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SPINAL DEFORMITY

In Relation to Obstetrics

BY

A. H. FREELAND BARBOUR

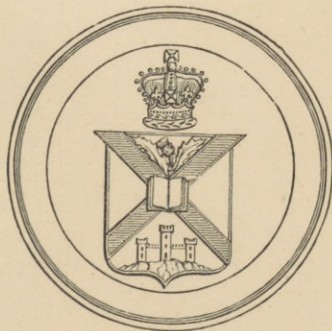
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Being a Thesis for Graduation in Medicine at the University of Edinburgh, for which a Gold Medal was awarded in 1883



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LITERATURE.

THE KYPHOTIC PELVIS.

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THE SCOLIOTIC AND KYPHO-SCOLIOTIC RICKETY PELVIS.

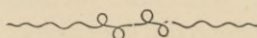
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INTRODUCTION.



THE influence of the form of the Spine on that of the Female Pelvis has attracted attention only within the last five-and-twenty years.

Matthews Duncan cleared the way for future investigators by shewing how the weight of the trunk is transmitted to the Pelvis, and through it to the lower extremities. The facts demonstrated by him, briefly stated, were these: the Sacrum does not act like the keystone of an arch; it forms a strong transverse beam, suspended, by means of the sacro-iliac ligaments, between the two curved cotylo-sacral beams; the weight of the body acts as a force tending to draw the sacral ends of the cotylo-sacral beams downwards and inwards, which movement is counteracted by the upward and inward pressure of the heads of the femora (on the cotyloid ends of these beams), as well as by the tie-beam of the pubic bones.

This new theory of the mode of transmission of the weight of the trunk through the Pelvis was adduced to explain the changes which the normal pelvis undergoes in passing from the infantile to the adult type, and also such abnormal types as the Rickety and the Malacosteon. More recent researches have, however, shewn that the peculiarities in form, which were attributed by Matthews Duncan and others to the weight of the body transmitted in the manner described above, may be present in the pelvis before birth. Fehling, who has studied specially the development of the Normal Pelvis, has demonstrated that the vertical curving of the Sacrum, the transverse widening of the Brim, the incurvation of the Cotylo-sacral Beams, are found already in the Fœtal Pelvis. The researches of Kehrer into the mode of origin of the rickety type of pelvis have shewn that this abnormal form is sometimes developmental. With regard to the Malacosteon alone, all investigators are agreed that the peculiarities of form are due to the action of the weight of the trunk on the cotylo-sacral beams.

The effect which the curvature of the Spine has on the form of the Female Pelvis may be studied in two ways:— Methods of studying this subject.

1. We may take the normally curved Spine and the normal or pathological Pelvis, and, by examining these at various periods of development, learn what relation exists between the appearance (development) of the cervical, dorsal, and lumbar curves of the Spine, and alterations in the shape of the Pelvis. This could be studied only on a series of frozen sections of the whole trunk made at various periods of development. By this method we should see precisely the effect of the *normally curved* Spine on the Pelvis—normal or diseased.

2. We may observe what changes in the Pelvis are associated with the abnormally curved Spine. Here we must also take into account whether the Pelvis is normal or pathological, as a Deformity of the Spine will produce different effects, according as it is acting on a pelvis in which the bones are healthy or diseased; compare, for example, the effects of kyphosis on a normal and on a rickety pelvis.

Studied with regard to the effect of Spinal Curvature, the different forms of pelvis arrange themselves in the following groups:—

- A. Spine normally curved : (a) Pelvis normal ;
(b) Pelvis diseased ; rachitic,
malacosteon,
unequally contracted
- B. Spine abnormally curved : (a) Pelvis normal ; kyphotic,
scoliotic.
(b) Pelvis diseased ; kyphotic rickety,
scoliotic rickety,
kypho-scoliotic rickety,
other varieties.

Of Spinal Curvature, there are two pathological types—the antero-posterior or Kyphosis (with compensatory Lordosis), and the lateral or Scoliosis.

Breisky's valuable monograph first drew attention to the effects of Kyphosis, and laid the foundation for the subsequent investigations of Chantreuil, Höning, and others. The results of Scoliosis and Kypho-scoliosis have been more recently systematized by Leopold.

There still remain many points to be cleared up. This can only be done in two ways. (1) All the available preparations must be carefully described with special reference to the Pelvis. By doing this, we shall gradually accumulate a sufficient number of facts to reason from. (2) A systematic method of investigating such cases clinically, with regard to the nature and extent of the deformity and its effect on Pregnancy and Labour, must be adopted.

Material used as
basis of Thesis.

As the basis of this Thesis, I have taken the available material in the Obstetrical and Anatomical Museums of the University and that of the Royal College of Surgeons of Edinburgh, along with a cadaver from a case of Kyphosis in which death followed immediately after delivery. I gladly avail myself of this opportunity of acknowledging the kindness of Professor Turner and Professor Simpson, of Dr Blair Cunynghame and Dr Miller—the Conservator and the Chairman of the Museum Committee of the Royal College of Surgeons, in allowing me to describe and photograph these Preparations.

The following list gives the source of the Preparations described. I have arranged them in groups, and, for brevity in referring to them, have lettered them A to N; under such designation (*e.g.* Preparation N or Pelvis N) they will be referred to throughout the thesis.

NOTE.—The terms "Kyphotic Pelvis" and "Scoliotic Pelvis" are unfortunate, as it is the Spine and not the Pelvis which is Kyphotic and Scoliotic. They have, however, passed into general use. As the term "kyphotic rickety pelvis" is applied to that form in which the Pelvis is rickety and the Spine kyphotic, the term "kyphotic normal pelvis" should be used to describe that form in which the bony constituents of the Pelvis are normal, and the altered form is due to the altered mechanical conditions under which it has grown. As this term might lead to confusion, we shall speak of the latter form as the "pure kyphotic," or simply "kyphotic."

LIST OF PREPARATIONS.

KYPHOTIC PELTS.

A—Edinburgh University Anatomical Museum	-	-	-	-	-	<i>Dorso-lumbar Caries.</i>
B—Pelvis taken from frozen section	-	-	-	-	-	<i>Dorso-lumbar Caries.</i>
C—Royal College of Surgeons' Museum—No. 346; 21, D.	-	-	-	-	-	<i>Dorso-lumbar Caries.</i>
D—University Anatomical Museum	-	-	-	-	-	<i>Dorso-lumbar Caries.</i>
E—Royal College of Surgeons' Museum—No. 558	-	-	-	-	-	<i>Lower-dorsal Caries.</i>
F—Royal College of Surgeons' Museum—No. 345	-	-	-	-	-	<i>Upper-dorsal Caries.</i>
G—Royal College of Surgeons' Museum—No. 344	-	-	-	-	-	<i>Dorso-lumbar Caries.</i>

SCOLIOTIC RACHITIC PELTS.

H—University Anatomical Museum.

KYPHO-SCOLIOTIC RACHITIC PELTS.

J—Royal College of Surgeons' Museum—No. 587.
 K—Royal College of Surgeons' Museum—No. 559 and 560.
 L—University Anatomical Museum—No. 510.
 M—Obstetrical Museum.
 N—Obstetrical Museum.

These, with the exception of D and L, were photographed according to the exact scales of $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{4}$, and are accurately represented in Plates I.—XV. A typical normal and a rickety Pelvis from the Obstetrical Museum were also photographed for the sake of comparison, as well as a complete rickety skeleton from the Royal College of Surgeons' Museum.

Division of sub-
ject.

The subject of this Thesis naturally falls into the three following parts:—

- I. The changes in the form of the Female Pelvis present in Spinal Deformity;
- II. The displacement of the Viscera and the relations of the Pelvic Organs (post-partum) in a case of Kyphosis, studied in a series of frozen sections;
- III. The influence of these Deformities of the Pelvis on labour, and their Clinical Study.

PART I.

THE CHANGES IN THE FORM OF THE FEMALE PELVIS PRESENT IN SPINAL DEFORMITY.

In this section, two subjects require investigation :—

- (1) The Nature, Seat, and Extent of the Deformity of the Spine ;
- (2) The Form of the Pelvis.

These must be ascertained by methods which can be applied clinically.

(1) To determine the Kyphosis, the spine of the most prominent vertebra was ascertained at the angle of junction of the two limbs of the kyphotic portion ; the length of each limb was measured along the spinous processes, and the distance of the spinous process which formed its further end was measured from a perpendicular let fall through the apex of the kyphosis—the skeleton being placed in the upright posture. The inclination of the Brim of the Pelvis to the horizon was always noted. The determining of kyphosis.

The amount of Scoliosis was ascertained by letting fall a perpendicular from the spinous process of the II. cervical vertebra (the skeleton being placed in the erect posture), and measuring from this perpendicular the distance of the spinous process and of the outer margin of the body of the vertebra which formed the apex of the curve. Pl. XXII. gives the curves of the most interesting Preparations, reduced to scale $\frac{1}{2}$. It brings out this important point that, owing to the rotation of the vertebræ, the curve formed by the spinous processes is much less than that formed by the bodies of the vertebræ : a slight amount of curvature of the spines implies a much greater curvature of the bodies or of the vertebral column as a whole. Of scoliosis.

(2) In measuring the Pelvis, a pair of ordinary compasses was used for the sake of exactness. Variations in length of 1—2 mm. are of no importance, as the most careful measurement of the same pelvis on different occasions gives slightly different results owing to the bony land-marks not being precise. I have followed Breisky's method, as it is the one generally adopted. The distances are given in centimetres for ease in calculation and comparison with the results of other investigators. I am greatly indebted to Dr David Smart for his assistance in checking the measurements of the Pelves and making out the Tables. Mode of measuring pelvis.

Table I. gives the absolute length. To compare one pelvis with another, the measurements must be expressed for each in terms of a standard-line which will vary with the size of the pelvis. The standard-line adopted by Breisky is the greatest breadth of the sacrum in the *linea terminalis*, *i.e.* between the sacro-iliac joints. This standard is open to the objection that the breadth of the sacrum (relative to the pelvis) varies in different types. In the kyphotic type, there is a narrow sacrum ; hence all the measurements will be exaggerated. In the pure rickety type there is a wide sacrum ; the measurements will be proportionately diminished. Further, in the same type of pelvis, the breadth of the sacrum varies. To ascertain this, I measured the breadth of the sacrum, and also the circumference of the brim—measured across the standard-line. Pelves F and G are both kyphotic, but the proportion of the breadth of the sacrum to the circumference of the brim is as follows :—

F.—Stand. Line : Circum. of Brim : : 10.5 : 41.4—or about 1 to 4
G.—Stand. Line : Circum. of Brim : : 9 : 27 —or about 1 to 3.

Table II. gives the length expressed as a percentage of Breisky's standard-line, which in want of a less variable one we have adopted. The advantage of such a table will be evident from an example :—the *conjugata vera* of B is (according to Table I.) to that of A as 175 to 160 ; Table II. gives the proportion as 184 to 178 which expresses the relative length more nearly, because B is a larger pelvis.

As to the diameters mentioned in the tables, they were taken between the usual points. The oblique diameters at the brim were measured anteriorly to the prominence (*tub. ileo-pubicum*) on the brim, above and to the inner side of the cotyloid cavity. By the corner of the S curve on the iliac crests is meant a point on the outer lip of the crest opposite to the attachment of the ileo-lumbar ligament. The "*conjugata normalis*" is represented by a line drawn from the upper margin of the Symphysis to the middle of the third sacral vertebra. The "*conjugate of the outlet*" is measured from the lower border of the Symphysis to the lower end of the Sacrum (*sacro-coccygeal articulation*)—not to the Coccyx. By the "*linea terminalis*" is meant the line which forms the circumference of the plane of the Brim. I have called the line joining the anterior superior iliac spine and the ischial tuberosity the "*ilio-ischial line*," which is shorter if not so exact as a literal rendering of *Huftstachelsitzknorrenlinie* (*Hip-spine, sitting-tuberosity line*).

DETAILED DESCRIPTION OF PREPARATIONS A TO N.

PREP. A. PELVIS, VERTEBRAL COLUMN, AND RIBS FROM A CASE OF KYPHOSIS DUE TO DORSO-LUMBAR CARIES (*v.* Pl. I. II. and V.).

No catalogue description.

VERTEBRAL COLUMN. Kyphosis, in dorso-lumbar region. Apex at IX. dorsal spine ; V. dorsal to III. lumbar vertebræ ankylosed ; the

bodies of these two in part preserved, of the intermediate ones blended. The upper limb passes upwards and slightly to the right, to end at the VII. cervical spine—11.5 cm. from the perpendicular; the lower passes forwards, and ends at the V. lumbar spine—8 cm. from the same (fig. 18).

THORAX. Owing to the absence of the sternum, the form cannot be ascertained, but the ribs evidently touched the iliac crests.

EXTREMITIES. Absent.

PELVIS. Markedly funnel-shaped.

False Pelvis. Iliac crests expanded and flattened. Bone thin and translucent in the fossæ—specially the left. Anterior spines thrown apart, posterior approximated. The fossæ look forwards and only slightly inwards. The crest forms a simple arch; the incurvation, corresponding to the fossa, is absent.

To compare the form of the crest with that of the normal pelvis, the arch of it was regarded as an arc of which the chord is a line (on the outer surface of the bone) joining the anterior superior and posterior superior spinous processes; the height of the arc is measured by a perpendicular let fall from the highest point of the crest on this line.

	<i>Normal Pelvis.</i>	<i>Kyphotic A.</i>
Chord	15.2	16
Height of Arc	6.2	6.6
Length of Arc	23	24

True-Brim. Oval with greatest diameter antero-posterior. For diameters, see Table I. The promontory stands higher than in the normal pelvis: a line crossing the iliac crests so as to touch the vertebral column, lies 11 cm. behind the anterior superior spines (instead of 5.5, as in pelvis O), and cuts the middle of the body of the V. lumbar vertebra (instead of its upper margin, as in O).

The linea terminalis has, from the drawing-out antero-posteriorly of the iliac crests, a flattened instead of a rounded contour on each side. This is brought out in the following measurements. As the sacrum does not take part in the alteration of the contour, the arc is measured from the sacro-iliac joint to the symphysis along the linea terminalis: the shortest distance between these points forms the chord from which the height of the arc is measured by a perpendicular.

	<i>Normal Pelvis.</i>	<i>Kyphotic A.</i>
Chord	11.6	13.2
Height of Arc	3	3.2
Length of Arc	13.2	14.5

These measurements shew elongation and relative diminution of curvature.

Cavity. Markedly diminished from above downwards. For diameters, see Table I. Sacrum, vertically much elongated. The first vertebra is convex from above downwards, the others are concave; they are all concave transversely except the first two, which are flattened. The foramina are large and rounded. The bodies of the lowest three vertebræ are slightly carious.

Outlet. The pubic rami meet at an acute angle, and run almost parallel backwards. The ischial tuberosities and spines are approximated. Owing to the posterior inferior iliac spines coming nearer to the ischial spines, the sciatic notch is almost oval. The tip of the coccyx touches a line joining the tuberosities; and the lower end of the sacrum is 5.3 cm. from the same line.

PREP. B. PELVIS, VERTEBRAL COLUMN, AND THORAX FROM A CASE OF KYPHOSIS DUE TO DORSO-LUMBAR CARIES (v. Plate XXXV.).

This preparation was obtained by putting together the pieces of bone from the frozen sections described in Part II. The obstetric History of this case will be referred to in Part III. The peculiarity of this pelvis is that while it shows the kyphotic characteristics at the brim, these are absent at the outlet.

VERTEBRAL COLUMN. Kyphosis in dorso-lumbar region. Apex at X. dorsal spine. The upper limb passes forwards and to the right to end at the VII. cervical spine 7.5 cm. from the perpendicular; the lower passes forwards and to the right, and ends at the V. lumbar spine 4 cm. from the same. Brim placed at an angle of 65°.

THORAX. The form of this is best studied in the sections—Part II.

PELVIS. Larger than A, funnel-shape not pronounced.

False. Crests not thrown so far apart as in A (cf. Inter-spinous and cristal diam. in Table II.). Arching almost normal: Chord, 15; Height, 6.2; Length, 22.

True-Brim. Elongated antero-posteriorly. The portion of bone which formed the tip of the promontory was unfortunately in the section where the plaster ran in and was thrown away; the conjugate was not less than 17.5 cm. or 6 $\frac{7}{8}$ in. In A it was 16 cm. or 6 $\frac{1}{2}$ in.; but as the whole pelvis is larger, expressed in terms of S.L. (standard-line), the conjugate of these compared is A : B :: 178 : 184. The transverse measures 13 cm. or 5 $\frac{1}{8}$ in. Compared with A it is shorter as 137 to 139. The linea terminalis measures as follows: Chord, 14; Height 3.4; Length, 16.5.

Cavity. The sacrum is narrowed transversely as in A, and still more elongated vertically as 135 to 128.

Outlet. The Conjugate (measured to the end of the Sacrum) is contracted to the same degree as A; its absolute length is 12 cm. or 4 $\frac{3}{4}$ in. The transverse is not contracted, and measures 10.4 cm. or 4 $\frac{1}{8}$ in. Compared with A, the transverse is as 109 to 40.

On taking out the bones from the sections, I observed that there was a considerable range of mobility of the bones at the left sacro-iliac joint. Unfortunately the right joint had become dried before my attention was directed to this point by the condition of the left one.

PREP. C. PELVIS, VERTEBRAL COLUMN, AND RIBS FROM A CASE OF KYPHOSIS, IN A YOUNG SUBJECT, DUE TO DORSO-LUMBAR CARIES (*v.* Plate VII.).

Catalogue description: "Fine example of the curve which is a consequence of caries and ankylosis in a young person. The œsophagus reached directly from the neck to the diaphragm, so that it was not more than three inches in length, while the Aorta measures between same points, nine inches."

VERTEBRAL COLUMN. Kyphosis in dorso-lumbar region; very slight scoliosis to the left side. Apex at X. dorsal spine; VIII. dorsal to II. lumbar vertebræ ankylosed, the bodies of these two in great part preserved. The upper limb rises from left to right, to end at VII. cervical spine—9 cm. from the perpendicular; the lower ends at the V. lumbar spine—8.7 cm. from the same.

THORAX. Sternum absent. The ribs pass forwards and slightly outwards. From I. rib to tip of XI., the vertical measurement is 13 cm. The XI. rib comes to within 1 cm. above the crest of the ilium, and about 3 cm. internal to it (on both sides).

PELVIS. Small and delicately shaped.

Iliac bones thin and very translucent.

The linea terminalis is less arched on the right side. The sacrum is vertically convex from the I. to lower margin of III. vertebra, where it becomes concave.

PREP. D. PELVIS, VERTEBRAL COLUMN, AND THORAX FROM A CASE OF KYPHOSIS DUE TO DORSO-LUMBAR CARIES.

No catalogue description.

VERTEBRAL COLUMN. Kyphosis in dorso-lumbar region. From the I. dorsal to the III. lumbar vertebra, the bodies have been destroyed by a rapid carious process. The spinal canal is covered in anteriorly by irregular portions of spongy bone with spaces between them. The IV.—VII. dorsal spines are blended into a ridge; those of the other dorsal vertebræ are distinct. The transverse processes from the IV. dorsal to the III. lumbar are more or less destroyed. The IX. left and the VII. VIII. with the X. and XI. right ribs do not come up to the spinal column, the head and neck of these ribs and the corresponding transverse process being absent.

THORAX. The upper limb of the Kyphosis passes, from the apex at the VII. dorsal spine, downwards and forwards so that the upper dorsal spines form an arch with the convexity downwards, the IV. cervical spine (which lies 1.1 cm. below the level of the V. dorsal) being 11 cm. from the perpendicular. The lower limb passes vertically downwards, arching slightly to the right side, to end at the V. lumbar spine—4 cm. from the perpendicular.

The cavity is much diminished vertically. The sternum looks upwards in its upper half, upwards and forwards in its lower. Side-wall of chest measures vertically 16 cm.; the IV. rib on the left side bifurcates anteriorly to articulate with the sternum by two cartilages.

PELVIS. Somewhat funnel-shaped.

False. Iliac fossæ less curved than the normal. The crest is more arched on the left side.

	<i>Chord.</i>	<i>Height and Length of Arc.</i>	
Right—	13,	5.6,	20.
Left—	13,	5.8,	21.

True-Brim. Unequal; linea terminalis flatter on the right side, while the symphysis is pushed to the left.

	<i>Right.</i>	<i>Left.</i>
Chord	12.5	12.5
Height of Arc	1.1	3.4
Length of Arc	14.5	15

Cavity. Sacrum. First and second vertebræ convex vertically and transversely; others concave. Foramina larger on the right side, and the linea terminalis passes more vertically to the promontory.

Outlet. Pubic arch narrow. The left limb of it passes more directly downwards to the tuberosity. The left ischial tuberosity and spine stand at a lower level and nearer the middle line than the right. The condition at the outlet is the opposite of that at the brim, which is contracted at the right side as shewn by the shorter right sacro-cotyloid and left oblique diameters.

PREP. E. RIGHT HALF OF A SECTION OF PELVIS, VERTEBRAL COLUMN, AND THORAX FROM A CASE OF DORSAL KYPHOSIS IN A YOUNG SUBJECT (*v.* Plate VIII.).

Catalogue description: "Distortion of spine produced by caries of the vertebræ introduced here as an object of comparison." As only one half of the section is present, the description and measurements are restricted.

VERTEBRAL COLUMN. Kyphosis in the lower dorsal region. Apex at IX. dorsal spine; VII.—XII. dorsal vertebræ ankylosed. Upper limb extends to VII. cervical spine 5.5 cm. from the perpendicular; the lower to the III. lumbar spine 4.2 cm. distant from the same, below which there is a slight compensatory lordosis.

THORAX. The sternum runs parallel to the lower limb of the Kyphosis: upper end 10.2 cm. distant from cartilage between I. and II. lumbar vertebræ, lower end equally distant from that between the IV. and V. From symphysis to lower end of sternum—16 cm.

PELVIS. The ilium has not yet ankylosed with the pubis or ischium. The ilium forms 4 cm., the pubis 4.2, and the half of the sacrum 3.8 cm. of this half of the linea terminalis. The arching of the iliac crest is as follows:—

Chord, 10; Height of Arc, 4.2; Length of Arc, 15.5.

PREP. F. COMPLETE SKELETON FROM A CASE OF KYPHOSIS IN THE LOWER DORSAL REGION
DUE TO CARIES (*v.* Plate IX.).

Catalogue description: "Two perpendicular sections of a spine in which there has been caries of the upper dorsal vertebræ." The curve forms a good contrast with No. 344.

VERTEBRAL COLUMN. Kyphosis in lower part dorsal region. Apex at VIII. dorsal spine; the V. to XI. dorsal vertebræ have become blended into one bony mass. The upper limb extends from this to the VII. cervical spine 8 cm. from the perpendicular, at which point the curve begins to pass more directly upwards to become vertical at the III. cervical vertebra. The lower limb extends to the IV. lumbar spine, 7.6 cm. distant from the perpendicular. The spinal canal is not encroached on at the apex of the kyphosis, but is slightly compressed in the lower limb.

THORAX. The sternum runs almost parallel to the lower limb of the kyphosis—its superior end being 7 cm. distant from the middle of the I. lumbar vertebra, its inferior end being 8.9 cm. from the cartilage between the III. and IV. From superior end to lower border of VI. cervical vertebra, 4.4 cm.; from the inferior to the symphysis, 24.1 cm. Vertical measurement of side-walls of thorax—19.1 cm. The XI. rib is 3.5 cm. distant from the iliac crest of the same side. The cartilage of the X. rib stands 3.5 cm. internal to a perpendicular let fall on the anterior superior iliac spine of the same side.

False. Crests not thrown apart and arch normal.

PELVIS—True. The promontory stands high (relative to the ilia). A line passing between the iliac crests so as to touch the vertebral column lies 7 cm. behind the anterior superior iliac spines and crosses the promontory. The linea terminalis is shorter and flatter on the right side:

	<i>Right.</i>	<i>Left.</i>
Chord	12.2	12.5
Height of Arc	3.2	3.5
Length of Arc	14.2	14.5

The sacrum measures 10.5 at the standard-line, and the brim measured across the same line is 41.4.

PREP. G. COMPLETE SKELETON FROM A CASE OF KYPHOSIS IN THE DORSO-LUMBAR REGION
DUE TO CARIES (*v.* Plate X.).

Catalogue description: "Two perpendicular sections of a spine in which there has been caries of the lumbar region." As the skeleton is entire, they form good examples of the peculiar curve produced when the disease has attacked the lower part of the column.

VERTEBRAL COLUMN. Kyphosis in the dorso-lumbar region. Apex at XII. dorsal and I. lumbar spines; the IX. dorsal to III. lumbar vertebræ are ankylosed. The upper limb passes forwards and to the right, to end at the VII. cervical spine—12 cm. from the perpendicular; the lower limb passes also to the right, and ends at the V. lumbar spine 3.6 cm. from the same. The spinal canal is not encroached on at the curvature.

THORAX. The sternum which approaches the vertebral column above (from upper end of manubrium to body of VI. cervical vertebra is 5.1 cm.) diverges from it as it passes downwards (from lower end of sternum to inside of apex of kyphosis is 20.3 cm.); it slopes from right to left, and looks directly forwards. Side-walls of thorax measure vertically 16 cm. On the left side, the X. rib is just above the iliac crest; on the right side, the same rib is 3.8 cm. above the crest, and turns forwards and inwards so as to lie 5 cm. internal to it.

PELVIS. Bones as a whole more slender than those of F. Iliac bones translucent. The promontory does not stand so high as in F. A line joining the iliac crests and touching the vertebral column lies 9.6 cm. from the anterior superior iliac spines, and cuts the lower margin of the V. lumbar vertebra. The linea terminalis is longer and more arched on the left side.

Right:	chord	11.5,	height 3.1,	length 13.5
Left:	"	12,	" 3.2,	" 14

PREP. H. SKELETON—COMPLETE EXCEPT HEAD AND STERNUM—FROM A CASE OF SCOLIOSIS
DUE TO RICKETS (*v.* Plate XI.).

No catalogue description.

VERTEBRAL COLUMN. There is a scoliosis, with a curve to the right side in the dorsal region, and a compensatory dorso-lumbar curve to the left. A perpendicular was let fall from the second cervical spine, which (with the skeleton in the erect posture

crossed the apex of the X. dorsal and V. lumbar spines. From this perpendicular the distance of the most divergent spine and of the outer side of body in each curve is as follows:—

Right-sided dorsal curve	IV. dorsal spine 2 cm. distant,
	VI. dorsal body 5.6 cm. distant ;
Left-sided lumbar curve	I. lumbar spine 1.4 cm. distant,
	II. lumbar body 4.8 cm. distant.

The sacrum slopes gently to the right again, the I. sacral spine being .5 and the tip of the coccyx 1.1 to the right of the perpendicular. the relation of these curves will be evident from Pl. XXII., fig. 1, in which they are drawn to scale $\frac{1}{2}$.

EXTREMITIES. The left leg is shorter than the right—the femur and tibia being more curved on this side. The left patella stands a little higher than the right.

PELVIS. When the skeleton is in the erect posture, the brim is almost vertical to the horizon; the left iliac crest stands on a higher level than the right.

False. The iliac wings are small; the fossæ look directly forwards; the bone in the fossæ is slightly translucent on the left side, opaque on the right. The right crest is the longer, and the muscular ridges on it are more prominent; its anterior and posterior spines are more developed, and the plate of bone is thicker.

The difference between the crests is as follows:—

	<i>Left.</i>	<i>Right.</i>
Chord	10.1	10.2
Height of Arc	3.4	3.9
Length of Arc	14.3	16.2

True-Brim. The promontory stands high: a line joining the iliac crests and touching the vertebral column, lies 1.9 cm. behind the anterior superior spines and crosses the promontory. The linea terminalis is flatter and shorter on the left side.

	<i>Left.</i>	<i>Right.</i>
Chord	8.2	8.7
Height of Arc	1.2	1.4
Length of Arc	8.6	9.2

The promontory is pushed towards the right side so as to contract the brim on that side, so that the right sacro-cotyloid is 5.3 while the left is 5.6.

As the Iliac are not ankylosed to the Pubes, we can determine the extent to which the various bones enter into the formation of the brim (measured across the standard-line).

Sacrum		8.3
Ilium—right	3.5	} 6.6
left	3.1	
Pubis—right	5.1	} 10.2
left	5.1	
Breadth of Symphysis		1.1
Circumference of Brim		<u>26.2</u>

Cavity. Sacrum.—All the vertebræ are convex transversely. Vertically, the bone is flat over I.-III. vertebræ but becomes slightly curved over IV. and V. The right half is compressed and measures 3.9 cm. across the lower margin of the I. vertebra instead of 4.3 as on the left side. The right sacro-sciatic notch is compressed so as to be more oval than the left.

Outlet. Pubic arch wide. Right ischial tuberosity is on a lower level and turned more outwards than the left. Sacrum and coccyx directed to the right.

PREP. J.—COMPLETE SKELETON FROM A CASE OF SCOLIOSIS (*v.* Plates XII. and XIII.).

Catalogue description: "Skeleton of a woman presenting a very remarkable case of distortion by rickets. It measures from the top of the head to the heel but $31\frac{1}{2}$ inches. The heel touches the knee. The measurement from the Sacrum to the Pubis is $2\frac{1}{2}$ in.; from prominence of os coccygis to the pubis 3 inches; from base of one ilium to that of the other $4\frac{3}{4}$ inches. The spine is distorted in the form of an S, the ribs of the left side especially are flattened and compressed. The cranium has a natural appearance and the teeth are not affected. The arm bones are only distorted by the action of the muscles." (See Shaw on Distortions, Plate V.)

VERTEBRAL COLUMN. A perpendicular let fall from the II. cervical spine, runs along the next two cervical spines, crosses the VIII. dorsal and V. sacral spines (see Pl. XX., fig. 3). In the dorsal region, there is a curve to the right side: apex at III. dorsal spine which is 2.5 cm. from the perpendicular; the body of V. dorsal vertebra (measured to its outer side) is 7 cm. from the same line. In

the lower dorsal, the lumbar and sacral regions, there is a wide curve to the left side; apex at II. lumbar spine 5 cm. from the perpendicular; the cartilage between the I. and II. lumbar vertebræ is 12 cm. from the same. The I. sacral spine is 3 cm. to the right of the vertical.

The kyphosis is so slight that it may be left out of account.

THORAX. Right half much flattened and stands at a higher level than the left—the right clavicle and scapula being tilted upwards. The sternum slopes downwards and to the left.

EXTREMITIES. The bones of the upper are apparently of normal length the hands; with arms extended, touch the knees. Both femora are markedly curved and rotated outwards. The tibia are sharply bent inwards so that the heel touches the knee-joint. The long axis of the foot is almost vertical, when the skeleton is erect.

PELVIS. This is represented full-size in Plate XIII.

False. The right innominate bone stands higher than the left, the right anterior superior spine being 8 cm. above the left. The right ilium is flattened and looks almost directly forwards. The left looks inwards, is deeply concave and shortened from before backwards. The muscular ridges are more strongly marked on the right ilium and the plate of bone is thicker and less translucent.

True-Brim. The promontory is pushed downwards and to the left side. The linea terminalis is, on the right side, rounded posteriorly; on the left side, it is bent sharply on itself 1 cm. in front of the sacro-iliac joint; it bulges inwards over the left acetabulum. The symphysis is pushed slightly to the right side, though it is nearer the left end of the standard-line than the right (*v.* Table I.).

Cavity. *Sacrum* expanded unequally. The left wing stands on a lower level and is narrower than the right; the right half of sacrum, measured across the I. vertebra, is 6 cm. while the left is 5.6. From the great projection of the bodies of the first two vertebræ beyond their wings, the sacrum is convex vertically in this part but is concave below this. The sacro-sciatic notch is narrower on the left side; the posterior inferior iliac spine standing on a lower level, while the ischial spines are at the same level on each side.

Outlet. The pubic arch is wide, the left limb of the arch is bent on itself at the junction of the rami of the pubis and ischium. The form of the outlet is of the rachitic type; the tuber ischii is not turned outwards on the left side as in N.

**PREP. K. VERTEBRAL COLUMN AND PELVIS FROM A CASE OF KYPHO-SCOLIOSIS
IN THE DORSO-LUMBAR REGION (*v.* Plate VIII.).**

Catalogue description: "Section of the pelvis and spine of a female. Spine greatly distorted. Pelvis natural. The canal of the spinal marrow is perfect. The inter-vertebral substance healthy, the internal structure of the vertebræ unaltered but some of the transverse and articulating processes ankylosed."

VERTEBRAL COLUMN. Kyphosis in dorso-lumbar region. Apex at XII. dorsal vertebra. The upper limb extends to the I. dorsal spine perpendicular; lower limb to V. lumbar spine 5 cm. distant. Pelvis at angle of 60°.

The Scoliosis is in the form of a long wide curve beginning about the X. dorsal vertebra and passing upwards and to the left so that the spine of the VII. cervical is 7 cm. from a perpendicular let fall through the X. dorsal spine.

PELVIS. Roomy both antero-posteriorly and transversely. The relatively small iliac crests, wide pubic arch and the nature of the curvature shew that this is a rachitic pelvis and a well marked kypho-scoliosis of the spine.

**PREP. L. PELVIS, VERTEBRAL COLUMN, AND THORAX, FROM A CASE OF KYPHO-SCOLIOSIS,
THE SCOLIOSIS BEING TO THE RIGHT.**

VERTEBRAL COLUMN. No catalogue description.

Kyphosis in lower dorsal region. Apex at spine of VII. dorsal; no ankylosis of the bodies of the vertebræ. Lower limb extends to IV. lumbar spine—6.2 cm. distant from perpendicular; upper to VII. cervical spine—5 cm. distant from same. Pelvis placed at an angle of 50°.

Scoliosis. A perpendicular let fall from the III. cervical spine crosses the IV. dorsal and V. sacral spines. There is a slight curve in the lower cervical region to the right and another (also slight) to the left in the upper dorsal. The chief curve is a long gradual one to the right in the lower dorsal and lumbar regions; apex at XI. dorsal spine which is 1.8 cm. distant from the perpendicular while the body is 7 cm. distant.

THORAX. Much flattened on the right side and is most prominent anteriorly along the left costal cartilages so that the sternum looks upwards, forwards, and to the right. The flattening on the right side is due to the rotation of the vertebræ which causes the ribs of this side to have a longer course. Upper end of sternum is on a level with the body of the I. cervical vertebra from which it is 3 cm. distant; the lower end is 23.2 cm. from the symphysis.

PELVIS—False. Iliac crests both small; left stands more vertical and looks more inwards than the right.

True-Brim. Ovoid, unequal, contracted on left side. Promontory stands high; a line passing between iliac crests and touching vertebral column lies 6.5 cm. behind certain superior iliac spines and crosses lower margin of V. lumbar vertebra. The linea terminalis sweeps in a gentle curve

on the left side, and rises rapidly to the promontory; on the right side, it has an obtuse angle 1 cm. in front of the sacro-iliac joint and rises more gradually to the promontory. The measurements are as follows:—

	<i>Right.</i>	<i>Left.</i>
Chord	10·2	9·8
Height of Arc	3	3·1
Length	12·7	12·7

Cavity. Sacrum arched from above downwards throughout; transversely the I. vertebra is convex, the II. and III. flat, the others concave. First foramen is larger on the right than on the left side. Both wings equally developed.

Outlet. Nothing worthy of note.

PREP. M. COMPLETE SKELETON (MALE?) FROM A CASE OF KYPHO-SCOLIOSIS DUE TO RICKETS.

