale), the most prominent part of the great trochanter and the lower part of the tuberosity of the ischium (punctum ischiadicum), and bisects a line connecting the anterior and posterior iliac spines. When the arm is extended at right angles in front, the scapula is so rotated as to bring its inferior angle into this vertical. The level of the crest of the ilium is usually a little lower than the umbilicus, corresponding to the disc between the fourth and fifth lumbar vertebræ, though it may reach as high as the body of the fourth.

On this aspect the situation of the great trochanter should be noted. Usually a distinct prominence, more in relief than the crest of the ilium, in fat persons, owing to the tendinous insertion of the gluteus maximus, it may be marked by a depression. Its top is on a level with the middle of the acetabulum, and when the thigh is at rest, with the muscles relaxed, it just touches a line drawn from the anterior superior spine of the ilium downward and backward to the tuberosity of the ischium (Nélaton's line). It may rise somewhat above this line when the thigh is fully abducted (Sheild).

The most prominent features of the pelvic region, when viewed from the rear, are the rounded masses forming the buttocks or nates. While the main body of these protuberances is formed by muscles they owe their rounded outlines to a thick layer of fat. For this reason they are

better developed in well-nourished persons, in the young, and in women, than in athletes, and are frequently the seat of lipomatous tumors. In some African tribes the deposit of large quantities of fat in this region seems to be normal, especially among the females, and it forms a large projecting mass (steatopygy). The underlying masses that influence surface form are the gluteus maximus nearest the median line and the gluteus medius laterally. In muscular individuals in good training the separation between these two muscles is usually observable on the surface. They are especially important for keeping the trunk upright; and since man is the only animal that habitually walks erect, the prominence of the nates is peculiar to him.

The nates are separated from each other by a well-marked cleft, the intergluteal furrow (crena ani), usually quite deep. At its bottom is found the tip of the coccyx, a little lower than the horizontal line drawn through the top of the symphysis pubis, and about a finger's breadth farther forward is the margin of the anus, hidden from sight except in emaciated persons. Here the furrow ends in the male; in the female it becomes continuous with the beginning of the genital cleft.

Below, the nates are limited by a sharp crease, the gluteal fold (fold of the nates, gluteo-femoral fold, sulcus gluteus), caused by the attachment of the integument to the deep fascia by means of fibrous bands, which prevent the fat of the buttock from sliding down into the thigh when the sitting posture is assumed, thus making of it a veritable cushion. This fold does not correspond to the edge of the gluteus maximus, which runs obliquely downward and outward to its femoral insertion, but is nearly or quite horizontal when the subject is standing erect. When he is resting on one leg only and allowing the gluteus maximus of the free member to become stretched, the fold assumes more nearly the direction of the muscle. Externally each natis is defined by a broad, shallow depression (lateral gluteal furrow), due to change from muscle fibres to aponeurosis of insertion.

The nates are bounded above by the crest of the ilium, which terminates toward the middle line in the posterior superior spine, on a level with the spine of the second sacral vertebra, and at a point corresponding to the middle of the sacro-iliac synchondrosis. Immediately above the spine is a small area of bone quite free from depression, and therefore marked externally by a depression, especially noticeable in females. Below this the converging masses of nates leave between them a flattened triangular area which extends down as far as the fourth or fifth sacral vertebra. This flattening extends upward as far as a depression just below the spine of the fifth lumbar vertebra, and takes altogether the area constitutes a rhomboidal field (sacral rhomboid, Kreuzraute of Waldeyer) of which the two upper sides are much shorter than the two lower ones. In females the upper angle is 3–4 cm. higher than the line connecting the posterior superior spines. Through the middle of this there extend from above downward on the median line the coalesced spines of the sacral vertebræ (sacral crest, crista sacralis media), the most prominent part of which is the third sacral spine.

The general direction of the gluteus maximus is indicated by a line drawn from the posterior superior iliac spine to the most prominent part of the great trochanter. The juncture of the first and second thirds of this line is at the level of the great sciatic notch, where the gluteal artery emerges from the pelvis.