The Pelvis is figured in outline in Plate V. of Hamilton's "Practical Observations" as "the brim of a pelvis in a skeleton in the author's collection; the spine, thighs, and legs of which are considerably deformed."

VERTEBRAL. The Kyphosis is situated in the dorsal region. The apex is at spine of IX. dorsal vertebra; the bodies of the vertebræ are not ankylosed though much compressed. The upper limb passes (at first) horizontally and to the left, rises at the IV. dorsal vertebra and ends at the VII. cervical spine 5 cm. from the perpendicular; the lower limb passes downwards, forwards, and to the left to end at the I. lumbar spine, 4·5 cm. from the same. There is a slight lordosis with the apex between the III. and IV. lumbar vertebræ.

Scoliosis (*v.* Pl. XXII., fig. 2). A perpendicular let fall from the I. cervical spine passes between the IV. and V. dorsal and through the I. lumbar spine. There is a slight curvature to the left side in the cervical and dorsal regions: the apex is at the I. dorsal spine which is 1·2 cm. distant from the perpendicular; the body of the same vertebra is 2·9 cm. distant. There is a well-marked curvature to the right side in the dorsal region: the apex is at the VII. dorsal spine, 4 cm. from the perpendicular; the body of the IX. dorsal vertebra being 8·5 cm. distant. There is a less pronounced curve to the left side again in the lumbar region: the apex is at the V. lumbar spine which is 0·8 cm. distant, the body of the IV. lumbar Vertebra is 3—2 cm. distant. The I. sacral spine is 2 cm. and the tip of the coccyx 3·2 cm. to the left of the perpendicular.

COLUMN EXTREMITIES. The left leg is slightly shorter than the right. The left patella and hip-joint are both on a higher level than the right. Bones slightly curved.

PELVIS. The left innominate bone stands higher than the right. The deep symphysis and narrow pubic arch shew that it is probably a male pelvis.

False. Both ilia are thrown widely apart anteriorly, so that the fossæ look forwards; the fossa of the right one is flattened throughout, while that of the left is deeply cupped towards its posterior part. The anterior superior spine and crest stand higher on the left side; the left crest is apparently more arched, but the measurements shew them to be the same.

Right and left: chord 14·3; height of arc 5·5; length of arc 22.

The bone is dense and not translucent.

True-Brim. Heart-shaped and contracted unequally—on the left side. The promontory is pushed slightly to the left. The linea terminalis shortened and flattened on the left side.

	<i>Right.</i>	<i>Left.</i>
Chord	10·4	10·9
Height of Arc	2·4	1·7
Length of Arc	12·5	11·6

The sacrum forms 33·3% of the circumference of the brim.

Cavity. Less unequally contracted than the brim. Sacrum, all the vertebræ are convex transversely; vertically, the bone is flat.

Outlet. Not specially altered from the rickety type. Coccyx turns in at a right angle to the sacrum.

PREP. N. SKELETON OF A RACHITIC FEMALE WITH KYPHO-SCOLIOSIS OF THE VERTEBRAL COLUMN (see Plate XV.).

The Pelvis is figured in outline in Plate VI. of Hamilton's "Practical Observations" with the following note.—"The pelvis of a skeleton in the author's collection, which formerly belonged to the late Dr Chas. Stewart, and which was presented to the author by his friend Dr Dyer. Dr Stewart repeatedly informed the author that the individual from whom the skeleton had been obtained had had the Cæsarean operation unsuccessfully performed upon her."

VERTEBRAL COLUMN. Kyphosis in lower dorsal region. Apex at VII. dorsal spine. Upper limb passes horizontally and to the left to end at the III. dorsal spine, 2·3 cm. from the perpendicular; the lower limb passes downwards, forwards, and to the left to end at the I. lumbar spine 6·3 cm. from the same. Brim at an angle of 40° to the horizon. There is a slight compensatory lordosis—apex at the IV. lumbar vertebra.

Scoliosis. As some of the cervical vertebræ were detached, the perpendicular was let fall from the VII. cervical spine: it passed over the V. dorsal and I. lumbar spines and fell 1 cm. to the left of the last sacral spine (*v.* Pl. XXII., fig. 4). In the upper dorsal region, there is a slight curve to the left side: apex at III. dorsal spine which is 7 cm. distant from perpendicular; the body of the same vertebra (outside measurement) is 4·5 cm. distant. In the lower dorsal region, there is a large curvature to the right side: the apex is at the VII. dorsal spine,

which is 1.7 cm. distant from the perpendicular; the body of the VIII. dorsal is 7.2 cm. distant. Below this the spine curves to the left again so as to bring the I. lumbar spine up to the perpendicular and carry the cartilage between the II. and III. lumbar vertebræ 4 cm. beyond it. From this point the line joining the sacral spines diverges again to the right, the V. sacral spine being 1.5 cm. from it.

EXTREMITIES. Both legs have the femur, tibia, and fibula markedly curved. The left leg is shorter than the right: from great trochanter to os calcis left, 53 cm. and right, 55.5.

PELVIS. Distinctly rickety. The posterior iliac spines project beyond the sacrum which has been, as it were, pressed down between them. The transverse process of the IV. lumbar vertebra touches the iliac crest on the left side, but is 1.1 cm. distant from it on the right. The V. lumbar spine is 1.7 cm. distant from the right and 3 cm. from the left posterior superior iliac spine.

False. Both ilia small: right stands higher than left. Right fossa is elongated in its antero-posterior and diminished in its vertical measurement (the right crest is 6.4 cm. above the brim, while the left is 7 cm.; cf. also distance from the end of S.L. to the S curve on the crest). The arching of the crests is the same on both sides, but the sinuosity is diminished on the right which is therefore longer.

	<i>Right.</i>	<i>Left.</i>
Chord	14.5	13.6
Height of Arc	5.3	5.3
Length of Arc	20.5	20

True-Brim. Exaggerated heart-shape; contracted antero-posteriorly and to the left. Promontory low down: a line crossing the iliac crests and touching the vertebral column passes 4.4 cm. behind the anterior superior spines and across the lower third of the IV. lumbar vertebra. The linea terminalis is flattened and shortened on the left side.

	<i>Right.</i>	<i>Left.</i>
Chord	9.4	9.6
Height of Arc	2	.8
Length of Arc	11.7	10

On the left side it forms an acute angle (instead of an arch) in front of the sacro-iliac joint, and bulges inwards over the acetabulum.

Cavity. Sacrum directed backwards: vertically, flat over first three vertebræ; transversely, convex over I.-III. and flat over IV. and V. Foramina compressed vertically. Wings equal on both sides.

Outlet. Pubic arch wide. Left tuber ischii rotated outwards—cf. tuberoso-sacro measurements.

DIAGRAMMATIC REPRESENTATION OF THE MOST IMPORTANT MEASUREMENTS IN THE PELVIS.

As the measurements, as given in Table I., do not appeal to the eye, I have followed Breisky's method of plotting out the most important of these in a series of diagrams. He represents the pelvis in three planes:—a *horizontal* one, which shows the form of the brim; a *sagittal* one, which shows the relation of the conjugate of the brim to that of the cavity and outlet; a *coronal* one, which shows the relation of the transverse of the outlet to the anterior transverse of the brim and to the inter-spinous diameter of the false pelvis. It is evident that, as the plane of the brim is not a flat surface, this diagram cannot exactly represent all its measurements; as the conjugate is measured from the promontory, the symphysis will appear farther forwards than it really is. The diagrams are given in Plates XVI.-XXa., and are constructed in the following way:—

1. *Sagittal Plane* (v. Pl. XVI., fig. 2). A line Sn is drawn at an angle of 30° to a horizontal Sh : this represents the inclination of the conjugata normalis (a line drawn from the upper corner of the symphysis to the middle of the III. sacral vertebra) to the horizon; and the point of their meeting S is taken as the upper edge of the symphysis. The length of the conjugata normalis (SN) is measured off from S along Sn ; N therefore represents the middle of the III. sacral vertebra. Given the length of the conjugata vera (SP), and the distance of the promontory from the middle of the III. sacral vertebra (NP), we find P as the position of the promontory. Given the conjugata diagonalis (PC) and the vertical height of the symphysis (SC), we find C as the position of the lower edge of the symphysis. Given the anterior vertical height of the sacrum (PB), and the conjugate of the outlet (CB), we now fix B as the position of the lower end of the sacrum. The angle PNB represents the vertical arching of the sacrum.

2. *Horizontal Plane, or Plane of the Brim* (v. Pl. XVI., fig. 1). A line ab is taken to represent the direction of the standard-line and a vertical cd drawn from it: the point of their meeting c is taken as the centre of the standard-line which is measured off accordingly and thus we find $S.L.$ Given the ends of $S.L.$ and their distance from the symphysis we determine the direction of the conjugata vera, which is to be drawn and measured from the promontory. From the ends of the standard-line the right (St) and left (Lt) oblique diameters are taken so that the distance between their anterior ends is equal to the anterior transverse diameter; tt is therefore the anterior transverse. Having thus determined the anterior ends of the sacro-cotyloid diameters, we find the promontory P at their point of meeting; Pt, Pt are thus the sacro-cotyloid lines. From the promontory we now measure off the conjugata vera PS in the direction of the symphysis previously ascertained. The transverse of the brim TT is found by the distances of its ends from the ends of $S.L.$, and from the promontory.

3. *Frontal or Coronal Plane* (v. Pl. XVII.). A horizontal hh and a vertical vv having been taken, the transverse of the outlet TT is marked off on hh so that its central point corresponds to the intersection of vv and hh . From T and T the ilio-ischial lines are drawn upwards so that the distance between their upper ends S and S is equal to the inter-spinous diameter. The lines ST, ST are prolonged downwards till they meet; the angle thus formed expresses the relation of the transverse of the outlet to the inter-spinous. From TT lines are drawn upwards, corresponding in length to the side-walls of the Pelvis, so that the distance between their ends $t t$ is the anterior-transverse diameter; this shews the relation of the transverse of the outlet to the anterior-transverse of the brim.

The diagrams thus obtained would require, for the sake of comparing them, to be superimposed on each other in three figures—one for each plane. As the number of lines gives rise to confusion, we have grouped them in a series of three (Pls. XVI.—XXa.).

In studying this interesting collection of Pelves, we shall look first at the Kyphotic, and then at the Scoliotic with the Kypho-Scoliotic series.

I. KYPHOTIC SERIES—Preps. A—G.

We shall take up here these three points:—1. The peculiarities of the Pelvis; 2. The relation of the peculiarities of the Pelvis to the Spinal Deformity; 3. Their Etiology.

1. THE PECULIARITIES OF THE KYPHOTIC PELVIS.

The following points are brought out by the diagrams of the planes.

In Plates XVI. and XVII. we have the diagrams of the planes **A**, **B**, **C**, and **D** compared with that of the normal pelvis—**O**. On looking at the *Plane of the Brim* (Pl. XVI., fig. 1) we see at once the alteration in the form of the brim: the standard-line is shortened, the transverse diameter is shortened absolutely and still more relatively to the conjugata vera, the conjugata vera is increased, and this increase is due (except in the case of Prep. **D**) mostly to a backward displacement of the promontory; the forward displacement of the symphysis is to a great extent the result of the mode of construction of the diagram, as the promontory is first fixed, and the conjugata vera then measured from it. Peculiarities of
kyphotic pelvis.

In the *Sagittal Plane* (Pl. XVI., fig. 2) we see more distinctly the extent to which the promontory is displaced backwards. This is most marked in **C** in which the angle (corresponding to S N P) is greater than a right angle; in **A**, **B**, and **D**, this angle is more obtuse than in the normal pelvis. At the outlet, except in the case of **A**, there is no diminution in the conjugate corresponding to the increase at the brim.

In the *Frontal Plane* (Pl. XVII.) we note that the ilio-ischial lines meet in the normal pelvis at an angle of 38° , which is smaller than the angle (42°) given by Breisky for his standard pelvis; that this angle is increased in the kyphotic series, becoming as wide as 72° in pelvis **A**. The increase in this angle is due to two factors; the increase in the inter-spinous diameter is indicated by the greater distance between the points SS; the diminution of the transverse of the outlet, shewn in the approximation of the points T T. This approximation is greatest in Pelvis **A**, and only slightly marked in Pelvis **B**.

In Plates XVIII. and XIX. we have the diagrams of the planes of the other kyphotic pelvis and of the scoliotic one **H**. In them we only draw attention to the fact that the diagrams of **F** and **G** are, in all the planes, very similar, except that **F** is more contracted in the conjugate of the outlet.

SUMMARY OF THE PECULIARITIES OF THE KYPHOTIC PELVIS BASED ON THESE PREPARATIONS.

PELVIS—False. The iliac crests are drawn out from before backwards; the arching of the crests is diminished and their sigmoid curve lessened. The anterior superior spines are thrown apart.

PELVIS—True. Funnel-shaped.

Brim. Conjugate greatly increased. Transverse diminished relatively (to the conjugate) and sometimes absolutely. The promontory higher (relative to the iliac crests) and farther back. The linea terminalis less arched at the sides.

Cavity. Conjugate increased but to a less extent than at the brim. Sacrum narrowed transversely and elongated vertically: its vertical curvature is diminished throughout; its transverse, in the upper portion of the bone.

Outlet. The Conjugate is not usually altered. The Transverse *may* be contracted and that to an extreme degree. The Pubic arch is narrowed.

The most characteristic *anatomical* peculiarity of the kyphotic pelvis is *an increase in the antero-posterior diameter of the Brim*; this is present in all these preparations.

The *contraction in the transverse diameter of the outlet* which is the feature of *obstetric* importance (*v.* Part III.) is not so constant.

2. THE RELATION OF THE PECULIARITIES IN THE PELVIS TO THE SPINAL DEFORMITY.

Breisky laid down the general principle that the lower the region in which the kyphosis is, the more marked are the kyphotic changes in the pelvis—being more pronounced in dorso-lumbar than in dorsal-caries, and still more in lumbo-sacral. This series of preparations gives us data for investigating the point; and we shall find it convenient to look at the two kyphotic characteristics separately—(1) the elongation at the brim and (2) the contraction at the outlet. Relation to Spinal
Deformity.

(1.) *The increase in the conjugate of the brim.*

The preparations fall into the following order, according to the position of the apex of the kyphosis:—

In D,	the apex is at the VII. dorsal spine.
„ F,	„ „ „ „ VIII. „ „
„ E and A,	„ „ „ „ IX. „ „
„ B and C,	„ „ „ „ X. „ „
„ G,	„ „ „ „ XII. „ „

To estimate the amount of the increase in the conjugate, I have measured the angle which the line P N forms with S N in the sagittal section: this increases with backward displacement of the promontory. It will increase also with vertical flattening of the sacrum (as in the rickety pelvis); as all of these pelves are non-rachitic and of the same (female) type, the size of this angle seems the best method of estimating the increase in the conjugate.

For comparison, the lines P N, S N have been taken out of the various sagittal planes and placed together in Pl. XXI., fig. 1. According to the increase in this angle, the pelves fall into the following order:—

In the Normal Pelvis, the angle is	57° ;
„ Pelvis D,	„ „ „ 72° ;
„ „ F,	„ „ „ 84° ;
„ „ G,	„ „ „ 85° ;
„ „ E and A,	„ „ „ 90° :
„ „ B,	„ „ „ 98° ;
„ „ C,	„ „ „ 100° ;

The order in this table is the same as in one immediately above, with the exception of G. The reason for this exception is not evident. As the carious process has destroyed a considerable number of the vertebræ, so that the spines are not related to the bodies, we might place the apex at the IX. dorsal spine, which would bring G in before B and C in the first table; on the other hand, the marked shortening of the lower limb of the kyphosis (to 9 cm.—the shortest in the series) brings the kyphosis nearer the sacrum than in any other of these specimens. This preparation must therefore be considered an exception to the deduction which may be made from the others of the series that *the lower the kyphosis the greater is the increase in the conjugate of the brim*. As to the cause of this exception, the rapidity of the carious process (as shewn by the destruction of bone without much new-formation) may not have given sufficient time for the production of the changes in the pelvis.

This deduction is of some importance as a guide in examining cases clinically, as the most prominent dorsal spine can be easily ascertained. To determine why there is this relation (which may be a mere coincidence) is a much more difficult question; in treating it as a problem in mechanics, we would require to take into account the length of the limbs, with the angle of the kyphosis, and the inclination of the brim to the horizon. As we shall see under Etiology, a purely mechanical explanation does not account for all the facts.

(2) *The contraction in the transverse of the outlet.*

To determine the degree of the contraction, we have compared the frontal planes. Instead of taking the end of the anterior transverse as the point to which the line T T' is drawn, we have in Pl. XXI., fig. 2, made the point T' correspond to the end of the *transverse* of the brim. The angle T' T H. will therefore represent the relation of the transverse of the outlet to that of the brim, and diminish with the contraction of the former. According to the diminution of this angle, the pelves fall into the following order:—

<i>Kyphosis at Outlet.</i>	<i>Kyphosis at Brim (see p. 9).</i>
In B, the angle is 82°	D,
„ F, „ 79°	F,
„ G, „ 79°	G,
„ C, „ 73°	A,
„ D, „ 64° +	B,
„ A, „ 64°.	C,

For the sake of comparison, we have placed in the second parallel column the order of the pelves according to the degree of kyphosis at the brim. This comparison brings out the fact that the *contraction at the outlet does not bear any relation to the elongation at the brim, nor consequently to the kyphosis of the spine*. In the normal pelvis (O) this angle is 79°.

3. THE ETIOLOGY OF THESE CHANGES IN THE KYPHOTIC PELVIS.

The explanation usually given is that two rotations of the pelvic bones have occurred: the sacrum has rotated round a transverse axis so that the promontory has passed backwards while the coccygeal end has come forwards; the innominate bones have rotated round an antero-posterior axis so that the iliac crests have been thrown apart and the ischial tuberosities approximated. Breisky traces an etiological connection between these and speaks of the backward rotation of the upper end of the Sacrum, as pressing the posterior ends of the iliac crests apart.

A study of these preparations shows that there is *not*, as a rule, a *rotation of the Sacrum round a transverse axis*; and that the contraction at the outlet is not related to the elongation at the brim. Further this mechanical theory leaves out of account the action of the muscles and the alterations in the inclination of the brim (due to muscular action) which is required to restore and maintain equilibrium. We have not enough specimens of the complete skeleton, to form deductions as to the alteration in the inclination of the brim. Plate IX. (from a complete skeleton) shews that this may be increased till the brim is almost vertical. That the contraction at the outlet implies a *rotation of the innominate bones* is shewn by the fact that the approximation of the tuberosities is related to the separation of the crests. The amount of separation of the crests may be estimated by the size of the angle formed by the junction of the ilio-ischial lines. According to the size of this angle (*v.* Table I.) the pelves arrange themselves as follows:—

B has an angle of	42°
F	„ 48°
G	„ 48° +
C	„ 66°
D	„ 70°
A	„ 72°

This order corresponds to that above in which they are arranged according to the approximation of the tuberosities.

II. THE SCOLIOTIC AND KYPHO-SCOLIOTIC SERIES—**Prep. H—N.**

These are all rickety pelvis. The question before us is therefore not what is the effect of scoliosis and kypho-scoliosis of the spine on the pelvis, but how do these deformities modify the rickety type.

The rickety pelvis presents features which are in many respects the opposite of the Kyphotic. The contrast will be evident if we compare Plate IV. with Plate I. It may be thus stated.

	RACHITIC PELVIS.	PURE KYPHOTIC PELVIS.
False Pelvis—Iliia	thick and stumpy	thin and drawn out
Crests Arching	not diminished	diminished
Sinuosity	not diminished	diminished
True Pelvis—Brim Linea terminalis	more arched laterally	less arched
Conjugate D.	diminished	increased
Transverse D.	increased	diminished
Promontory	depressed forwards	thrown backwards
Cavity Sacrum transversely	broadened	narrowed
„ vertically	shortened	elongated
Outlet Pubic Arch	widened	narrowed
Conjugate D.	increased	not increased
Transverse D.	increased	sometimes diminished
Tuberosities	thrown apart	sometimes approximated

Kyphotic pelvis contrasted with rickety.

A Scoliotic or a Kypho-scoliotic Rachitic pelvis will therefore present greater difficulties in its investigation.

We shall divide our series into three groups—H (as being a pure scoliotic), K and L, J, M, & N—and look at the form of the pelvis and its relation to the Spinal Deformity in each group.

1. PELVIS **H.**

The appearance of the Spine is well shewn in Pl. XI., and the curve is sketched in Pl. XXII., fig. 1. This figure and the others of Scoliosis (Pl. XXII.) bring out the fact that, owing to the rotation of the vertebræ, the sweep of the curve traced along the spines is much less than that of the bodies. In H, for the lumbar curve the distances are 1'4, 4'8, and for the dorsal curve 2, 5'6.

Study of the planes of the scoliotic and kypho-scoliotic pelvis.

The *Horizontal Plane* (Pl. XVIII., fig. 1) shows the Brim to be contracted on the right side (on the side opposite to the lumbar curve). The right half of the sacrum is compressed (*v. p.* 5) and the sacro-sciatic notch of the same side is flattened. These changes point to an increased throwing off the weight of the trunk to this side, corresponding to the dorsal scoliosis to the right. This pelvis is therefore an exception to the rule laid down by Leopold (and borne out by J, M, N) that the contraction of the pelvis is on the same side as the lumbar curve. Further the leg which is most curved and which has been subjected to the greatest pressure is the left one, *i.e.* the one on the opposite side from the contraction of the brim.

In the *Sagittal* (Pl. XVIII., fig. 2), and still more in the *Coronal* plane (Pl. XIX.), we see some kyphotic characteristics present in this pelvis, although there is no antero-posterior curvature.

An additional point of interest is the shortening of the linea terminalis on the left side and the smaller size of the left ilium as a whole, which looks more like a congenital than a pressure-phenomenon.

The history of this pelvis may have been the following: There was a congenital shortening of the left ilium which led to a disturbance of the equilibrium towards that side when the child began to go about; hence more weight was thrown on this leg, and a scoliosis developed towards the right side to restore the equilibrium.

2. Pelves K & L.

These form a pair having this in common that there is no marked contraction at the brim; the rickety peculiarity is therefore not well marked.

In K the brim is slightly contracted on the left side, in L on the right (*v.* the *horizontal plane*, Pl. XVIII., fig. 1). The symphysis is pushed away from the contracted side.

The *Sagittal plane* (Pl. XVIII., fig. 2) shows the conjugate of the brim to be longer than that of the outlet in both cases (kyphotic feature).

The *Frontal plane* (Pl. XIX.) shews the angle of the ilio-ischial lines to be about the same (46° and 50°), and wider than the normal.

Tracings of the Spinal Column shew that in K there is a wide curve to the left in the dorsal region, with a faint compensatory curve to the right in the lumbar region; in L there is a slight curve to the left in the dorsal region, with a long deep curve to the right in the dorso-lumbar.

These preparations show two points: (1) That a curve high up or a long slowly-rising one though low-down, does not markedly affect the form of the Pelvis; (2) that the Pelvis is contracted on that side towards which the *deepest* (not necessarily the lowest) curve lies.

Though these are rickety pelves, the rickety contraction is not present. This may be explained by the amount of kyphosis which has counteracted the rachitic contraction.

3. Pelves J, M, N.

These form another group shewing the results of kypho-scoliosis to a varying extent. J is only slightly kyphotic, and might almost be considered a pure scoliotic, but it falls most conveniently into this group.

As they are all rachitic, our standard of comparison must be a typical rachitic pelvis—not a normal pelvis, as in the case of the pure kyphotic—with a normally curved spine. Plate XIV. is a fine example of this, and the diagram of the rachitic Pelvis in Pls. XX. and XXa. is taken from it.

Taking the contraction of the conjugate of the brim as so far indicating the degree of rickety change, we find that the pelves form a series:—

	Absolute Length	In terms of S.L.
M	8 cm.	69
J	7.3 cm.	63
N	5.5 cm.	45

Though the antero-posterior contraction is less marked, a *unilateral* contraction is present in all the three and on the same (left) side. The exact amount of contraction is seen by comparing the sacro-cotyloid diameters at the brim.

	Absolute Measurements.		In terms of S.L.	
	R. S.C.	L. S.C.	R. S.C.	L. S.C.
M	8.1	5.3	70	46
J	6.6	5	57	43
N	6.7	4.6	54	37

The sacro-cotyloid diameters in the cavity show that the unilateral contraction is still present but much less marked.

	Absolute Measurements.		In terms of S.L.	
	R. S.C.	L. S.C.	R. S.C.	L. S.C.
M	7.4	7.3	64	63
J	6.6	5.9	89	83
N	7.3	6.2	59	50

The *Horizontal Plane* (Pl. XX., fig. 1) shews that while none of these three pelves has the typical rickety brim, N most nearly approaches it, while M does so least. A unilateral contraction on the left side is present in all three. In M and N the symphysis is pushed towards the right side (*i.e.* away from the contracted side—a peculiarity of the kypho-scoliotic pelvis which Leopold refers to), but in J it is pushed to the left.

The *Sagittal Plane* (Pl. XX., fig. 2) shows the relation of the promontory more precisely, and that M and J are both much less contracted than N, but differ less from each other than fig. 1 appears to indicate. As to the conjugate of the outlet, M and N show the rachitic elongation while J is nearer the normal.

In the *Frontal Plane* (Pl. XXa) we note first that the typical rickety pelvis has a wide ilio-ischial angle (63°), which we saw was also a peculiarity of the kyphotic pelvis. A comparison of Pl. XVII. and XXa. shews that this is only an accidental resemblance due to the fact that the throwing apart of the points S, S (*i.e.* the increase in the inter-spinous diameter which is characteristic of the rickety pelvis) increases this angle equally with the approximating of the points T, T. The side-walls of the pelvis which are convergent in the kyphotic pelvis are almost parallel in the rickety (*cf.* the lines T, t, in Pl. XVII. with the similar ones in Pl. XXa.).

These preparations bear out the admirable description of the kypho-scoliotic rachitic pelvis given by Leopold.

SUMMARY OF PECULIARITIES OF THE KYPHO-SCOLIOTIC PELVIS, BASED ON THESE PREPARATIONS.

- PELVIS—False.** The ilium, on the side opposite to the lumbar curve, stands more vertical and looks more inwards than the opposite one.
- PELVIS—True.** Of rachitic type, unless the kyphosis be low down; in this case it is funnel-shaped.
- Brim.** Usually contracted in the sacro-cotyloid diameter of the same side as the lumbar curve, but sometimes in that of the opposite one.
 - Cavity.** Unilateral contraction still present but less marked.
 - Outlet.** Of rachitic type unless the kyphosis be low down, in which case it becomes relatively contracted. The ischial tuberosity of the side opposite to the lumbar curve is sometimes everted.

RELATION OF THE FORM OF THE PELVIS TO THE DEFORMITY OF THE SPINE.

The effect of the *Kyphosis* is seen in the interference with the development of the rickety contraction at the brim.

With regard to the *Scoliosis* we have reproduced in Pl. XXII. the tracing of the curvature (reduced to $\frac{1}{2}$): the interrupted line indicates the curve of the spinous processes, the dotted line the curve of the outer side of the bodies of the vertebræ. In all four, there is a curvature to the right side in the dorsal region, and to the left side in the lumbar. The much greater divergence from the perpendicular of the bodies than the spines is evident. In the dorsal curve of N the spine of the VII. dorsal is 2 cm., while the outer side of the body of the VIII. dorsal is 7.6 cm. distant from the perpendicular; in the lumbar curve of J the spine of the II. lumbar is 5 cm. distant, while the outer side of the body of the I. and II. is 12 cm. distant. Given the divergence of the spines, that of the bodies may be two to three times as great. As to the relation of the *unilateral contraction* of the Pelvis to the scoliosis of the Spine, it is *usually* on the same side as the lumbar curve, but *may be* on the opposite (as in H).

PART II.

THE DISPLACEMENT OF THE VISCERA AND THE RELATION OF THE PELVIC ORGANS (POST-PARTUM) IN A CASE OF KYPHOSIS.

In the case of Prep. **B**, I obtained the thorax and abdomen and made a series of frozen sections. The patient had died from post-partum hæmorrhage.

METHOD OF PREPARING FROZEN SECTIONS.

The cadaver was frozen in the usual way—placed in the dorsal posture in a mixture of salt and ice for five days. It was then laid between two boards, in which saw-cuts had been previously made at the desired distance apart; blocks of wood were laid between their ends to keep them and the cadaver in position.

The sections, immediately after they had been cut, were embedded in plaster. This was done in the following way. The section was laid face downwards on a sheet of glass cut square to a convenient size. Round this sheet four slips of glass were placed (like the sides of a box) so as to form a temporary trough, the sides of which stood one inch or more higher than the section. Plaster was now poured in slowly to fill the trough, forming a layer one inch thick over the section; as soon as this set, the side-pieces of glass were removed. The section was thus embedded face downwards in a block of plaster; on inverting this, the tracing was taken on the glass. The advantages of this method of mounting are that the plaster is brought flush up to the surface of the section; and the cake, forming a solid block, the section can be easily lifted.

To ascertain the form of the spinal curvature and its relation to the pelvis, a mesial sagittal section was made. The right face of this was preserved. A lateral sagittal one, about two inches to the right of the former, gave the antero-posterior relations of the thoracic and abdominal viscera. To ascertain their relations in the vertical transverse plane, a series of coronal sections was made of the left half of the thorax and abdomen—as shewn in Plate XXXV., lines *a* to *g*. In the left half of the pelvis, one was made at the brim, a second in the cavity, and a third parallel to the last but one inch lower down—Pl. XXXV. *h-k*.

The tracings were taken on glass with pen and ink, and retraced on tissue paper. It is evident that many of the details, *e.g.* the exact course of the peritoneum, could not be put in till the preparations had thawed.

After the tracings had been completed, the bones were taken out and cleaned, and the skeleton put up with wire. From this was made the drawing in Plate XXXV., which shews the exact position of the coronal sections of the left half of the thorax and those of the pelvis. The sections are given in plates XXIII.—XXXIV.).

PLATE XXIII.—SAGITTAL MESIAL SECTION OF THORAX, ABDOMEN, AND PELVIS—RIGHT HALF.

The Section has hit the middle line in the cervical region and in the front of the pelvis. At the posterior part of the pelvis, it has passed 1.5 cm. to the right of the promontory of the sacrum—*c.f.* Pl. XXXII. in which the body of the I. sacral vertebra is seen. Due to the slight obliquity of the section, and still more to the deviation of the kyphosis to the left side, the right lumbar region is exposed.

BONES.

The last two cervical and first two dorsal vertebræ have been divided mesially and the spinal canal exposed. The III. dorsal vert. is cut to the right of the middle line, and the transverse processes of IV. V. and VI. have been divided with their corresponding ribs. The VII.—XII. right ribs are divided beyond the vertebræ. From the fact that the sternum (due to its being directed to the right side) was not mesial, the left superior angle and the II.—VII. costal cartilages are seen in front. The sacrum is divided 1.5 cm. to the left of the middle line along with the first coccygeal vertebra. The pubis is divided at the symphysis.

The antero-posterior diameter of the brim of the pelvis measures 17 cm. ($6\frac{1}{8}$ inches); this does not represent the full length of the conjugata vera as the promontory is not shewn. The plane of the brim, due to the high position of the promontory, is evidently more vertical than in the normal pelvis; it probably stood about 65° to the horizon.

MUSCLES.

The anterior abdominal wall is folded in upon the bladder and uterus; this shews that it was previously much stretched. The diaphragm arches to the level of a line joining the II. left costal cartilage and the transverse process of the VI. dorsal vertebra.

THORACIC VISCERA.

The heart occupies the anterior portion of the thoracic cavity, and lies between the diaphragm and the costal cartilages, the pericardium extending down to the IV. left costal cartilage. Its greatest vertical height is 10 cm., and its antero-posterior thickness 5 cm.

The pleura of the right lung is seen between the III. dorsal vertebra and the diaphragm, running as far down as the X. rib. The œsophagus has been cut into, in front of the III. dorsal vertebra.

ABDOMINAL VISCERA.

The liver, right supra-renal capsule, and kidney lie together in relation to the under surface of the diaphragm. The anterior edge of the liver extends 1 cm. inferior to the VII. costal cartilage. The highest point is on a level with the lower border of the II. left costal cartilage. It measures vertically about 7.5 cm.; along its diaphragmatic surface, 20 cm.; along its inferior surface, 15 cm.

The pyloric end of the stomach is seen just below the liver, in relation to the fissure. The stomach has indented the liver. The intestines are cut variously; they do not descend into the lower third of the utero-vesical pouch of peritoneum, and not at all into the pouch of Douglas.

The right kidney has been cut into. It has in relation superiorly and posteriorly the VII. to the XII. ribs (with the diaphragm intervening) inferiorly the diaphragm, and anteriorly the supra-renal capsule and liver. It measures 7.5 cm. vertically and 6 cm. antero-posteriorly (across its inferior half); this measurement does not give the longest diameter, as the organ is divided to the left of its mesial plane. The supra-renal capsule has the diaphragm above, the liver in front, and the kidney behind.

The post-partum uterus (the patient died 3 hrs. after the birth of the child— $1\frac{1}{2}$ after expulsion of the placenta)—*cf.* Pl. XXXII. and XXXIII.—fills the pelvic cavity. The body is of a pyramidal shape, measuring 10 cm. vertically and 9.5 across its base. The cervix has been compressed vertically, and flattened out antero-posteriorly and transversely; it measures 3 cm. vertically and 6—7 cm. antero-posteriorly; its posterior wall is folded in. The cervical canal is bulged outwards in its middle, and this bulging portion has been cut into although the os internum and externum lie to the right of the section. The anterior surface of the body of the uterus is in relation to the peritoneum-covered surface of the bladder for 1 cm., to the anterior abdominal wall for 3 cm., the intestines for 8 cm. The posterior surface has intestine in relation to it for 4 cm.; below this the peritoneum of the pouch of Douglas extends for 11 cm. The uterine walls measure: posterior, 2.5—3 cm.; anterior, 3—3.5 in thickness; and except towards the fundus are in a state of atony. The placental site is clearly seen on the anterior wall, which also shews sections of large venous sinuses all through its substance. The uterine cavity is triangular in shape, and measures 6.5 cm. vertically, and 6 cm. antero-posteriorly; it contains blood-clot. The cervical canal has not been cut into except in its folded middle portion.

UTERUS.

The vagina measures 10.5 cm. in length. The walls are slightly folded, specially the anterior, and are in close apposition.

VAGINA.

The bladder contains a little urine. It is triangular in shape, with the apex forwards and the base in line with the urethra. The superior and posterior walls are thicker (1.8 cm.) than that behind the pubes (2—3 cm.). The urethra is 3 cm. long, and its walls are thickened.

BLADDER.

The peritoneum is not thrown into folds over the uterus, but is markedly folded over the bladder and anterior abdominal wall. The utero-vesical pouch has its walls in apposition throughout. The pouch of Douglas extends to the level of the first coccygeal vertebra, and contains some serum in its upper part.

PERITONEUM.

The cellular tissue between the uterus and bladder is increased in amount. The retro-pubic tissue is flattened out over the pubes; it contains a large vein. The cellular tissue between the rectum and posterior vaginal wall is also apparently increased in amount.

CELLULAR TISSUE

PLATE XXIV.—LATERAL SAGITTAL SECTION OF THORAX, ABDOMEN, AND PELVIS—RIGHT HALF.

This section was made about two inches to the right of the last, and has bisected the right half of the thoracic and abdominal cavities, and exposed the muscular wall of the pelvic cavity.

The I.—XII. right ribs are seen in section posteriorly; with the right scapula, the clavicle, and the osseous portion of I. and cartilages of II.—VII. anteriorly.

BONES.

The right ilium has been divided in the posterior third, the pubes in the outer third of its horizontal ramus, the ischium through the tuberosity and the ischial spine.

The muscles of the scapula and back are well seen; also the scaleni and their relation to the vessels. The relations of the glutei, obturators and adductores are demonstrated. The diaphragm ascends to a line joining the II. costal cartilage (anteriorly) and the VII. rib (posteriorly).

MUSCLES.

The thoracic cavity measures 5 cm. vertically and 14 cm. antero-posteriorly.

THORACIC VISCERA.

The lung is altered in shape, its vertical being in proportion to its antero-posterior diameter as 1 to 3. The pleural cavity comes down to the IV. costal cartilage anteriorly and the IX. rib posteriorly.

The liver has been moulded downwards and inwards through the altered direction of the lower ribs, so that it has been cut very obliquely; hence it presents a large area in section from which no deduction as to actual size can be made. The gall-bladder is cut into. The highest point of the liver is on a line joining the lower margin of the II. costal cartilage anteriorly, and that of the VIII. rib posteriorly; its lowest point lies 3 cm. below the level of the posterior third of the iliac crest.

ABDOMINAL VISCERA.

The cellular tissue on the brim of the pelvis is seen and will be referred to again in describing Pl. XXXII.

PELVIS.

PLATE XXV.—CORONAL SECTION OF LEFT SIDE OF THORAX AND ABDOMEN, PASSING THROUGH THE LINE *a* IN PLATE XXXV.

The II.—X. ribs and the left ilium are seen in section.

BONES.

The falling in of the muscles of the abdominal wall, is more marked. The arch of the diaphragm rises to the V. rib.

MUSCLES.

The heart fills the thoracic cavity, extending from the II. to the lower margin of the VI. rib. It measures vertically 6.5 cm.—from the II. rib downwards; obliquely from the II. rib to the apex, 10 cm. The right auricle and ventricle are exposed, the walls of the latter measure 3—1 cm.

VISCERA.

There is some fluid at the apex of the pericardium.

The liver comes at its left border, to 1.5 cm. of the lower margin of the VI. rib; at its highest point, it is on a level with the upper margin of the IV. rib; at its lowest, with the lower margin of the VII.: greatest vertical measurement = $5\frac{1}{2}$ cm.; greatest transverse, 7 cm.

The intestines are cut variously. The fatty omentum occupies a considerable extent of the section.

PLATE XXVI.—CORONAL SECTION OF LEFT SIDE OF THORAX AND ABDOMEN, PASSING THROUGH THE LINE *b* IN PLATE XXXV.

Left superior angle of manubrium sterni, the II.—XI. ribs and the crest of the left ilium are seen in section.

BONES.

The muscles of the anterior abdominal wall have fallen in, as the result of their abnormal distension by the pregnant uterus and relaxation after parturition.

MUSCLES.

The heart extends from the lower margin of the angle of the sternum to opposite the middle of the VI. rib. Its greatest vertical measurement from this (the lowest) level in a straight line upwards is 6 cm. Measured obliquely from apex to angle of sternum, it is 8 cm. The pericardium is distant from the ribs as follows: II., 1.1 cm.; III., 1.1 cm.; IV., 1.4; V., 1.8; VI., 2.5. The thickness of the wall is 1.2 cm. The cavity contains blood-clot.

VISCERA.

The lung extends, along its external border, from the angle of the sternum to the upper margin of the VII. rib. The pleural cavity is

largely obliterated by adhesions. The thickness of the lung opposite to the various ribs corresponds to the distance of the pericardium from same points as given above.

The liver is, at its highest point, on a level with the lowest margin of the V. rib; at its lowest point, it is on a level with the lower margin of the VIII. Its left corner comes close up to the middle of the VII. rib, from which it is separated by the diaphragm and a corner of the pleural cavity. The area of liver substance exposed here measures in its greatest vertical diameter 6 cm. and in its transverse 9.5 cm.

The transverse colon is cut across at its left angle.

*PLATE XXVII.—CORONAL SECTION OF LEFT HALF OF THORAX AND ABDOMEN, PASSING THROUGH THE LINE *c* IN PLATE XXXV.*

The plaster ran in on parts of the face of this section, so that only an incomplete tracing was obtained.

The I.–XI. ribs are divided in their bony portions and the XII. through its cartilage.

BONES.

VISCERA.

The lung extends, along its external border, from the I. to the lower margin of the VIII. rib. Its base, at the arch of the diaphragm, is opposite the middle of the VII.

The heart is distant from the ribs as follows—measured between the nearest points: II., 2.4 cm.; III., 2.4 cm.; IV., 3.4 cm.; V., 3.5 cm.; VI., 3.7; VII., 3.9 cm. Its lowest border is on a level with the lower margin of the VII. rib. The posterior part of the cavity of the left ventricle is cut into.

The liver does not project so far into this section as into the last. Its diaphragmatic surface stops short .5 cm. internal to the corresponding surface of the heart or 4.5 cm. internal to the VII. rib.

The stomach lies in an area of which the highest point is at the level of the lower border of the VII. rib. It is 2.5 cm. internal to the latter, the corner of the lung and of the spleen intervening. On its inner side is the liver.

The spleen extends from the middle of the VIII. rib to the lower margin of the XI. It lies under cover of IX., X., and XI. ribs from which it is separated by the diaphragm. It measures vertically 9 cm. and transversely (at the X. rib) 2.5 cm.

*PLATE XXVIII.—CORONAL SECTION OF LEFT SIDE OF THORAX AND ABDOMEN, PASSING THROUGH THE LINE *d* IN PLATE XXXV.*

The coracoid process of the scapula, the clavicle and twelve ribs are seen in section. The V. lumbar vertebra and the intervertebral between it and the IV. are cut across.

BONES.

MUSCLES.

The diaphragm runs from the cartilage of the XII. rib (taking origin from it and the XI.) along the inner surface of the X. and IX., arches to the upper margin of the VII. The oesophageal opening in it measures 2 cm. across.

VESSELS.

The arch of the aorta is laid open above the root of the lung so as to expose the orifices of the innominate, left common carotid, and left subclavian arteries. The subclavian appears again below the scalenus anticus. The left pulmonary artery is seen above and the vein below the left bronchus.

VISCERA.

The left lung is divided coronally in a plane passing through its root. Its external border extends from the I. to the middle of the VIII. rib; its base is at the level of the upper margin of the VII. rib. Its greatest vertical measurement is 7 cm. and the transverse is 6.5 cm. The pleural cavity was almost obliterated by adhesions.

The left corner of the liver appears in the section.

The stomach (not distended) occupies an area of about 4 × 4 cm. between the liver and the spleen, and extends for another 4 cm. downwards internal to the spleen. The wall of the oesophagus is exposed at the oesophageal opening in the diaphragm.

The spleen measures 11 cm. vertically by 3.5 transversely. Its highest point is at the level of the middle of the VII. rib; its lowest is opposite the XII.

The intestines are divided in various directions.

The pancreas has superiorly the liver and stomach; externally the stomach; inferiorly the aorta, cellular tissue and IV. lumbar vertebra.

*PLATE XXIX.—CORONAL SECTION PASSING THROUGH THE BASE OF THE KYPHOSIS, ALONG THE LINE *e* IN PLATE XXXV.*

The clavicle and acromion, with the acromio-clavicular joint, are seen in section; also the neck and coracoid process of the scapula. The I. rib is divided at its articulation with the transverse process of the vertebra; the II. near its angle; the III.–XII. further forwards. The bodies of the last two cervical and first four dorsal vertebræ are divided coronally and that of the IV. lumbar antero-posteriorly, as the lower limb of the kyphosis runs almost horizontally.

BONES.

MUSCLES.

The muscles are all named in the section. The diaphragm can be traced from the XII. rib, arching to the level of the VIII. rib and then descending across the aorta.

VESSELS.

The aorta is divided obliquely in the thorax just above its passage through the diaphragm; branches passing forwards from it have been cut across below. The vena cava inferior has been laid open so that its posterior wall appears in the section (for about 5.5 cm.) to the right of the branches from the aorta.

VISCERA.

The left lung is divided one inch posterior to its root. Its left border extends from the II. to the middle of the IX. rib, while its base is on a level with the VIII.

The spleen extends from the upper margin of the VIII. rib to the middle of the inner surface of the XII., measuring vertically about 10 cm. Its greatest transverse breadth is opposite the X. rib when it measures 4.5 cm. Its superior border is in relation to the arch of the diaphragm; its internal border has the stomach in relation to its upper third, the pancreas in relation to its middle third, and the left kidney in relation to its lower third; it is surrounded by peritoneum except at the hilus.

The stomach occupies an area of $2 \times 3\frac{1}{2}$ cm. It is in relation externally to the spleen, superiorly and internally to the diaphragm, internally to the pancreas, inferiorly to the pancreas and branches of the aorta.

The pancreas measures $2\frac{1}{2}$ cm. transversely by 4 cm. vertically. It has in relation externally the spleen and kidney, superiorly the stomach, internally the aorta and vena cava inferior, inferiorly the IV. lumbar vertebra and adjacent cellular tissue.

The kidney measures 4.8 cm. vertically by 3 cm. transversely. It has superiorly and externally the spleen, superiorly and internally the pancreas, inferiorly the cellular tissue between it and the lumbar vertebra and muscles.

*PLATE XXX.—CORONAL SECTION OF THE POSTERIOR PORTION OF THE LEFT HALF OF THE THORAX AND ABDOMEN, ALONG THE LINE *f* IN PLATE XXXV.*

The VI. and VII. cervical and I.–VI. dorsal vertebræ are divided coronally. A portion of the VII. is seen as it passes backwards in the upper line of the kyphosis. The III. lumbar vertebra is divided antero-posteriorly, as the lower limb of the kyphosis is almost horizontal. The III.–XII. ribs have been divided. BONES.

The scalmi and scapular muscles are well seen.

The lung extends to the X. rib.

The spleen lies under the IX. rib, with a vertical diameter of 1.5 cm.

The left kidney extends from the lower margin of the IX. to 2 cm. below the XII. rib; it measures vertically 8 cm. and transversely 5 cm. The supra-renal capsule lies on its upper and inner surface—internal to the spleen.

*PLATE XXXI.—CORONAL SECTION PASSING THROUGH THE APEX OF THE KYPHOSIS, ALONG THE LINE *g* IN PLATE XXXV.*

The spines of the II.–V. dorsal vertebræ and the ankylosed bodies of the following dorsal and upper lumbar vertebræ are seen in section. The seven lower ribs, with the scapula, are divided. The muscles of the back at the apex of the kyphosis are also shewn.

*PLATE XXXII.—OBLIQUE ANTERO-POSTERIOR SECTION MADE AT THE LEVEL OF THE BRIM OF THE PELVIS, ALONG THE LINE *h* IN PLATE XXXV.*

The section has grazed the symphysis anteriorly, cut through a fold of the abdominal wall which had fallen into the brim of the pelvis (*cf.* Pl. XXIII.), divided the uterus and cut the corner off the promontory.

The V. lumbar and I. sacral vertebræ have been cut obliquely. The intervertebral disc (which, from its oblique position, is divided vertically) measures 3.7 cm. transversely and 1.5 cm. vertically. The section of the left ilium measures about 13.4 cm. antero-posteriorly; 1.3 cm. transversely at crest, .3 in the fossa, 1.5 at the anterior inferior spine. The crest is 6.2 cm. distant from the side of the lumbar vertebra. The conjugate, measured to the anterior edge of the I. sacral vertebra (below the promontory) is 16 cm. BONES.

Those of the folded-in anterior abdominal wall are cut irregularly. MUSCLES.

The rectum is not seen in the section as it enters the pelvis to the right of the middle line (*cf.* Pl. XXIII.). VISCERA.

The uterus has been cut obliquely below the fundus. It measures as follows: anterior wall, 3.3; posterior wall, 2.5–2.7; side-wall, 2.7. These measurements are of no value, as the section is oblique, except as shewing the greater thickness of the anterior wall. The uterus fills the pelvis, and has the abdominal wall in relation to its anterior surface.

The ovary shews its upper surface to the left and front of the uterus, but has not been cut into.

The fallopian tube has been divided obliquely.

The skin flap was drawn aside to ascertain the exact relations of the ovary and tube, which were as follows. The ovary is folded on itself at 2.5 cm. from its distal (non-uterine) end; when unfolded, it measures 3.8 cm. in length. Thus folded it lies antero-posteriorly, and is moulded between the uterus and the side-wall of the pelvis. The fallopian tube curves round the anterior convexity of the fold, and has been cut obliquely near the fimbriated end.

There is a considerable amount of cellular tissue at the brim of the pelvis which extends backwards to the region of the ovary and tube, and forwards between the iliacus muscle and the peritoneum. This deposit measures about 2 cm. transversely at a point opposite to the anterior inferior iliac spines.

*PLATE XXXIII.—ANTERO-POSTERIOR HORIZONTAL SECTION OF LEFT HALF OF PELVIS, MADE IN THE CAVITY, ALONG THE LINE *j* IN PL. XXXV.*

The III. sacral vertebra, the acetabulum, and the symphysis pubis have been divided. BONES.

The erector spinæ, gluteus maximus, pyriformis (passing through the sciatic notch), and obturator internus are well seen. MUSCLES.

The uterus fills the pelvis. The cervix and lower segment have been cut through below the cavity of the body, and to the left of that of the cervix—hence a solid mass of tissue is seen. VISCERA.

The rectum lies a little to the right of the middle line.

The peritoneum on the surface of the bladder is well shewn. As its distribution here was not made out till the section was thawed, we did not observe whether the corrugations were present—as seen in the vertical mesial section. The peritoneum of the pouch of Douglas comes forward to a point opposite the centre of the acetabulum. The distance between its reflection here and that of the utero-vesical pouch is 3 cm.; this corresponds to the base of the broad ligament and consists of loose cellular tissue. This loose tissue extends backwards as a thin layer, outside the peritoneum, as far as the rectum; and forwards to behind the symphysis.

PLATE XXXIV.—ANTERO-POSTERIOR SECTION OF LEFT HALF OF PELVIS, MADE PARALLEL TO THE LAST BUT ONE INCH LOWER DOWN, ALONG THE LINE *k* IN PL. XXXV

BONES.

The V. sacral vertebra, and the tuberosity and ramus of the ischium have been divided.

MUSCLES.

The relations of the levator ani, obturator internus and externus are well seen.

VISCERA.

The anterior vaginal wall and the adjacent part of the lateral and posterior fornices have been slit up. No cavity is exposed, because the urethra lies to the right, the bladder more superficial, the vagina deeper.

The rectum lies in the middle line.

The peritoneum of the pouch of Douglas is seen—the layers separated by a little serum (*cf.* Pl. XXIII.).

The cellular tissue round the lateral fornix is very abundant, and passes backwards alongside of the rectum; this is therefore the downward prolongation of the tissue of the utero-sacral ligaments. This deposit is the "Parametric Tissue" of Virchow.

SUMMARY OF FACTS DEMONSTRATED BY THESE SECTIONS.

The most important facts may be grouped under these two heads: the displacement of the viscera in kyphosis; the relation of the pelvic organs post partum.

I. THE DISPLACEMENT OF THE VISCERA IN KYPHOSIS.

DISPLACEMENT OF VISCERA IN KYPHOSIS.

A series of sections like the foregoing, when supplemented by the skeleton, form a scientific basis for clinical work the importance of which cannot be exaggerated. By this method we can map out precisely the relation of the viscera to the bony landmarks. The practical utility is lessened, in the case of this series, by the fact that we are dealing with a deformed skeleton and displaced viscera. Unfortunately, we know of no corresponding series of sections made on the cadaver and supplemented by the skeleton, with which to compare this series. Such a series would be of great value as an anatomical basis for clinical medicine.

We shall give briefly the position of the viscera as they could be localised on the skeleton in Pl. XXXV. along with the various lines indicated, stating the position of the organ, the vertical extent of its area and its depth from the surface.

LOCALISATION IN SKELETON.	DEPTH FROM THORACICO-ABDOMINAL WALL.	ORGAN.	VERTICAL MEASUREMENT ALONG WALL.
Along the <i>line a.</i>			
From II. to lower margin VI. rib.	superficial	Heart	12 cm.
Opposite VI. rib.	1.5 cm. deep, diaphragm and cellular tissue intervening	Liver	
Below lower margin of VI. and downwards.	superficial	Intestines	
Along the <i>line b.</i>			
From corner of sternum to upper margin VII. rib	superficial	Left Lung	13 "
" middle of II. to that of VI.	1 cm. deep above and 2.5 cm. below, lung intervening	Heart	6.5 "
Under VII. rib	diaphragm intervening	Liver (<i>left corner</i>)	
" VII. "	diaphragm intervening	Transverse Colon	
Along the <i>line c.</i>			
From I. to lower margin VIII. rib.	superficial	Left Lung	11 "
" II. " " VII. "	2.5 deep above and 4 below	Heart	6.5 "
" middle of VIII. to lower margin XI. rib.	diaphragm intervening	Spleen	9.5 "
" upper margin VIII. to that of X. rib.	3 cm. deep, spleen intervening	Stomach	5.5 "
Under upper margin VIII.	5 cm. deep, spleen and stomach intervening	Liver (<i>left corner</i>)	
Along the <i>line d.</i>			
From upper margin I. to upper of VIII. rib.	superficial	Left Lung	11 "
" lower margin VII. to XII. rib.	diaphragm intervening	Spleen	12 "
" middle of VII. to lower margin X. rib.	4.5 cm. deep, spleen intervening	Stomach	8 "
Under VII. rib.	7.5 cm. deep.	Esophageal opening of S.	
From upper margin X. to XII. rib.	5-6 cm. deep, spleen intervening	Intestines	
" " IX. to upper of XI. rib.	8 cm. deep, spleen and intestine intervening	Pancreas	5 "

LOCALISATION IN SKELETON.	DEPTH FROM THORACICO-ABDOMINAL WALL.	ORGAN	VERTICAL MEASUREMENT ALONG WALL.
<i>Along the line e.</i>			
From lower margin II. to middle of IX. rib.	superficial	Left Lung	11 cm.
„ upper margin VIII. to lower of XII. rib.	diaphragm intervening	Spleen	10.5 „
„ lower margin VIII. to upper of X. rib.	4 cm. deep, spleen intervening	Stomach	4 „
„ upper margin X. to 1 cm. below XI. rib.	4.5 deep from XI. rib with spleen and kidney intervening	Pancreas	5 „
„ upper margin XI. to 1 cm. below XII. rib.	2.5 spleen intervening	Left Kidney	5 „
<i>Along the line f.</i>			
From lower margin IV. to upper margin X. rib.	superficial	Left Lung	7 „
Under IX. rib.	1.5 cm. deep	Spleen	1.5 „
Under IX. rib.	4 cm. deep	Left S. R. Caps	1.5 „
From lower margin IX. to 2.5 cm. below XII.	diaphragm intervening to the XI. rib, superficial below this	Left Kidney	8.0 „

2. THE RELATION OF THE PELVIC ORGANS POST PARTUM.

The uterus fills the pelvis. The intestines descend only into the upper two-thirds of the utero-vesical pouch, and not at all into the pouch of Douglas even though the peritoneal folds are separated by serum. RELATION OF PELVIC ORGANS POST PARTUM.

The ovaries lie at the level of the brim.

The bladder lies within the pelvic cavity behind the pubis.

The uterine walls measure, when the organ is contracted, 2.5-3 cm. thick; that on which the placenta is situated is about .5 cm. thicker and much more vascular through its whole thickness. The body of the uterus was, in this case, of a pyramidal shape and measured 10 cm. vertically, and 9.5 across its base. The lower uterine segment and cervix is flabby and lies folded in below the firmer uterus.

The vaginal canal measures 10.5 cm. as compared with the normal length of 6 cm. (*cf.* Pl. A in Appendix).

The perineal body is not recognisable.

The cellular tissue is increased in amount specially at the base of the broad ligaments, and round the posterior fornix; but also between the bladder and cervix. From the distribution of the cellular tissue, it is evident how readily a cellulitic abscess finds its way into the inguinal region, if it has formed round the ovary (see Pl. XXXII.); and how, in rare cases, it burrows through the sciatic notch (see Pl. XXXIII.). The enormous increase of the cellular tissue at the base of the broad ligament is worthy of note.

The peritoneum was not in this case thrown into folds over the uterus itself, as Matthews Duncan has described it in some post partum uteri; over the bladder and adjacent part of anterior abdominal wall, it is distinctly corrugated.

PART III.

THE CLINICAL STUDY OF THESE DEFORMITIES WITH REGARD TO OBSTETRICS.

Under this head we shall consider (I) Kyphosis and (II) Scoliosis and Kypho-scoliosis.

I. KYPHOSIS.

Clinical study of the kyphotic pelvis.

The important obstetric character of the kyphotic pelvis is *at the outlet*, and consists in contraction of the *transverse diameter*; the peculiar form of the brim offers no obstruction to labour.

The kyphotic deformity thus contrasts with the rickety, the malacosteon and the scoliotic, all of which imply *inter alia* obstruction *at the brim*.

This obstetric character is not however always present in the kyphotic pelvis, and is often not sufficiently marked to affect the progress of the labour.

In these two facts, we have the reason why this deformity has only in recent years attracted attention. Experience had taught that hunchbacks have often easy labours, and the exceptional cases were not carefully investigated, because labour was not arrested with the head at the brim, which was considered the most important plane of the pelvis.

Three points require consideration here :

1. The method of examining cases of kyphosis clinically ;
2. The mechanism of labour in the kyphotic pelvis ;
3. The operative interference required.

1. THE METHOD OF EXAMINING CASES OF KYPHOSIS CLINICALLY.

Here the following mode of procedure may be adopted.

(a) The *period of life* at which the kyphosis appeared must be ascertained. If it has developed before the 10th or 12th year, its effects on the pelvis will be serious (*Chantreuil*).

(b) The *seat* of the kyphosis, the length of the limbs and their distance from the perpendicular, furnish us with an indication of the extent to which the pelvis will be affected. The lower the apex of the kyphosis, the more pronounced will the kyphotic changes be. The rapidity of the process has also some influence (*cf. Pl. X., and p. 10*).

(c) In *measuring* the pelvis, special attention must be paid to the *transverse of the outlet*. This is best estimated according to *Chantreuil's* method ; place the patient in the genu-pectoral posture (or in the lithotomy posture, though the former facilitates the measuring) ; pass the index fingers into the vagina, and turn them back to back so that the pulp of the finger rests on the inner surface of the ischial tuberosities ; an assistant lays the points of the callipers on the palmar surface of the fingers just outside the vulva, the distance of which apart, corresponds to the inside measurement between the tuberosities. This allows us to use the ordinary callipers. With a pair of callipers in which the points cross, the measurement can be made directly by carrying the callipers inside the vulva.

The condition of the joints should also be noted, *e.g.* whether the ischial tuberosities yield on being pressed apart. *Korsch* has demonstrated that even in the normal pelvis the transverse of the outlet can be thus slightly increased, this movement being accompanied by a diminution in the conjugate (*Zeitsch. f. Geb. u. Gyn. Bd. VI.*). In the kyphotic pelvis this mobility is sometimes exaggerated, as was noted on the bony pelvis first by *Lambl* and then by *Moor* and others. There is an interesting observation also in the living subject by *Korsch* (*v. case No. 31* in table) : the transverse at the outlet was 6.5 cm. before labour began and increased to 9.5 cm. as the head was driven through, returning to 7.5 cm. six hours after delivery. Sometimes the joints give way : in the case recorded by *Herbiniaux* (*No. 1* in table) there was a distinct crack heard during the birth of the head and the pubic bones were found to be movable on each other after the delivery ; in *Phænomenoff's* case (*No. 21*) rupture of the symphysis was confirmed by the post mortem.

2. THE MECHANISM OF LABOUR IN THE KYPHOTIC PELVIS.

With regard to the *Onset of Labour* we note from our table that apart from the cases of induced labour, in four cases it was premature ; these are too few to warrant us endorsing *Chantreuil's* statement that there is a greater liability to premature labour in cases of kyphosis. When labour has commenced, the anterior obliquity of the uterus may interfere with *the engaging of the head*. The shortening of the abdominal cavity causes the uterus to incline forwards ; it is interesting to observe the difference in shape of the thoracic cavity in dorsal and dorso-lumbar kyphosis (*cf. Plates IX. and X.*), which will modify the capacity of the abdomen also. With regard to the *position* of the head, *Hugenberger* and *Phænomenoff* both remark on the greater frequency of occipito-posterior positions. *Champneys* in his extremely interesting paper on the obstetrics of the kyphotic pelvis (*Lond. Obstet. Trans. 1883*) in which he gives a table of thirty-two cases of labour, says—"The right occipito-iliac position is much commoner than the left. The cause of this needs explanation. The head is usually more or less transverse." In our case (*No. 27*), the head lay right-occipito-posterior. As the head descends, the shape

of the pelvis favours *rotation backwards* into the hollow of the sacrum. It will be delayed at the outlet according to the degree of contraction. Case No. 27 had an easy labour, as there was no contraction at the outlet; in such a pelvis as A, it is evident that a full-time head could not pass the outlet (*v. Pl. V.*) unless the tuberosities separated. In Champneys' case the head passed posterior to the tuberosities.

3. THE OPERATIVE INTERFERENCE REQUIRED.

Here we have to consider the alternatives of forceps, embryulcia, Cæsarean section or Porro's operation; and, when the case is seen in time, induction of premature labour.

As to the limit for forceps, if the child's head is lying antero-posterior, we shall have the $3\frac{1}{2}$ in. bi-parietal diameter engaging in the transverse of the outlet. The head will admit of a certain degree of compression, but, on the other hand, the blades of the forceps take up some room. A transverse of $3\frac{1}{4}$ would be the limit for forceps in the kyphotic pelvis. The high maternal mortality, in cases of kyphotic pelvis, as shewn by the following table would justify perforation and cranioclasm at once (without trying forceps) with a transverse below $3\frac{1}{4}$.

The following table (based on one given by Phænomenoff) of all the cases of labour in kyphotic pelvis, which we could gather from the literature, shews the amount of contraction, the operative measures employed, and the result for mother and child.

We have omitted the three following cases which appear in Champneys' table; Kleinwächter's, as being a Robert's pelvis; Braun's, in which there was no spinal deformity; Breslau's, as he refers the contraction of the pelvis to a disease of the pelvic bones which had probably developed since a previous confinement, and not to the kyphosis. In this table we have thirty-two cases of kyphosis and fifty-two labours. Of 50 children (of whom 10 were destroyed by craniotomy, and 3 died sometime after birth) only 26 lived. From fifty-two confinements there were thirty-three recoveries, but of the thirty-two mothers nineteen ultimately died after labour. We have thus a *fœtal mortality of 52 per cent.*; and a *maternal mortality of 36.5 per cent.* according to the number of *confinements*, or *59.4 per cent.* according to the number of *cases of kyphosis*. In Phænomenoff's table, the fœtal mortality is 44 per cent., and the maternal, according to cases, 70 per cent.; in Champney's table, the fœtal mortality is 40.6, and the maternal 45 per cent. It must of course be remembered that a larger proportion of extreme degrees of deformity and of bad cases are recorded in all such statistics; still, such a high maternal mortality must make us consider carefully what treatment will give the mother the best chance.

Of 12 cases in which forceps alone were used,	5 died.
„ 12 „ of induction of premature labour, only 1 „	
„ 10 „ of craniotomy,	3 „
„ 7 „ of Cæsarean section,	6 „ —one, a case of Porro—not till 21 days after the operation.

Nine cases ended spontaneously, 2 of which died—one from post-partum hæmorrhage after retained placenta.

(See Table at end of this Part).

II. SCOLIOSIS AND KYPHO-SCOLIOSIS.

The important obstetric character of these pelvis is *at the brim* and consists in a *unilateral contraction*—in one sacro-cotyloid diameter. Where the kyphosis is low down, we may have in addition contraction at the outlet. Clinical study of the scoliotic and kypho-scoliotic pelvis.

References to this as a special type of pelvis in the literature are rare, because its characteristics had not been described till recently by König and Leopold. Hence our clinical knowledge of its obstetric features is still more meagre than in the case of the kyphotic pelvis.

Taking up the same points as in the case of the kyphotic pelvis, we would suggest the following:—

I. METHOD OF INVESTIGATING CASES OF SCOLIOSIS AND KYPHO-SCOLIOSIS.

(a) The *period* of life at which the scoliosis appeared should be recorded; also whether the child was able to walk or not, and whether both limbs were used to an equal extent. The hip-joints should be examined in this connection, and the length of the legs noted.

To determine the degree of scoliosis, let fall a perpendicular from the VII. cervical spine, and plot out on a chart, by vertical and transverse measurements from the perpendicular, the course of the curve of the spines. From this we can deduce the curve of the bodies by reference to such a series of tracings as are given in Pl. XXII., in which fig. 3 shews the commonest form of scoliosis; Pl. XIII. shews the pelvis from this case.

The amount of kyphosis can be determined as for a simple kyphotic pelvis.

(c) In examining the pelvis, we note the relative height of the anterior superior iliac spines, the form of the iliac bones, the direction and curve of the sacrum. In addition to the usual inter-spinous, inter-cristal and external conjugate, we measure the distance from the posterior superior spine of one side to the anterior superior of the other. On internal examination we note first whether the transverse of the outlet is diminished, or the ischial tuberosities everted. The form of the brim is noted, and special attention must be paid to the *sacro-cotyloid diameter* of the brim as well as to the conjugate. Unfortunately we have no means of determining precisely the length of this diameter. Freund's flexible block tin pelvimeter is the only available instrument, and it is not very satisfactory. With the hand, we can tell roughly whether there is an equal space on both sides of the middle line at the brim. The contraction is usually on the same side as the lower (lumbar) curve, *i.e.* the opposite side to the well-marked upper (dorsal) curve, although there are exceptions to this as pelvis H. shews.

2. THE MECHANISM OF LABOUR.

The curvature of the spine may produce, as in the kyphotic pelvis, an obliquity of the uterus, and thus interfere with the action of the uterus; the obliquity may be lateral and prevent completely the *engaging of the head* as in the case recorded by Polk (New York Med. Record, April 1883).

The head frequently *presents* R. O. P. The cases given below from König and Litzman bear this out; in König's first one, the deformity of the pelvis changed the position of the head from L.O.A. to R.O.P.

In a minor degree of scoliosis, the head tends to pass through the more roomy side of the pelvis with the usual mechanism of *flexion*, (not the typical rickety mechanism of extension which occurs when the conjugate is the only contracted diameter). The explanation of this probably is that the contracted sacro-cotyloid diameter cuts off the part of the brim which lies to the contracted side; as Schröder very well expresses it "the wide half of the pelvis . . . resembles a universally contracted pelvis, whose conjugata vera is formed by the sacro-cotyloid, and transverse by the oblique diameter." This comparison might be extended to the mechanism, as we sometimes find the posterior fontanelle dipping low down—the typical justo-minor mechanism.

In a major degree of scoliosis, the head will be arrested at the brim as in the simple rickety pelvis, and the kyphotic characters may cause delay at the outlet.

3. OPERATIVE INTERFERENCE REQUIRED.

Here we have to consider the alternatives of turning, forceps, perforation, and Cæsarean section or Porro; and if the case be seen in time, the induction of premature labour.

Turning will be more difficult than in a simple rickety pelvis, on account of the unilateral contraction which will give less room for the hand. In bringing down the head, this will pass more easily with the occiput to the roomy side of the pelvis.

The use of *forceps* may be distinctly indicated in the scoliotic pelvis, although it is a rickety pelvis for which the scientific treatment is, as a rule, turning. And this for the following reason: the contracted sacro-cotyloid diameter, by cutting off one portion of the brim, has converted the kidney-shaped rickety brim into a justo-minor one; hence we have marked flexion of the head and a distinct indication for Forceps.

The cases which we have collected from the literature of this subject are too few to allow us to draw any conclusions as to treatment from them.

Polk records the following case of labour in a scoliotic pelvis (New York Medical Record—April, 1883):

Patient was a primipara with extreme scoliosis—right-sided in the dorsal, and left-sided in the dorso-lumbar region. Anterior superior iliac spine stands $1\frac{1}{2}$ in. nearer costal margin on left than on right side; left leg $\frac{1}{2}$ in. shorter than right. The internal examination shewed no marked contraction, but the plane of the brim was twisted so as to look backwards and to the left. As the uterine axis was oblique to the right side and could not be rectified, the head did not engage and forceps had to be applied. The position of the head is not recorded.

König (Zeits. f. Geb. und Frauen. Bd. I.) records two cases of labour in kypho-scoliotic pelvis.

1. Case. Kypho-scoliosis developed in early youth. Left-sided lumbar and right-sided thoracic curve. Pelvis contracted on left side, and left ischial tuberosity everted; diag. conj. 11 cm., and transverse of outlet 10 cm. Her first labour (æ. 27) ended naturally. At the second, the head which was L. O. A. some days before labour began, became R. O. P. and the labour terminated naturally.

2. Case. Æt. 28. Same curvature. Relation of iliac bones and left ischial tuberosity as in foregoing case; diag. conj. $11\frac{1}{2}$, transverse of outlet 10 cm. Head was R.O.P. as was shewn by the depression of the right parietal bone which persisted till 4 weeks after birth.

Litzman, in his comprehensive and masterly series of one hundred and thirty-two observations of labour in contracted pelvis (Die Geburt bei engem Becken, Leipzig 1884) gives two examples of the Scoliotic pelvis.

Observation 14 (p. 284). "No history of rickets. Scoliosis said to have developed after a fall when 13 years old. . . . The spinal column shewed a lateral curvature to the right in the cervical and upper dorsal regions, on which followed compensatory curves to the left in the lower dorsal, to the right in the lumbar, and again to the left in the sacral region. . . . The pelvis is as a whole small and markedly inclined; the anterior wall, somewhat high and only slightly inclined; the sacrum in its upper portion straight and flat; the promontory directly opposite to the symphysis, and springing sharply forwards to a moderate extent; the right side-wall of the pelvis distinctly straighter in its anterior portion than the left, and somewhat bent inwards in the region of the acetabulum. . . . I estimated the conjugata vera at 9 cm. and considered the pelvis as a universally but a symmetrically contracted pelvis—the right half being the larger. I. labour, protracted: II. a footling: III. labour, when 30 years old, vertex presentation; the head presented at first in the transverse diameter, occiput to the right; then slipped to the (left) roomy side of the pelvis, and engaged with the posterior fontanelle low down and the sagittal suture antero-posterior; child born spontaneously and alive."

Observation 48 (p. 375). "Suffered from rickets as a child, and did not walk till 3 years old. . . . Slight scoliosis in the dorsal region with the convexity to the right, with a compensatory lumbar curve to the left. Sacrum is sunk downwards between the innominate bones; pelvis markedly inclined; promontory springing somewhat sharply forwards and to the left; left half of pelvis more contracted. Conjugata vera estimated at 9.9 cm. I. labour, æt. 30: head presented with the occiput to the roomy side of the pelvis (R. O. P.), became markedly flexed; the anterior parietal bone was pushed below the posterior (ascribed to the pressure of the pubic bone on the contracted side); after partial rotation into the transverse, delivery was finished by forceps. II. Labour. The occiput head presented at first L. O. A. then passed to the roomy side of the pelvis, and became R. O. A.; became markedly flexed, and was born spontaneously."