The tuberosity of the ischium, on which the body rests when sitting, is readily felt beneath the gluteal fold. It is situated in the same frontal plane as the transverse process of the fifth lumbar vertebra, and its middle is nearly the same horizontal distance behind the centre of the acetabulum that the anterior superior spine of the ilium and the spine of the pubis are in front. A line drawn from the posterior superior spine of the ilium to the outer part of the tuberosity of the ischium crosses the posterior inferior spine at 4 cm. and the spine of the ischium at 10 cm. distance, and the sciatic and internal pudic

arteries make their exit from the pelvis at the juncture of its middle and lower thirds. The tuberosity is well padded with fat contained in small loculi formed by fibrous bands that pass between it and the skin. Several small bursæ are frequent near it, one, under the tendon of the biceps and semitendinosus, being quite constant.

There is, besides, another aspect of the pelvis almost wholly concealed when the subject is standing erect with the thighs approximated, being then reduced to a mere furrow. This is the inferior or perineal aspect, corresponding to the outlet of the pelvis. To examine it the thighs should be flexed and abducted when there will be displayed a rhomboidal space known as the perineal region, lying between the thighs, having its angles at the angle of the pubis in front, the tip of the coccyx behind, and the ischial tuberosities on either side. Its sides are formed in front by the ischio-pubic rami, behind by the great sciatic ligaments, which may in this position be felt in thin subjects on deep pressure along the edge of the gluteus maximus.

It will be seen that the gluteal fold encircles on each side the inner aspect of the thigh and ends in the genito-femoral furrow. Frequently an accessory furrow is found running parallel to it. From the rounded protuberance of the nates a pointed process extends forward, bounded laterally by the gluteal fold on the one side, mesially by a furrow (gluteo-perineal furrow) that separates it from the external genitals and ends in front by uniting with the genito-femoral furrow.

In both sexes the external genital organs impinge upon the anterior part of this space, the area occupied by them being known as the pudendal region. The remaining space is usually divided for topographic purposes by a line drawn arbitrarily between the anterior part of the tuberosities of the ischium (interischiadic line). It has been pointed out by Waldeyer and others that a more suitable line, from a morphological point of view, is formed by curving somewhat forward to where the urogenital trigone, or triangular ligament, meets the pelvic diaphragm (line of the perineal septum). This separates a urogenital region through which the urogenital orifices pass, from an anal (ano-rectal) one through which the alimentary canal discharges.

In this region there may be noted, in the median line, the tip of the coccyx, often marked by a slight depression; the anus, its centre about 3–4 cm. in front of the coccyx in the male and a little farther in the female; then the median raphe of the perineum, extending in the male from the anus to the scrotum, in the female lost almost at once in the genital cleft. The point where the raphe crosses the line of the perineal septum is called the tendinous centre of the perineum (centrum perineale), where the two layers of deep fascia and the triangular ligament meet. It affords a point of origin for several muscles. A slight swelling in front of this marks in the male the underlying bulb of the urethra, situated 1–1.5 cm. from the anterior edge of the anus.

The Osseous Pelvis.—Of the bones composing the pelvis two, the sacrum and the coccyx, belong to the spinal column; and two others, the so-called ossa innominata, or hip bones, belong to the limbs and constitute the pelvic girdle, which differs remarkably from the thoracic girdle in that it is articulated firmly with the sacrum, thus affording a firm basis of support.

The Sacrum.—This bone is said to owe its name to the use made of it by nations who offered human sacrifices, it being held to be particularly sacred to the gods, because it was used as an offering representing the entire victim, it being evident that the subject must be dead if the sacrum was offered. It is reputed to be found entirely uninjured when other portions of the skeleton have decayed, and a rabbinical tradition holds that it is the essential or sacred part of man, which is to be preserved, and from which the entire body is to sprout at the judgment day. Hyrtl, whose authority on such matters is entitled to weight, considers, however, that these are mere etymological fantasies, and that in the phrase *os sacrum* the adjective is used in the sense of great or im-

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portant, because it is the largest bone of the spinal column.

The bone presents the appearance of an irregular pyramid, the axis of which has been curved so that the concavity looks downward and forward, the base presenting upward, jointing with the last lumbar vertebra, the apex downward, jointing with the coccyx. Laterally it articulates with the innominate bones. Even a superficial examination shows it to be composed of coalesced vertebræ, normally five in number, six or four being occasionally found; but this is usually accompanied by a corresponding increase or decrease of the vertebral elements of contiguous regions of the spinal column. Accordingly the main descriptive features of the sacrum depend upon its composite character. There are, on the anterior surface, transverse lines showing the original divisions; on the posterior, vestiges of the spinous and articular processes, and of the laminæ; on both surfaces
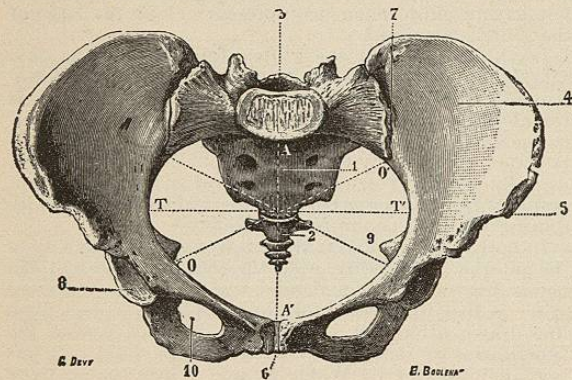

FIG. 3769.—Antero-Superior Aspect of the Pelvis. (From Testut.) 1, Sacrum; 2, coccyx; 3, sacral canal; 4, internal iliac fossa; 5, anterior superior spine of the ilium; 6, symphysis pubis; 7, sacro-iliac articulation; 8, acetabulum; 9, spine of the ischium; 10, obturator foramen. The dotted lines indicate the diameters of the superior strait. A A', conjugate diameter; T, T', transverse diameter; O, O', oblique diameter.

foramina for the exit of nerves from an axial canal, a continuation of the spinal canal of the lumbar region. Anteriorly, obliquely cut grooves lead from the sacral foramina outward, affording, to the sacral nerves that lie in them, some protection from sliding pressure.

The non-articular surfaces diminish rapidly in size, their characters are more obliterated, and they curve forward much more than the others. The summit of the curve formed by the sacrum is therefore in the third sacral vertebra, the spine of which projects in the median line. The prominence of the spine is not, however, a good guide to the convexity of the curve, which varies much in different individuals. The depth of the curve from a line subtending the arc averages 18.8 mm., having a maximum of 44 mm. and a minimum of 4 mm. The curve is developed during intra-uterine life, being probably due to an adaptation of the spinal column to the pelvic viscera. Cunningham found it in a fœtus 46 mm. long (about ten weeks). It is also seen in anthropoids.

Meyer calls that part of the sacrum which articulates with the ilium the pelvic portion, the remainder the perineal portion. Broca has pointed out that, in considering the question of the number of bones that form the tail of a vertebrate animal, we should not make the division at the sacro-coccygeal joint, as that is a character which may be considered merely a matter of special arrangement for each animal, but should rather begin to count at the non-articular portion of the sacrum. Viewed in this manner the articulating vertebræ would form a true sacrum, and those which follow would belong to the tail, and be divided into *true caudal*, having a spinal canal, and *false caudal*, reduced to centra only. According to this view, almost all the lower apes have three sacral vertebræ, as has man; and man has a tail formed of from six to eight

pieces, resembling in this respect the anthropoid apes, they varying merely in the unimportant circumstance of having a few segments more or less.

The rectum reaches the spinal column at the third sacral vertebra and thence continues along it. Rose therefore designates the portion of the spinal column thus related as the rectal cover (*Mastdarmdecke*). As it may be necessary to remove some of these vertebræ in operations for tumors, it becomes important to know how high it is safe to go. While the spinal cord terminates far above this, its envelopes continue down within the sacral canal, and the sac containing the cerebro-spinal fluid may reach as low as the third sacral vertebra. It is therefore allowable to remove the fourth and fifth sacral vertebræ; and, since the sac is pointed, to encroach laterally upon the third. In children the sac is lower than in adults. The width of the sacrum at the upper limit of surgical interference (between the second and third sacral vertebræ) is 8–11 cm. (3¼–4½ in.). In the last two vertebræ the arch becomes deficient behind, leaving the sacral canal covered by membrane. This is, therefore, a weak point, and sloughing bedsores may here invade the canal and induce a meningitis. At the sides of the coalesced vertebræ fused costal elements form strong bars known as the lateral masses of the sacrum.

As compared with other animals the sacrum of man is broad in proportion to its length. The same holds when the sacra of Europeans are compared with those of the lower races of man. In order to express this Sir William Turner has devised the *sacral index*, obtained by multiplying the breadth of the sacrum by 100 and dividing by the length. The following are the average results of many measurements: European, female, 116; European, male, 112; negro, 106; Australian, 99; Andaman Islander, 94; Orang, 87; Gorilla, 72.