Leopold has observed the following cases (Das skol. u. rachit. kypho-skol. Becken: Leipzig 1879).

Scolio-Rachitic.

Case I., æt. 26, 1-para.—Left-sided dorsal scoliosis with compensatory lumbar curve: pelvis, flat rickety, contracted on right side at brim, and

roomy on same side at outlet : c. vera 7, c. of outlet $10\frac{1}{2}$ and transverse 8 : premature labour induced : breech presentation and extraction of asphyxiated child.

Case II., aet. 24, 2-para.—Right-sided dorsal scoliosis with left-sided dorso-lumbar curve : pelvis, contracted on left side at brim, and roomy on same side at outlet : c. vera 6 cm., left sacro-cotyloid 4 cm., conjugate and transverse of outlet $9\frac{1}{2}$: induction of premature labour and cephalotripsy. (First child was premature, spontaneous, and lived.)

Kypho-Scoliotic Rachitic.

Case III., aet. 28, 2-para.—Left-sided kypho-scoliosis with apex at X.-XI. D; vertebra, and compensatory right-sided scolio-lordosis : pelvis contracted on right side at brim : c. vera $8\frac{1}{2}$ - $8\frac{3}{4}$, conjugate of outlet 9, and transverse $8\frac{1}{2}$ cm. : perforation and craniodasm. (First delivery by perforation and cephalotripsy.)

Case IV., aet. 32, 1-para.—Right-sided kypho-scoliosis (which developed at 7th year) with apex at X. D. vertebra, left-sided scolio-lordosis : pelvis contracted on left side at brim, and slightly funnel-shaped : c. vera 10, c. of outlet $8\frac{3}{4}$, and transverse 9—left tuberosity not pushed outwards : labour full-time, breech presentation, left half of brim not occupied by presenting part, forceps applied to after-coming head ; child lived.

Case V., aet. 37, 4-para.—Left-side kypho-scoliosis (which appeared at the $8\frac{1}{2}$ year) apex at X.-XII. dorsal, right-sided scolio-lordosis : pelvis, promontory stands high, brim somewhat contracted on the right side : c. vera 10, c. of outlet $9\frac{1}{2}$ and transverse $7\frac{3}{4}$ —right tuberosity stands more inwards : transverse presentation, turning, living child. (The first three were breech presentations—all living—forceps applied to after-coming head in I. and III.)

Case VI., aet. 28, 1-para.—Right-sided dorso-lumbar kypho-scoliosis which began at $6\frac{1}{2}$ years : pelvis funnel-shaped, some contraction on left side of brim : c. vera $10\frac{1}{2}$, c. and transverse of outlet $8\frac{1}{2}$ -9 cm. : premature labour at $7\frac{1}{2}$ mo.

Case VII., aet. 24, 1-para.—Left-sided scoliosis of upper dorsal vertebra and right-sided kypho-scoliosis in dorso-lumbar region : promontory not accessible, transverse of outlet $8\frac{3}{4}$ cm. pelvis markedly funnel-shaped : premature labour, child living but died in 5 days.

TABLE I.
ABSOLUTE MEASUREMENTS OF THE PELVIS IN PREP. A-N.

	A	B	C	D	E	F	G	H	J	K	L	M	N	O Normal Pelvis.
Standard line	9	9.5	9	9.4	7.6	10.5	9	8.3	11.5	11.5	9.5	11.5	12.3	11
Inter-spinous Diameter	24.4	22.3	22.2	22.3	—	22.5	21.7	19.5	23.9	25.5	21.4	26.2	22	21.5
Inter-cristal Diameter	26	25.3	23.5	24.2	—	25	23.9	18.5	25.7	26.2	22.4	26.6	22	25.2
External Conjugate (to I. sacral Spine)	18	18	15	17.2	11.5	16.4	17.5	10.5	12.5	18.2	15.3	14.2	11	17.8
Between corners of S curve on crests	13.2	14.5	15.8	14	—	14.4	13.5	10.4	12.1	15	14.5	9.9	11.5	16.1
Between post. sup. iliac spines	6.1	9	6.5	6.7	—	6.7	7	4.4	8.1	7	6.5	5.1	5.4	7.6
Between corner of S curve and S.L.—left	6.8	7	5.6	6.2	—	5.6	6	5.3	6	6.8	5.7	7.1	7	8
” ” ” right	6.8	6.8	5.4	6.2	5	6.7	5.7	5.1	6.2	6	6.6	6.8	5.4	7.6
” ” ” and post. sup. spine—left	6.5	6.5	5.9	6	—	6.9	6.3	5	5.9	7.7	7.3	6.3	6.5	7.4
” ” ” ” right	6.5	6.3	5.9	6.8	4.7	6.5	6.3	5.1	6.6	8	7.3	6.3	7	7.6
Between ant. sup. spine left and post. right	20.8	—	18.2	18.3	—	19.1	19	13.7	18.5	21	17.5	18.2	18.7	19.5
” ” ” right ” left	19.8	—	18.2	17.1	—	19.3	18.5	13.7	18.9	21	17.9	18.7	16.5	19.1
Anterior vertical height of Sacrum	11.5	12.8	11.5	10.4	6.8	12.8	10.7	8.2	8.5	12.2	11.3	11.4	9.8	10.8
Vertical height of Symphysis	4.3	3.4	3.2	3.4	2.8	4	3.4	2.2	2.6	3.5	3	3.5	3	3.5
Vertical height of side-wall of pelvis left	9.8	9.5	7.7	7.8	—	8.2	8.2	7	7	9.3	8.3	9.4	7.2	8.8
” ” ” right	9.8	9.5	7.5	7.8	6.5	8.2	8.2	7	6	9.3	8.7	8.8	7	8.8
Ilio-ischial line—left	16.8	—	13.8	14.5	—	15.7	15.9	12.4	13.2	16.9	14.9	16	13.7	15.7
” ” —right	16.8	16.3	13.5	14.7	10.7	15.7	15.1	12.2	13.2	17.4	13.8	16	14	15.7

Conjugata vera	16	17.5	13.8	12.4	9.5	13.9	14.4	7.9	7.3	12.8	10.2	8	5.5	11
Left Oblique	12.2	12.5	11	12.2	—	12.7	12.2	8.8	10.8	14	11.4	12.8	12.8	12.5
Right Oblique	12.2	13.5	11.6	12.8	—	13	12.2	8.8	10.5	13.2	11.3	11.5	10.7	12.5
BRIM. } Transverse	12.8	13	11.5	12.5	—	13	12	9	12.1	14.6	12.7	13.5	13.5	13.8
Anterior Transverse	11	12.3	10.3	10.8	—	11.1	10.3	7.8	8.5	12	10	10.8	10.2	11.3
Right Sacro-cotyloid	12	13.5	11	9.7	7	11.1	11.4	5.3	6.6	11.2	8.9	8.1	6.7	9.3
Left Sacro-cotyloid	12	13.5	11	10.5	—	11.7	11.4	5.6	5	10	9.1	5.3	4.5	9.3
Conjugata diagonalis	17	18	14.7	14	10.8	15.5	15.9	9.7	9	14.5	12.5	9.8	6.6	12.6
Conjugata normalis	14.4	14.3	10.7	12.2	8.3	12.5	13	7.6	10.1	14	10	10.9	10	12.8
Conjugate of cavity	13.3	13.5	10.1	11.7	8	11.6	12.6	7	9.4	13.1	10	9.6	8.5	12
Oblique of cavity—left	11	12.5	10.5	11	—	12	11.8	8	11	13.2	10.5	11.9	12	12
" " right	11	13	10.2	11.8	5.2	12	11.8	8.2	—	12.8	10.5	11.5	11.1	12
Between centre of base of Acetabula	9.5	11.9	9.5	9.8	—	11.4	10.6	7.5	9	13.5	9.2	11.2	10.2	12.5
Between middle of III. Sacral Vertebra and centre of base of Acetabulum—left	9.3	9.9	7.8	7.2	—	8.9	9.3	5	5.9	9.5	7.9	7.3	6.2	9.5
" " right	9.3	9.9	7.8	7.2	6	8.9	9.3	4.8	6.6	10.2	7.8	7.4	7.3	9.5
Conjugate of outlet	11.2	12	10	11	7.8	9.2	11.2	7.3	8.5	11.8	9	11.2	10.5	11.2
Between ischial spines	6.4	9.8	6.9	6.3	—	8.5	10.4	5.9	8	11.4	8.1	9.1	10.7	11.2
Transverse of outlet	3.6	10.4	7.1	5.5	—	9.8	8.5	6.7	8.1	10	8.5	9.1	10.5	11.5
D. spinoso-sacra—left	3.5	4.7	3	—	—	—	4.3	2.1	—	5	3	3.5	3.7	5
D. spinoso-sacra—right	3.5	4.7	3	—	—	—	4	2.8	—	4.8	3	3.5	3.7	5
D. tuberoso-sacra—left	6	6.6	5	—	—	—	7	5.6	—	8	5.5	7.4	8.2	8
" " right	6	6.6	5	—	—	—	7	5.2	—	8	5.5	7.4	6.6	8
Breadth of Sacrum, at lower corner of sacro-iliac joints	8.4	9.1	8	9.1	—	—	8.9	6.5	11	10	7.8	9.4	10.9	9
" " , at its lowest end	5	5	4.8	—	—	—	6	4.1	—	—	5.2	6	6	6.4
From end of S. L. to Symphysis—left	13.1	13.5	10.7	12.5	—	13	11.6	8.2	9.9	13	9.9	10.9	9.6	11.4
" " right	13	14	10.9	12.5	8	12.6	11.6	8.7	10.2	12.5	10.2	10.4	9.4	11.4
From end of S. L. to ends of Trans.—left	4.2	4.3	3.9	4.2	—	4.8	4.2	1.4	1	3.4	3.3	1.4	.5	2.9
" " right	4.2	5	3.9	4.2	—	3.5	4.2	1.4	1.5	4.5	3.3	2.5	2.2	2.9
From Symphysis to ends of ant. Trans.—left	8	8.4	6.8	7.8	—	6.5	6.8	5.6	6.3	7.6	6	7.1	6.3	7.2
" " right	8	8.4	6.8	7.8	4.2	7.5	6.8	5.5	6.6	7.6	6	7.1	6.7	7.2
" Promontory to ends of Trans.—left	10.5	11.8	9.7	9.1	—	9.9	9.3	5.5	6.5	8.9	8.4	6.2	6.5	8.5
" " right	10.5	12	9.7	8.6	—	9.2	9.3	5	7.2	10	8.3	8.5	7.5	8.5
Angle of ilio-ischial lines	72°	42°	66°	70°	—	48°	48° +	61°	73°	45°	50°	65°	48°	38°

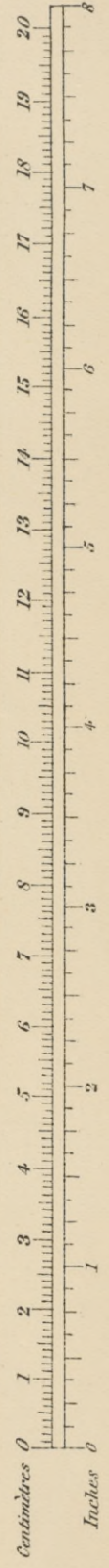


TABLE II.
MEASUREMENTS OF THE PELVIS IN PREP. A-N EXPRESSED AS A PERCENTAGE OF THE STANDARD-LINE.

	A	B	C	D	E	F	G	H	J	K	L	M	N	O Normal Pelvis.
Standard-line	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Inter-spinous Diameter	271	235	247	237	—	214	241	235	208	222	225	228	179	195
Inter-cristal Diameter	289	266	261	257	—	239	265	223	223	228	236	231	179	229
External Conjugate	200	189	167	183	151	156	194	126	109	158	161	123	89	162
Between corners of S curve on crests	147	152	175	149	—	137	150	125	105	130	153	86	93	146
Between post. sup. iliac spines	68	95	72	71	—	64	78	53	70	61	68	44	44	69
Between corner of S curve and S. L.—left	75	74	62	66	—	53	67	64	52	59	60	62	57	73
” ” ” —right	75	71	60	66	66	64	63	61	54	52	69	59	44	69
” ” and post. sup. spine—left	72	68	65	64	—	66	70	60	51	67	77	55	53	67
” ” ” —right	72	66	65	72	62	62	70	61	57	69	77	55	57	69
Between ant. sup. spine left and post. sup.—right	231	—	202	195	—	182	211	165	161	183	184	158	152	177
” ” ” right ” —left	220	—	202	182	—	184	205	165	164	183	188	163	134	174
Anterior vertical height of Sacrum	128	135	128	111	89	119	119	99	74	106	119	99	79	98
Vertical height of Symphysis	48	36	35	36	37	38	38	26	33	30	32	30	24	32
Vertical height of side-wall of pelvis—left	110	100	85	83	—	78	91	84	61	81	87	82	58	80
” ” ” —right	110	100	83	83	85	78	91	84	52	81	92	76	57	80
Ilio-ischial line—left	187	—	153	154	—	149	176	149	115	147	157	139	111	143
” ” —right	187	172	150	156	141	149	168	147	115	151	145	139	114	143
Conjugata vera	178	184	153	132	125	132	160	95	63	111	107	69	45	100
Left Oblique	136	132	122	130	—	121	135	106	94	121	120	111	104	114
Right Oblique	136	140	129	136	—	124	135	106	91	115	119	100	87	114
Transverse	142	137	128	133	—	124	133	108	105	127	134	117	110	125
Anterior Transverse	122	129	114	115	—	106	114	94	74	104	105	94	83	103
Right Sacro-cotyloid	133	142	122	103	92	106	127	64	57	97	94	70	54	85
Left Sacro-cotyloid	133	142	122	112	—	111	127	67	43	87	96	46	37	85
Conjugata diagonalis	189	189	163	149	142	114	177	117	78	126	132	85	54	115
Conjugata normalis	160	150	119	130	109	119	144	91	88	122	105	95	81	116

BRIM.

Conjugate of cavity	148	142	112	124	105	110	140	84	81	114	105	83	59	109
Oblique of cavity—left	122	132	117	117	—	114	131	96	96	115	110	103	97	109
” ” —right	122	137	113	125	68	114	131	48	48	111	110	100	90	109
Between centre of base of Acetabula	105	125	105	104	—	108	118	90	78	117	97	97	83	114
Between middle of III. Sacral Vertebra and centre of base of Acetabulum—left	103	104	87	77	—	85	103	60	51	83	83	63	50	86
” ” —right	103	104	87	77	79	85	103	58	57	89	82	64	59	86
Conjugate of Outlet	124	126	111	117	103	88	124	88	74	103	95	97	85	102
Between ischial spines	71	103	77	67	—	80	115	70	69	99	85	79	87	102
Transverse of Outlet	40	109	79	58	—	93	94	81	70	87	89	79	85	105
D spinoso-sacra—left	39	49	33	—	—	—	48	25	—	43	31	30	30	45
” ” —right	39	49	33	—	—	—	44	34	—	42	31	30	30	45
D tuberoso-sacra—left	67	69	55	—	—	—	78	67	—	69	58	64	67	73
” ” —right	67	69	55	—	—	—	78	63	—	69	58	64	54	73
Breadth of Sacrum at lower corner of sacro-iliac joints	93	96	89	97	—	—	99	78	96	87	82	82	89	82
” ” at its lowest end	55	52	53	—	—	—	66	49	—	—	55	52	49	58
From end of S. L. to Symphysis—left	145	142	119	133	—	120	129	98	86	113	104	95	78	104
” ” —right	144	147	121	133	105	124	129	105	89	108	107	90	76	104
From end of S. L. to ends of Trans.—left	47	45	43	45	—	45	47	16	9	29	34	12	4	26
” ” —right	47	52	43	45	—	33	47	16	13	39	35	22	18	26
From Symphysis to ends of ant. Trans.—left	89	89	75	83	—	62	75	67	55	66	63	62	51	65
” ” —right	89	89	75	83	55	71	75	66	57	66	63	62	54	65
” Promontory to ends of Trans.—left	116	124	108	96	—	94	103	66	56	77	88	54	53	77
” ” —right	116	126	108	91	—	87	103	60	63	87	87	74	61	77

CASES OF LABOUR IN KYPHOTIC PELVES.

NO. REPORTED BY.	SEAT OF KYPHOSIS.	TRANSVERSE OF OUTLET.	AGE.	PARA.	PERIOD OF ONSET OF LABOUR.	OPERATIVE INTERFERENCE.	RESULT TO MOTHER.	RESULT TO CHILD.	REFERENCE.
1	dorso-lumbar	—	—	—	—	Spontaneous	Recovered	Living	Traité sur divers accouchemens laborieux. Pt. I. Brussels, 1782. Phænomenoff's table.
2	lumbar	48	—	I.	full-time	Cæsarian Section	Died	—	—
3	lumbar	7	—	I. II.	full-time	Forceps	Stricture and Cicatrices of Vagina	Dead	Beiträge z. Lehre vom schräg verengten Becken. Königsberg, 1852.
4	lumbar	7-25	—	II.	full-time	Cæsarian Section	Died	—	—
5	lumbar	—	32	I. II. III.	fœtus weighed 4 lbs. full-time full-time premature	Forceps	Recovered	Dead	Phænomenoff's table.
6	lumbar	8	42	I.	full-time	Forceps	Recovered	Dead	Monats. f. Geburtsk. Bd. XV. and XVI.
7	lumbar	8	40	I.	full-time	Premature Labour induced	Died	—	—
8	lumbar	—	34	I.	full-time	Forceps	Died	Living	Würzburg med. Zeit. Bd. VI.
9	lumbar	8-5	32	I. II. III. IV.	full-time full-time full-time full-time	Cæsarian Section Cephalotripsy	Died	Dead	Phænomenoff's table.
10	lumbar	7-5	—	I. II. III.	premature premature premature	Spontaneous Spontaneous Forceps	Recovered	Living	St Pet. med. Zeitsch. Bd. XV.
11	lumbar	36	34	I.	premature	Prem. labour induced and forceps Prem. labour Prem. labour	Recovered	Living	Bullet. de l'Academ de Méd., 1869.
12	dorso-lumbar	10-5	31	I.	full-time	Cæsarian Section	Died	Living	Archiv. f. Gynäk. Bd. I.
13	dorsal	9	—	I.	premature	Spontaneous	Died	Living	Gazette Hebdomaire, 1870.
14	dorsal	5	36	I. II.	premature full-time full-time	Prem. labour induced Cæsarian Section Forceps	Died	Living	—
15	lumbar	4-6	—	I. II. III. IV.	full-time full-time full-time full-time	Forceps Prem. labour induced Spontaneous	Died (Rupture of Uterus)	Living	Beiträge zur Lehre vom kyphotisch verengten Becken. Bonn, 1870.
16	lumbar	—	41	I.	premature full-time	Craniotomy	Recovered	Dead	Das in Zurich befindliche kyphotisch querverengte Becken. Zurich, 1865.
17	lumbar	96	28	I.	full-time	Cæsarian Section	Died	Dead	Monats. f. Geburtsk. Bd. XXXI.
18	lumbar	8	—	I.	full-time	Spontaneous	Recovered	Living	Archiv. f. Gynäk. Bd. IV.
19	lumbar	7-58	—	I. II.	premature	Craniotomy Prem. labour induced and forceps	Recovered	Dead	Klinik der Geb. Erlangen, 1855.
20	lumbar	9	—	I. II.	full-time full-time	Craniotomy Prem. labour induced and forceps Cæsarian Section	Recovered	Living	Phænomenoff's table.
							Died	Dead	Centralblatt f. Gynäk. No. 2, 1880.

21	Phaenomenoff	dorso-lumbar	9	30	I.	full-time	Forceps	Died (rupture of symphysis)	Living	Zeitsch. f. Geb. u. Gyn. Bd. VII. S. 254.
22	Chantreuil	dorso-lumbar	8	—	—	premature	Prem. labour	Recovered	Dead	Leçon's faites à l'hôpital des cliniques. Paris, 1880.
23	Chantreuil	lumbar	7	20	—	premature	Prem. labour and forceps	Recovered	Died 13th day	" "
24	Taylor	—	4·5		{ I. II.	full-time full-time	Craniotomy Porro's operation	Died (21 days after)	Dead Living	Lusk's Midwifery p. 487.
25	Hüter	lumbo-sacral	9·5	25	I.	premature	Prem. labour	Recovered	Died shortly	Zeitsch. f. Geb. u. Gyn. Bd. V., S. 22.
26	Winckel	lumbo-sacral	6	26	{ I. II.	full-time premature	Forceps then Craniotomy Prem. labour induced	Recovered	Dead Died in 12½ hours	Klinische Beobachtungen zur Dystokie durch Beckenenge. Leipzig, 1882.
27	Barbour	dorso-lumbar	10·4	23	I.	full-time	Spontaneous	Died (post partum haemorrhage)	Living	v pp. 2 and 20 of this thesis.
28	Stadtfeldt	lumbar	7·5	42	{ I. II. III.		Craniotomy Craniotomy Craniotomy	Died	Dead Dead Dead	Med. chirurg. Review, Jan. 1869.
29	Negri	lumbo-sacral	8	23	I.	full-time	Craniotomy	Died	Dead	Annali di Ostet. 1882.
30	Kezmarszky	—	—	—	—	—	Forceps	Recovered	Living	Wien. med. Wochenschr. 1872, IV. 2.
31	Korsch	dorso-lumbar	6·5 to 9·5	30	I.	full-time	Forceps	Died	Living	Archiv. f. Gyn. Bd. XIX.
32	Champneys	dorsal and dorso-lumbar	5·5	31	{ I. II. III.	premature premature premature	Spontaneous Spontaneous Prem. labour induced	Recovered	Living Living Dead	London Obst. Trans. 1883.

A P P E N D I X.

THE sections given in this Appendix have been made since the Thesis was written. It was my intention to make in a normal cadaver a series of sections similar to those made in the kyphotic one, and determine the relation of the viscera to the normal skeleton; we should thus have had a standard of comparison by which to determine the displacement of the viscera. Before freezing this cadaver, it was observed that the spine was slightly prominent in the upper dorsal region; but the general contour of the body was not much altered. The vertical mesial section showed that there was caries of the spine in both the upper dorsal and lumbar regions. This section has been reproduced here as bringing out the important point that there may be a considerable amount of caries without much deformity of the spine; it shows also the degree of pelvic deformity present under these circumstances. To determine the shape of the pelvic arch and the direction of the articulations in the erect posture, a series of coronal sections (*i.e.* in the direction of the coronal suture) were made so as to run vertical to the horizon when the body stands erect; the two most interesting ones are given in Plates B and C, and bring out some points of importance in topographical anatomy.

PLATE A.—VERTICAL MESIAL SECTION.

There has been caries of *the spine* in two places. In the upper dorsal region, the 5th vertebra has been in great part destroyed and fused with the 4th; in the lumbar region, the 2nd, 3rd, and 4th vertebrae have been blended into a mass of bone which, as it lies to the left of the mesial plane, does not appear in the section. The resulting deformity is a shortening of the spine without much curvature; the body has been telescoped, as it were. If we compare the length of the healthy portion of the spine with the corresponding portion of a normal spinal column (*e.g.* that in the frozen section figured in "The Relations of the Abdominal and Pelvic Organs in the Female," by Professor A. R. Simpson and Dr D. Berry Hart), so as to make allowance for the relative shortness of the spine in this subject, we find the absolute shortening to be as follows: The distance between the intervertebral disc above the I. and that below the XII. dorsal vertebra is 23.6 cm. ($9\frac{1}{4}$ in.) instead of 24.9 cm. ($9\frac{3}{4}$ in.); the dorsal region has been shortened by 1.3 cm. ($\frac{1}{2}$ in.). The distance between the disc above the I. and that below the V. lumbar vertebra is 10.2 cm. (4 in.), instead of 13.4 cm. ($5\frac{1}{4}$ in.); the lumbar region has been shortened by 3.2 cm. ($1\frac{1}{4}$ in.).

The bones of the *pelvis* are also carious. The conjugata vera is 11.7 cm. ($4\frac{3}{4}$ in.), and the conjugate of the outlet—measured to the lower end of the sacrum—6.3 cm. ($3\frac{1}{4}$ in.). The conjugata normalis is 11.2 cm. ($4\frac{3}{8}$ in.), and the angle representing the amount of kyphosis is 72° ,—the same as Pelvis D (*v.* p. 10), which had the kyphotic characters the least pronounced of any of the series.

The *Uterus* is retroverted; from its deviation to the left of the middle line (*v.* Pl. B), the section has passed through the body to the right of its mesial plane and has not gone through the cervix. Its position is noteworthy; it lies with its long axis almost vertical, although clinically it would be described as slightly retroverted. As the anterior part of the section passes slightly to the left of the mesial plane, the external genitals have been divided through the left labium minus; for the same reason the urethra is not laid open. The *Vagina* runs parallel to the plane of the brim, and is exposed for 3.8 cm. ($1\frac{1}{2}$ in.). The right lateral fornix is separated from the peritoneum of the utero-vesical pouch by 1.2 cm. ($\frac{1}{2}$ in.) of tissue, and from that of the lateral pouch of Douglas by .6 cm. ($\frac{1}{4}$ in.). The *Bladder* is contracted, and forms an ovoid with the long axis antero-posterior; it contains a little urine. The *Peritoneum* of the pouch of Douglas descends .5 cm. (almost $\frac{1}{4}$ in.) on the posterior vaginal wall, and to the level of the 2nd bone of the coccyx. It does not contain any intestines, but the utero-vesical pouch has intestines coming down to its lowest point. There are no adhesions in the pouch of Douglas, nor any utero-sacral cellulitis to explain the position of the uterus. The *Rectum*, which is slightly distended, has not been exposed in its lowest third.

PLATE B.—VERTICAL CORONAL SECTION OF LEFT HALF OF PELVIS.

If on Plate A a line be drawn joining the points B B (on the intervertebral disc at the promontory, and below the perineum), it will indicate the direction in which this section runs. When the body is erect, this line will be almost vertical to the horizon; and from the point at which it passes through the last lumbar vertebra, it nearly represents the direction through which the weight of the trunk is transmitted to the pelvis. The section (*v.* Pl. B) passes through the posterior corner of the acetabulum, and through the ischial tuberosity. It represents therefore the line of support in an upright sitting rather than a standing posture.

In the *bony pelvis* we note that the sacro-iliac joint runs from above downwards and inwards, so that the sacrum, in this particular plane, has the appearance of a wedge. The body of the sacrum bulges downwards, and the ischial tuberosity projects inwards so that the side-wall of the pelvis is not straight: both of these are abnormalities. The anterior portion of the sacro-sciatic notch is seen.

The *Levator Ani* is seen arising from the pelvic fascia over the obturator internus, and passing down to be inserted into the perineal body. The muscles of the perineum are also exposed. The body of the retroverted *Uterus* is seen in great part, the frozen intestines having been removed so as to expose the fundus; the left Fallopian tube and round ligament have been divided as they pass forwards from the uterus. The left *Ovary* has been partially cut across, and the removal of the intestines has exposed it entirely. It lies vertical to the horizon; as there are no adhesions, this position is apparently due to the action of the infundibulo-pelvic ligament which holds up its distal end. The section passes through the vesico-uterine and vesico-vaginal cellular tissue. Some cellular tissue is also exposed in the broad ligament; and there is some fatty cellular tissue external to this and continuous with the sub-peritoneal fatty tissue which lies external to the ovary and in the region of the sacro-sciatic notch.

PLATE C.—VERTICAL CORONAL SECTION OF LEFT HALF OF PELVIS.

The direction of this section will be indicated by a line joining the points C C (on the intervertebral disc below the I. sacral vertebra, and opposite to the rectum) in Plate A.

In the *bony pelvis* we note that the sacro-iliac joint has here the form of a very open V with the apex pointing outwards—a shape well adapted to secure immobility. The spine of the Ischium has been divided where it gives origin to the Levator Ani; the tuberosity is cut through in its posterior part, where it gives origin to the muscles.

The *Levator Ani* is seen arising from the ischial spine and passing downwards to be inserted into the rectum (*cf.* Pl. A), at the internal sphincter. External to it lies the ischio-rectal fossa, which extends upwards as far as the ischial spine; internal to it, a well-marked layer of the pelvic fascia is displayed.

The *Uterus* has been sliced across from the ovarian ligament to below the utero-sacral ligament (*cf.* Pl. A.); the intestines seen above it occupy the highest part of the pouch of Douglas. The *Peritoneum* of the pouch of Douglas has been cut across in two places,—where it covers the body of the uterus about the level of the ovarian ligaments, and also 1.3 cm. ($\frac{1}{2}$ in.) above the bottom of the pouch of Douglas.

SUMMARY OF FACTS BROUGHT OUT BY THESE SECTIONS.

From a study of these three sections we learn the following facts:—

There may be extensive disease of the spinal column without much antero-posterior curvature. This is a point of great clinical importance; with so little kyphosis to attract attention to the condition of the spine, a case like this would mislead us as to the extent of the carious process. Further, where the kyphosis of the spine is slight, the typical kyphotic changes (by which is meant the changes due to the disturbance of the equilibrium of the trunk referred to on page 10) are not well marked. In this pelvis, however, there are changes due to the transmission of the weight of the body in the normal direction, but through diseased pelvic bones: the sinking down of the body of the sacrum, and the dislocation inwards of the ischial tuberosities, are probably both the results of pressure acting on carious bone—in the one case of the downward pressure of the weight of the trunk, in the other the upward and inward counter-pressure on the ischial tuberosities produced in the sitting posture. From this section we learn also another mode by which the transverse diameter of the outlet may be contracted. At page 10 we referred to the rotation of the innominate bones as bringing the tuberosities nearer to one another. In this pelvis, apart from any rotation, the tuberosities are approximated by a bending of the ends of the diseased bone inwards.

The direction of the sacro-iliac joint in Pl. B does not correspond with the representation of that joint given by Matthews Duncan (Researches in Obstetrics, p. 68). The appearance of the joint varies, as he has pointed out, with the part of it through which the section runs, and the inclination at which the pelvis is held. The section which he figures (*op. cit.* p. 68) is made parallel to the plane of the brim; the section in Plate B runs vertical to the horizon when the trunk is placed erect, and cuts the plane of the brim at an angle. As already stated, the plane of section B may be taken to represent the direction in which the weight of the body is transmitted in the sitting posture; and the pressure-changes in the bone corroborate this. Pl. C shows the “joggle” which Matthews Duncan has described in this joint.

The relations of the Levator Ani to the Vagina and Perineal body are of great practical importance. In Pl. B we see its origin from the pelvic fascia and its insertion into the vagina; in Pl. C, its origin from the ischial spine and insertion into the rectum. From its relation to the vagina (*v.* Pl. B) we understand how its contraction produces vaginismus. Marion Sims was the first to draw attention to this condition, and Hildebrandt referred it to the action of the Levator Ani; Henrichsen has recorded recently an interesting case, and gives the literature of the subject (Archiv. f. Gyn. Bd. XXIII, S. 59). Of greater importance is the relation of the Levator Ani to the Pelvic Floor. Dr Hart was the first to describe the sacral segment of the pelvic floor as supporting the pelvic contents (Structural Anatomy of the Pelvic Floor); more recently, he has described the fixed portion of the pelvic floor as formed by the Levatores Ani, and the displaceable portion as comprising the structures lying internal to them (Atlas of Female Pelvic Anatomy, p. 58). Pls. B and C show how the Levator Ani forms the support. If we draw a line, in Pl. B, vertically downwards from the middle of the posterior vaginal wall, it will pass through the structures divided in a deep perineal laceration; from this we see that the importance of such a tear depends on the tear not of the skin and the cellular tissue but of the fibres of the Levator Ani. Schatz has described recently the various tears which may occur in the Levator Ani (Archiv. f. Gyn. B. xxii., S. 298).

The position of the ovary (Pl. B) is of some interest from a clinical point of view. A great deal of unnecessary refinement is shown in defining its precise anatomical position under normal conditions, as this must vary with the position of the uterus which is constantly changing. In cases of retroversion of the uterus, however, it becomes a point of clinical importance to know whether the ovaries have been displaced also; when they can be felt in the pouch of Douglas, the case is much more difficult to treat. Pl. B shows their position when they do not prolapse. As there are no adhesions fixing the ovary, we have attributed its position here to the action of the infundibulo-pelvic ligament; prolapse of the ovary may be due to the stretching of this ligament, but this has not been proved anatomically.

INDEX OF PLATES.

Plate I.—Preparation A ($\frac{1}{2}$): pelvis with vertebral column and ribs from a case of simple kyphosis due to dorso-lumbar caries. (*University Anatomical Museum.*)

The ilium is flattened and elongated antero-posteriorly; the tip of the coccyx is in a line with the ischial tuberosities.

Plate II.—Pelvis of Prep. A, seen through the brim ($\frac{1}{4}$).

The brim is greatly elongated antero-posteriorly. The iliac bones are thrown apart and flattened. The sacrum is narrowed transversely and elongated vertically; from the high position and backward displacement of the promontory, much more of its anterior surface is seen than in a normal pelvis—*cf.* Plate III.

Plate III.—Brim of a normal pelvis, for comparison with Plate II. ($\frac{1}{4}$).

Plate IV.—Brim of a rickety pelvis ($\frac{1}{4}$).

This presents an appearance which contrasts with that of the kyphotic—*cf.* Plate II.

Plate V.—Outlet of pelvis A ($\frac{1}{4}$).

From the funnel-shaped form of the pelvis, the posterior surface of the sacrum is seen, not the anterior—as in the normal pelvis Plate VI.; more of the external surface of the ilia is seen than in the normal. The tip of the coccyx is in a line with the ischial tuberosities. The pubic arch is narrowed. The ascending rami of the ischia run parallel; the tuberosities and the spines are approximated.

Plate VI.—A normal pelvis placed in the same position as that in Plate V. for the sake of comparison, ($\frac{1}{4}$).

Plate VII.—Preparation C: pelvis with vertebral column and ribs from a case of kyphosis in a young subject due to dorso-lumbar caries. (*Royal College of Surgeons' Museum: No. 346.*)

This shows the kyphotic curvature as seen from the front, the high position of the promontory and the relatively forward displacement of the lower end of the sacrum and of the coccyx, the antero-posterior elongation of the brim and the diminished curvature of the linea terminalis.

Plate VIII.—Preparation E—to the right hand: pelvis with thorax (shown in section—right half) from a case of pure kyphosis due to caries of the lower dorsal vertebræ ($\frac{1}{2}$). (*Royal College of Surgeons' Museum: No. 558.*)

The pelvic bones are not yet ankylosed.

Preparation K—to the left hand: pelvis with vertebral column from a case of kypho-scoliosis due to rickets. (*Royal College of Surgeons' Museum: No. 559 and 560.*)

The changes in the pelvis are due to rickets and the kypho-scoliosis.

Plate IX.—Preparation F: skeleton from a case of kyphosis due to caries of the dorsal vertebræ ($\frac{1}{2}$). (*Royal College of Surgeons' Museum: No. 345.*)

The skeleton is shown in section—right half—and placed in the erect posture.

Plate X.—Preparation G: skeleton from a case of kyphosis due to caries in the dorso-lumbar region. (*Royal College of Surgeons' Museum: No. 344.*)

The kyphotic characteristics in the pelvis are more pronounced than in Prep F.

Plate XI.—Preparation H: skeleton from a case of scoliosis in a young subject due to rickets ($\frac{1}{2}$). (*University Anatomical Museum.*)

The brim of the pelvis stands almost vertical and is contracted on the right side. There is a right sided scoliosis in the dorsal region and a compensatory curve to the left in the dorso-lumbar region.