Sacra having an index above 106 are termed platyhieric; those between 100 and 106, subplatyhieric; those below 100, dolichohieric. The variations in width appear to depend mainly upon variations in the lateral masses.

The Coccyx.—This is also an assemblage of from four to five coalesced vertebræ, and corresponds to the tail of the lower mammals; and, in very rare instances it may, like that, be enclosed in a fold of skin. The vertebral characters of its elements are very much reduced, there being but little more than the centra or bodies, with two vestigial articular processes called the cornua, which articulate with the sacrum. It is triangular in form and continues forward the curve of the sacrum, making together with it an almost complete quadrant, so that the apex points directly forward. It may be readily felt in rectal or vaginal examination.

The number of vertebræ in the coccyx is subject to considerable variation; five is considered the normal number in the male, four or five in the female, while six are sometimes found. In vertebrate animals the number of caudal vertebræ varies greatly, from two hundred and seventy in some sharks to two in the gibbon and fruitbat.

The Innominate Bone.— This is a complex of three originally distinct elements, the ilium, the ischium, and the pubis. When complete it resembles in shape two of the twisted blades of a propeller extending radially on opposite sides of an axial depression, the acetabulum, which receives the head of the femur. The upper expanded and somewhat longer blade is the ilium; the lower one, which has a large fenestration or obturator or thyroid foramen, is formed by the combined ischium and pubis, the pubis forming the anterior por-
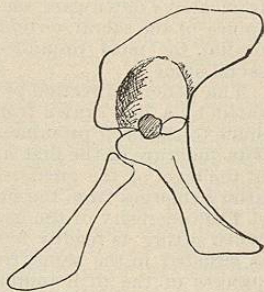

FIG. 3770.—Innominate Bone of Alligator, showing the Rod-like Character of the Separate Elements.

tion, the ischium extending backward and downward to afford support while sitting. The narrowest part of the bone (the isthmus coxæ of Waldeyer) is just above the acetabulum, lying between the greater iliac notch of Henle (from the anterior inferior iliac spine to the symphysis pubis) and the great sciatic notch.

A study of the characters of the bone throughout the vertebrate series shows that its components were originally rod-like in form. This is shown in a striking manner in the alligator (Fig. 3770), and is also indicated by the course of ossification in the human bone, for accessory points form at the crest of the ilium, the symphysis pubis, the tuberosity of the ischium and within the acetabulum, that is to say, exactly where terminal epiphyses would form at the extremities of long bones. Even in the higher mammalia the rod-like character of the bones is still apparent (Fig. 3771). When the upright position begins to be assumed, lateral expansions becomes necessary to support the weight of the body. A transition form is seen in the pelvis of the gorilla (Fig. 3772).

The thickness and strength of the different parts of the innominate bone vary according to the weight and strain to which they are subjected. While a person is standing,
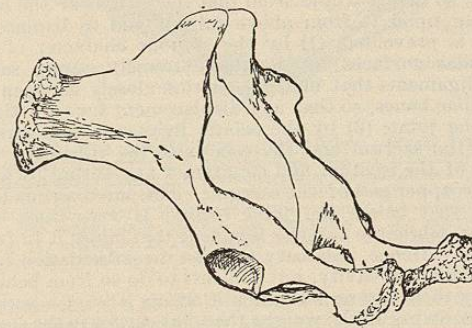

FIG. 3771.—Pelvis of the Horse.

the weight of the body is supported by the upper lip of the acetabulum, whence it is transmitted to the symphysis pubis on the one side and the sacro-iliac joint on the other. Hence a strong bar of bone extends from the symphysis along the upper edge of the acetabulum and the ilio-pectineal line to the posterior superior spine of the ilium, where it ends in a protuberance called by Waldeyer the tuber glutæum posterius. This bar may be called the pubic trabeculum. While an individual is sitting, the greater portion of the weight is borne by the tuberosity of the ischium, and is transmitted through the thick strong body of the ischium (superior ramus of many authors) and the posterior edge of the acetabulum, directly upward to a thickened portion of the crest of the ilium (tuber glutæum anterius of Waldeyer). This also is a thickened bar, and may be called the ischial trabeculum. These bars cross each other at about right angles near the axis of motion of the hip-joint.

The upper edge or crest of the ilium is sinuous and thick, and gives attachment in front to the great, sheetlike muscles that form the parietes of the abdomen, and behind to the muscles of the back. Below the crest is a comparatively thin portion caused by the hollowing out of the substance of the bone within, for the attachment of the iliacus muscle, forming the internal iliac fossa, and without, for the attachment of the glutei muscles, forming what is sometimes called the external iliac fossa (ala ossis ilium). The internal iliac fossa supports the weight of the intestines laterally and forms in the articulated pelvis the lateral portion of what is known as the false pelvis, separated from the true pelvis by a ridge (ilio-pectineal line, linea terminalis) passing from the crest of the pubis backward and upward.

The acetabulum or cotyloid cavity appears a little below the middle of the external surface of the innominate bone. It is hemispherical in shape, formed by portions

of the ilium, ischium, and pubis, and receives the head of the femur. It may become perforated by suppuration within the cavity, and thus inflammation of the intrapelvic structures may be induced. Below, the edge of the cavity is incomplete, giving passage to vessels that supply the joint. This notch is usually directed downward, and it therefore affords a means for establishing the normal position of the bone.

The united ischium and pubis constitute the side of the true pelvis. They here form three bony bars that surround the large obturator foramen, closed in, during life, by a thick sheet of fascia called the obturator membrane. This is deficient above, affording, between it and the bone, a

FIG. 3772.—Pelvis of a Gorilla.

passage about an inch long, walled in above by the bone and below by the membrane, the obturator muscles and some masses of fat. This passage, the obturator canal, contains the obturator vessels and nerve. The membrane is reinforced near the canal by independent bands attached to small bony projections on the edge of the foramen. Three of these projections have been distinguished as fairly constant. They are named by Waldeyer according to their situation—the tuberculum obturatorium laterale superius, the tuberculum obturatorium laterale inferius, and the tuberculum obturatorium mediale. The arrangement of the fibrous bands and the shape of the canal have important effects upon obturator hernia.

The two anterior bars enclosing the foramen are known as rami, the upper one being the horizontal ramus of the pubis, the lower one being the descending ramus of the pubis above, the ascending ramus of the ischium below. It may be remarked that these terms apply rather to the artificial position of the pelvis given when it is set upon a table than to its true position in the body during life, as the "horizontal" ramus is far from being horizontal, varying from that by as much as 80° in some subjects. Along these bars are attached the muscles of the perineal
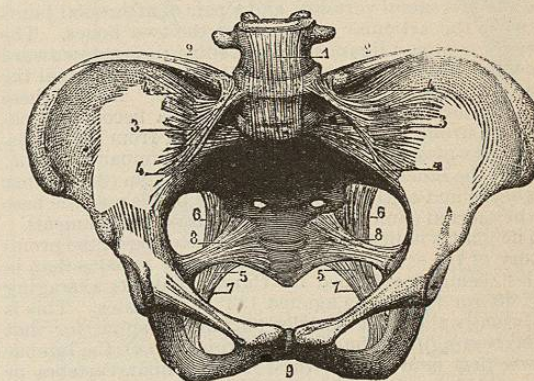

FIG. 3773.—The Articulations of the Pelvis as Seen from the Front. 1, Anterior common ligament; 2, ilio-lumbar ligament; 3, lumbo-sacral ligament; 4, anterior sacro-iliac ligament; 5, great sciatic ligament; 6, its external border; 7, its internal border; 8, lower sacro-sciatic ligament; 9, symphysis pubis.

floor and the urogenital diaphragm, on the inner side the muscles of the abdominal wall, below the adductors and rotators of the femur.

Behind, the ischium expands to a large tuberosity that gives origin to the great hamstring muscles (biceps, semitendinosus, semimembranosus), and affords attachment to the great sciatic ligaments. A pointed process (spine of the ischium) divides the posterior border into two notches, the greater and lesser sciatic.

Articulations.—The pelvic bones are joined together by five joints, all of which are synchondroses (Figs. 3773 and 3774). Two of these are vertebral joints, viz., the lumbo-sacral and the sacro-coccygeal; there is one on either side of the sacrum where it unites with the ilia; and one in front, where the innominate bones join, called the symphysis pubis.

At the lumbo-sacral joint we have the same general features as in other spinal joints, viz., a union by means of fibro-cartilage between the bodies of the last lumbar and the first sacral vertebra, and a pair of arthrodial joints between the articular processes of the two bones. The anterior common ligament of the spine passes downward upon the sacrum in front, and within the spinal canal the posterior common ligament does the same. Besides these the anterior lamina of the lumbar fascia becomes thickened to strong bands, which, springing from the transverse processes of the fourth and fifth lumbar vertebræ, pass to the inner lip of the crest of the ilium (ilio-lumbar ligament) and to the brim of the true pelvis and the base of the sacrum (lumbo-sacral or sacro-lumbar ligament).