Plate XII.—Preparation J: complete skeleton from a case of scoliosis due to rickets ($\frac{1}{4}$). (*Royal College of Surgeons' Museum: No. 587.*)

The direction of the curves is similar to that in H. The pelvis contracted on the left side (the same side as the lumbar curve) while in H, it is contracted on the opposite side.

Plate XIII.—Pelvis of skeleton J, life-size, to show its exact form.

Plate XIV.—**Rachitic skeleton** with an almost normal spinal curvature ($\frac{1}{4}$). (*Royal College of Surgeon's Museum*: No. 586.)

The conditions here are the same as in Prep. **J**, except that the curvature of the spine is not much affected; a comparison of the pelvis (see text) brings out the effect that spinal deformity has on the form of the pelvis.

Plate XV.—**Preparation N**: skeleton from a case of kypho-scoliosis due to rickets ($\frac{1}{2}$). (*University Obstetrical Museum*.)

The kypho-scoliosis is to the right side with a compensatory curve to the left. Brim of pelvis contracted on the left side.

Plate XVI.—**FIG. 1.** **Diagram** representing the following diameters in a **horizontal plane** (plane of the brim) of a normal pelvis, and of Pelves **A, B, C, D**: S L, standard line; T T, transverse of Brim; $t t$, anterior transverse diameter; P s, conjugata vera; P t , sacro-cotyloid diameter of Brim.

FIG. 2.—**Diagram** representing the following diameters of same pelvis in a **sagittal mesial plane**: S P, conjugata vera; S N, conjugata normalis; C B, conjugate of outlet.

Plate XVII.—**Diagram** representing the following diameters in a **coronal plane** of a normal pelvis, and Pelves **A, B, C, D**: S S, interspinous diameter; T T, transverse of outlet; $t t$, anterior transverse of brim. The angle which the ilio-ischial lines S T, S T', make at v is the ilio-ischial angle. The lines $t T$, $t T'$, represent the direction of the side-walls of the pelvis.

Plate XVIII.—**FIG. 1.** **Horizontal plane**, and **FIG. 2.** **Sagittal plane** of pelvises **F, G, H, K, L**.

Plate XIX.—**Coronal plane** of pelvises, **F, G, H, K, L**.

Plate XX.—**FIG. 1.** **Horizontal plane**, and **FIG. 2.** **Sagittal plane** of a typical rickety pelvis and of pelvises **J, M, N**.

Plate XXa.—**Coronal plane** of typical rickety pelvis, and of pelvises **J, M, N**.

Plate XXI.—**FIG. 1.** **Diagram** representing the angle S N P in Pl. XVI, XVIII, and XX, which is lettered A, B, etc. according to the pelvis it is taken from; the increase in this angle expresses the amount of increase in the conjugata vera.

FIG. 2. **Diagram** representing the relation of the transverse diameter of the Brim to that of the outlet; T' T represents the direction of the side-wall of the pelvis, and the angle T' T H is lettered A, B, etc. according to the pelvis.

Plate XXII. **Diagram** (to scale $\frac{1}{2}$) of the **Scoliosis** in Preps. **H, J, M, N**. The interrupted line represents a line passing through the spinous processes, and the dotted one a line passing along the outer side of the bodies. The vertebral spine and body which forms the apex of each curve, is lettered, and also the spine through which the perpendicular falls.

Plate XXIII.—**Vertical mesial section** of a frozen cadaver with kyphosis in the dorso-lumbar region due to caries.

The section has divided the cervical vertebræ and the symphysis mesially but has passed 1.5 cm. to the right of the promontory. The anterior-posterior diameter of the brim, as it appears in the section, is shorter than the conjugata vera; that of the outlet nearly corresponds to the actual length. Due to the slight obliquity of the section and to a distinct deviation of the kyphosis to the left, the right lumbar region is exposed. From distortion of the sternum to the right, the left costal cartilages are divided. The condition of the pelvic organs is that immediately post partum.

Plate XXIV.—**Lateral sagittal section** through the right half of the same cadaver, two inches to the right of that shown in Plate XXIII.

The right lung, the liver and some of the small intestines are exposed.

Plate XXV.—**Coronal section** of left half of thorax and abdomen of same cadaver made through the line *a* in Plate XXXV.

Plate XXVI.—**Coronal section** of left half of thorax and abdomen made through the line *b* in Plate XXXV.

Plate XXVII.—**Coronal section** of left half of thorax and abdomen made through the line *c* in Plate XXXV. As the plaster ran in on part of this section, the tracing is incomplete.

Plate XXVIII.—**Coronal section** of left half of thorax and abdomen through the line *d* in Plate XXXV.

Plate XXIX.—**Coronal section** of left half of thorax and abdomen made through line *e* in Plate XXXV.

Plate XXX.—**Coronal section** of left half of thorax and abdomen through the line *f* in Plate XXXV.

Plate XXXI.—**Coronal section** of left half of **thorax and abdomen** made through the line *g* in Plate XXXV. It has sliced off the apex of the kyphosis without cutting into the thorax or abdomen.

Plate XXXII.—**Antero-posterior section** of left half of pelvis made in the plane of the brim, through the line *h* in Plate XXXV.

Plate XXXIII.—**Antero-posterior section** of left half of pelvis made in the cavity, through the line *j* in Plate XXXV.

Plate XXXIV.—**Antero-posterior section** of left half of pelvis made in the cavity parallel to last and through the line *k* in Plate XXXV.

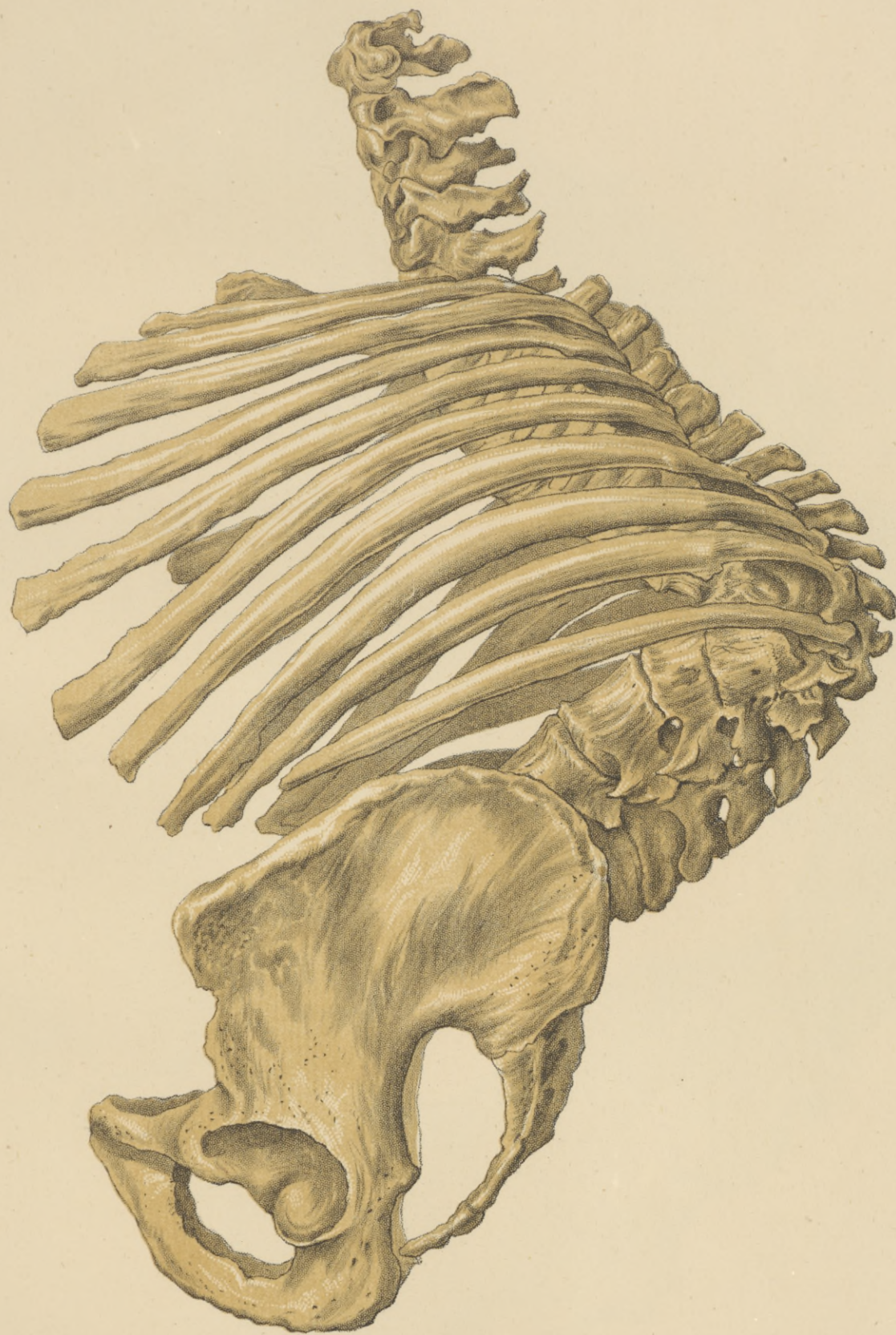
Plate XXXV.—Side view of skeleton of cadaver from which the foregoing sections were made. The red lines represent the saw-cuts in the bones. For sections *a-g*, see Plates XXV.—XXXI.; for *h-k*, see XXXII.—XXXIV. The pelvis is kyphotic.

APPENDIX.

Plate A.—Vertical mesial section of a cadaver with caries of the spine, and only slight antero-posterior curvature (kyphosis).

Plate B.—Coronal section of left half of pelvis passing through a line joining the points B B (on intervertebral disc at promontory, and below perineum) in Plate A.

Plate C.—Coronal section of left half of pelvis passing through a line joining the points C C (on intervertebral disc between I. and II. sacral vertebræ, and below anus) in Plate A.



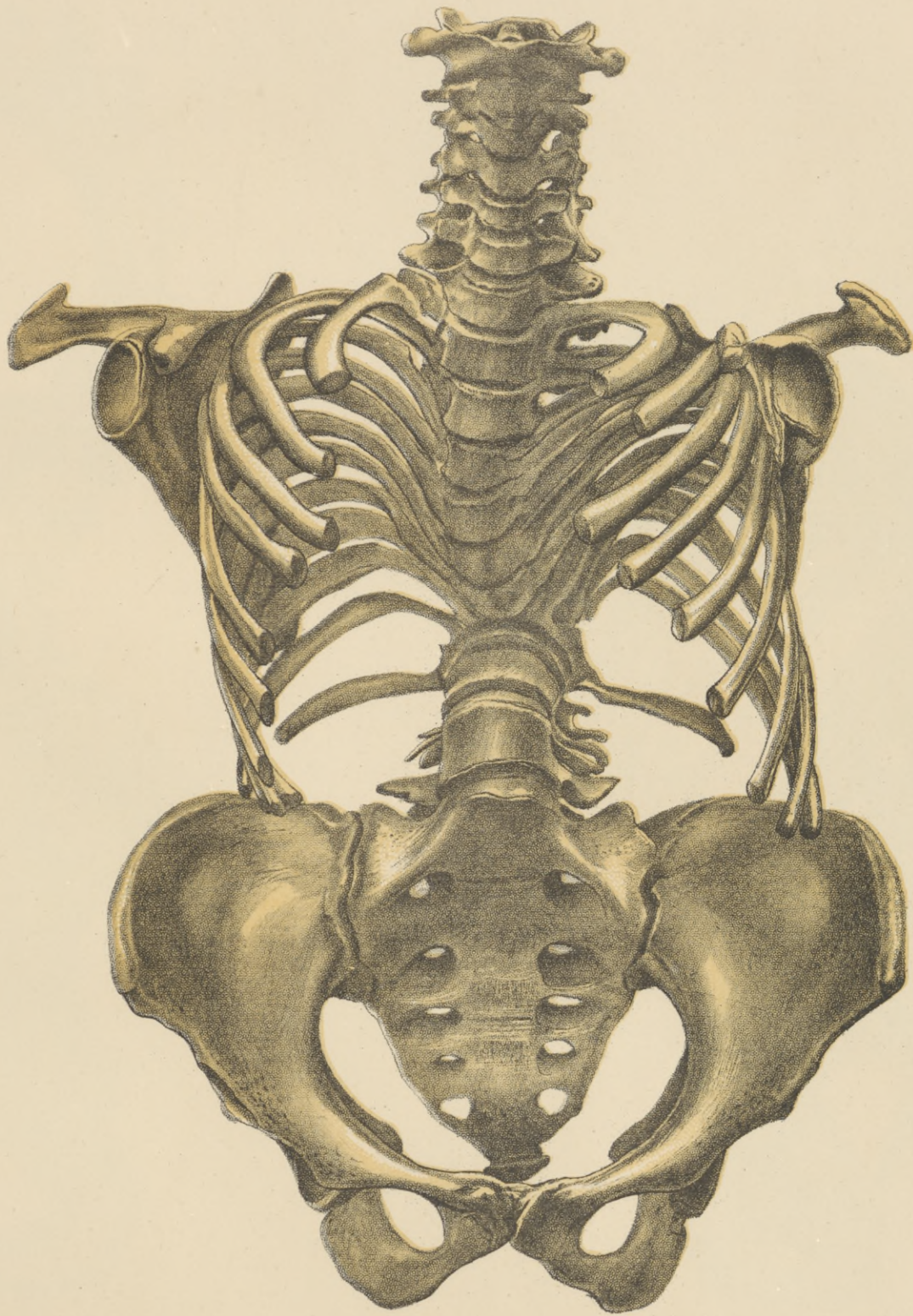


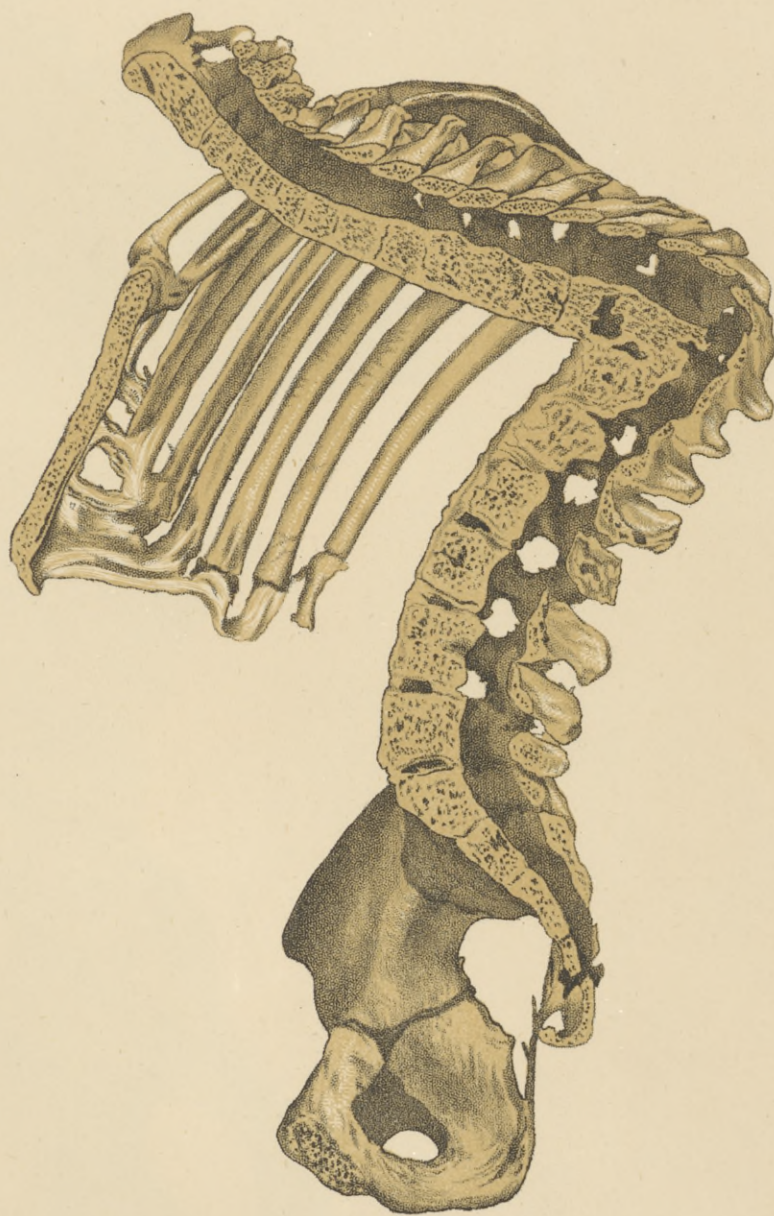


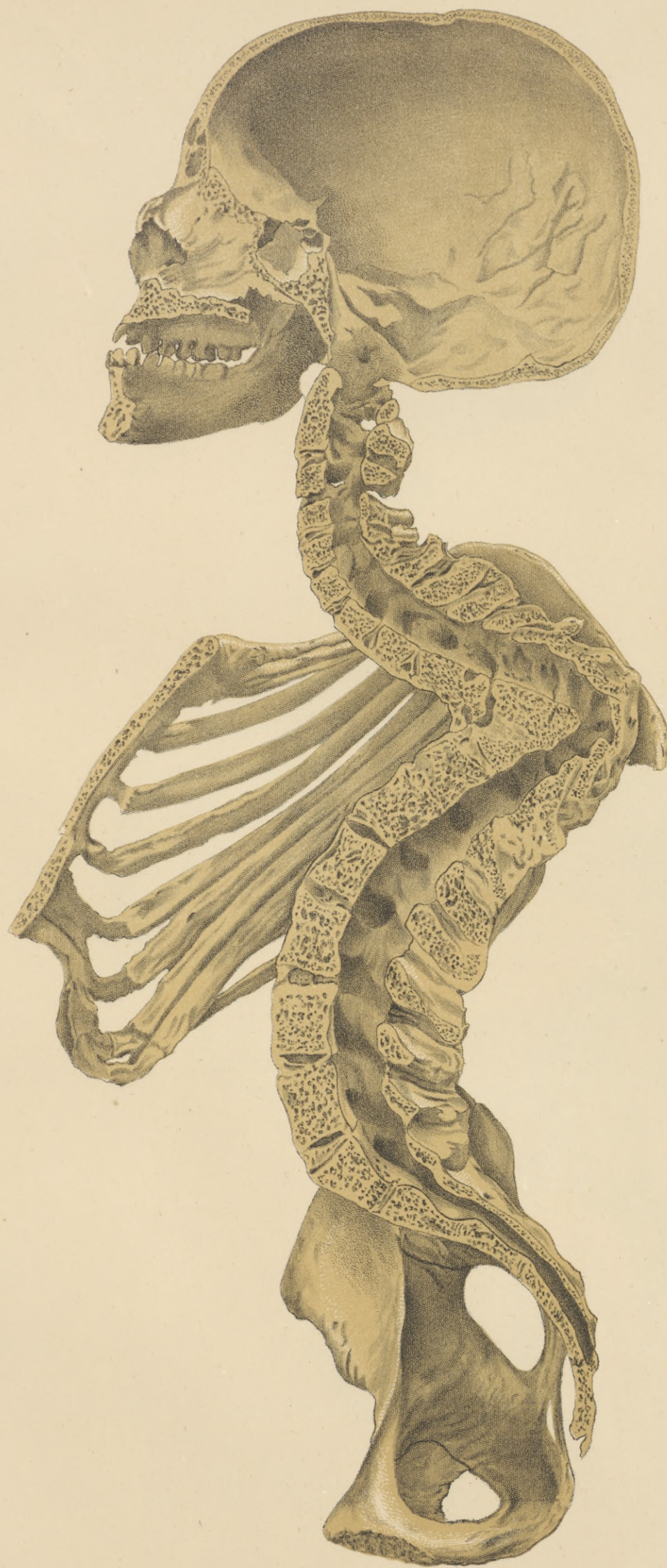


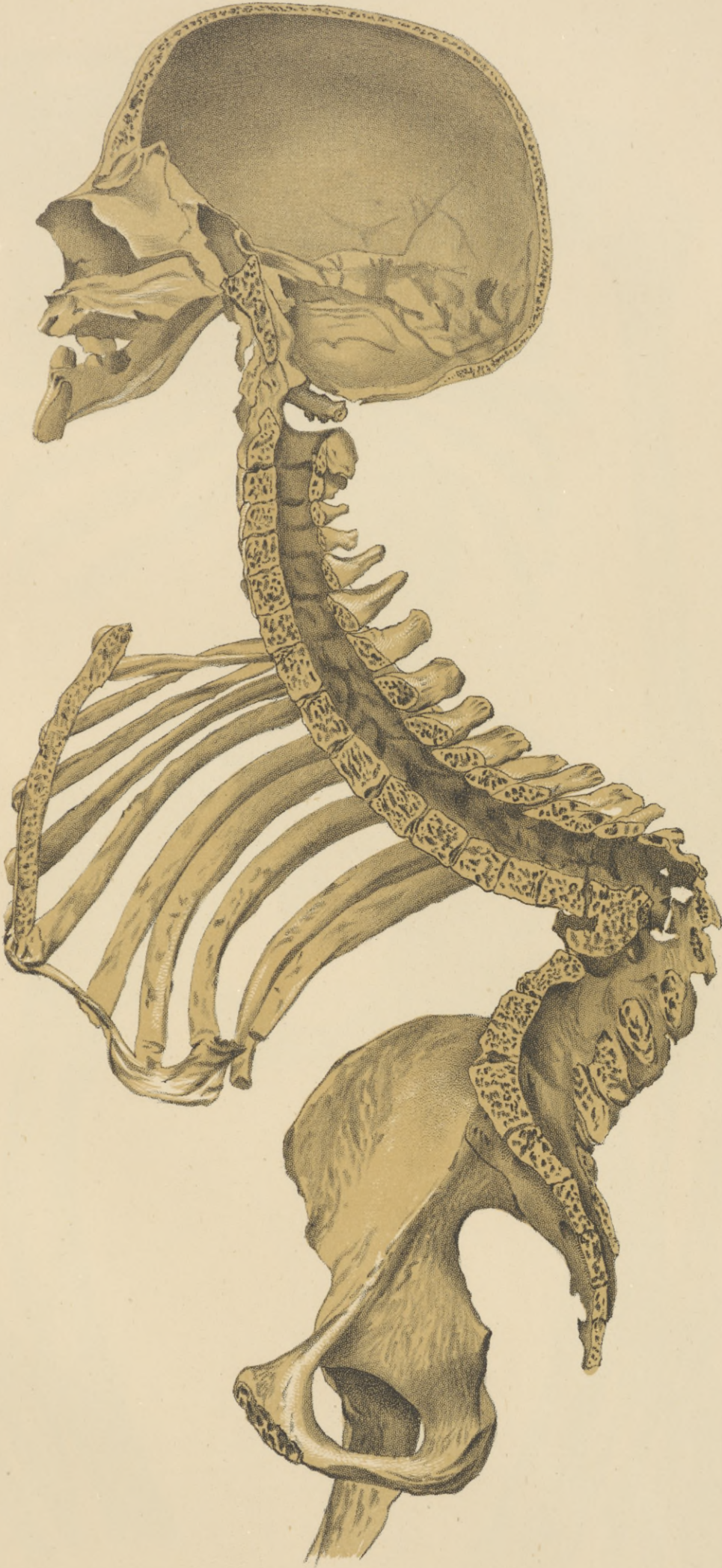


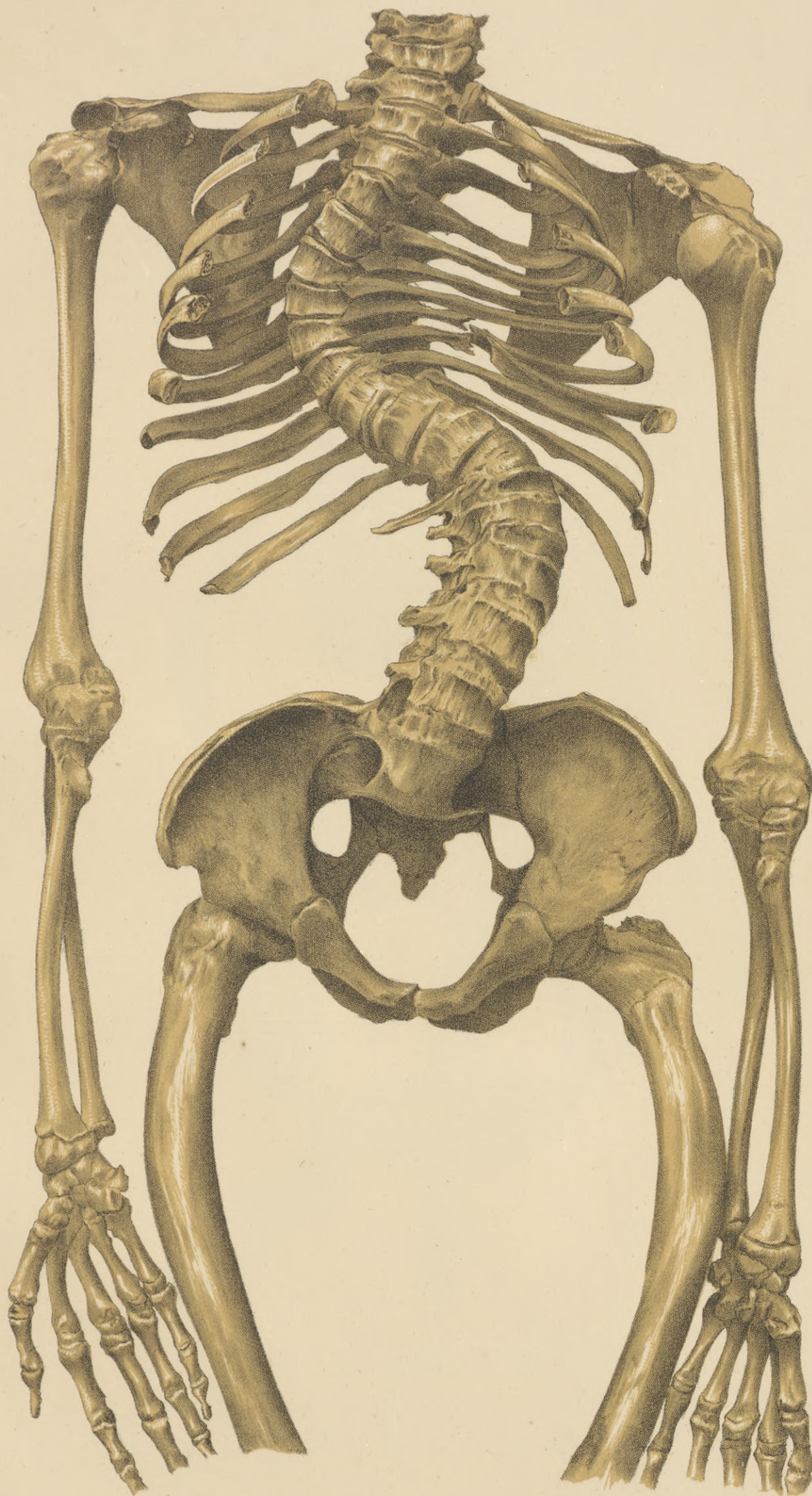




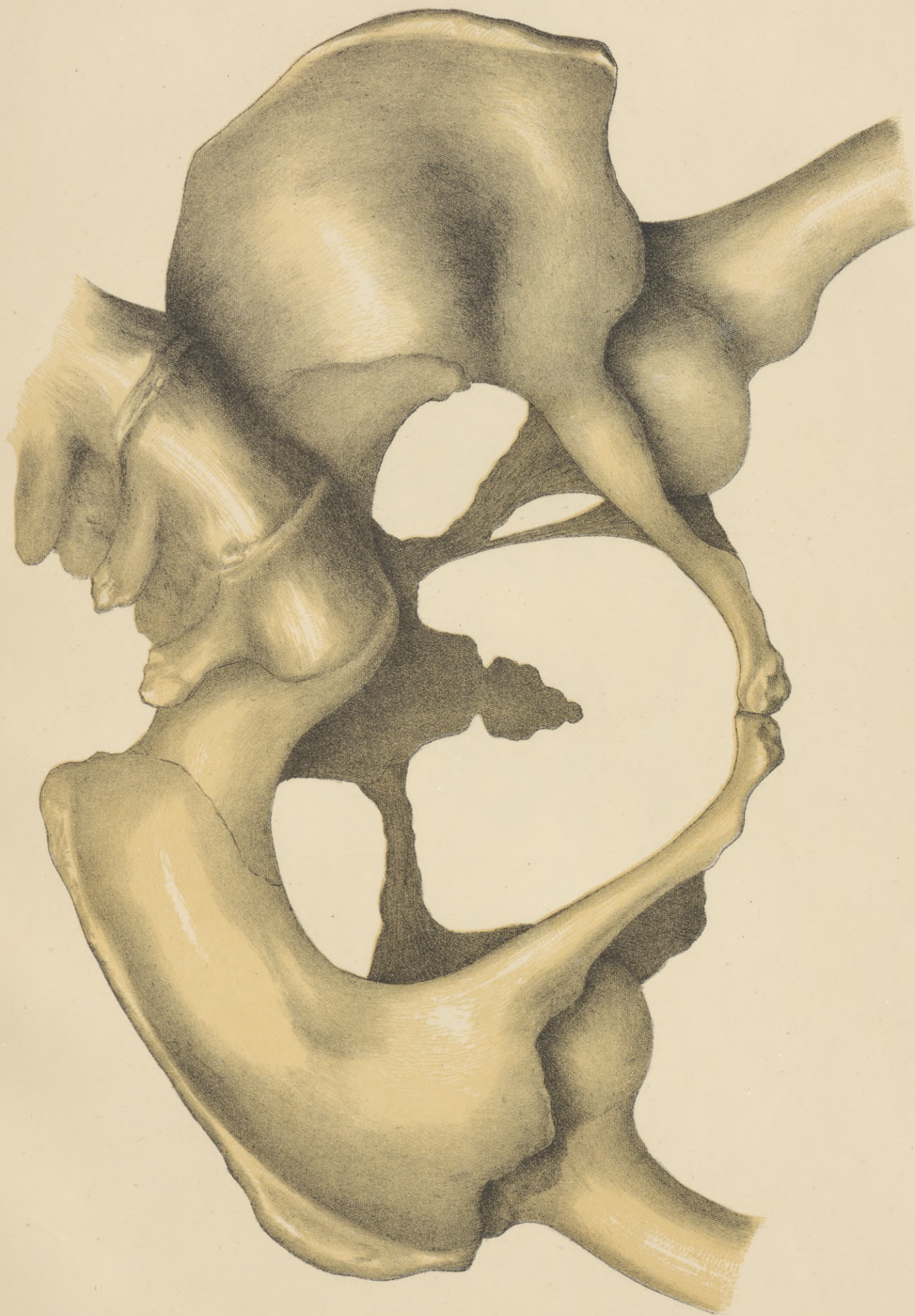


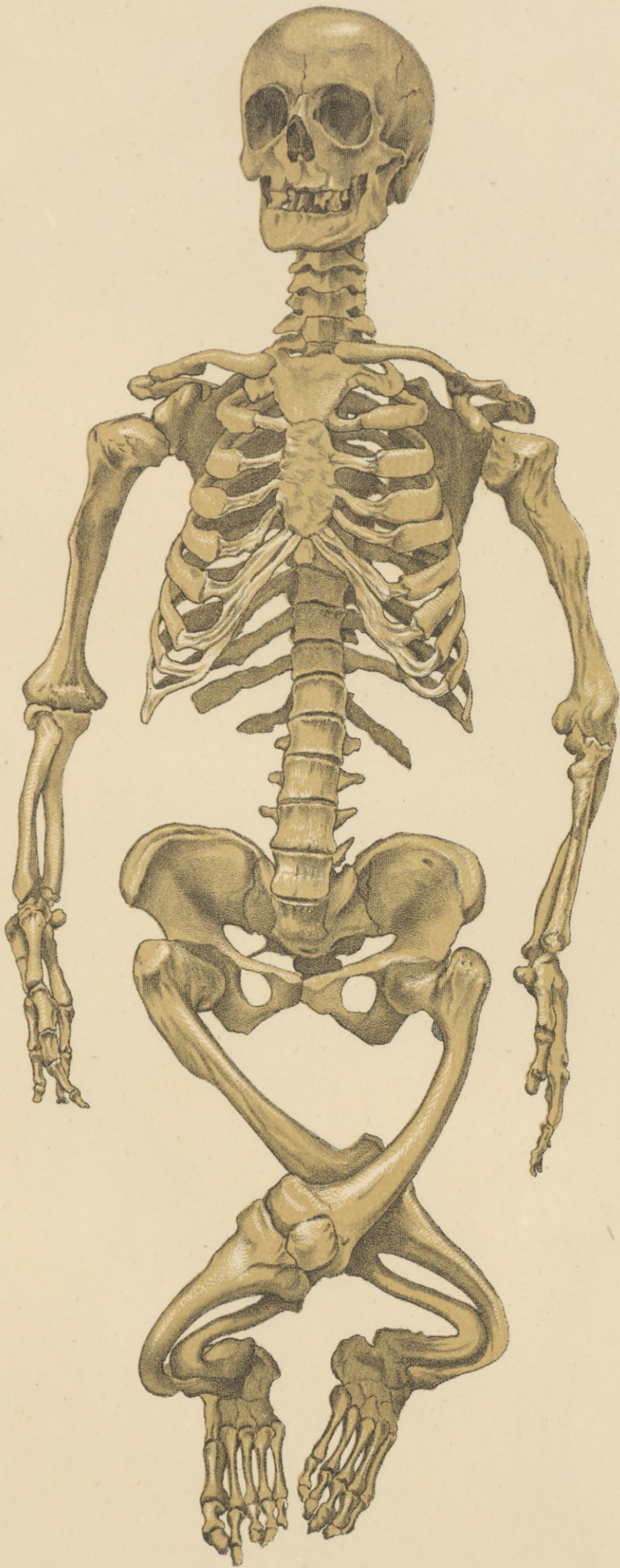














Normal Pelvis	thus
A	— (solid line)
B	— (dotted line)
C	— (dashed line)
D	— (dash-dot line)

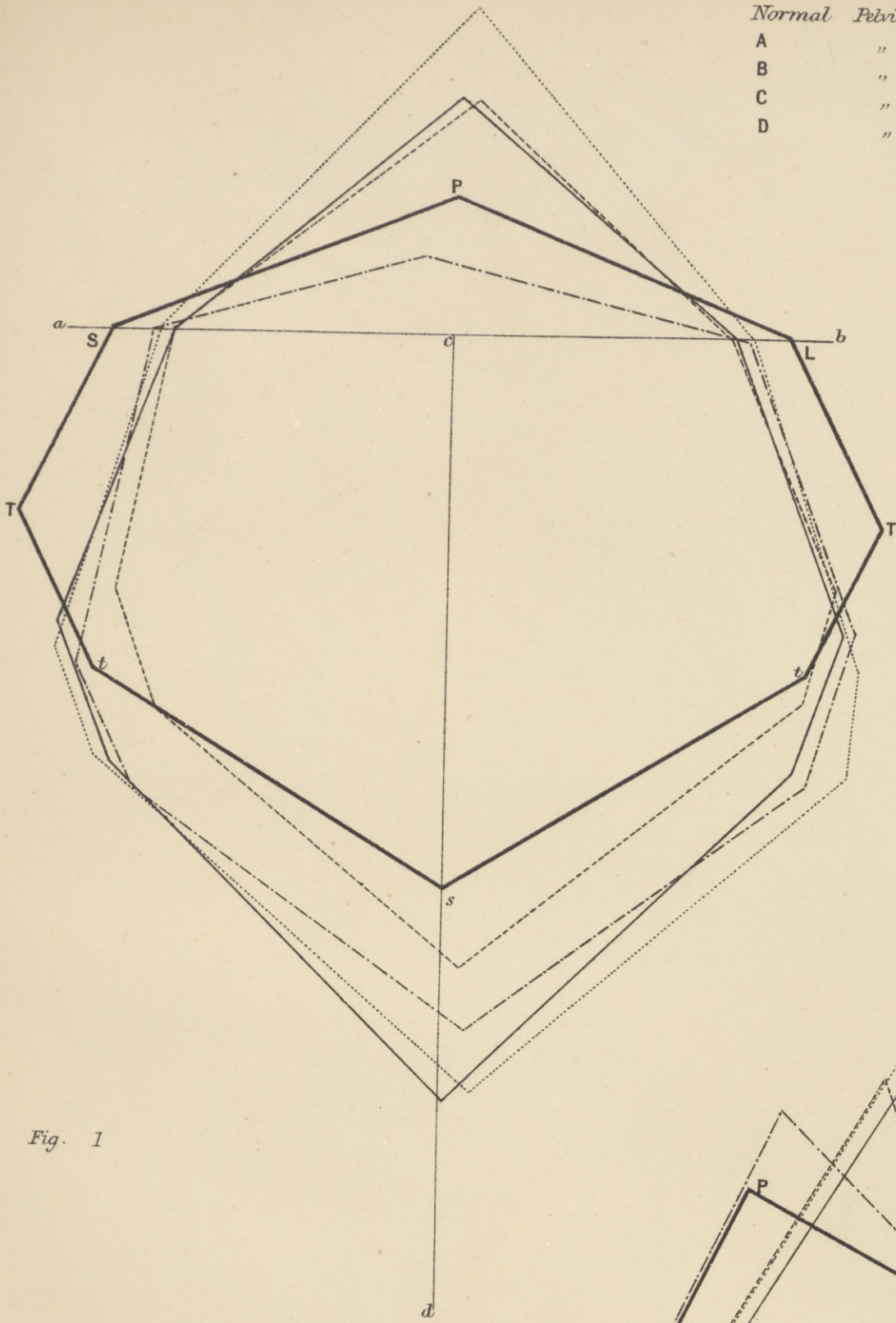


Fig. 1

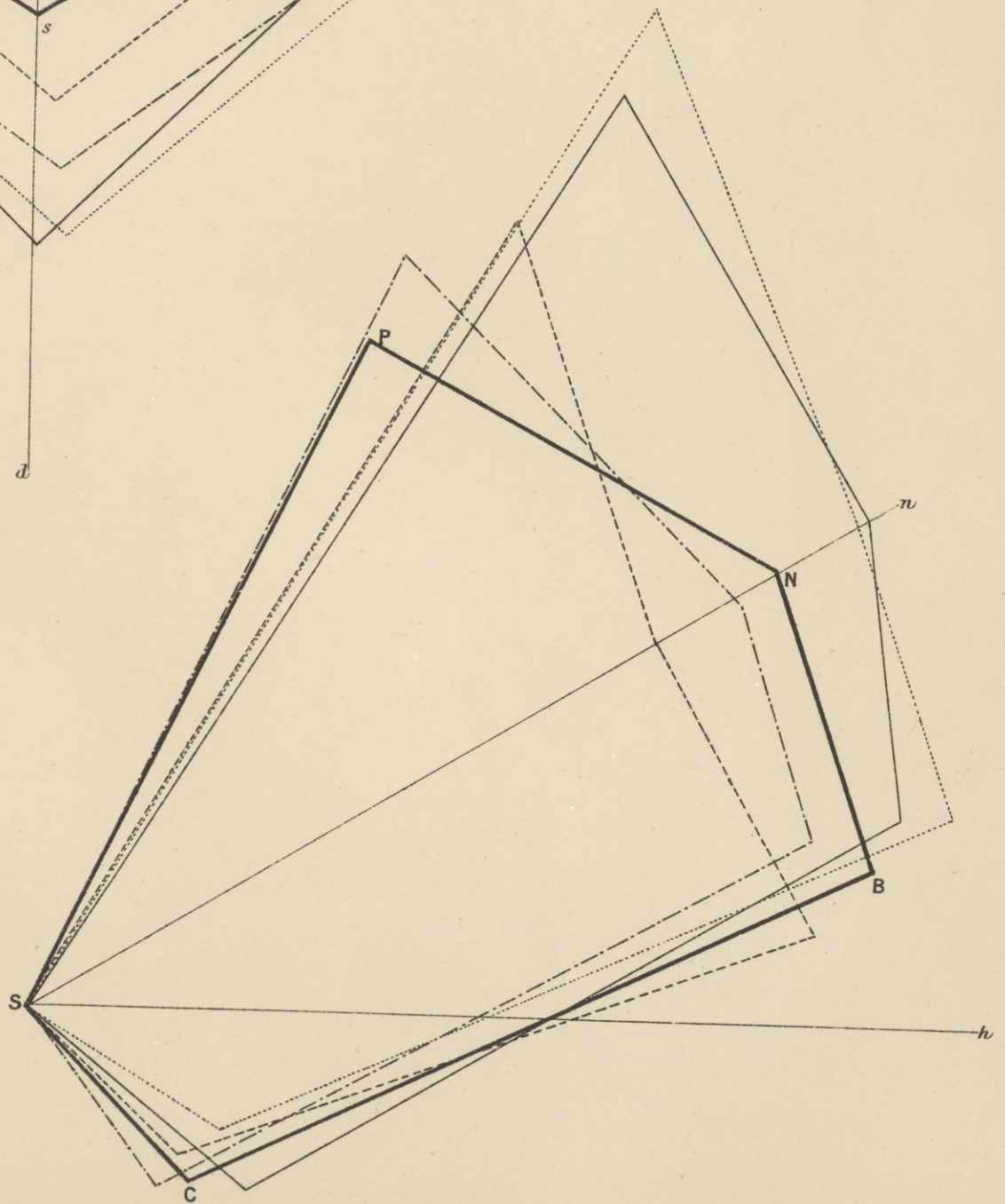
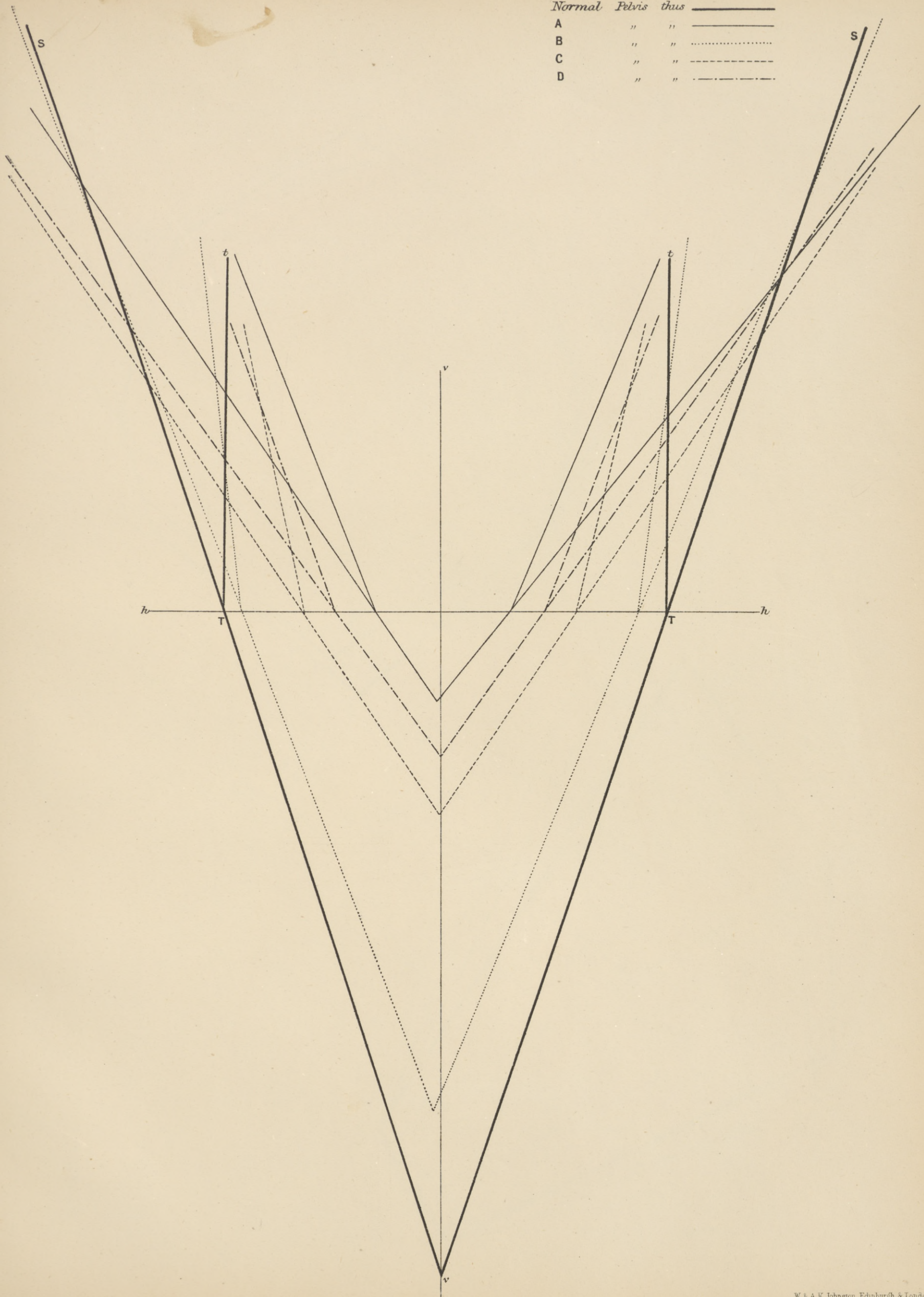


Fig. 2

Normal	Pelvis	thus	
A	"	"	—————
B	"	"
C	"	"	- - - - -
D	"	"	- · - · -



F	Pelvis,	thus	—————
G	"	"	—————
H	"	"
K	"	"	- - - - -
L	"	"	- - - - -

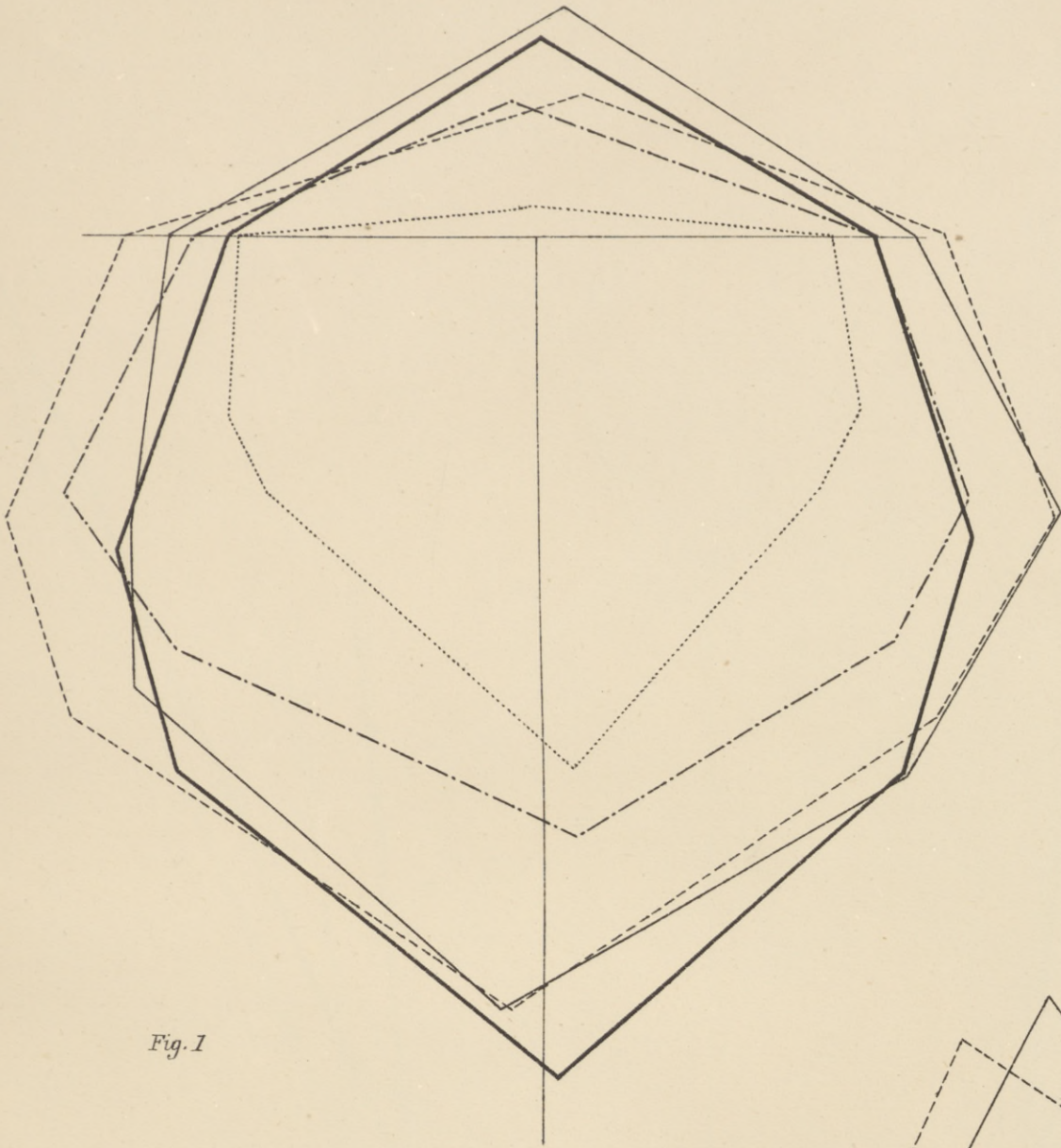


Fig. 1

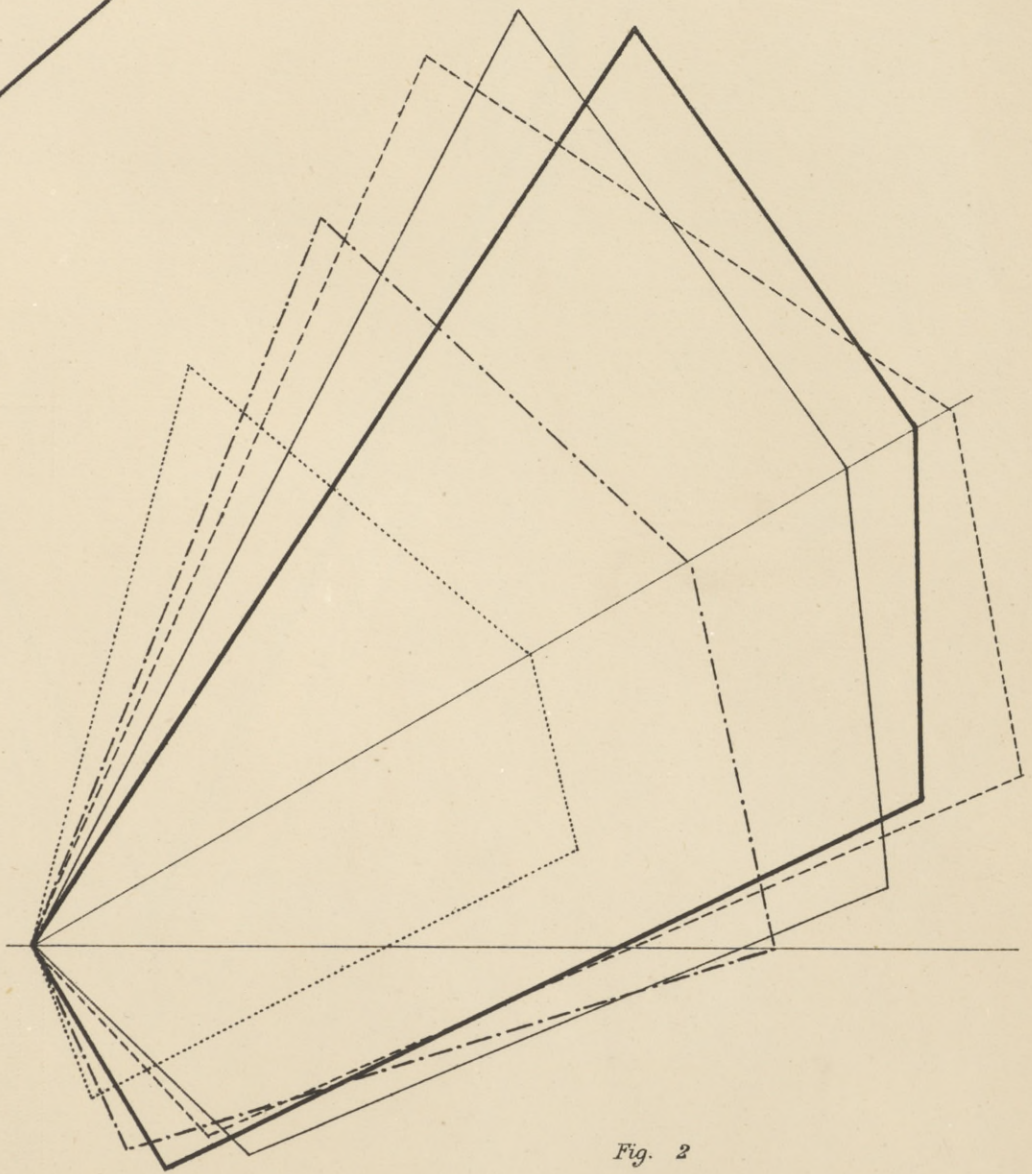
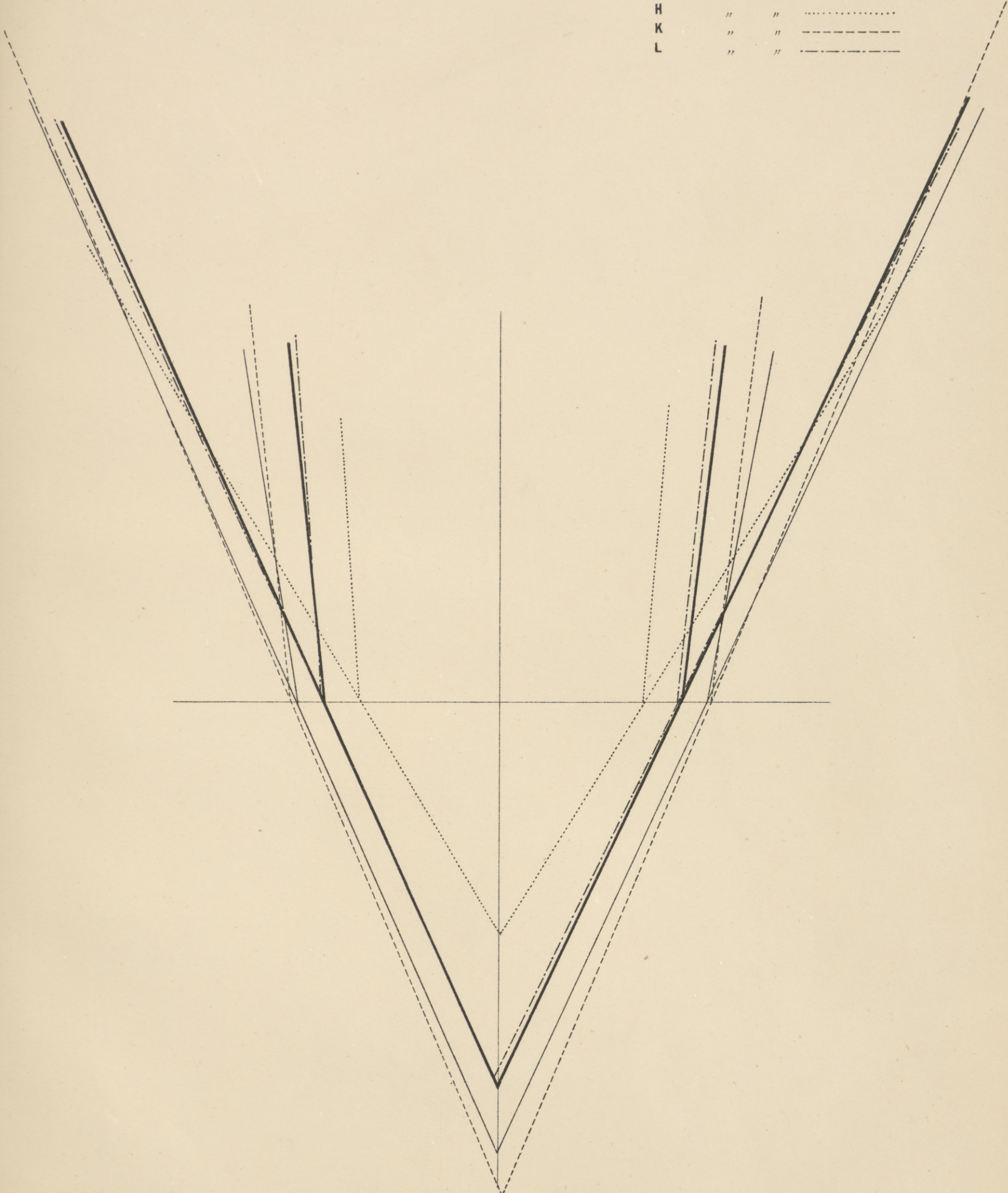


Fig. 2

F	<i>Pelvis,</i>	<i>thus</i>	—————
G	"	"	—————
H	"	"
K	"	"	- - - - -
L	"	"	- - - - -



(Typical Rickety Pelvis) thus

J	"	"	—————
M	"	"
N	"	"	-----

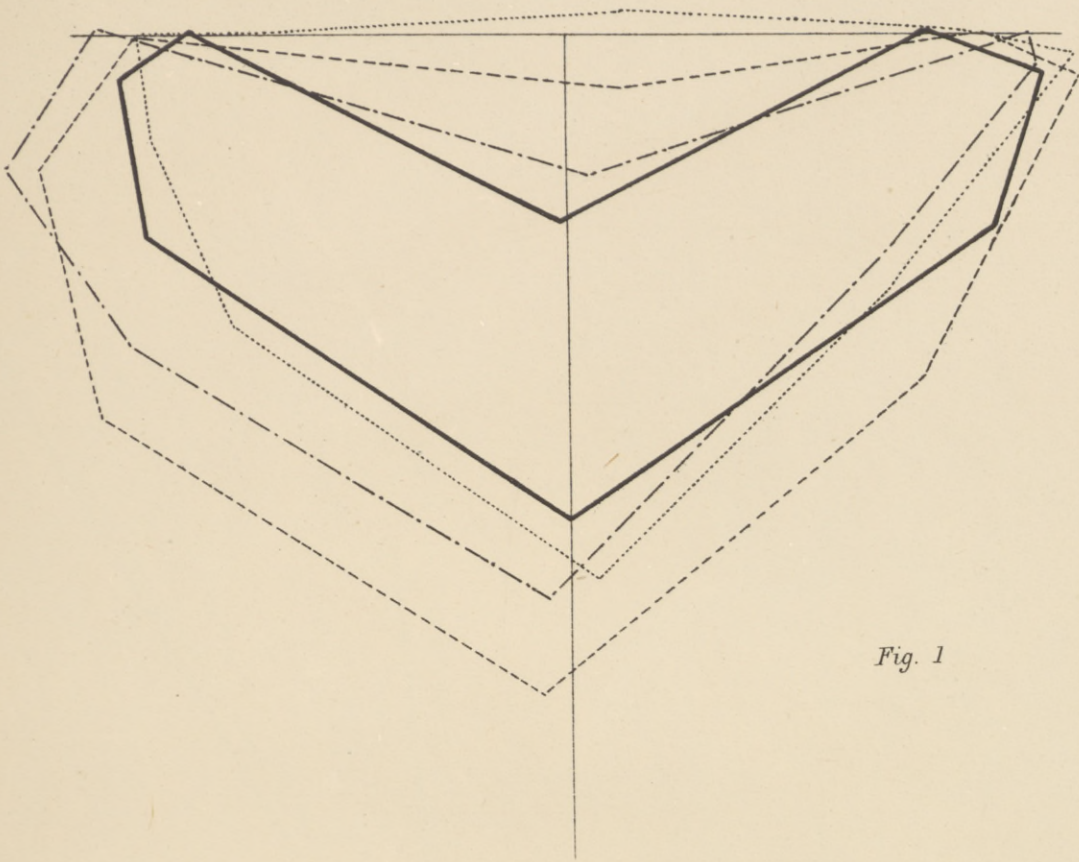


Fig. 1

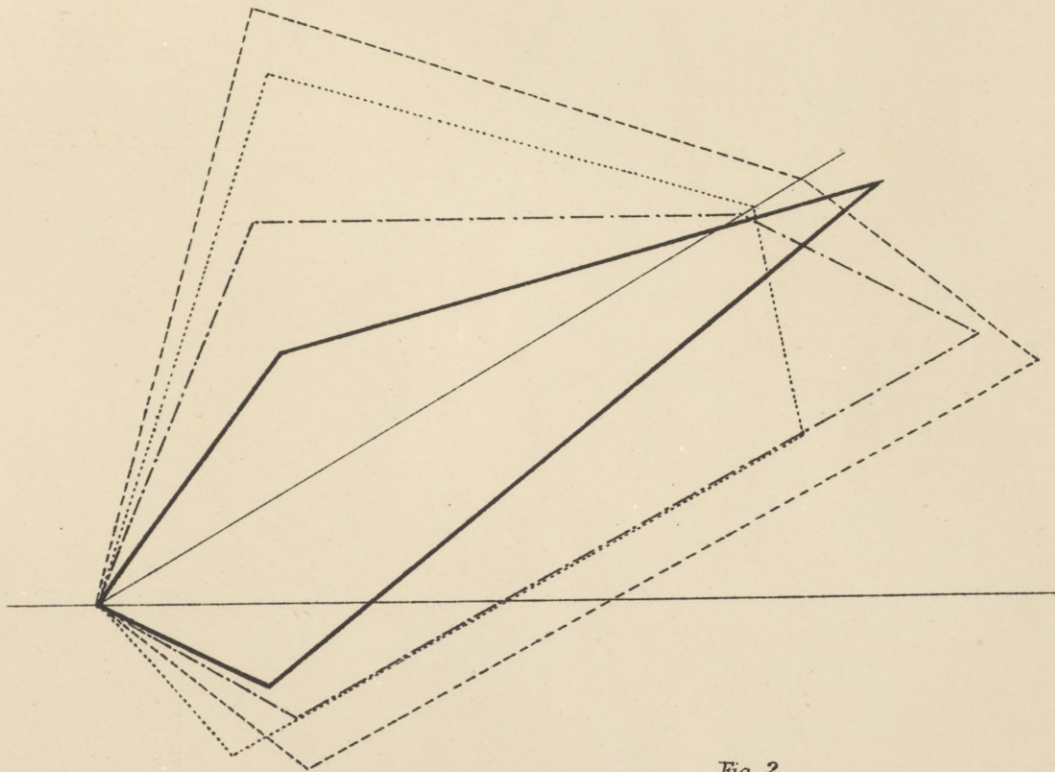
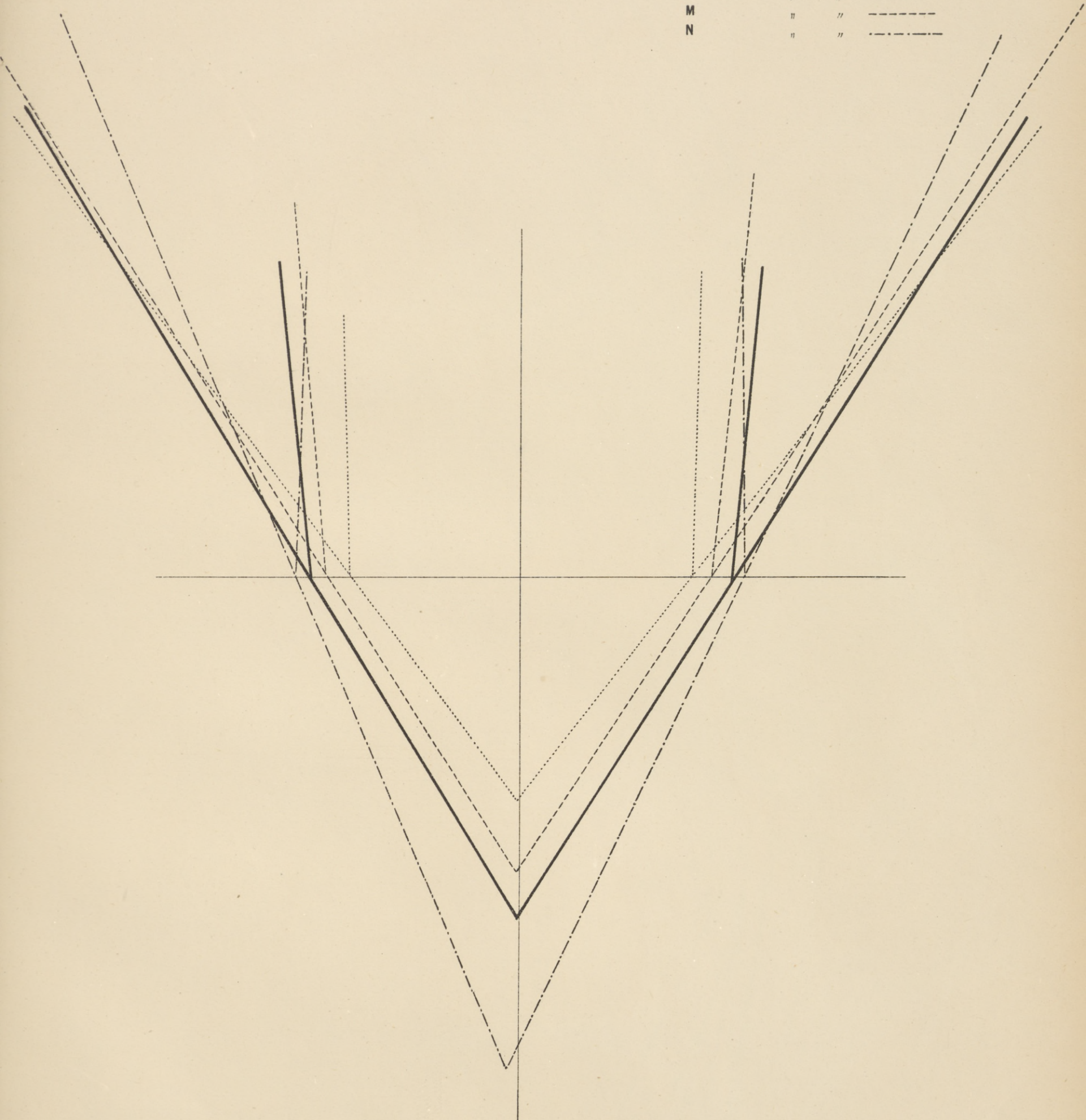