The joint is indicated by a well-marked angle, the promontory of the sacrum, slightly greater in females than in males, being determined by Cunningham as averaging 137° 40' for females as against 133° 6' for males. This is not usually the most anterior part of the spine, for that must be sought in the forward projection of the lumbar curve, that is to say, in the fourth lumbar vertebra or even as high as the disc between the fourth and the third. Externally it may be felt on deep pressure of the relaxed abdominal wall if the subject is lean. It is one of the landmarks by which a contracted pelvis is known, and cannot, in a properly formed pelvis, be reached by the finger through the vagina, but can easily be felt in a rectal examination.

The joint between the sacrum and the coccyx is very simple, being entirely similar to that between the bodies

of the vertebræ. The articulation is usually sufficiently free to permit the apex to be displaced some 2 cm. or more, and there is sometimes a midcoccygeal vertebra. Movement usually occurs during defecation and labor, but the bone may be so firmly ankylosed to the sacrum that it offers an obstacle to the delivery of the head of a child. In the male pelvis the joint is frequently obliterated quite early. A number of ligamentous bands have been described, but they appear to have no practical importance beyond that of an investing capsule.

The joint between the sacrum and the iliac bones on either side possesses an incomplete synovial cavity. The ear-shaped articular surfaces may be divided into two parts—an upper which is clothed with cartilage and synovial membrane, and a lower whose surfaces are interconnected by means of an interosseous ligament. The joint is a very strong one, as the entire weight of the trunk is thrown upon the articulation. Owing to the wedge-like shape of the sacrum it is often described as the keystone of the pelvic arch. It should be noted, however, that in the natural standing position the bone is somewhat narrower behind and above than below and in front, so that it would seem that the weight of the body resting upon it from above might tend to displace it. This is prevented, (1) by the sinuous character of the articular surfaces; (2) by the extremely strong sacro-iliac ligaments that bind the sacrum closely between the two iliac bones, so that any displacement forward tightens the joint; (3) by the sciatic ligaments that stretch from the sacrum and the coccyx to the tuberosity and spine of the ischium and counteract any tilting forward of the upper end of the sacrum. The interosseous ligament that closes the joint behind is very thick and strong, while the anterior ligament that closes it in front is thin. Hence it is easy to open the articulation from the abdominal cavity, but difficult to do so from behind. Injury to it is rare, but when it occurs it is of a serious nature, owing to the weight the joint carries in the standing posture.

The articulation usually affects the three upper sacral vertebræ, but variations from this frequently occur. The following are the results of 265 cases observed by Paterson and Waldeyer:

S 1 + 2	21 times.
S 1 + 2 + 3	242 "
S 1 + 2 + 3 + 4	3 "
S — 2 + 3	3 "
S — 2 + 3 + 4	3 "
L 5 + S 1 + 2 + 3	1 "
L 5 + S 1 + 2	4 "
L 6 + S 1 + 2	2 "
L 6 + S 1 + 2 + 3	1 "
Total	280 "

The total amounts to 280 instead of to 265 for the reason that in 15 cases the articulation differed on one side from that on the other. It will be noted that the second sacral vertebra is always involved in the articulation.

As already mentioned, the sacro-sciatic ligaments act as restraining bands to this articulation. (See Figs. 3773 and 3774.) The great or posterior sacro-sciatic ligament (ligamentum sacrotuberosum) appears as if a continuation of the sacro-iliac, passing to the lateral parts of the sacrum and the coccyx and then to the external surface of the tuberosity of the ischium. It is somewhat narrower in the middle than at either extremity, and in its course becomes twisted upon its axis. At its lower insertion it runs as a thin sharp band (falciform process) along the ramus of the ischium and protects the internal pudic artery. Its interlaced fibres are somewhat extensible, so that it offers no considerable resistance to the moderate movement of the coccyx during labor. It is believed to represent a former continuation of the biceps and semitendinosus muscles whose tendons pass directly into it.

The small or anterior sacro-sciatic ligament (ligamentum sacrospinosum) lies in front of the great ligament

and is partly covered by it. Triangular in form, it passes from the side of the sacrum and coccyx to the spine of the ischium. It blends at its insertion with the coccygeus muscle and is regarded morphologically as a fibrous reduction of it.