Fig. 2

(Typical Rickety Pelvis) thus ————
J " "
M " " - - - -
N " " - - - -



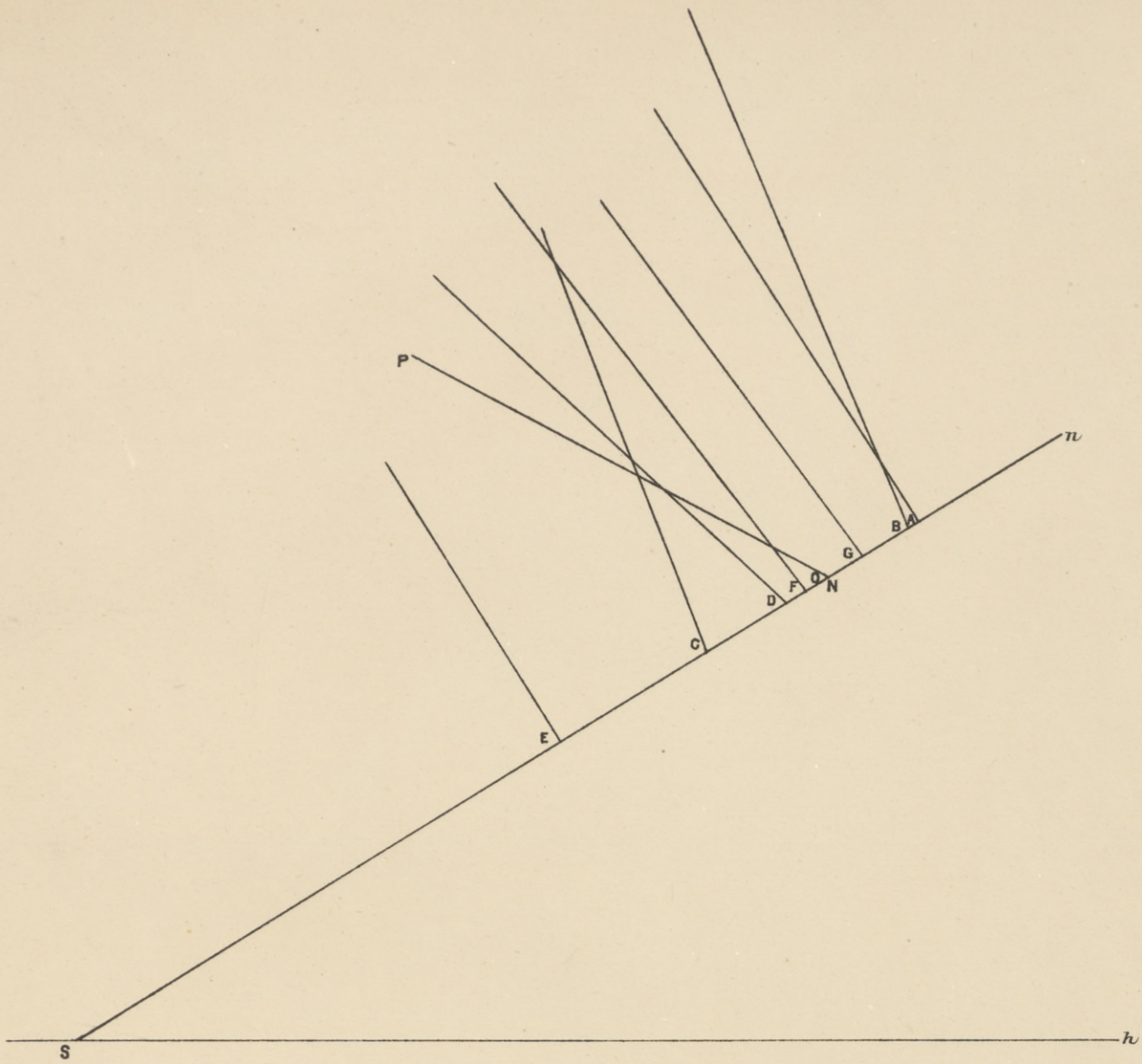


Fig. 1

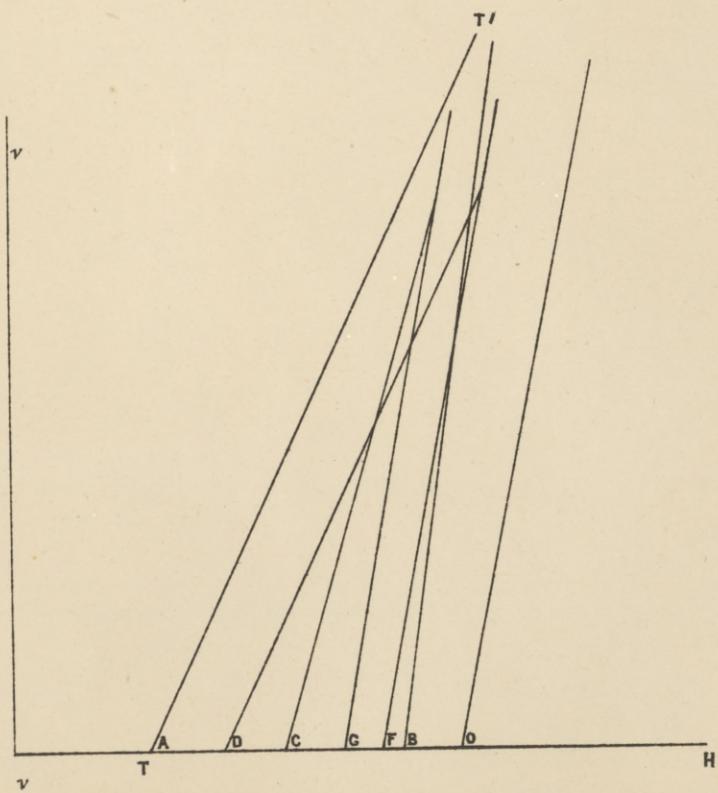


Fig. 2

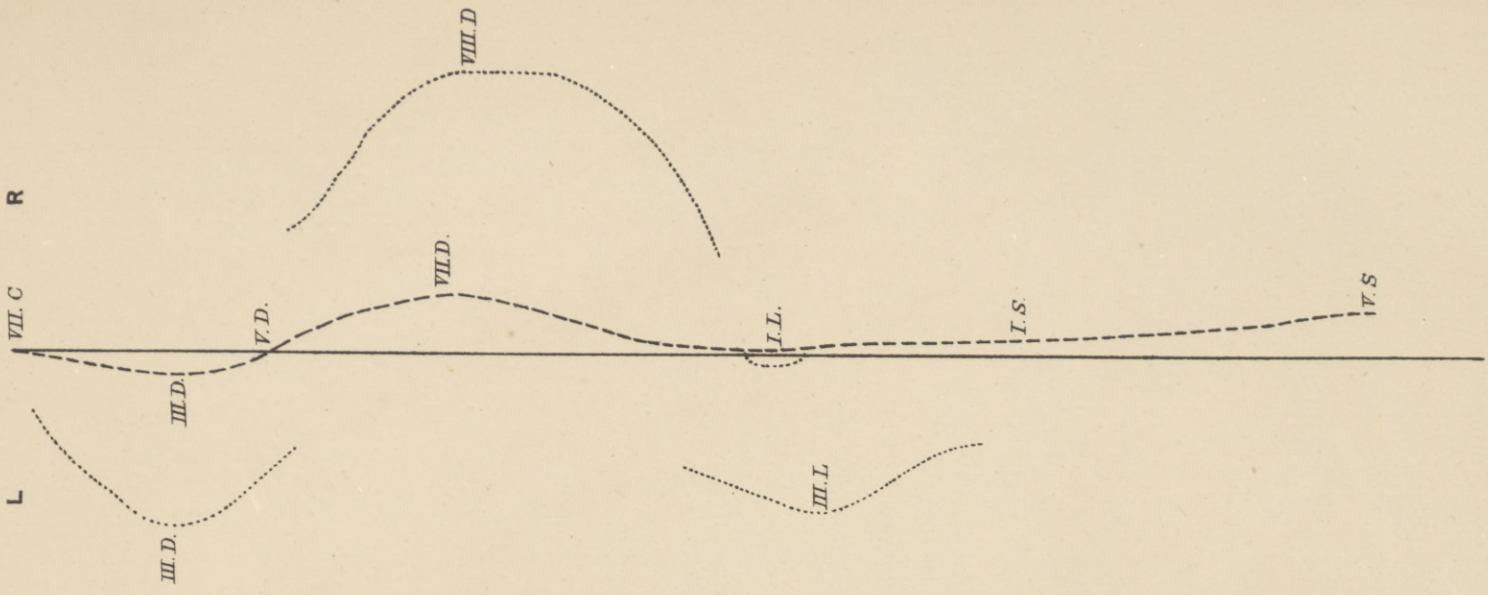


Fig. 4
Scoliosis in N

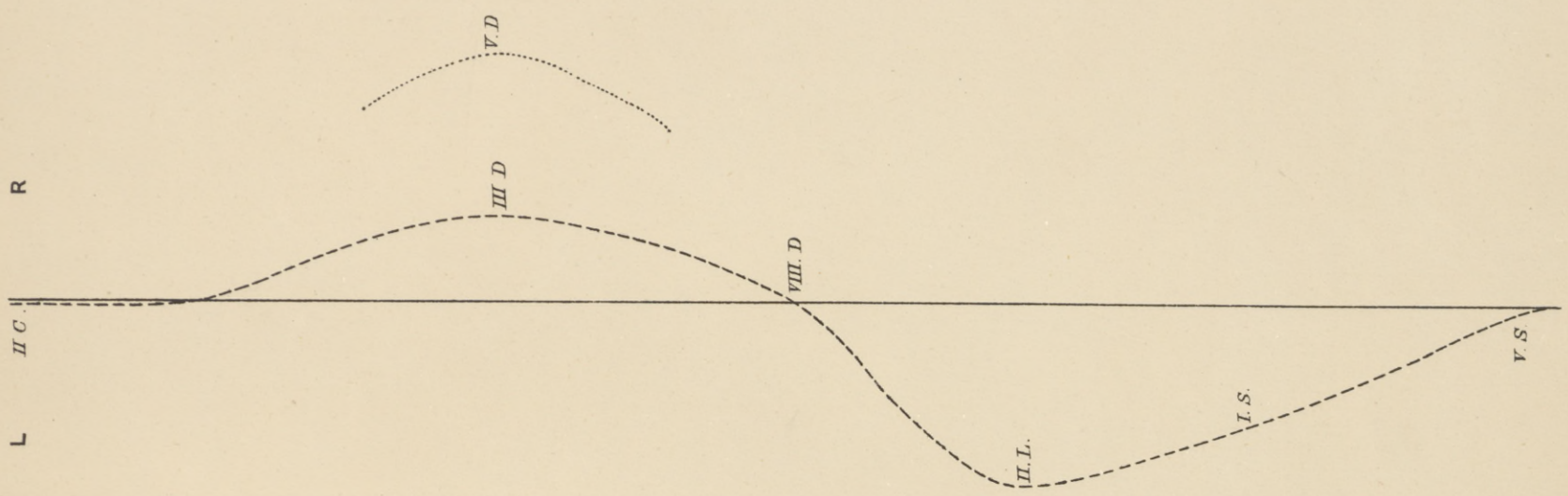


Fig. 3
Scoliosis in J

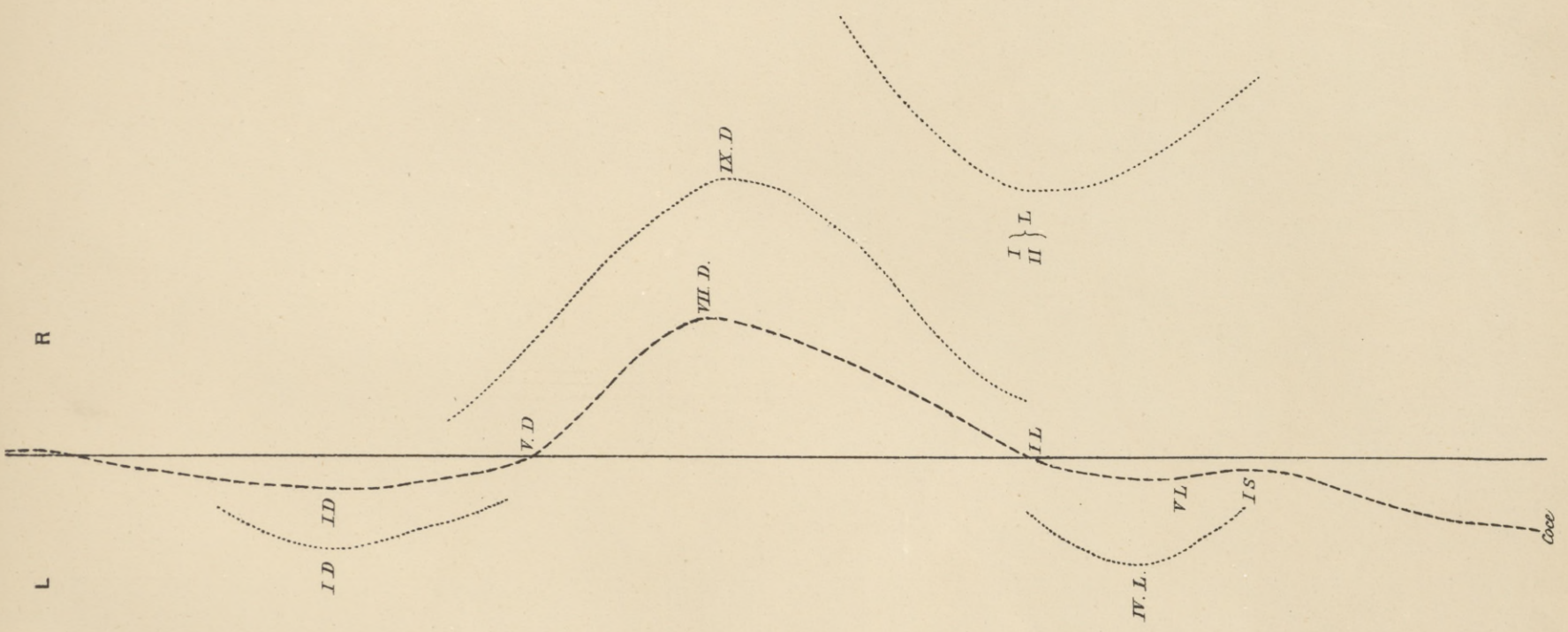


Fig. 2
Scoliosis in M

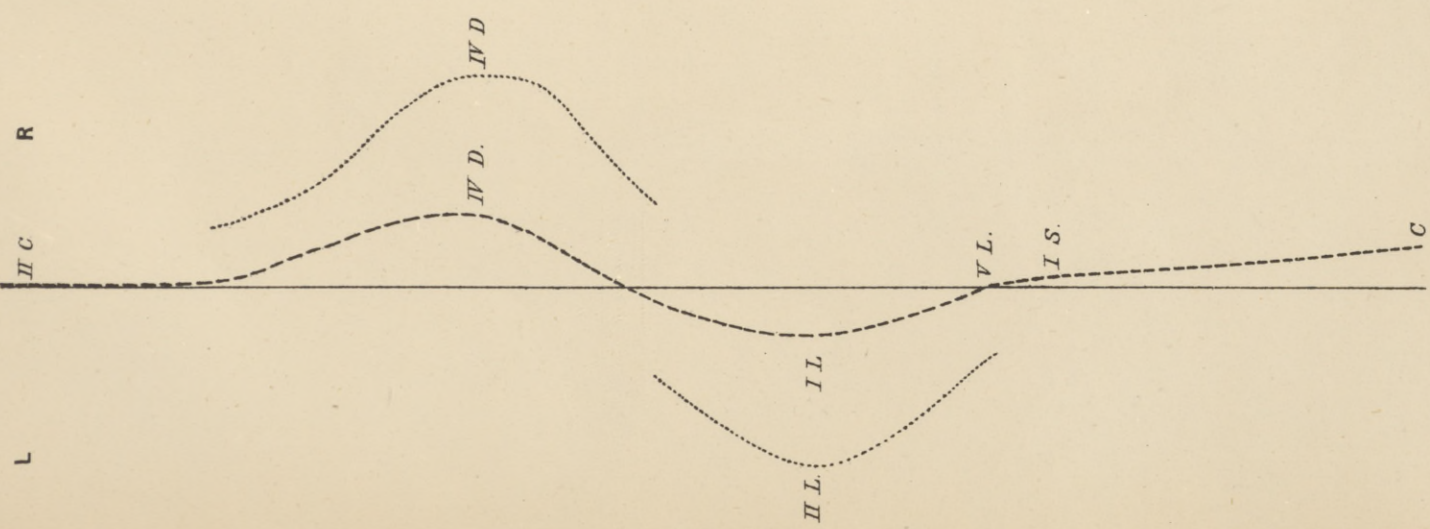
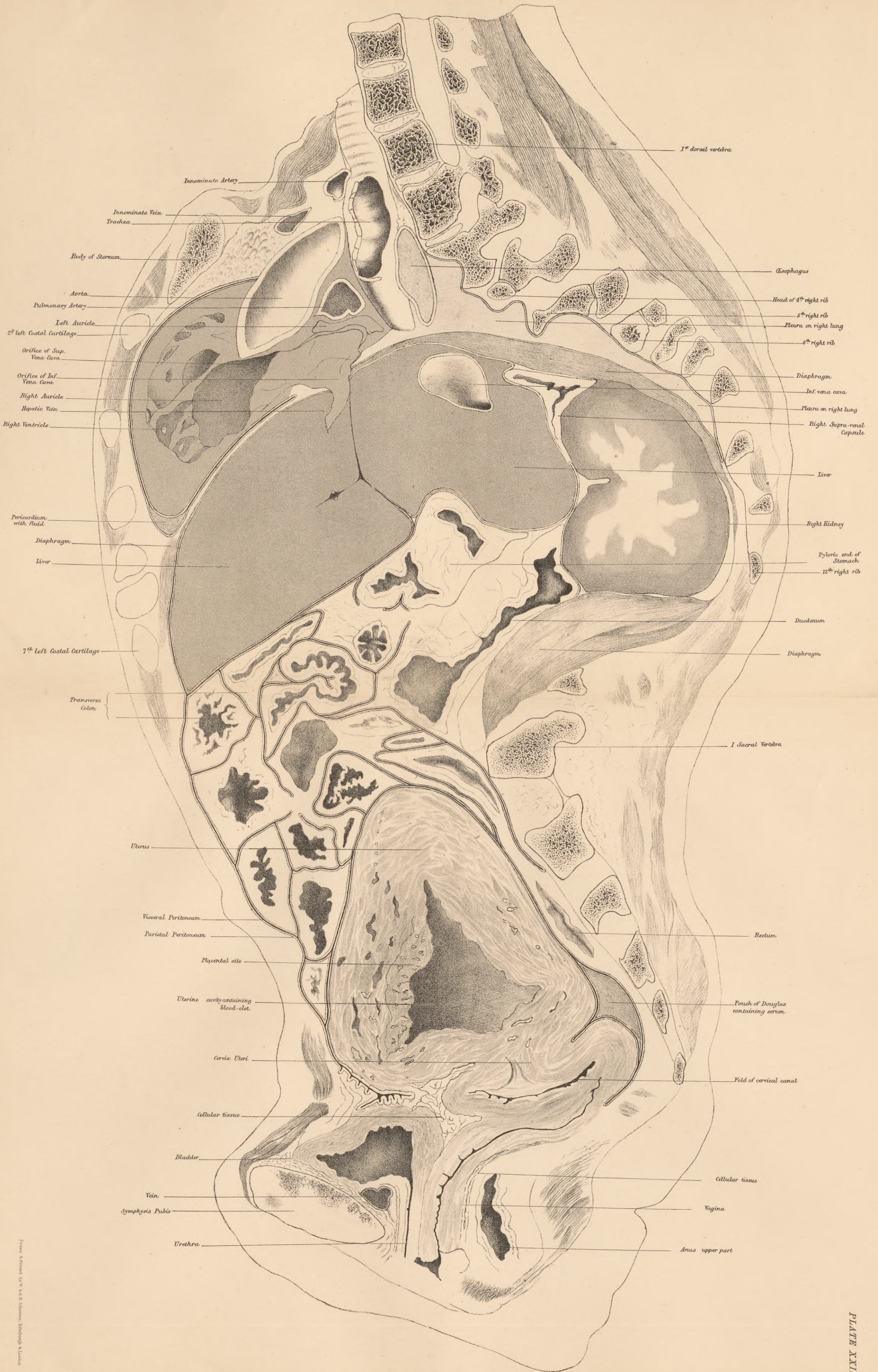
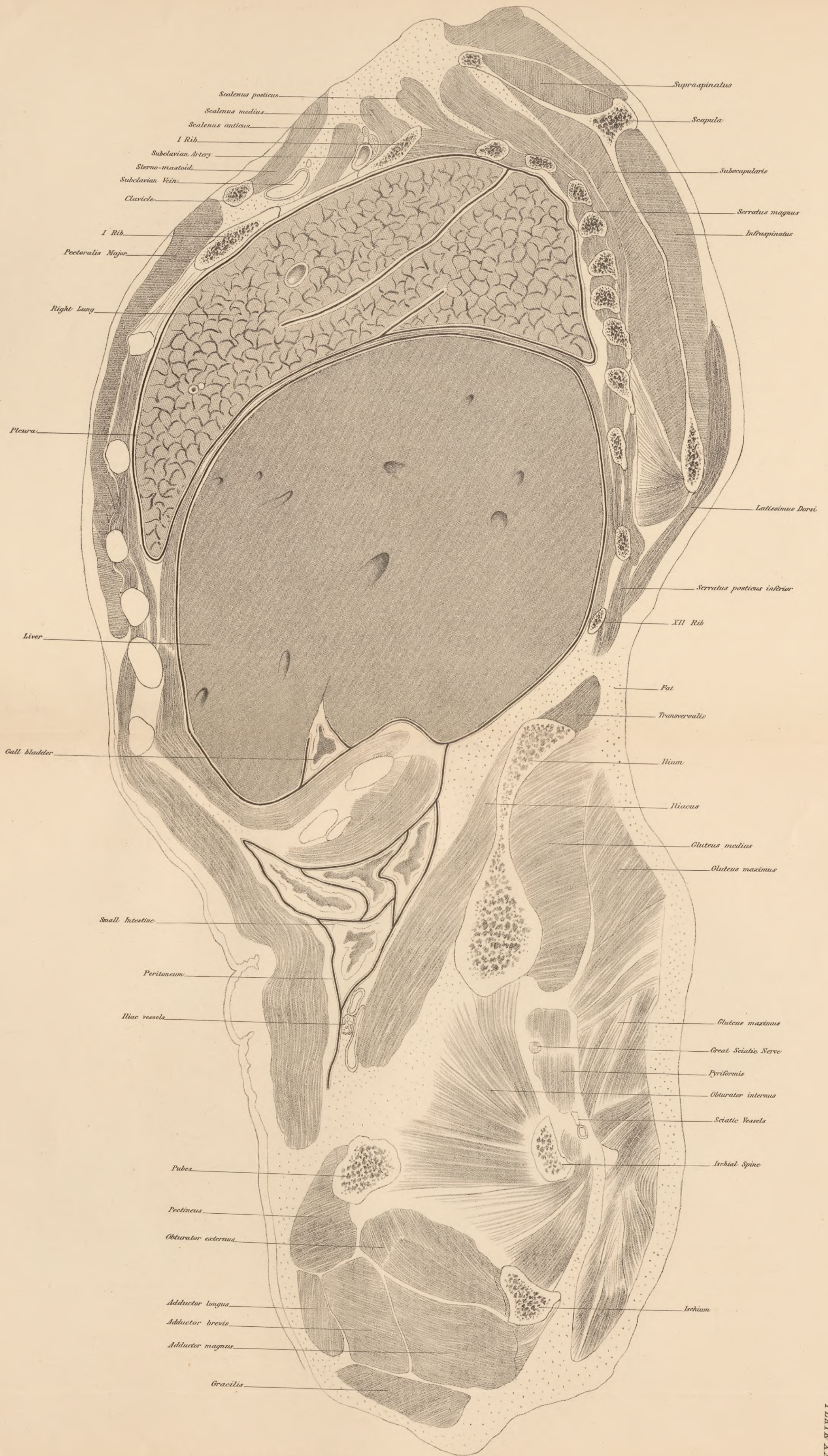


Fig. 1
Scoliosis in H



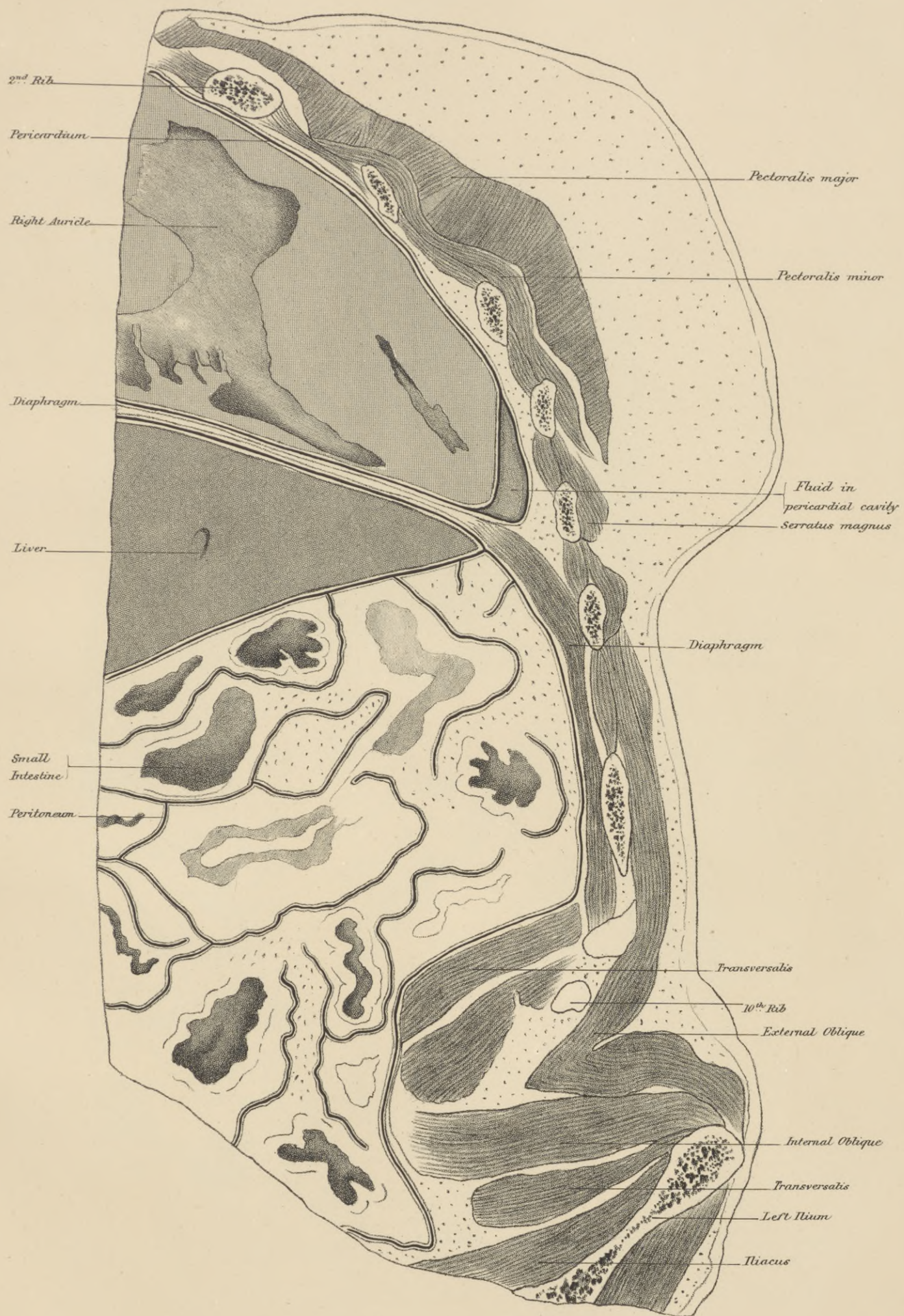
VERTICAL MESIAL SECTION



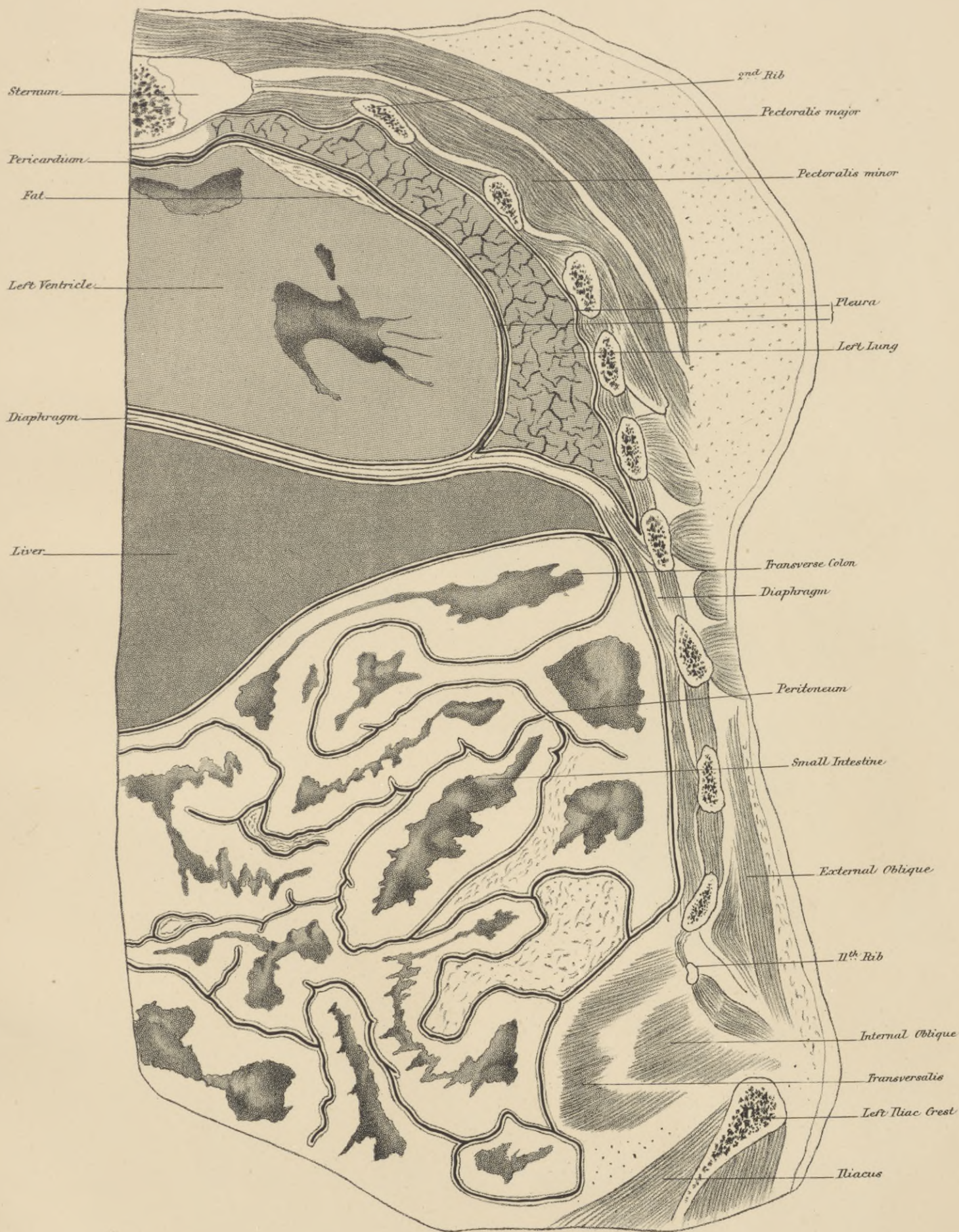
Supraspinatus
Scapula
Subscapularis
Serratus magnus
Infraspinatus
Latissimus Dorsi
Serratus posterior inferior
XII Rib
Fat
Transversalis
Ilium
Iliacus
Gluteus medius
Gluteus maximus
Gluteus maximus
Great Sciatic Nerve
Pyriformis
Obturator internus
Sciatic Vessels
Ischial Spine
Ischium
Scalenus posterior
Scalenus medius
Scalenus anterior
I Rib
Subclavian Artery
Sterno-mastoid
Subclavian Vein
Clavicle
I Rib
Pectoralis Major
Right Lung
Pleura
Liver
Gall bladder
Small Intestine
Peritoneum
Iliac vessels
Pubes
Pectineus
Obturator externus
Adductor longus
Adductor brevis
Adductor magnus
Gracilis

LATERAL SAGITTAL SECTION

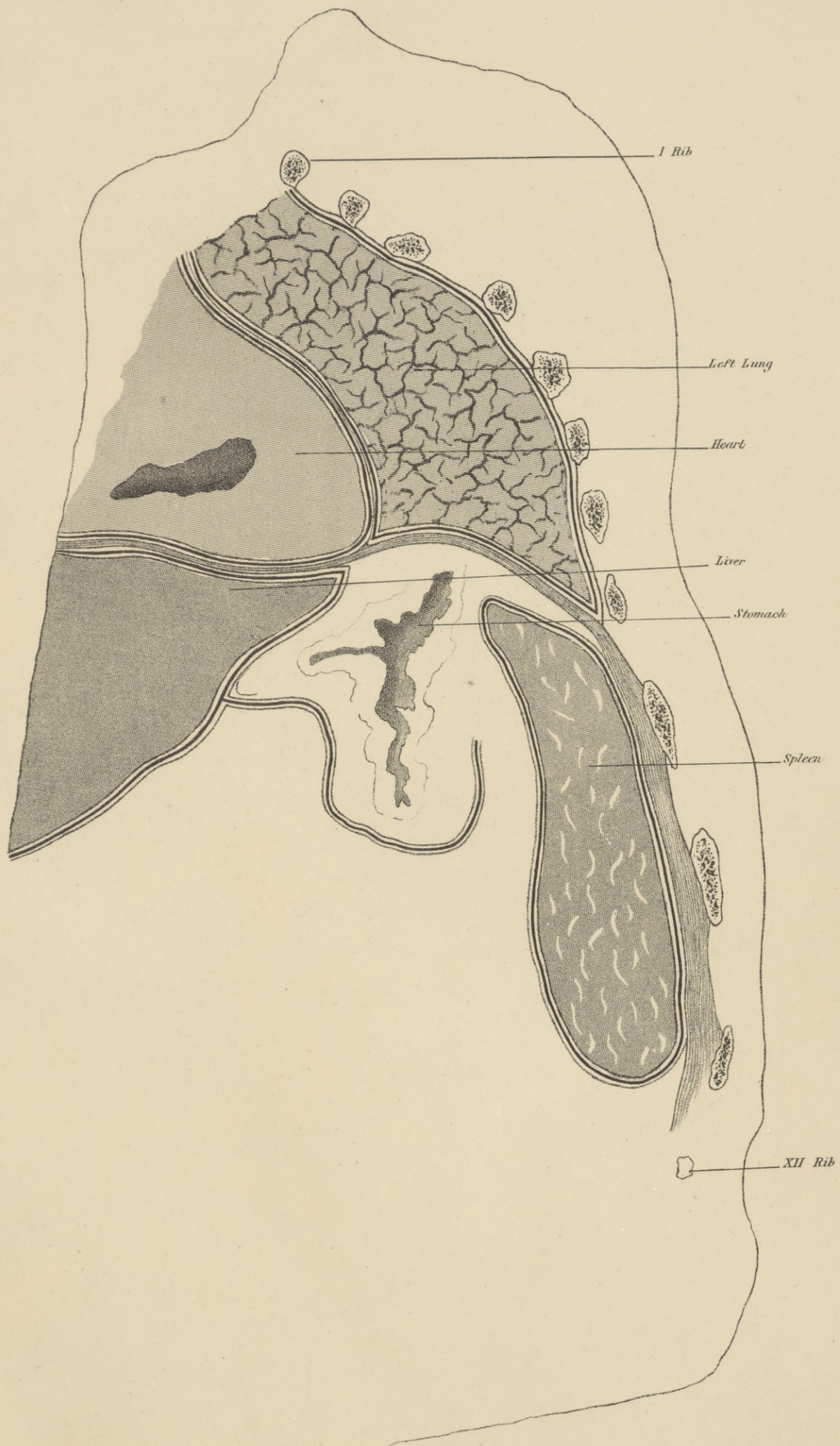
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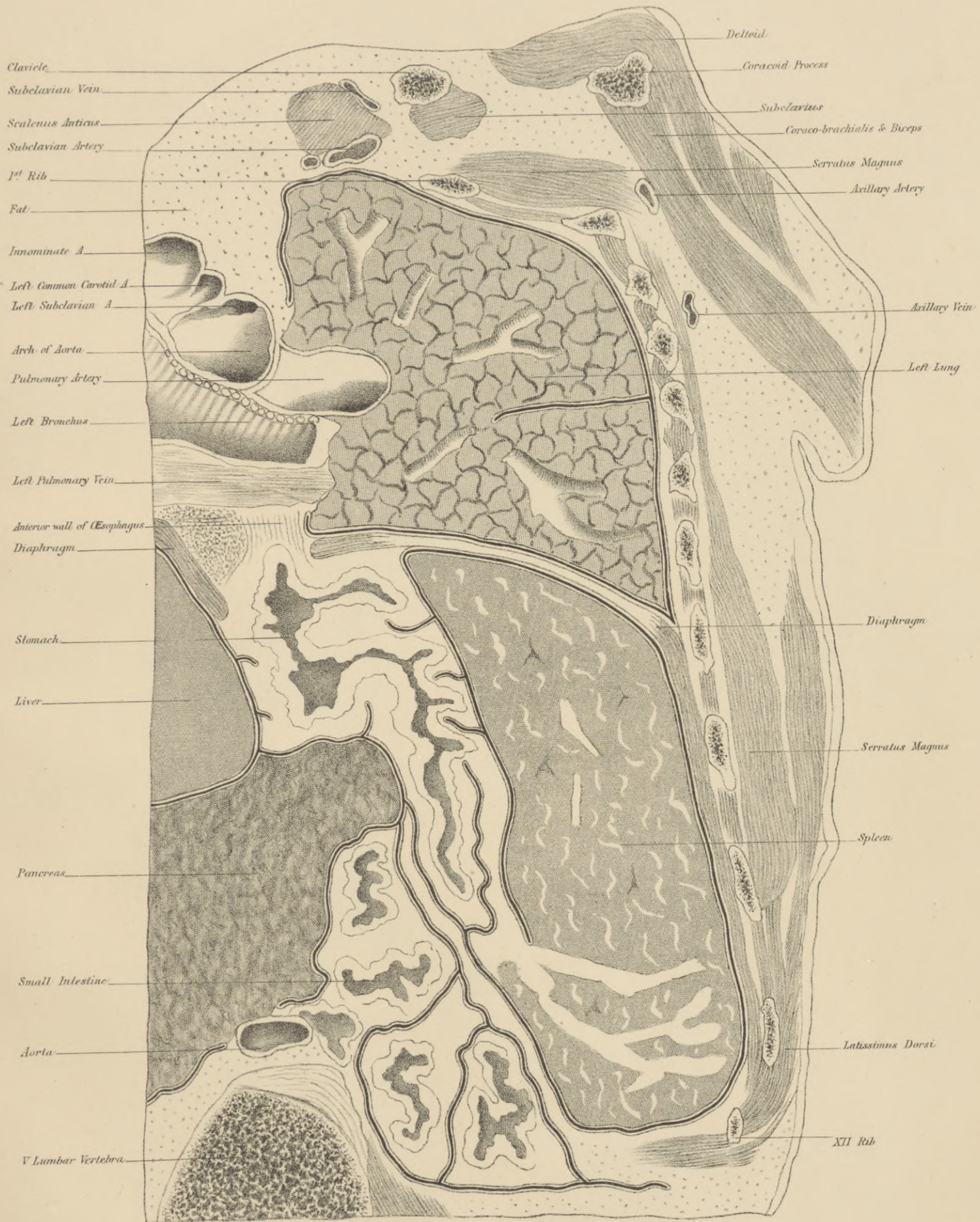
SECTION THROUGH LINE a PLATE 35