These two ligaments convert the sciatic notches of the innominate bone into foramina, through which pass important structures. The greater sciatic foramen, above the spine of the ischium, is nearly filled by the pyri-
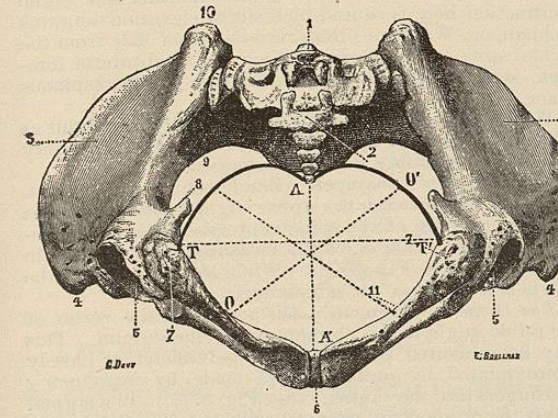
FIG. 3775.—The Inferior Strait of the Pelvis. (From Testut.) 1, Sacrum; 2, coccyx; 3, 3, external iliac fossæ; 4, 4, anterior superior spines of the ilium; 5, 5, acetabula; 6, symphysis pubis; 7, 7, tuberosities of the ischium; 8, spine of the ischium; 9, great sciatic notch; 10, posterior inferior spine of the ilium; 11, ischio-pubic rami. The dotted lines indicate the diameters of the inferior strait. A, A', conjugate or coccy-pubic diameter; T, T', transverse or bi-ischiatic diameter; O, O', oblique diameter.

formis muscle, small intervals being left above and below—the suprapyriform and infrapyriform foramina of Waldeyer. Through the former pass the gluteal vessels and the superior gluteal nerve; through the latter the internal pudic vessels and nerve, the sciatic vessels and nerves, the inferior gluteal nerve and the muscular branches of the sacral plexus. Through the lesser sciatic foramen, below the spine of the ischium, pass the obturator internus muscle, and the internal pudic nerve and vessels re-entering the pelvis.

The two pubic bones are united in front by a fibrocartilage that forms a slight eminence on the pelvic aspect of the joint. During pregnancy this swells and relaxes, and there is thus obtained a mobility that may persist for some time after delivery. Traces of a synovial cavity are occasionally found as a small slit lying near the pelvic surface, not lined with synovial membrane and apparently being a simple lymph space. This is found in both males and females, though it is larger and more constant in the latter, and is not dependent upon pregnancy. It is not found in young children. Four peripheral ligaments are described: anterior, posterior, superior, and inferior. The investment is strengthened by fibrous expansions from the recti muscles of the abdomen and the adductors of the thigh. Malgaigne considered that the height of the symphysis increased considerably after the menopause, being 38 mm. at forty-five years, and 45 mm. at seventy and eighty years. The arrangement of the abdominal muscles in their insertion about the joint is such as to draw the ends of the bones together, so that during the bearing-down pains of labor the joint is strengthened.

The Ligamentous Pelvis.—Taking now the pelvis as a whole, we find it to be divided into two well-marked parts by a line, the linea terminalis, made up of the promontory of the sacrum, the rounded angle between the upper and the lower surfaces of the sacrum, the ilio-pectineal line, the pecten or crest of the pubis, and the upper surface of the symphysis pubis. The part above this line which supports the abdominal contents is termed the *false* pelvis; the *true* part below it, containing the pelvic viscera, the *true*

pelvis, forming the bony ring through which the fœtus is expelled.

The superior opening of the true pelvis is termed the inlet or the superior strait (apertura pelvis superior). (See Fig. 3769.) Its shape is reniform in the female, cordiform in the male. Similarly the lower opening, by which the fœtus is expelled, is called the outlet, or the inferior strait (apertura pelvis inferior). (See Fig. 3775.) It is bounded by the ischio-pubic rami in front, on the sides by the tuberosities of the ischium, behind by the sciatic ligaments and the coccyx, only about half of its circumference being bony. Its form is elliptical, slightly encroached upon by the coccyx.