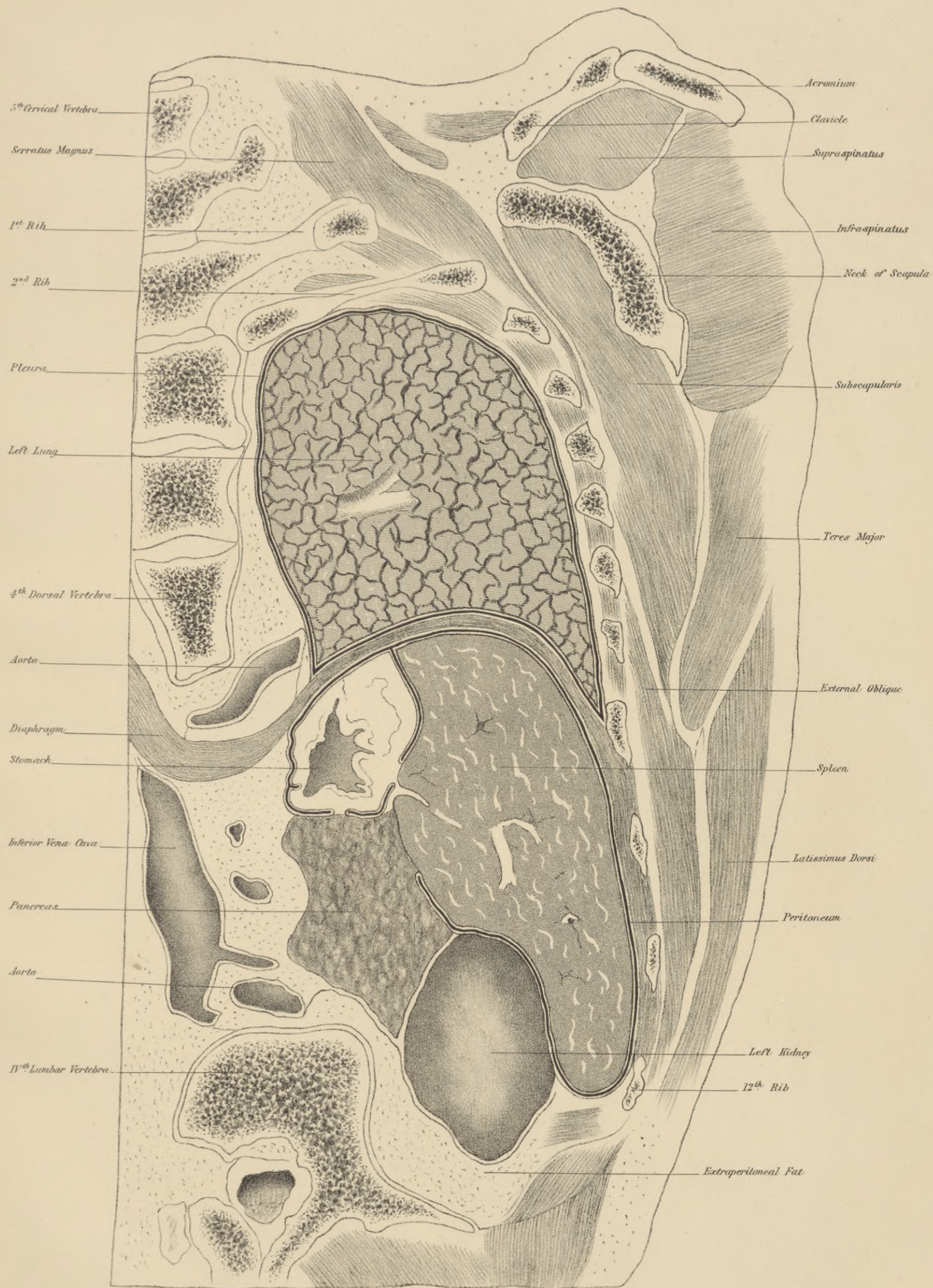
SECTION THROUGH LINE b PLATE 35



SECTION THROUGH LINE c PLATE 35



SECTION THROUGH LINE d PLATE 35



5th Cervical Vertebra

Serratus Magnus

1st Rib

2nd Rib

Pleura

Left Lung

4th Dorsal Vertebra

Aorta

Diaphragm

Stomach

Inferior Vena Cava

Pancreas

Aorta

IVth Lumbar Vertebra

Acromium

Clavicle

Supraspinatus

Infraspinatus

Neck of Scapula

Subscapularis

Teres Major

External Oblique

Spleen

Lattissimus Dorsi

Peritoneum

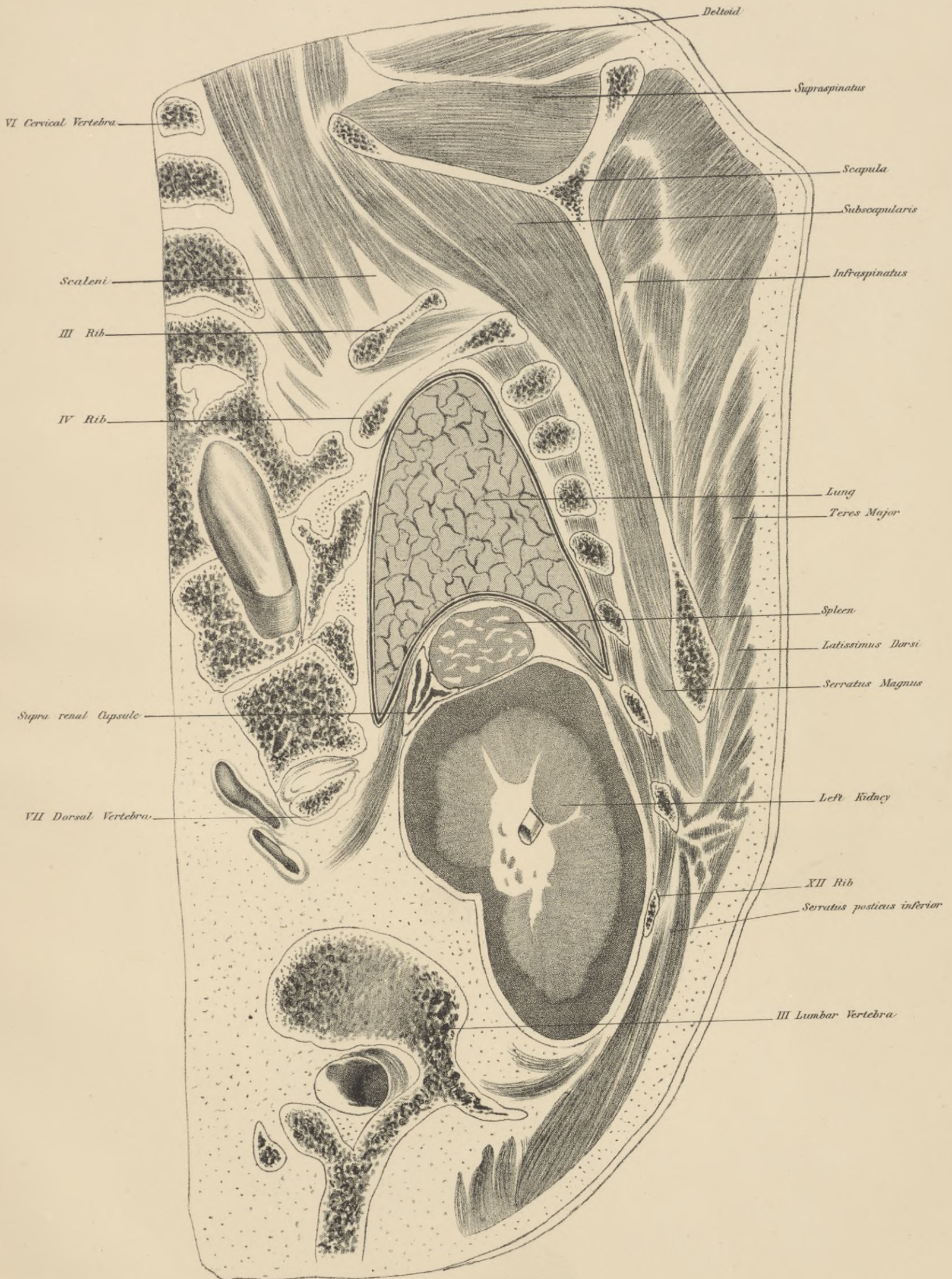
Left Kidney

12th Rib

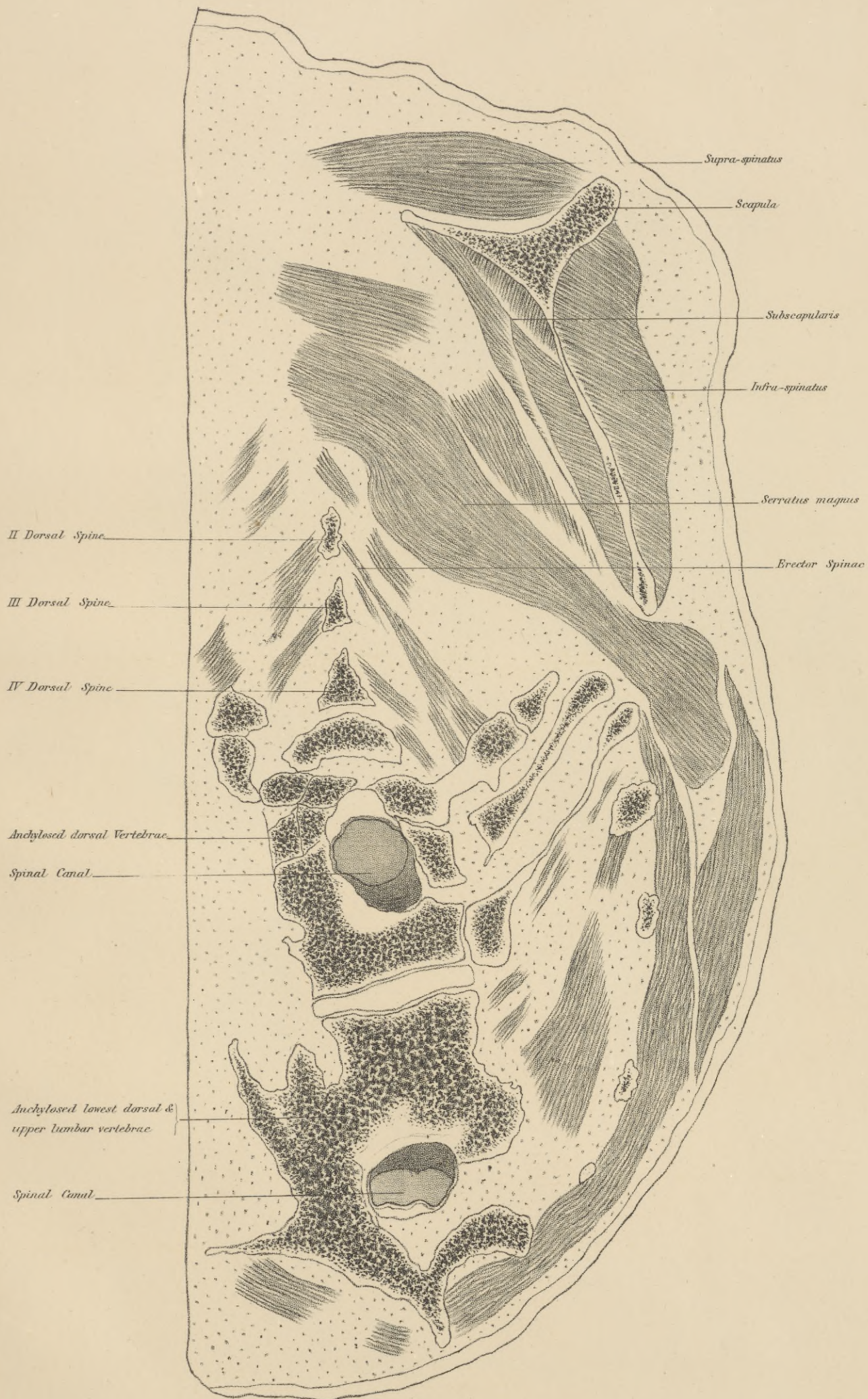
Extraperitoneal Fat

SECTION THROUGH LINE e PLATE 35

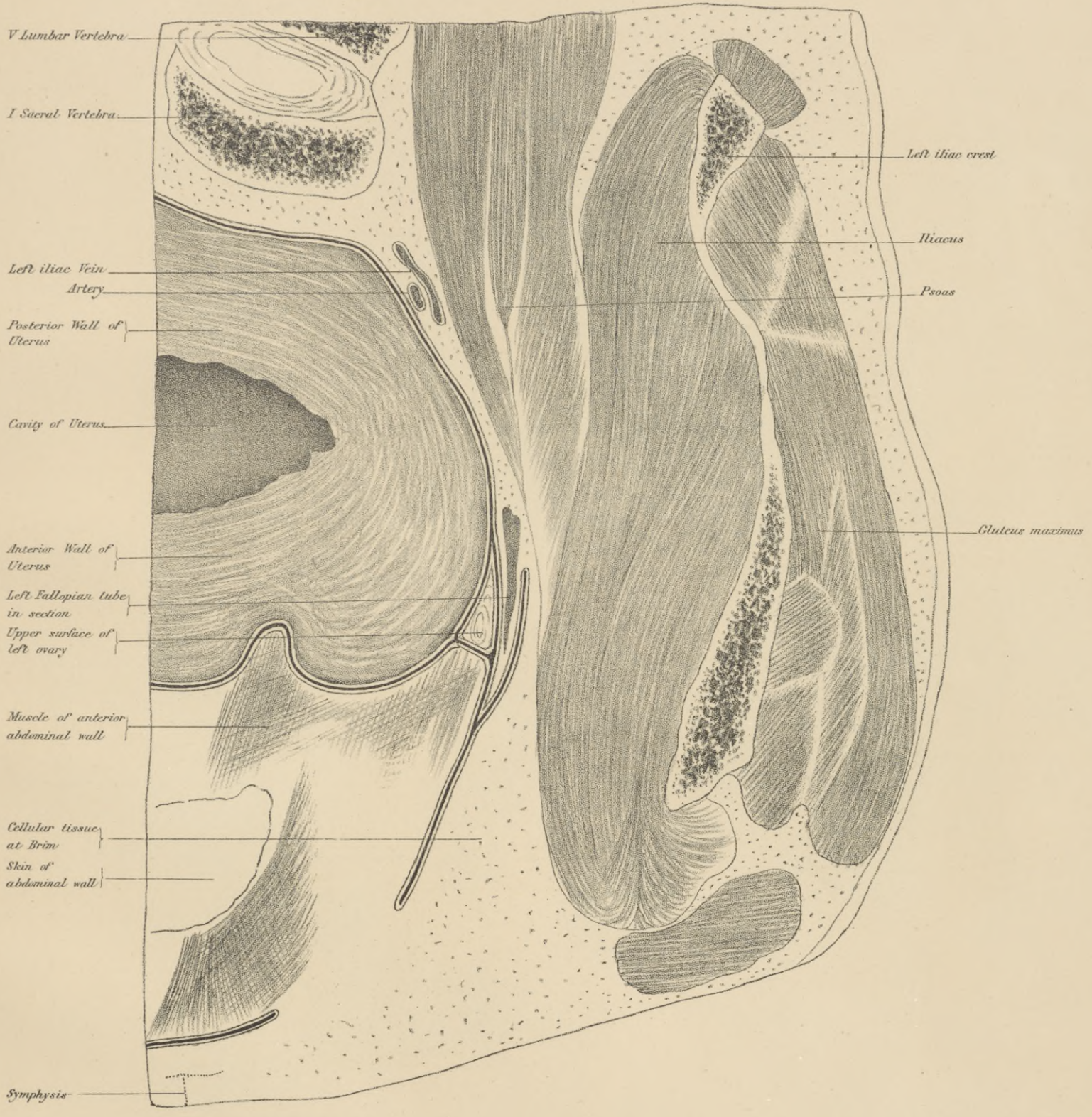
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SECTION THROUGH LINE f PLATE 35



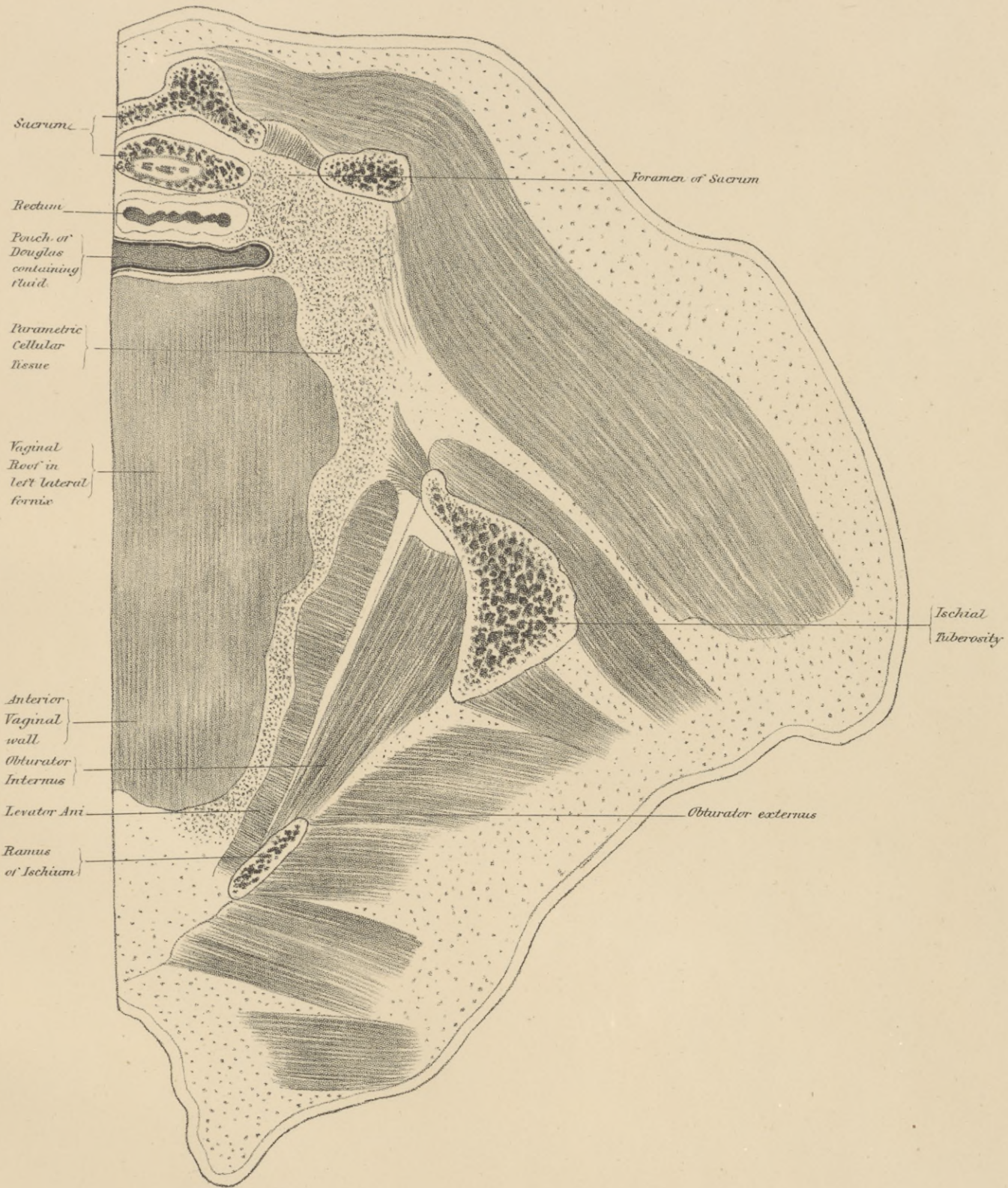
SECTION THROUGH LINE g PLATE 35



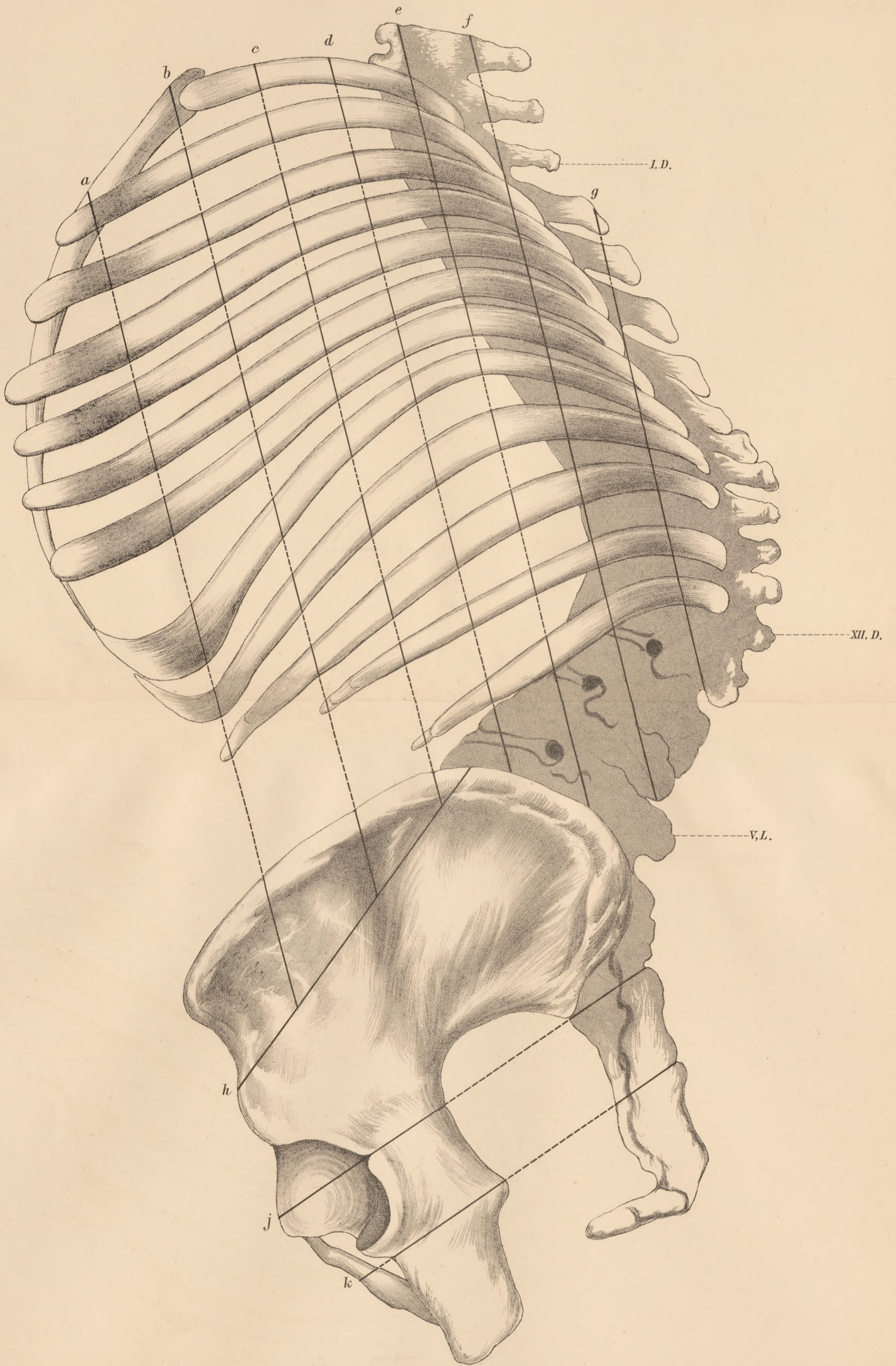
SECTION THROUGH LINE h PLATE 35

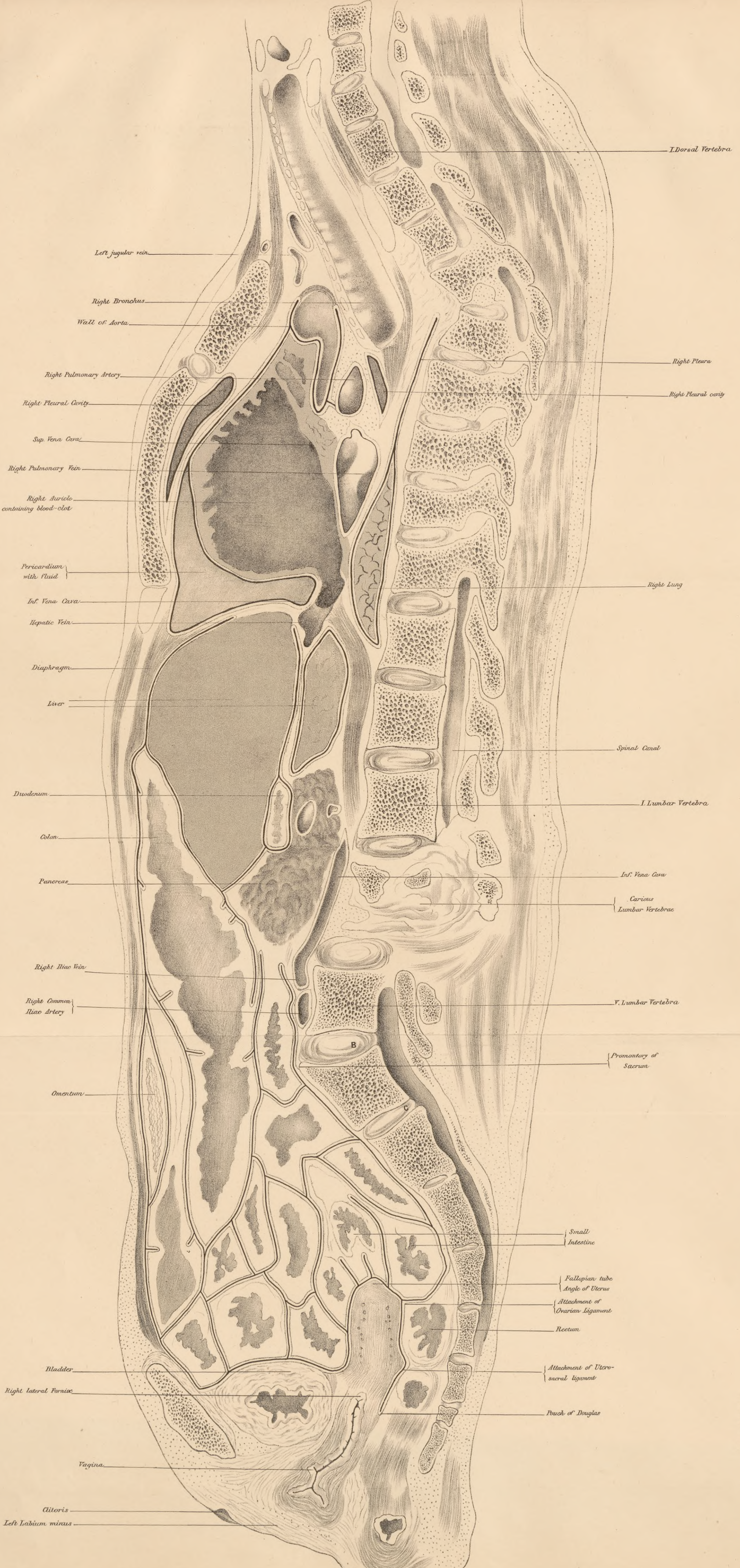


SECTION THROUGH LINE j PLATE 35



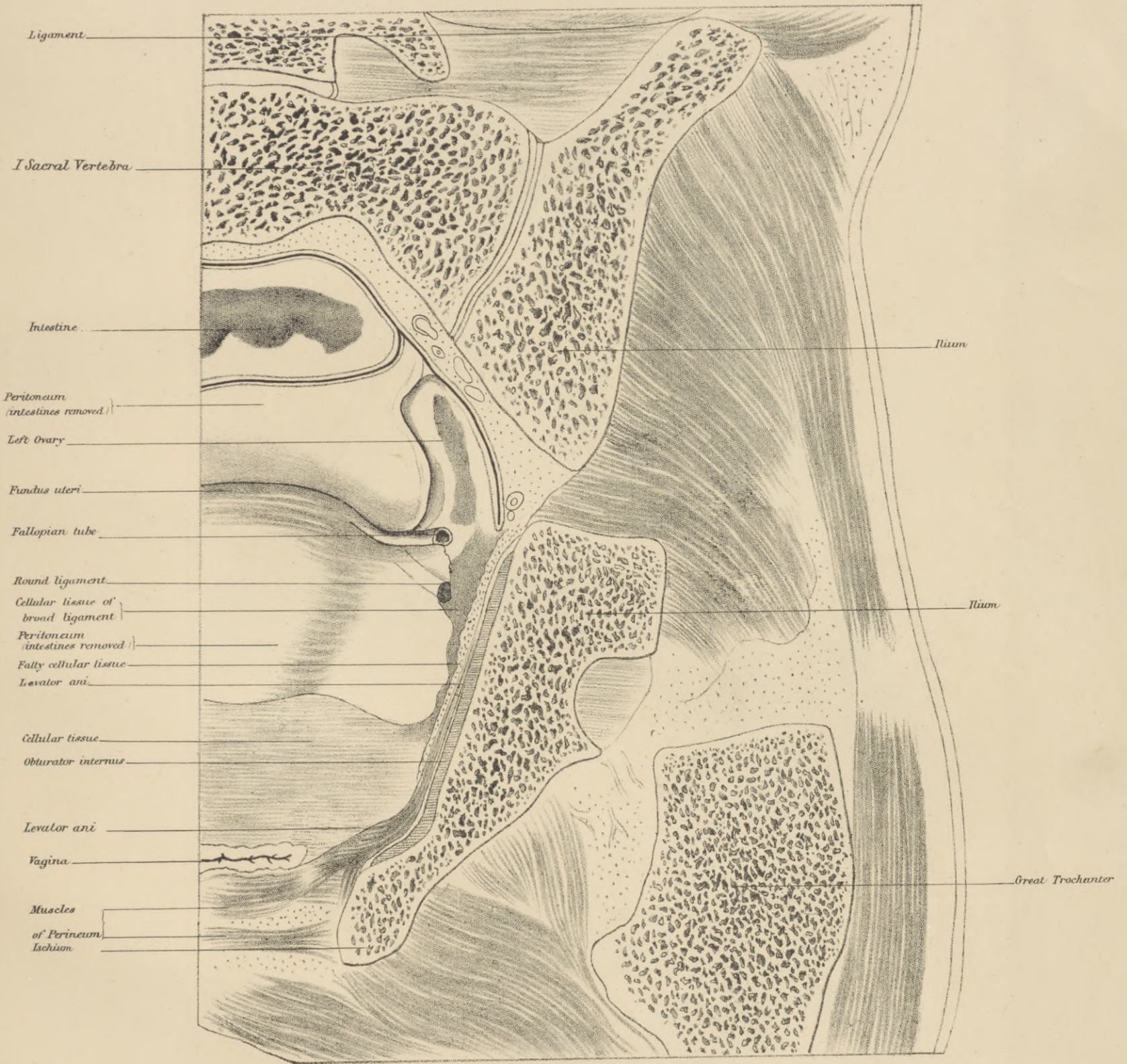
SECTION THROUGH LINE k PLATE 35



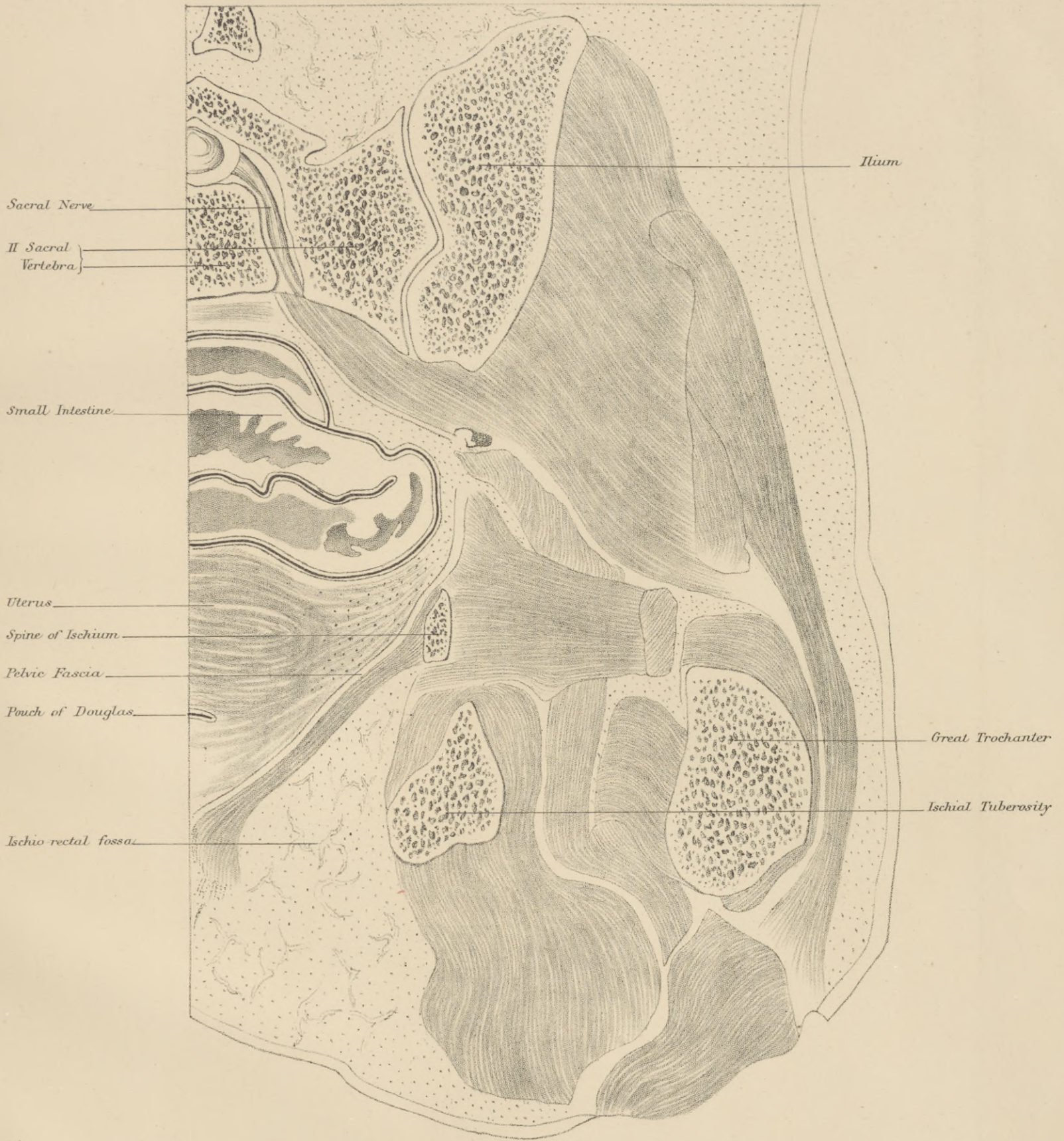


VERTICAL MESIAL SECTION

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CORONAL SECTION OF LEFT HALF OF PELVIS THROUGH A LINE JOINING POINTS BB IN PLATE A



CORONAL SECTION OF LEFT HALF OF PELVIS THROUGH A LINE JOINING POINTS CC IN PLATE A

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