That part of the pelvic canal between the inferior and superior straits is called the cavity of the pelvis. It is customary to divide this into four regions, an anterior, a posterior, and two lateral. The anterior comprises the symphysis pubis, the posterior surface of the body of the pubis, and the obturator foramen with its membrane. It is limited by a line passing from the tuberosity of the ischium to the ilio-pectineal eminence. The posterior region is formed by the anterior surfaces of the sacrum and the coccyx; the lateral regions are between the anterior and the posterior. Each is again subdivided into two portions called the anterior and posterior inclined planes. The anterior comprises the internal face of the ischium and the interior surface that corresponds to the acetabulum. Its direction is oblique, downward, and backward. The posterior inclined plane is entirely composed of soft parts, and is directed downward and forward. The planes meet at a line passing through the ischial spines.

Normal Position.—When standing erect the pelvis is tilted forward, so that the anterior superior iliac spines and the spine of the pubis lie in the same vertical plane. The promontory of the sacrum is then 9.5–9.9 cm. (3¾–3⅞ in.) above the upper edge of the symphysis pubis and at about the same level as the posterior superior iliac spines and the interspace between the first and second sacral spines. The frontal plane tangent to it cuts the middle
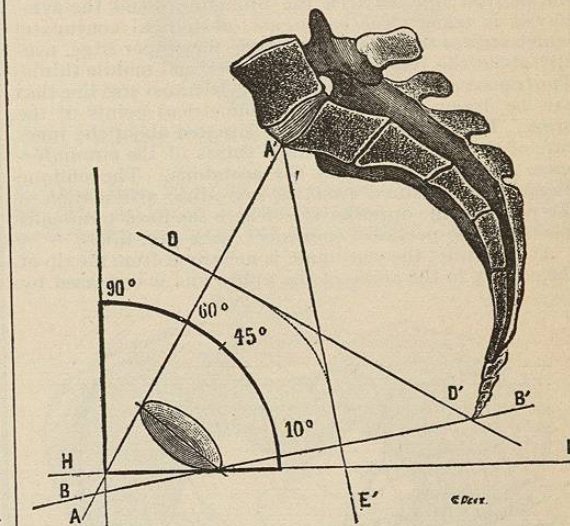
FIG. 3776.—Axes and Inclinations of the Pelvis. (From Testut.) A, A', Plane of the superior strait; B, B', plane of the inferior strait; D, D', axis of the superior strait; E, E', axis of the inferior strait; H, H', the horizontal plane, with which the plane of the superior strait, A, A', makes an angle of from 55° to 60°.

of the acetabulum and passes close behind the angle of the pubis.

In this position the planes of the pelvic inlet * and outlet are inclined to the horizontal plane, the first making

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* Strictly speaking the limits of the superior strait do not lie in the same plane, as the promontory never coincides with the plane of the linea terminalis (ilio-pectineal line).
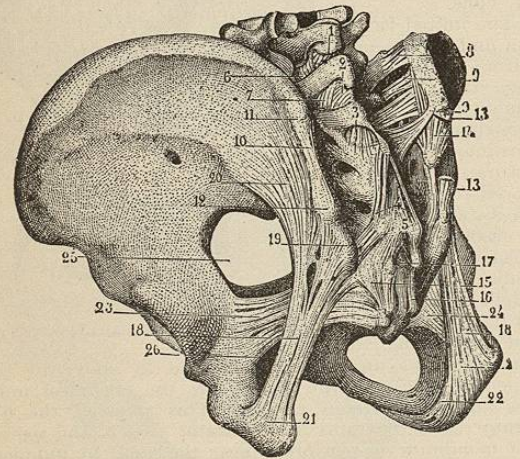

FIG. 3774.—Posterior View of the Ligaments of the Pelvis. 1, 2, 3, 4, 5, Interspinous ligaments; 6, 7, ligamenta subflava; 8, ilio-lumbar ligament; 9, posterior sacro-iliac ligament; 10, its oblique portion, continuous externally with the great sacro-sciatic ligament; 11, posterior superior spine of the ilium; 12, tubercle representing the transverse process of the fourth sacral vertebra; 13, deep layer of the posterior sacro-iliac ligament; 14, insertions of the same; 15, 16, lateral ligaments of the sacro-coccygeal articulation; 17, posterior ligament of the same; 18, great sacro-sciatic ligament; 19, its sacral insertion; 20, its iliac insertion; 21, its ischiatic insertion; 22, reflected portion; 23, lesser sacro-sciatic insertion; 24, its attachment to the sacrum and coccyx; 25, great sciatic notch converted into a foramen by the sacro-sciatic ligaments; 26, lesser sciatic notch, forming with these ligaments a triangular orifice.